

Project Report
Evaluation of the Impacts of the IDRC-Funded
Research Project
on Agriculture

by

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Part I

Important Elements, Objectives, and Methods of Presentation of Evaluation

Agricultural research projects which were evaluated.

The IDRC, aiming at evaluating the impacts of IDRC-supported projects, requested the DTEC to assign an evaluator to carry out evaluation work from May 1987-March 1988.

In Thailand, there were five research projects funded by the IDRC to be evaluated in terms of their impacts, namely:-

1. Vegetable Seed Production in Opium and Rice-Based Agriculture, conducted by Department of Plant Sciences, Faculty of Agriculture, Chiangmai University.

2. Groundnut Sheller and Stripper Project, conducted by Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen University.

3. Home-processed Legume, Conducted by Department of Agricultural Produce, Faculty of Agriculture, Khon Kaen University.

4. Cassava Nutrition, conducted by Department of Animal Sciences, Faculty of Agriculture, Khon Kaen University.

5. Cropping System (Thailand) Project, conducted by Farming Research Institute, Department of Technical Agriculture.

In fact, there was another IDRC-supported research project, "Breeding and Intercropping of Sorghum, Soybean and Peanut for Northern Thailand (Phase I)" which was conducted by the Department of Plant Sciences, Faculty of Agriculture, Khon Kaen University. However, owing to certain circumstances, for example, the project leader was not free and the other project implementers had no confidence to give an interview; the evaluator could not evaluate the impacts of this project.

General Objectives of the Evaluation of Impacts from Agricultural Research Projects.

The major objective of this evaluation was to evaluate the impacts of the completed projects in order to determine the values of the projects towards technologies, society, and environments. The evaluator had laid three more objectives in details:-

1. To evaluate the implementation of the projects, aiming at finding out: the agreement between the projects and current problems in the country, the purpose of the projects to solve such problems, the directions of the research, the efficiency in implementation, and the achievement of the projects.

2. To evaluate both the direct and indirect impacts of the research projects to determine the usefulness and

applicability in terms of economic; and to study whether the projects created deeper interests toward research or encouraged development, or created new types of work.

3. To evaluate the appropriateness in the extension of work. If it proved essential to continue the research, what aspects should be improved so as to make the results more useful. (The details of objectives are shown in the Appendix, under "Terms of References".)

Methods and Models for the Evaluation

A. The Evaluator

The evaluator is an associate professor from the Department of Field Crops, Faculty of Agriculture, Kasetsart University, holding a Ph.D in crop physiology; is a university researcher in plant sciences, agricultural and farming systems; and is well-qualified in agriculture and country development work.

B. Models and Methods Used in Evaluation

This evaluation could be divided into different stages:-

1. Desk Review

This stage involved the study of papers and documents and covered about 60% of the implementation. This study was aiming at

- understanding the projects, their rationales, approaches, directions, methods, procedures, results and usefulness;

- planning other models for evaluation, eg., interviews, interviewing techniques, interviewees;

- evaluating the status of research projects and impression.

Reading was actually done all-through evaluation procedures especially before report writing.

2. Interviewing Project Leaders and Researchers

One important point of evaluation depends on the perception of detailed information which can be achieved through briefing by the project leader or the researchers. The contents of the brief should include major elements, rationale, underlying problems, steps in implementation and results. At this stage, the evaluator usually wants to ask some questions from the project implementers and the head of departments where researchers belong.

3. Field Survey and Interviewing Relevant Personnel

The third stage was to make a field survey. The project's field work could be an experimental farming, production factories, or every-day work of farmers, every-day life of villagers influenced by research results. The interviews could be on the usefulness of research results according to the farmers, the change of life and economic conditions of farmers as a results of the research.

4. Additional Interviews

Often the evaluator needs to make an additional interview on the principles, requirements and opinions

towards the research results. The interviewees need not be involved in the project, they could be farmers in general.

5. Report Writing

This was the last stage and was covering four aspects which could be presented under the following heading:-

C.Methods for the evaluation

The project evaluator decided to present the results in four different aspects:-

1. The importance, descriptions, benefits and weak points of project.

2. Implementation of research results.

3. Impacts of research results.

4. Discussion of project in general and recommendations.

Part II

Evaluative Results of Each Project

Project No.1 : Vegetable Seed production in Opium and Rice-based Agriculture

1. Major Elements

1.1 Responsible department and researchers

This project was conducted by the Department of Horticulture, Faculty of Agriculture, Chiangmai University. The implementation was divided into 2 phases: Phase I, from 1982-1984, with a grant of C \$ 208,800, Phase II, from 1985-1987, with a grant of ~~B~~ 4,309,200.

The researchers consisted of teachers and staff of the Departments of Horticulture, Plant Diseases, Soil Sciences and Economics:-

- | | |
|-------------------------------|----------------|
| 1) Dr. Manee Wiwatanawongwana | Project leader |
| 2) Dr. Paiboon " | " Researcher |
| 3) Mr. Pipop Lamyong | " |
| 4) Mr. Pichit Tanee | " |

1.2 Rationale

This research project was initiated from two types of agricultural and social problems in Thailand, namely.

1.2.1 Opium was vastly grown in the North because of the ease of growth and the weather, the fertile soil and the amount of sunlight. Moreover, the hill tribe people used the money obtained from opium cultivation for their political matter. These were the reasons why opium was grown on a large scale.

The arising problems were the conditions of temporary agricultural practices or slash-and-burn agriculture which rapidly destroyed the forests and soil fertility, resulting in floods, and in the long-run, the land would no longer be suitable for agricultural purposes.

1.2.2 The second important problem was that seeds had to be imported from abroad. During 1979-1980 alone, Thailand had to import seeds at a cost of 3 millions. It was therefore essential to produce seeds within the country. If the vast mountain area was used to grow different vegetables to produce seeds which could easily be transported to a lower area, Thailand would be able to reduce the import of seeds from abroad.

1.3 Implementation

Research Stations: Four research stations were used for the experiments on vegetable seed production :-

1. Experimental plots in Chiangmai University's area.
2. Huan Luck Royal Agricultural Station, Chiang Daw District, Chiangmai.
3. Mae Hae Royal Agricultural station, Mae Jam District, Chiangmai
4. Intanon Royal Agricultural station Jom Tong District, Chiangmai.

Experimented vegetables:

Five types of vegetables were emphasized in this research :-

1. Head lettuce, Lactucasativa L.
2. Chinese radish, Raphanu sliuus
3. Leaf mustard, Brassica juncra L.
4. Sweet corn, Zea ways var rugosa L.
5. Tomato, Lycopersicon esculentum L.

The implementation of the project could be classified into 2 types:-

1.3.1 Research

1.3.1.1 Research into vegetable breeding which involved stages in introduction of seeds from abroad, selection and hybridization. The following is the list of objectives:-

1. High productivity
2. Endurance to environment
3. Endurance to diseases and insects
4. High quality, suitable for consumption
5. Demanded by the market
6. Producing high-quality seeds

The examples of the experimental steps in the breeding were:-

1. Chinese Cabbage

- Improve Chinese cabbage so that it formed a good head, e.g. the tropical delight breed.
- Improve heatburn capacity.
- Improve the breed so that there were less hair on stems and leaves.
- Use various parent breeds, e.g., 77M(3)-22 bred by Asian Vegetation Research and Development Institute.

2. Sweet Corn

- Improve inbreds in order to find a good method of producing F1 hybrids.
- Improve plant's adaptability to environment, seedling vigour, fresh crop quality, synchronisation of tasselling and silking.
- Improve resistivity to corn leaf blight disease.

3. Leaf Mustard

- Because leaf mustard is a self-pollinated crop species, thus, one step was to select and improve indigenous species.
- Foreign breeds were used as parent breeds.
- Select leaf mustard breed that formed good head.
- Improve resistivity to diamond black mott.

4. Chinese Radish

- Improve breed so that it becomes accepted in market.
- Select pure line to develop genuine breed.
- Select breed accepted in market, especially the round-shape breed.

5. Head Lettuce

- Improve resistivity to highland temperature and improve healburn capacity.
- Improve resistivity to tipburn which occurs in high moisture area, common during summer and rainy seasons.

6. Tomato

Plan a master program in breeding tomato (funded by FAO).

1.3.1.2 Research into land area, improvement of products, soil, and fertilizers.

In order that the agricultural products both from research stations and ordinary holders became efficient; the vegetation could adjust themselves to the weather, soil, and could resist insects and diseases; the project had to conduct a research on land area, soil and fertilizers. There were many findings from this research, for example:-

1) The study of various nutrients at Huay Luek Royal Agriculture Station, Chiangdao District, Chiangmai showed that phosphorus, and in certain cases, nitrogen and potassium were important nutrients for plants in this area.

2) Among micro-nutrients, Boron (B) was the major type. Without this element cabbage could have a hollow stem, for instance.

3) The study of specific nutrients mixed at Huay Luek Royal Agriculture station showed that production of seeds depended on two other major micro-nutrients, ie., iron (Fe) and magnesium (Mg).

4) The study of planting seasons for various vegetables showed the difference of vegetable produce in different seasons.

Moreover, a study was also carried out on different management eg., straw mulching, plastic mulching, close-spaced and widely-spaced seedings.

1.3.1.4 Research on cropping and farming systems

Chiangmai University had been conducting research on cropping and farming systems since 1968, with an assistance from Ford Foundation under the project called "Multiple Cropping Project". The research conducted under this project could be divided into 2 types. :-

1) The study of cropping system in which vegetable was emphasized.

A pattern of cropping was found from the survey of high land agriculture:-

1	May	August	December
	corn	Opium and local vegetable	
2	May	August	December
		Rice seedling transplant	
	May		December
		Upland rice and local vegetable	

The system suggested to high-land farmers was :-

	May	September
Planting		producing seeds
various breeds		fresh vegetables
February	April	October
		December

2) The economic and social analysis of seed producing of high-land crops.

A study was carried out on the investment and income of highland cropping, and on the management and possibility of cropping for consumption and breeding purposes. Problems and limitations to fresh vegetable and seed production were also recorded. For investment, it was found that the cost varied from one type of vegetable to another. The methods of cropping also varied from villages to villages. The numerical data were recorded.

1.3.1.5 Research into the production of seeds

The research on the production of seeds required information from previous studies on the improvement of seeds, agronomy fertilizers, cropping systems, and an economic analysis of vegetable cropping.

In this research, the suitability of cropping land was emphasized by studying the growth, flowering, produce and seeds of each type of vegetables.

For the breeding purposes, the following impacts were achieved:-

1) Breeder seed
2) Foundation seed graded from breeder seed which was produced by the farmers trained in seed production techniques.

3) Certified seed: The certified seed was produced from foundation seed. It was a high-quality seed and was produced by well-trained farmers. The seeds were directly purchased by the project to be cleaned, packed, and then sold.

4) Post harvest handling and marketing
The project followed these steps in post harvest handling :-

- Drying, grading, and packing
- Maintaining seed identification
- Collecting data concerning:-
 - types of breeds and types of vegetables
 - names and addresses of breeders, transporters and purchasers.
 - dates received

- amount/weight of breeds, etc.
(Details of production process are shown in Figure 1)

5) Advancement in breeding techniques

The following are the examples of research procedures in the production of different types of vegetables:-

Head Lettuce

- Study the productivity during and off seasons at Huay Luek (300 m. from sea level), and at Intanon (1,200 m.) The study showed that production was high in low land.

- Carry out single plane selection and produce breeder seed.

leaf Mustard

- Carry out single seed production and produce breeder seed (Certified seed production was only at a primary stage).

- Study temperature influence on seed incubation, because this type of vegetable has a high temperature dormancy.

Chinese Radish

- Study the productivity from different dates of seeding in lowland and highland areas.

- Emphasize production in highland areas during November to replace opium.

- Produce breeder seed down to levels of foundation seeds and certified seeds.

Sweet Corn

- In the seed production stage, emphasize Fl-hybrid seed production.

- Seed production was achieved at foundation seed level.

Chinese Cabbage

- Improve the suitability of land area for production of breeder seeds.

1.3.2 Training and Extension of Research Findings

According to the project plan, the following trainings and extension of research results were carried out :-

1.3.2.1 Training the agricultural extension officers

This training was not efficiently conducted owing to the fact that most of the work was still on a study level. Moreover, the project itself did not involve development and extension work.

1.3.2.2 Training the officers from Hill Tribe Welfares Project

This training was satisfactory. The officers were trained in vegetable cropping and seed production, in order that they would, in turn, initiate other projects or supervise this type of work for the hill-tribe people.

1.3.2.3 Training farmers

Most of the farmers being trained were hill-tribe people. The training aimed at:-

1) Providing technical knowledge. The officers from Hill-Tribe Welfare Project were invited as teachers.

2) Training practical work. Most of the training involved practical work on cultivating, seeding, fertilizing, improving vegetable beds, spraying chemicals.

1.3.2.4 Promoting vegetable planting and seed production

This type of work was not widely conducted since this project was still at Phase I.

2. Evaluation Results and Recommendations

2.1 Importance of Project

2.1.1 The research work in general

The project "Vegetable Seed Production in Opium and Rice-based Agriculture" was a very successful project. 90% of the work was truly research work which emphasized the improvement of breeds, the stages, and methods of improvement. The researchers were well-qualified, and experienced in research and improvement of breeds. Thus, the evaluator believes that the results of breed improvement would yield good- and high quality breeds to the market.

2.1.2 Relationships between researchers and other technical sectors

The researchers of this project had a good relationship with other technical sectors and research institutions both in Thailand and overseas. This relationship had extremely contributed to research implementation. For example, the AVRDC gave the breeds, lines, and breeding materials to the project. FAO supported in terms of policy, monetary, data, and documents. Vegetation research projects of other institutions eg., Vegetation Research and Development Project, Kasetsart University, Tomato Seeds Production and Improvement Project, Khon Kaen University; enabled the researchers to obtain different breed lines.

2.1.3 The integration of different disciplines in the project

The scope of this project was very large, including many steps of implementation :-

- The improvement of breeds
- The improvement of agronomy and management
- The production of breeder seeds
- The improvement of technical management of breeder seeds and seeds
- Technology transfer to farmers

It can be seen from the above steps that they involved different types of study, eg., the study of soil and fertilizers, the study of plants reactions to calcium, magnesium, and iron in different environment.

However, when the number of researchers was considered, it can be seen that it was difficult for them to extend the project into a multi-disciplinary research.

2.1.4 The encouragement and coordination among the faculty's departments and other disciplines.

In order that this project completed its course, supports and coordinations from other departments were necessary.

- Research in other close disciplines should be encouraged.

The evaluator believes that certain other research studies are needed to fulfill this project, for examples, the agronomy, management, study on the influence of water, temperature, etc., management towards insect pests, study on post harvest technology; which had only been partly studied by the project implementers. The Faculty of Agriculture, Chiangmai University should enable the researchers in the other departments to conduct such studies. Monetary support should be requested from the IDRC or other agencies; the Faculty's budget and the Government's research funds should be allocated for this purpose.

2.2. Project's Extension and Training

From the evaluation, it was found that the project emphasized research studies more than extension work. The work on extension of the project's findings and the trainings which had been organized could not be said to follow appropriate procedures and to be fully efficient. However, the trainees, especially the hill-tribe people, were reported to have grown more crops and obtained better results.

2.3 Problems and Obstacles

The problems and obstacles as viewed by the evaluator were :-

2.3.1 The researchers worked independently, without support from other lecturers in the department.

2.3.2 The project faced a major obstacle in terms of experimental sites which were in the area responsible by the royal projects.

2.3.3 The relation of this project with other projects and other sectors, eg., the Department of Agricultural Extension and Project USDA Contract No. 12-14-0605-167, conducted by Dr. Tongchai Tonguthaisri; was not on a scale which enabled the project implementers to obtain sufficient information or findings.

2.4 Implementation of Results

It can be said that the results of this project were utilized on a very large scale :-

2.4.1 The Improvement of Breeds

A direct effect of the improvement of breeds was that many new vegetable-breeds were originated. Each

breed had a special trait, eg., disease resistance, insect resistance, good head forming, taste, and market appeal. These traits could also be incorporated in the future breeding.

An indirect effect was the development of techniques in improving new breeds, eg., emasculation technique, selection and breeding under specific conditions. There were two applications of these techniques:-

- Improving the quality of vegetables and other crops in other stations.
- Teaching undergraduate and graduate students.

2.4.2 Other Research

The other research results could lead to continuing research projects, which in turn, would increase the quality of vegetable produce. Other types of extensions, for example, seminars and publications of research results would enable other research projects to utilize the results and techniques from this research.

The Department of Horticulture at Chiangmai University itself could apply the research results in the teaching and learning and further studies in this field.

2.5 Potentials of Research Results

The research project yielded the following impacts and potentials :-

2.5.1 It was the basis for the initiation of other research and development of vegetables or of other national breeder seed production centers. The project could be improved :-

- technically, by promoting multidisciplinary research on improvement and management, and by encouraging cooperation among various sectors;

- through technology transfer, by encouraging production tests and acceptance of technology, by studying the scope of technology transfer and extension, by studying sociological conditions of the farmers, and by planning trainings at different levels;

- in seed production, through implementation of other centers, and by introducing contract growers to produce good breeds; and

- in terms of marketing and economy of seed production, by surveying the market, local, provincial, and national demands in order that technical workers can plan the work appropriately.

It is recommended that complete modification of the project will create good cooperation among various academic and non-academic institutions, agencies and other sectors. provided the cooperative work is conducted institutionally, the extension of this project will be viable on a very large scale.

2.5.2 This project could be a medium for Chiangmai

University to attract overseas funding agencies in terms of assistance and cooperation towards research study of other crops.

The success of this project would make the overseas agencies trust the quality of Chiangmai University's researchers. Thus, the chance for the University to receive monetary assistance for research purposes would increase.

2.5.3 The potentials of vegetable and seed production of hill-tribe farmers increased. Three important results would be obtained :-

- The farmers would grow less opium.
- Because transportation and marketing made it difficult to retain vegetable's freshness, farmers would have to turn to produce more seeds.
- More relations would be made between the seed production and sale company and the farmers.

2.6 Recommendations

Recommendations have been made on these aspects:-

2.6.1 The researchers

The researchers should conduct research on agronomy, management, plant care and pest control, and post harvest technology by inviting other researchers to join and find a supporting agency. The project should be planned so that the proportion of basic research, field experiments, and technology transfer is 40:30:30 respectively. It should also follow a developmental research model. The researchers should also form a good relationship with agricultural extension officers, officers from the Hill-tribe Welfare Project, etc.

2.6.2 The University and the Department

The University and the Department with which the project was affiliated should:-

2.6.2.1 Support the project by the following actions :-

1) Encouraging multidisciplinary research and research into agronomy, management for planting and maintenance, study on physiology, on heredity and ecology, etc.

2) These research studies can be conducted independently of IDRC support. The administrators can allocate budget for equipment, wages. Application for research funding can also be made to the Government and other agencies such as USAID or FAO.

3) The University can appoint a committee to supervise such research projects and to assist in the planning of implementation period. The University should also select the research personnel according to the types of work. The duties and responsibilities of each person should also be predetermined.

4) Representatives from each unit or sector should be appointed in order to give useful advices

and suggestions for research procedures, technology transfer, as well as coordination of work, for example :-

- Encourage research in each unit which supports work of the project

- Test seed production on a larger scale using the project's techniques.

- Conduct tests in technology transfer with the projects in the determined area, give suggestions and assistance in training and management at all levels.

- Arrange for some private companies to buy the breeds so as to test the commercial possibility.

Improvement and Initiation of Certain Types of Work in Phase II

Chiangmai University and the Faculty of Agriculture should consider methods of half-technical implementation which resulted from the vegetable seed production project, namely :-

- The project results concerning improvement of breeds, management and agronomy to increase production.

- The encouragement of developmental research. The university should initiate seed production project which is conducted on a small commercial scale.

- Such project should be separated from the Vegetable Seed Production Project. It should be a business agriculture project conducted by technocrats in vegetation and seeds, production economics and marketing. It should start from the study and survey on marketing to determine the types of vegetables, amount of seeds and the purchasing unit. The next step would be the production stage utilizing the research technology which controlled the investment cost. Evaluation should be carried out at all stages while implementation supervised by the researchers.

- Many impacts could be created from such project. The researchers would be informed of obstacles toward seed production, and unprofitable technology. The profits made could be used to support other research projects or to develop the university's seed production, providing extra income for the university.

Solution of Some Problems of the Project

The evaluator sees that the university and the faculty should solve the problem of misunderstandings between the researchers and certain northern agricultural development units which carried out experiments on the same areas. The researchers had worked independently while the university did not stipulate any policies to supervise such work. The misunderstandings could arise from many factors such as the establishment of purposes which was not clear for both cases and inadequacy of communication between the two projects.

2.6.3 Recommendations for the International Development Research Center

2.6.3.1 The department or organization with which any funded research project is affiliated should contribute in the establishment of directions of the research. Chiangmai University, in the case of this project, should be asked to assign a policy board which will be responsible for this and for coordinating research work among different departments and outside sectors.

2.6.3.2 The IDRC can set up certain conditions before funding allocation so that the funded research project will be efficiently conducted and the research results are utilized to the fullest extent.

2.6.3.3 The IDRC can inform other sectors of the research project saying that at the stage of technology transfer, coordination among different sectors is essential.

Project No.2 : Groundnut Shellers and Strippers Project

1. Major Elements

1.1. Responsible department and research implementers

This project was conducted by the Department of Agricultural Engineering, Khon Kaen University. The IDRC allocated US \$ 21,120 for the implementation of the project. The implementers consisted of the staff of the Department of Agricultural Engineering, namely:-

- | | |
|--------------------------|----------------------|
| 1) Dr.Winit Chinsuwan | Project Leader |
| 2) Mr.Seree Wongpichet | Researcher |
| 3) Mr.Somkiat Hengnirun | " |
| 4) Mr.Sompote Sudajan | Assistant researcher |
| 5) Mr.Wanchai Supapenkul | " ----" |

The period of implementation was one year, from April 1985 to March 1986.

1.2 Rationale

Groundnut is an economically-important bean plant in Thailand. Thai people use groundnut to cook their meals, desserts and many types of food. It also contains protein which is an important nutrient especially for rural villagers.

The price of unshelled groundnut is approximately 7.5 /kg, and shelled groundnut is 15.5/kg. It can be seen that farmers could raise their incomes from shelling groundnuts by 8/ kg. If this is considered in terms of the overall production of the country which is 1,250 kg/hectare; it can be seen that the farmers could increase their incomes from shelling their groundnuts by 2,087-3,062 per hectare. However, the farmers at present sell their groundnuts unshelled owing to the necessity to have the money as well as to the fact that they do not have any sheller.

Before the research into the development of groundnut shellers, the traditional sheller was not popular among the farmers because of its inefficiency and a high percent of breakage (30%). Therefore, the farmers preferred to shell groundnuts by hand.

With this reason, this project was initiated in order to develop efficient and cheap groundnut shellers and strippers.

1.3 Objectives of the Project

1.3.1 To survey the conditions of groundnut stripping and strippers in Thailand; advantages and disadvantages of different strippers; and the testing of these strippers in real situations to assess their capacity and efficiency.

1.3.2 To design, construct, and improve a comb type stripper, a drum-type stripper and a spike-tooth stripper powered by a motor.

1.3.3 To design, construct, and modify a rice

thresher into a groundnut stripper which contains a winnower in itself.

1.3.4 To design, construct, and improve a rubber tire sheller, and a wood-propeller sheller, both motor-driven, and manually-driven.

1.3.5 To promote local users of these shellers, by arranging trainings for local skilled workers.

1.3.6 To disseminate the use of groundnut stripper and sheller to the farmers by demonstration, training and seminar organization.

1.4 Project Implementation

The implementation of the project was divided into 2 phases :-

1.4.1 Phase I(1981-1983): Development of A Groundnut Sheller

The results of the project in Phase I enabled the project to construct and improve a manually-operated rubber tire sheller, through the study of advantages and shortcomings of different types of shellers:-

- Iron and mesh sheller which yielded 30% breakage. The prototype being studied was brought from Africa.

- Wooden grinder which had a problem in the adjustment of clearance between the revolver and mesh.

- Iron grinder with a concrete revolver. This had a higher efficiency than the first two but still was not satisfactory.

- The capacity of this sheller was 83 kg/hour, with 3.2-4.9% breakage, and a shelling percentage of 82.

- A motor-operated rubber sheller. This sheller was developed to serve the needs of the farmers, agricultural cooperative, and dessert factories. The following is the efficiency of this type of sheller:-

- 1) Capacity : 300 kg/hour
- 2) Shelling percentage = 95%
- 3) Breakage : 3-5%

- A motor-operated rubber sheller. This sheller was developed to serve the needs of the farmers, agricultural cooperative, and dessert factories. The following is the efficiency of this type of sheller:-

- 1) Capacity : 300 kg/hour
- 2) Shelling percentage : 95%
- 3) Breakage: 4-6%
- 4) Cleanliness : more than 99%

However, this motor-operated rubber sheller was not suitable for use when the purpose was to produce breeds.

1.4.2 Phase II (1983-1986): Development of A Groundnut Stripper/Winnower, Quality Improvement and Tests of Groundnut Shellers.

The following strippers, and winnowers were

studied:-

- A comb-type stripper. The capacity of this stripper was 1.7-4.6 kg/person/hour. It was, however, a little better than beating groundnut on the ground.

- A drum-type stripper developed by the project in 1983; it was found that its capacity is no better than the comb type.

- A spike-tooth stripper developed in 1983. The capacity was still not satisfactory. The vine-attached pods showed that stripping was not clean.

- A paddle stripper/winnow. This stripper/winnow was suitable and was widely-accepted by farmers. From the experiment with farmers in December 1983, it was found that percentage of breakage was low, and the number of vine-attached pods was low too. The test also showed that this stripper/winnow was especially suitable in low-lying land, and for small-scale holders (3-4 rais). The capacity was found to be 12-15 kg/person/hour, and was 20 kg/person/hour in stripping dried groundnuts.

- A hold-on engine operated stripper, developed by the project. A special trait of this stripper was that it contained a clean blower, and a mesh-screen to grade the grains. However, the capacity was found to be only 2-4 kg. higher than hand stripping. The shortcoming of this stripper was that the user needed to stoop and feed the groundnut into the machine which was time-consuming. And if sped up, breakage percentage became higher, making this stripper not suitable for use.

- The modification of rice thresher into groundnut stripper. The modified stripper was tested in 1985 in Srisaket. It was found that this stripper was suitable for use on highland and during raining season.

2. Evaluation Results and Evaluation

2.1 The Importance of Project

The project had been following the predetermined procedures and the principles of machinery development. The research methods consisted of :-

- 2.1.1 Surveying the conditions of groundnut planting, the demand of farmers for a stripper and a sheller, and the stripping conditions and constraints in low-lying and high land.

- 2.1.2 Testing different types of strippers and shellers, studying the benefits and shortcomings, and developing a high-capacity stripper, and sheller.

- 2.1.3 Testing the performance of motors in the strippers and shellers in real situations in 5 villages in Roi-ed and Kalasin to find breaking percentage, number of vine-attached pods, and the efficiency of the engine.

- 2.1.4 Testing and evaluating in terms of economics.

- 2.1.5 Introducing knowledge and the machines to the farmers, and to private business sectors for further

production and sell.

The implementation was very efficient, creating the following results :-

1) Two types of high-quality shellers were developed: a manually-operated rubber tire sheller and a motor-operated rubber tire sheller.

2) A paddle stripper/winnowing and a modified rice thresher/ groundnut stripper were developed which were applicable by farmers.

3) Appropriate procedures in research and development of small machinery for Thailand. These procedures were also useful for the teaching and learning, the fact found from participation of the students in this project. The students had contributed in:-

3.1 Surveying the groundnut planting situations, understanding the problems and the need to develop agricultural machinery.

3.2 Assessing the advantages and disadvantages of the former types of machinery, helping the researchers building the prototypes, experimenting with the prototypes to determine the moisture impact on percentage of breakage.

3.3. Introducing the machinery to the farmers, forming a good relationship, knowing the farmers' situations, and thus being able to bring these problems into account for future machinery development.

3.4 Earning an income from participating in the project. This was a good aspect because many of the university students were poor.

3.5 Being able to use the obtained knowledge for further studies.

4) Promoting staff development by

4.1 Sending researchers and assistant researchers overseas for a training course or further study.

4.2 Two assistant researchers: Mr.Somkiat Hengniran and Mr.Seree Wongpichet were recruited as Government officials.

4.3 An assistant researcher continued his study at the Technical University of ~~Novo~~ Scotia, Canada.

5) The Department of Agricultural Engineering received the following impacts:-

5.1 The Department became wellknown in developing practical agricultural machinery. This shows the potentials of the Department as being an outstanding technical resource, resulting in a larger opportunity for the extension of courses at a graduate level.

5.2 The Department obtained a number of vacant positions to recruit more lecturers.

5.3 The teaching and learning of the department were much improved because of high technology being available at hand, and chances for the students to practise work with villagers in real situations, which

resulted in enabling the students to obtain direct and valuable experiences for their future career.

5.4 The project became a model which encouraged the other staff members to write project proposals applying for research scholarships from overseas agencies.

General Impact of Research Results

For the farmers, an efficient groundnut stripper and sheller was available for them to use, which brought many benefits to them. The evaluator had a chance to observe how a few agricultural holding families in Roi-ed earned their living. These farmers formerly grew seasonal rice and groundnut after harvesting. However, because of unreliable raining and water scarce, the produce was not satisfactory. Mr. Boontan, Ban Dongsing, for example, became a groundnut shelling labor since 1978. Shelling labor was done at first by these methods:-

- 1) Buying good-quality groundnuts from farmers, shelling the groundnut, halving, and transporting them to icecream manufacturer. The price of purchased groundnuts was 7-9/kg. and they sold in halves at 30.00 per kg.

- 2) Buying groundnuts from factory at 5-6/kg. (These groundnuts were of low quality and sometimes there were molds); shelling, grinding the groundnut and selling to noodle shops at 24/kg.

The nuts had to be roasted before they were sold. When the sheller and winnower were obtained, production increased. There was no need to hire labors any longer. Some farmers had a permanent contract with icecream producers. In such case, a large quantity of groundnuts were demanded, so the icecream producers would buy groundnuts from other farmers and sell them to the farmers who shelled them. Roasted groundnut could also be sold in little plastic bags when there was an excess quantity of groundnuts left.

- 3) The farmers could change their occupation and could make profits from the new occupation, especially when they owned a stripper and a sheller designed by the project.

- 4) The extension of farmers' production at Ban Dongsing started from a group of farmers buying the sheller/stripper from the Department of Agricultural Engineering at KKU. The department had supervised their production while at the same time collecting information concerning the farmers' operation. It was found that the farmers needed certain other types of equipment and thus the trends for further machinery development.

- 5) Groundnut mechanization

Another major impact was the initiation of groundnut mechanization project which would involve the development of machinery used for seeding, producing, etc.

Recommendations

The evaluator sees the possibilities to improve the

project's implementation related to the following aspects:-

1) There was not much coordination with other projects. Thus, time had been wasted on surveying information. Some tests should be conducted with researchers in plant sciences, seed technology, economics, etc.

The Research Development Institute at Khon Kaen University should encourage coordination among different departments and units. Many projects on planting and cropping systems at the Faculty of Agriculture could be helpful to this project. Moreover, the evaluation of impacts could be conducted with cooperation from economists, for instance.

2) The evaluator would like to make recommendations concerning the implementation of the Groundnut Mechanization Project which is an extension of this project as follows:-

2.1 Agricultural engineering part:

Design, develop and construct machinery for seeding, producing, maintaining, harvesting and utilizing groundnuts.

2.2 Field work: Coordinate and assist all planting processes which would involve development of cultivator, reaper; and stages of seedling vigour of groundnuts.

2.3 Seed technology section: assist in testing dominant characters in drying, moisture percentage in seedling, deteriorating factors at the stage of developing the groundnut digger, sheller, and stripper.

2.4 Home economic section: give advice and cooperate in grinding and roasting in developing machinery from a traditional grinder and from a pan and a stove by considering the quality of seed after roasting, the percentage of molds and cleanliness.

2.5 Economic and social section: evaluate every stage of the study; study the farmers' situations using a case-study method in order that the researchers can use the information to improve machinery; survey the farmers' demand of various machinery and determine priority.

The evaluator would like to suggest an organization of workshop in the form of a monitoring tour at the beginning stage of the new project in order that researchers from every section will understand the situations in production, cultivation, harvest, and occupation.

3) The dissemination of the sheller was still in a limited boundary. Dissemination was carried out through demonstrations and introduction to farmers and distribution of shellers to:-

- 5 universities and colleges
- 10 regional, provincial and district agricultural offices
- the Ministry of Science and Technology
- the Research Institution (2 shellers)
- a few private companies.

From evaluation, the distribution of machinery was not large enough.

One important point to note is that a project which develops such machinery should survey market's and population's demand of the machine before implementation. From the evaluation, it was found that there were not more than 5 farmers per village whose occupation was shelling groundnuts. This was because the number of factories and manufacturers of groundnut food was not many, resulting in one limiting factor for the expansion of this technology.

If this project had a coordination with an agricultural business section, the researchers would be informed of market's state, farmers' demands, and forecasts of the machinery before implementation. Thus, the project could not have wasted the time for the modification of such sheller or stripper. From the evaluation, it could be seen that the farmers did not find it very necessary to use a motor-driven sheller. Manually-operated one was adequate for their use. It can be concluded here that market survey, farmers' demands and forecast of saturation of a machine is a very important point to consider before any development work.

To conclude, it is obvious that the researchers of this project are well-qualified and could conduct the work according to the set plans. The dissemination was inadequate because of the limited number of researchers.

Obstacles concerning administration of the project was not found since there were only a small number of project implementers. The Department of Agricultural Engineering believed that this was an outstanding project of the department. The project leader was very competent. However, the project did not receive cooperation from other researchers in the university, reducing the chance to obtain explicit information; there was not much integration of knowledge during the machinery developmental stage either.

The outcomes were two types of groundnut shellers, one type of stripper/winnower, and another type of thresher which had been modified into a stripper/winnower. The farmers preferred manually-operated machines than a motor-driven one. The factor behind this preference was the limited amount of raw material and groundnut produce. The distribution of the machines was in a small limit.

Project No.3: Home Processed Legume (Thailand)

1. Major Elements

1.1 Responsible department and research implementers

Home Processed Legume Project was carried out by the Department of Agricultural Products, Khon Kaen University. The IDRC gave monetary assistance for the implementation of the projects. which was divided into three phases:-

Phase I : 1978-1980

Phase II : 1988-1982

Phase III : 1983-1985.

The researchers consisted of the staff of the Department of Agricultural Products, Khon Kaen University, namely:-

- | | |
|---------------------------|--|
| 1) Dr.Kawee Jutikul | Dean, Faculty of Agriculture
Director of the Project |
| 2) Mr.Wirote Pongsakul | Deputy Dean, Assistant
Director |
| 3) Dr.Tipwanna Ngarmsak | Head of Department of
Agricultural Products,
Project Leader. |
| 4) Mrs.Pratum Sangsom | Researcher |
| 5) Mrs. Usa Jaroenwatana | " |
| 6) Miss Somjai Srilaorkul | " etc. |

1.2 Rationale

85% of northeastern population live in rural areas and earn their living by growing crops, eg., rice, cassava, jute and cotton. The per capita income is low, ie., 7300 per year only. Because of the low income, the people become malnourished; they do not have enough protein. Nutritional deficiencies which are found consist of protein and energy malnutrition, beri-beri, riboflavin deficiency, Vitamin A deficiency, iron deficiency, anemia, iodine deficiency, urinary bladder, stone disease, etc.

Home processed Legume Project (Thailand) emerged from the encouragement of research work into the development of food products to solve the problem of protein deficiency in ASEAN countries by the Asian Group of Food Scientists and Technologists. The Group met in Singapore and agreed to have the Department of Agricultural Products at Khon Kaen University conduct this research.

The weather, water, and farming systems of the countries in Southeast Asia, eg., Thailand, are more suitable for planting than for animal farming. Animal farming usually requires a large amount of investment and good technology, therefore it is not suitable for farmers whose income is low. Protein is also available in plants, such as peas. The solution of protein deficiency could be achieved by growing such plants.

Home Processed Legume Project selected cowpea (*Vigna umbiculata*) as the plant to be developed into supplement food which increased protein for consumers. At the beginning stage of this project, there were other projects

conducted by the faculty of Agriculture which studied many species of peas. If the university's cropping system project succeeded in introducing cowpeas to villagers in Khon Kaen, it would be easy for Home Processed Legume Project to develop food products from cowpeas for villagers since there would be enough raw materials.

1.3 Objectives and procedures

The project had an aim to develop many types of food products from cowpeas which included the meals, the desserts and snacks which could be prepared, cooked and produced in the household. The village food shops would also be able to produce them for sell. The developed food products must not be different from ordinary food consumed by the farmers and the recipes must not be different from the ones familiar by them. Finally the developed food products must be accepted by the farmers.

The project's implementation procedures were arranged into 3 phases:

Phase I : The improvement and development of protein food for people in the Northeast by cowpeas. These steps were to be followed:

1. Develop the methods of raw material preparation, eg., shelling and hulling by soaking cowpea in water, grinding and rolling until flour is formed; so that these steps could be followed by village house wives and food shops.

2. Use product from 1 (ground flour) to make main meals and desserts by developing food recipes.

3. Develop a model to promote agricultural food products.

Phase II : The development of cowpea flour production on a larger scale by village farmers' house wives and venders of food. These steps were carried out:-

1. Develop main meal recipes which used cowpea flour.

2. Develop recipes for desserts which used cowpea flour.

3. Analyse and evaluate the possibility of cowpea products, trades, and use of cowpea products in villages where cowpeas were grown.

Phase III : The dissemination of 7-day menu in at least 27 villages in Khon Kaen :-

1. Develop methods of rolling and producing cowpea flour at village levels.

2. evaluate results of cowpea introduction in villages and develop a suitable cowpea promotion model.

3. Introduce the model to the officers of agricultural home economics in order to extend the idea on a larger scale.

1.4 Project Implementation

Phase I

- 1) Survey of eating habits in ten villages in

Khon Kaen provinces.

So that the development of cowpea food recipes was accepted by the farmers, the project had to survey the villagers' eating habits and the following is the conclusion:-

- Villagers' foods consisted mostly of glutinous rice and vegetables. Sometimes protein food from fish was eaten.

- Villagers did not usually have fat and fruits.

- Villagers ate locally available food. Often they ate fermented food, eg., fish, bamboo shoot, and dried chillies.

- Cooking was very simple, eg., barbecuing, boiling, and sometimes frying.

There was a possibility to use peas to increase protein since it was found that the farmers grew and ate many types of peas.

2) Development of cowpea dishes and 7-day menu for villages in Northeastern Thailand.

From the survey of eating habits and types of dishes eaten, recipes and 7-day menu were developed. (See details in Figures 1 and 2)

3) The introduction of cowpeas in a nutritionally-balanced menu.

In this project, three models were used in the introduction of cowpea dishes and 7-day menu to farmers in 6 villages in Khon Kaen:-

- Describe 7-day menu and introduce cowpea recipes to village headmen

- Ask the headmen to arrange a food party in each village so that the villagers would try the dishes and see the menu.

- Use video tape to demonstrate cooking of all dishes.

- Arrange cooking contests or contests of cowpea foods.

Figure I Schematic Showing Selection of Raw Materials for Dishes.

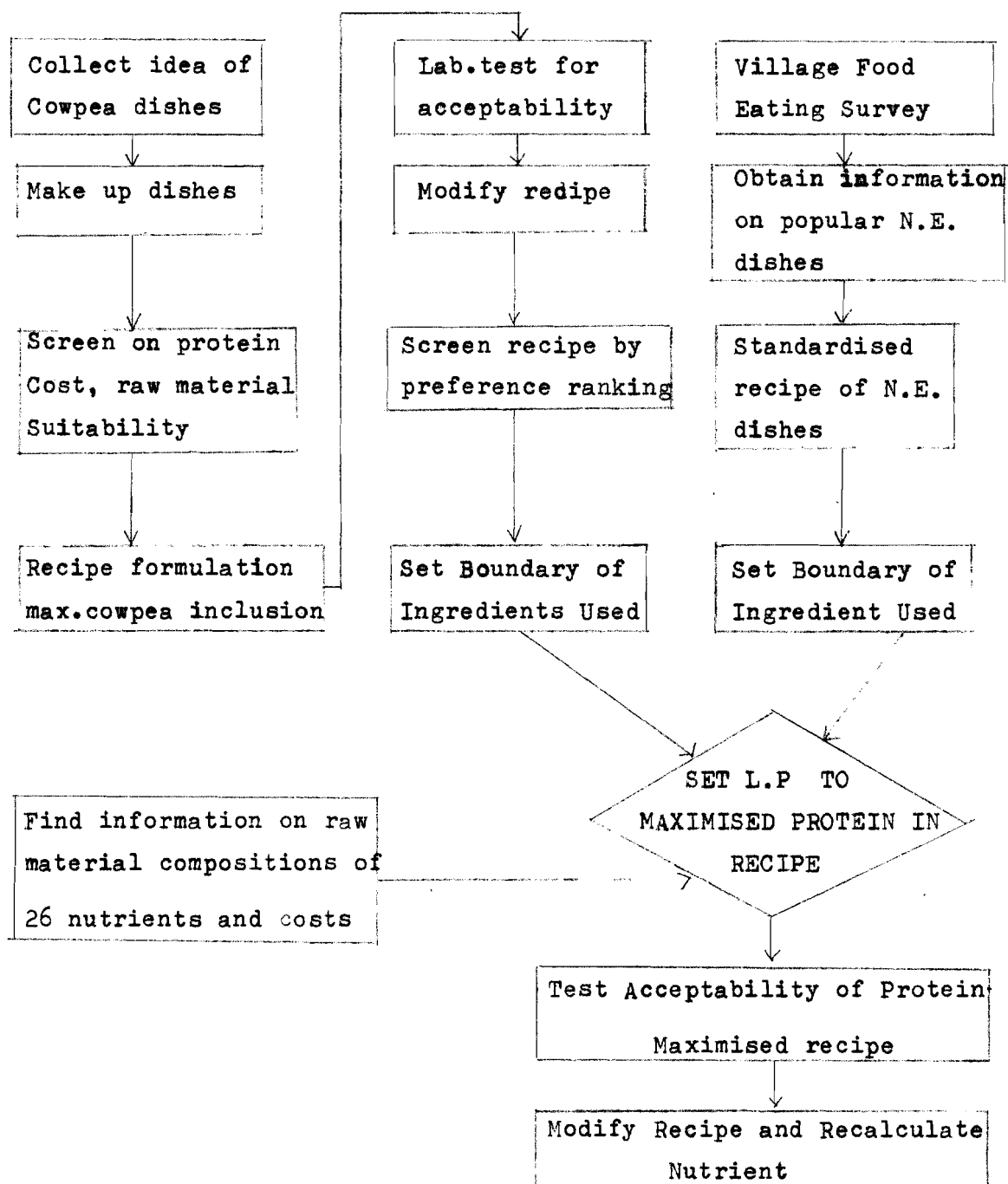
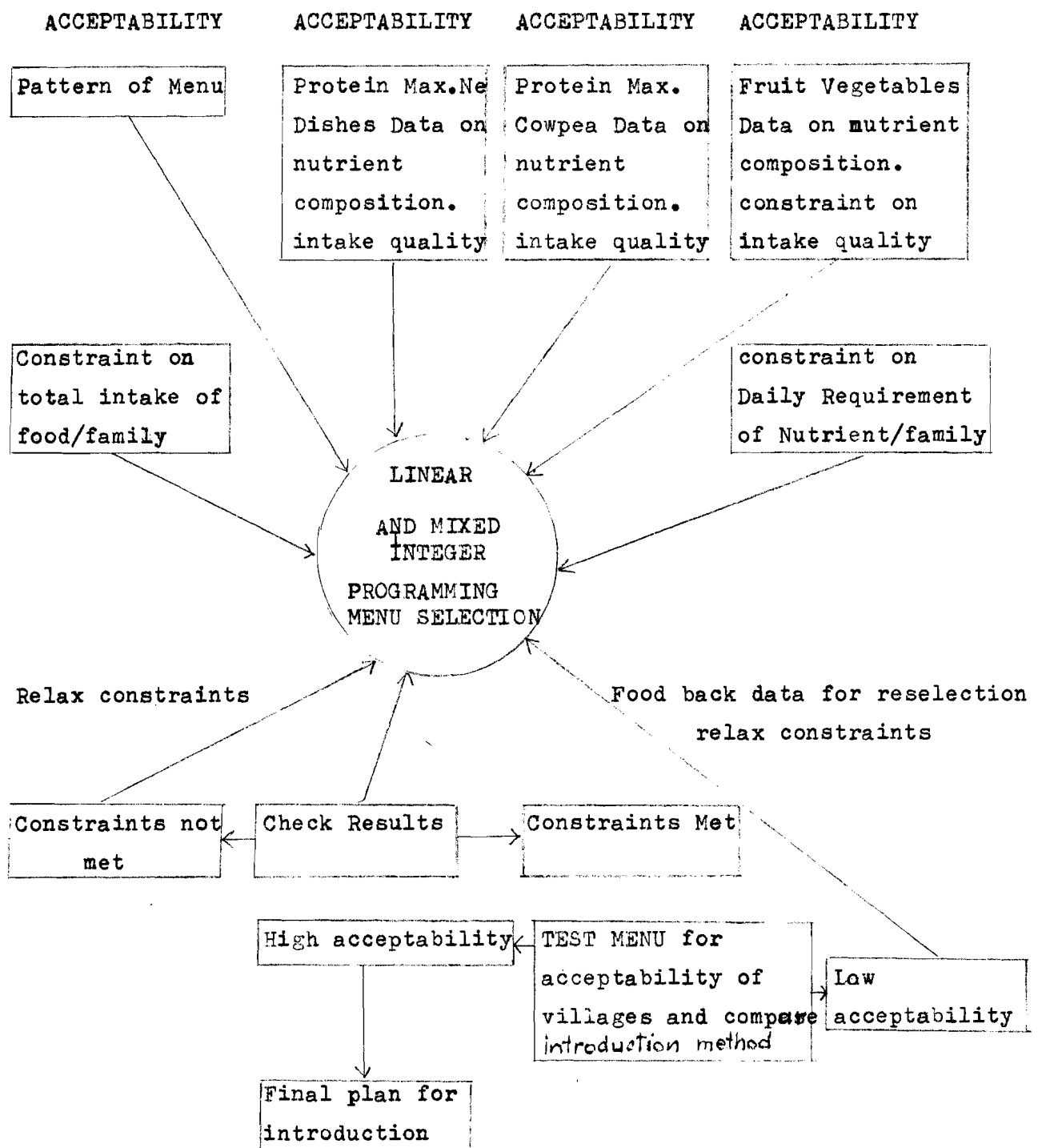


Figure II Schematic Showing Menu Planning.



Phase II

1) Development of cowpea flour

The project had introduced a PRL dehuller which hulled, ground, and rolled the pea continuously, in Ban Muang Village in 1982. The production in 1982 was 87 kg, and 140 kg. in 1983. In 1984 it reduced to 39 kg. as there were not enough cowpeas.

2) Introduction of cooking methods and types of cowpea food.

Four types of food were introduced:-

- Cowpea flour batter, with vegetables, or fish, shells, frogs, and certain insects.

- Fried cowpea ball, made by mixing the flour with pumpkin, potato, fish, prawns, and shells ground together.

- Cowpea and fish hot sauce, made from cowpea flour and fish, chilly, ginger, and fermented fish cooked into thin sauce.

3) Introduction of cooking and types of dishes to venders.

The project intended to introduce snacks and puffed food for venders who could then sell them to villagers. The venders would earn some money, the farmers would be able to sell cowpeas to the venders. These foods made use of cowpea flour cooked into different kinds of desserts and snack products with cowpea content of 30-70%.

After the introduction, it was found that the number of desserts sold by the venders which were made of cowpea flour increased. However, the promotion was not really successful because they tended to make traditional desserts.

4) Introduction of cowpea products for bakeries.

The following types of bakery products were introduced:-

- Bakery products

- Snack products

- Puffed products

However, the flour had some defects, eg., some smell, and there was only 10% of cowpea flour mixture in cowpea bread. This made it difficult to be accepted.

Phase III

Phase III involved the introduction of food cooked with cowpea to 27 villages, and the production of cowpea flour for further cooking. The final step was the transfer of technology so that other institutions would be able to utilize it.

1) The promotion of cowpea growing

The project had promoted cowpea growing in the villages, using the following breeds: red cowpea, VITA-3 and TVX 4654-44E. Red cowpea yielded maximum product, i.e., 2,053 kg/rai, VITA-3 and TVX 4654-44 E yielded low product, sometimes as low as 20 kg/rai. It could be concluded that cowpea growing in Khon Kaen was not successful; an appropriate breed still could not be found and there was a problem from diseases and insects too.

2) Dissemination of knowledge.

A workshop was arranged for village second headmen, teachers, housewives and farmers. The result of this workshop was useful for the dissemination of knowledge.

3) Study on other utilization of cowpeas

The project carried out the study on :-

- The utilization of cowpea for animal feeding: not very successful.

- The capital in harvesting and transporting cowpea stems for animal feeding: the figure only showed when it was necessary, naturally the farmers harvested and transported plants by themselves.

- The use of cowpea as compost : this proved worthwhile.

- The use of cowpea plant to prepare mushroom plots : not really satisfactory.

2 Evaluation Results and Recommendations

2.1 Importance of Project

It could be seen that the different steps of recipe development, preparation and planning were very essential because they all aimed at developing population's health. The project, therefore, attempted to initiate other extension work in order to make the growing and using of cowpea viable. Promotion of cowpea growing in order to sell the peas to the project ; or promotion of cowpea growing on a large scale for an exporting purpose; an attempt to initiate utilization of cowpea for different purposes, eg., production of compost, use of crops' residue for animal nutrients, use of cowpea stems for mushroom planting, or the study of seeds' resistance to insects in storage conditions; were the examples of extension work. Even though these extensions were not directly related to the research project, they showed the attempts of the researchers to integrate knowledge from different areas.

2.2 Implementation of Results

The implementation of the results of this project was less than expected, which could be due to the following reasons:-

2.2.1 It was difficult to change the people's eating habits.

The evaluator believes that people's eating habits could be changed only temporarily. This was due to the fact that the villagers had low income, were not adequately educated to be able to understand the matter of nutrition. Even though the food seemed to be delicious for them, they did not have enough time to prepare because they had to do many types of work for their living.

2.2.2 It was difficult for the farmers to accept the 7-day menu.

Usually, villagers planned their meals according to:-

- food remained from previous meals
- raw materials which could be obtained
- appetite
- Ceremonies or visitors

Therefore, the evaluator would like to suggest that the introduction of different dishes and desserts, together with the methods of cooking should be adequate and more suitable for their situations than the 7-day menu.

2.2.3 The research results were used in a small-scale due to the scarcity of raw materials.

This project faced a very important obstacle, i.e., cowpea was not an economic crop of Thailand. As a result, there was a scarcity of raw material for the cooking.

It could be seen then, that the weak point of this project was in the selection of raw material or plant which had no economic importance. From the experiment on growing cowpea in the university, it had been found that the plant could adapt itself well in the conditions, and yielded a high production. Moreover, it could be incorporated into a multiple cropping system. However, all these did not mean that the plant would become an economic plant. For any plant to become economically important, it would require a long period of time.

The evaluator thinks that the researchers should look at some other types of peas or beans which also contain protein. Soybean could be of a problem in the Northeast because of the chemical structure of the soil which made it difficult to produce fruits. However, the evaluator believes that it would still be possible in certain areas in the Northeast. Groundnut could create problems in the development of food products because it often contains alfa toxin. Still, different development methods should enable researchers to solve this problem, e.g., the use of chemicals, or drying techniques. Mungbean is another type of beans which has protein content, can be prepared into food products, and is already known among farmers.

The selection of plant to develop food product is very important. Often the raw material is not grown in the project area, but is being transported from other parts. It is true that the development should be done from the

plant which is grown in the area. However, there could be other obstacles, eg., weather, economic and social conditions, limited purchase, etc.

2.2.4 Food products developed could be produced from other types of flour.

One obstacle to the development of cowpea products from cowpea flour was the fact that there were already a great variety of flours in the market. Cowpea flour, in fact, had a unique smell and was not white, and thus the vendors did not use the flour, especially when it was not their intention to promote high-protein food. The following considerations could be raised:-

1) Villagers' situations

Villagers did not use cowpea flour for their cooking ingredients because:-

- cowpea flour was rare,
- villagers did not have time to cook dishes which required time,
- villagers used the flour available at hand.

2) Vendors' situations

Food made from cowpea flour had a smell and taste which could not compete with other flours. Vendors naturally wanted their customers to buy their products, and so they used the types of flour which would make their food delicious rather than paying attention to the protein content.

3) Bakeries' situations

There was a limitation of use for cowpea flour eg., in baking bread, only 10% of cowpea flour was needed for the whole ingredients. In making cookies and cakes, the bakers were more familiar with other types of flour, not cowpea flour. In addition, they were not certain of the availability of cowpea flour in the market.

2.2.5 The dissemination of technology or the promotion of product utilization were not completely achieved.

The dissemination and promotion of technology were not efficient due to these reasons:

- 1) The scarcity of raw materials, eg. cowpea.
- 2) There was no cooperation from other sections. The evaluator has seen that this project received few participations from agricultural extension and home economic units. This could be due to the fact that:-

- They knew that cowpea was scarce.
- Their work load was already high.

2.2.6 The project spent time on research and development of other aspects which did not concern the development of the aimed product.

The extension work on promotion of other means to utilize cowpea which have already been discussed above, eg. the use of crop residue as animal feeding, or as a compost, etc. should be conducted by other units. The project should have emphasized the promotion of cowpea

growing.

2.3 The Impacts of the Research Project

There were not many impacts from this research since the application of research results was not wholly possible. It can be said that the impacts consisted of :-

2.3.1 The project could be a good example of the development of food product to increase protein for farmers since the implementation of each procedure was based on the research methods and principles.

They were:-

- 1) Recognition of problem
- 2) Field survey
- 3) Development of product
- 4) Technological dissemination development
- 5) Extension and utilization of result.

2.3.2 This project indicated the requirement of parallel research on other aspects in order to make the developed food products usable.

2.3.3 The experiences and knowledge emerged from this project were beneficial to the teaching and learning of the Department, eg., the courses "Cereal and Legume Processing", "Nutritional Food Production Development" and "Technique in Food Technology Survey".

2.3.4 The researchers and lecturers obtained a lot of benefits. The project led to a chance for some lecturers to continue their studies overseas.

2.4 Recommendations

The following recommendations are made by the evaluator:-

2.4.1 The researchers from Home Processed Legume Project (Thailand) should continue their research on cowpea products in order to:-

- 1) Reduce cowpea flour's smell and flavour, and improve its color and quantity.
- 2) Raise the cowpea proportion in the ingredients of bakery products.

2.4.2 The researchers from this Project should find methods of product development using other peas, beans together with the development of cowpea products. Then a comparative analysis can be made to assess the quality of each type. It will not be necessary to promote the use of cowpea and other peas in the area where such peas are grown. If in any village, protein increase project is successful, the obtaining of raw materials from other areas nearby should be possible.

2.4.3 Research and development to increase protein should be a sub-project within a major one. The sub-

project will conduct research and development of food products, plan the menu, and demonstrate, without necessarily using peas or beans. Protein supplement food for infants and small children should be emphasized. Raw materials in this case can include green vegetables, different types of peas and eggs. If it is necessary to produce materials, the promotion of kitchen gardening is possible.

2.4.4 Home Processed Legume Project should not conduct research on crop residue.

2.4.5 Khon Kaen University and/or IDRC Project should support research into improvement of breeds, improvement of produce, and cowpea growing system so that adequate studies on crop production are made, leading to the promotion of cowpea growing and the adequacy of raw materials for future research projects.

2.4.6 Khon Kaen University and/or IDRC Project should assist the project on home-processed legume to coordinate work with and transfer technology to agricultural home economic units which are affiliated with the Department of Agricultural Extension. The researchers of this project should study and develop a promotion model and carry out promotion work only in target villages. The large-scale promotion should be conducted by the Department of Agricultural Extension. Khon Kaen University may establish the directions for promotion work with the units under the Department of Agricultural Extension. The IDRC may find a means to encourage the promotion model, having Home Processed Legume Unit as a supervising unit. Following these, the methods to develop cowpea products as protein supplement food would be more viable.

Project No.4 : Cassava Nutrition Project
(The improvement of the nutritive and economic value of cassava root product)

1. Major Elements

1.1. Responsible department and research implementers

The project "Improvement of the Nutritive and Economic Value of Cassava Root Product" or Cassava Nutrition Project was carried out by the Department of Animal Sciences, Faculty of Agriculture, Khon Kaen University. The IDRC had assisted in terms of monetary support. There were two implementation stages:-

Phase I : 1975-1978

Phase I Project received C \$153,000 from IDRC, and C\$ 74,592 from the Royal Thai Government

Phase II : 1979-1982

IDRC donated C\$ 225,160 and the Royal Thai Government allocated \$4,675,000 for the implementation of this phase.

The researchers consisted mainly of lecturers from the Department of Animal Sciences, Faculty of Agricultural, There were some other participants from the Faculty of Engineering and from the Departments of Economics and Microbiology too. Following is the list of researchers:-

- 1) Dr.Kawee Jutikul Dean, Faculty of Agriculture
Director of the Project
- 2) Dr.Sarote Kajaroen Department of Animal Sciences
Project Leader
- 3) Dr.Yaowamarn Kajaroen Researcher
- 4) Dr.Norong Hutanuwat "
- 5) Dr.Kanok Plarak "
- 6) Mr.Suwit Teerapanwat "
- 7) Dr.Cherdchai Ratanasettakul "
- 8) Dr.Narong Kitpanit "
- 9) Dr.Suchin Simarak "

1.2 Rationale

90% of cassava produced in Thailand was exported (data before the project started) which comprised over 90% of cassava products in European Economic Community. However the price of Thai cassava was usually 5-10% lower than cassava products from other exporters. Thai cassava was said to have a lower price because of the high content of other grains, the percentage of damage, and dust. The price of cassava, in addition, always varied according to the price sold at the EEC; which in turn, depended on the supply and demand. Whenever the price was low, the cassava holders in Thailand were affected.

It was very essential for Thailand to make a research study on cassava so that its nutritive value would be improved and thus could compete with cassava from other countries. Some means should also be found to enlarge cassava utilization in the country in order to be able to sell the products whenever EEC stopped importing Thai

cassava.

It could be said that this project had been in accordance with the government's policy to reduce cassava growing. The expansion of land area for the growing of cassava had resulted in deforestation, while a lot of growing lowered its price. The price became even lower when the normal price at EEC was not good. Therefore, the reduction of cassava growing and the promotion of cassava product utilization would contribute in increasing its price.

1.3 Project Objectives

Phase I

1. To analyse the nutritive value of cassava products from different sizes of factories in cassava-growing areas in Thailand.
2. To develop methods of cassava conversion so as to yield higher nutritive value.
3. To find ways of using cassava as animal feeding and develop animal produce by cassava instead of other crops.
4. To find a means to grade cassava products according to quality.
5. To promote the University's research on nutrition and animal production by students and researchers, having Cassava Nutrition Project as a resource for knowledge and training.

Phase II

1. To follow up the change of Thai's cassava's quality after implementation and dissemination work in Phase I.
2. To evaluate nutritive values of different grades of cassava which have been analysed biologically, eg., the relation of the degree of energy expended by animal with the degree of grain content in cassava; and the agreement between chemical and biological analyses.
3. To improve nutritive value of cassava as simple animal nutrient, eg., as a nutrition supplement to cure certain toxicoses.
4. To evaluate economic feasibility of adding cassava in animal nutrients.

In conclusion, the general aim was to improve the quality and nutritive value of Thai cassava in order to use cassava as animal nutrient.

1.4 Implementation

The project had followed the following steps in implementation:-

1.4.1 Studying the structure of Thai cassava in order to determine its quality and nutritive value.

The project collected cassava product samples from different factories in Thailand for a laboratory analysis. The result showed that the cassava pellets had

a low quality, containing from 2.4-2.4 percent of grains, and dust, when compared to cassava chips or products from China and Indonesia.

Because of these, the price of Thai cassava was low.

1.4.2 Studying the method to grade cassava product's quality, using the following table:-

Grade	Main Composition			Minimum Price %	Production Method
	Maximum Fiber%	Maximum Sand %	Maximum Powder %		
1	2.0	0.4	90.0	110.0	Wash Cassava, cut
2	3.0	1.0	69.0	107.	Sieve, cut
3	4.0	1.7	64.0	104.0	No sand, soil, or residue before
4	5.0	2.4	60.4	100.0	Present product

The above grade levels were established by the project, using the standards set up by the Ministry of Commerce, and at the same time reducing unwanted substances eg., soil, sand and fiber.

1.4.3 Studying the feasibility of the development of animal nutrients containing cassava.

The main purpose of this project was to find the trend in the production of animal nutrients which contained cassava. The details of this study were clearly determined:-

- Consider the nutritive value of cassava by sampling from factories, and evaluate the result of cassava nutrients in animal feeding.

- Develop the formula which has a maximum cassava composition.

- Evaluate the economic feasibility in replacing other crops with cassava.

- Develop and find methods to solve the limitations in using cassava as animal nutrient.

- Study the effect of the reduction in nutritive value of cassava products because of other unwanted substances, on energy value for animals.

- Establish quality grades justified by animal feeding, and minimum index price of each grade, to be used as incentives for producers to improve their products' qualities.

1.5 Research Results

Table 1 depicts the conclusion of research results from the using of cassava nutrients in animals in place of crop nutrients.

- It is shown that cassava can be used to supplement

crop nutrition for different animals. However, cassava has a high content of carbohydrate, but a low content of protein and fat. It is therefore necessary to be careful when using it in food formula. In many cases protein, methionine, minerals, vitamin and fat need to be added.

- From the study, it was not found that mixtures of soil and sand in cassava products reduced the growth of animals. However, they resulted in a lower degree of meat gain and the efficiency of food utilization, and digestion was reduced especially in the formula with over 40% cassava.

- One factor preventing farmers from using cassava for animal feeding is the toxicity of hydrocyanide acid content. From the study, if the content of cassava in animal nutrient is 50%, the acid content did not show any effect. However, methionine had to be added to destroy the toxicity.

Table 1. Levels of Cassava Replacement In Animal Nutrients

Types of animals	Age (week)	Weight (Kg)	% Cassava in place of crops	Note
Broiler	0-8	-	57.5	granular food
Broiler	0-8	-	20	powdered food
Layers	0-7		40	powdered food
	7-20		60	"
	22-62		50	"
Porkers		13-35	50	
		35-60	60	
		60-100	70	
Dairy cow	Milking stage	-	65	thick food low protein
Dairy cow	Milking stage		69	thick food standard Protein

2. Evaluation Results and Recommendations

2.1 Importance of Projects

The beginning of this project was a very important point to consider. Thai cassava's price at that time was very low, the farmers could only sell it at 0.18/kg. Moreover, it could not be exported because of the low quality.

During the period of 1974-1975, the farmers could not decrease cassava growing land area in order to grow other crops because there was not at that time adequate

technology for the cultivation of other crops. In addition, cassava was a very simple-growing crop, requiring low cost of investment. These made the farmers continued growing cassava even though its price was very low. The initiation of this project was therefore extremely appropriate.

The mixture of unwanted substances in the cassava products occurred during production and conversion processes. The project also aimed at finding out the answer to this, and hence, to find solutions to the problems arising with Thai's production of cassava. The implementation of this research project was mainly pure science and could be of use whenever it became necessary. The project was therefore important both in terms of problem solutions and steps of implementation.

2.2 Implementation of Results

2.2.1 The characteristics of the project's results

The results of the project were in the form of knowledge for the application of cassava products. For example, when it was necessary to use cassava products for broilers, aged 0-8 weeks, what amount should be used and what constraints would arise, etc. These results could be used on a very large scale by animal nutrient producers and animal farmers who had to turn to cassava products because of the increasing price of corn.

2.2.2 The utilization of research results

- The extent to which the research results were utilized in animal farming industries could not be determined. Formal reports had not been obtained either as to the utilization by other sectors. It was only found that animal nutrient producers, and some animal farming organizations and some small animal farming holders utilized the results.

- At present the evaluator expects that utilization of the results is not on a large scale because the prices of cassava have improved from $\text{฿ } 0.18/\text{kg}$ in 1975 to $\text{฿ } 0.95/\text{kg}$ in 1987. With the present price, the chance for cassava to be used as animal nutrient will reduce.

- Hence, the research results of Cassava Nutrition Project can be said to be in terms of technical information which will always be available whenever the country faces with an excess quantity of cassava.

2.2.3 The impacts of research results

2.2.3.1 A larger amount of cassava was used, especially in poultry and pig farmings. The presentation and report of this project were in details and dissemination work was also achieved by training farmers and by presentation in different technical conferences and periodicals.

2.2.3.2 The researchers and project

implementers obtained a lot of experiences while some were able to be trained abroad:-

- Mr.Kanok Palarak- received scholarship for a training and afterwards received a Ph.D degree from Tokyo University of Agriculture, 1984.

- Mr.Suwit Teerapanwat was granted an IDRC scholarship to do a master's degree in animal Nutrition at Nagoya University.

- Mr.Narong Kitpanit presented his work from the project to Tokyo University and received a Ph.D in Animal Nutrition in 1981.

2.2.3.3 More training opportunities were attained on animal farming and nutrients.

2.2.3.4 The researchers had a chance to attend seminars and workshops both in Thailand and abroad, and to organize a seminar in Thailand, the results of which included a wider scope of knowledge, experiences, and chances to conduct research with overseas scientists.

2.2.3.5 There was a distribution of knowledge and technology through publication in technical periodicals and proceedings of international conferences.

2.2.3.6 The teaching and research of the department obtained a lot of benefits from the research because the lecturers applied the research results in their teaching and the students had a chance to participate in research work.

2.3 Recommendations

It could be said that Cassava Nutrition Project had achieved its objectives. Analyses were performed concerning nutritive values of cassava, concerning the effects of unwanted substances in cassava product, and a table to measure different grades of cassava.

As for the use of cassava products in animal feeding, it was found that it was possible to use cassava in the food formula, replacing other crops such as corn. The research results also showed different conditions and limitations which animal producers must be ware of.

All these are academic findings, the utilization of which will depend upon many factors such as the price of cassava, the problems in exportation, and other factors which are beyond the capacity of the researchers to control.

Project No.5 : Cropping Systems (Thailand) project

1. Major Elements

1.1. Responsible department and research implementers

The International Research and Development Center-Canada had assisted Rice Cropping Division (Farming Research Institute at present), Department of Agriculture, and Kasetsart University to conduct research and development on cropping system emphasizing field work with farmers. The aim was to apply the research results in the promotion of cropping so that the farmers' income would be increased.

The researchers consisted of staff and lecturers from two institutions as follows:-

The Department of Agriculture

- | | |
|----------------------------|-----------------------|
| 1) Dr.Damkoeng Janpanya | Researcher and Leader |
| 2) Mr.Narong Oonyawong | Researcher |
| 3) Mr.Wicharn Worthong | " |
| 4) Mr.Rasamee Kiritawee | " |
| 5) Mr.Nattawoot Payawanit | " |
| 6) Mr.Supachai Bangliang | " |
| 7) Mr.Hasachai Boonjoong | " |
| 8) Mr.Chalermkiat Saisoong | " |

Kasetsart University

- | | |
|-----------------------------|-----------------------|
| 1) Dr.Apipan Pookpakdee | Researcher and Leader |
| 2) Dr.Issara Sooksatarn | Researcher |
| 3) Dr.Prasarn Yingchon | " |
| 4) Dr.Jamnian Boonma | " |
| 5) Dr.Nuengpanit Sinchaisri | " |
| 6) Dr.Surachet Jamornmarn | " |
| 7) Mr.Worakarn Pinya | " |
| 8) Mr.Winit Sereeprasert | " |

1.2 Rationale

The Government has long been wanting farmers to increase agricultural produce and hence, their income. Experts from various institutions all agreed that one way to increase the farmers' produce and income was intensive cropping which enabled low-income farmers to grow different types of crops or plants continuously on their land in a system called "multiple cropping".

However, multiple cropping could not be achieved at all time. The number of times of planting, types, breeds and cultivation techniques all depended on other factors, eg., soil, water, rainwater, temperature. It did not mean either that it was possible to grow the plants in one area as often as they could be grown in other areas. In an experiment station, it might be possible to grow the crops frequently in a sequential cropping system provided that production factors such as water, temperature, soil and technology were available. Nevertheless, the farmers still could not always duplicate the pattern demonstrated at the station. They might lack labors, money, incentives, markets and other production, economic, and social factors. Thus, the research study which aimed at enabling the

farmers to effectively apply good cropping systems should be conducted in real situations, with participations from farmers.

From 1965 to 1975, research institutions both in Thailand and abroad had become alert in research on multiple cropping. In 1967, the International Rice Research Institute started research on multiple cropping or cropping system intensively. Chiangmai University, supported by the Ford Foundation, started research on multiple cropping in 1967. Kasetsart University received assistance from the IDRC and commenced work on the same field in 1973.

Multiple cropping research at Chiangmai and Kasetsart universities at the beginning was mainly experiments in the stations. Meanwhile, the Department of Agriculture conducted experiments on direct seeding of rice. The results of these experiments enabled farmers to grow crops after rice. It could be said that these experiments were a source of experiences for researchers and a resource for technologies, the degree of utilization of which was still a confusing matter.

In 1975, a workshop was held on cropping system at the Rice Research Institute, the Philippines. Meanwhile the Institute had established an Asian Cropping System Working group so as to stipulate regulations for research on cropping systems and to give support to the countries which participated in the workshop, in terms of technical benefits from the Institute. There would also be an exchange of information in this respect. The representatives from Thailand had agreed as to the areas that each one would be responsible for, for cropping system work. Chiangmai University took the responsibility of research in the area of partial irrigation in the North. Khon Kaen University was responsible for the upper northeastern rainfed area. The Department of Agriculture and Kasetsart University were responsible for rainfed area in lower northeastern and central parts.

Besides, the Department of Agriculture and Kasetsart University had agreed to submit a research proposal on cropping system to the IDRC to apply for a scholarship to conduct an extension project on multiple cropping, so as to follow the trend set by the Asian Cropping System Network. The assistance included the exchange of information, the training of officers at the International Rice Research Institute, at various universities such as Kasetsart or University of the Philippines, and the stationing of IDRC technical officers in Thailand.

The project appointed an officer from the Department of Agriculture as a project coordinator. The project site covered 4 areas in 1977 namely: Warin District, Ubonrajthani; Pimai District, NakornRajshima; Intaburi District, Singburi; Bangpae District, Rajburi. The first three districts were under the responsibility of the Department and the fourth under Kasetsart University.

1.3 Objectives

1.3.1 To obtain cropping systems and technology in rainfed area and partial-irrigated area.

1.3.2 To demonstrate and assess the feasibility of the developed cropping system when experimented in real situations.

1.3.3 To assist in the teaching and training of officers and researchers so that they understand the research on cropping system.

1.3.4 To develop a theory and principles concerning cropping system which are practicable in Thailand.

1.3.5 To build a good understanding and cooperation between different research sections.

1.4 Implementation

The implementation of this research project was divided into 4 phases as shown in Table 1.

Table 1 Phase of work, project site and responsible sections for research on Cropping System (IDRC)

Phase I	Phase II	Phase III	Continuing Phase
Project site	Project site	Project site	Project site
Pimai DA Ubon DA Inburi DA Bangpae KU	Pimai DA Ubon DA Bangpae KU Prankatai DA Prae DA	Pimai DA Prae DA Nakornsri DA thammarat	Banpai DLD DA, OAE (Crop & Livestock) integrated Project)

Evaluation Extent

Note DA = Department of Agriculture
KU = Kasetsart University
DLD = Department of Livestock Development
OAE = Office of Agricultural Economics

1.4.1 Project sites

1.4.1.1 Warin District, Ubonrajthani (Phases I, II)
Rainfed rice-growing area of
3,125,000 rais

1.4.1.2 Pimai District, Nakorn Rajsimma (Phases I, II, III)
Rainfed rice-growing area of
5,312,500 rais.

1.4.1.3 Inburi District, Singburi (Phase I)
Partial-irrigated rice-growing area.

1.4.1.4 Muang District, Prae (Phases II, III)
Partial-irrigated rice-growing area.

1.4.1.5 Prankratai District, Kampanget (Phase II)
Rainfed rice-growing area.

1.4.1.6 Muang District, Nakornsritammarat (Phase III)
Rainfed rice and rubber growing
area of 2,603,000 rais.

The above sites were under the responsibility of the Department of Agriculture.

1.4.1.7 Bangpae District, Rajburi (Phases I,II)
Rainfed rice-growing area of 950,000
raies.

After 1983, the Farming Research Institute saw the importance of the integration of cropping, animal farming and research into a farming system. Therefore, the Institute made a request to the IDRC to use the remaining budget from Phase III to conduct the "Crop-Livestock Integration Development Project". This project was a cooperation of research among Farming Research Institute, the Department of Livestock Development and the Office of Agricultural Economics, Choosing the project site at Ban Pai District, Khon Kaen. This project, however, was not in the scope of this evaluation.

1.4.2 The research work

Research methods and procedures followed by Cropping Systems Project were those established by the International Rice Research Institute and Asian Cropping System as shown in Figure 1. The procedures included site selection, base-lined survey, experimentations at stations which were conducted by graduate students of the Department of Field Crops, supervised by lecturers and researchers. From these experiments, technology was to be developed for further experiments in real situations.

1.4.3 Trials in real farms

The planning and implementation of these trials also followed the steps of cropping systems formulated by the Asian Cropping System Network. The experiment involved the use of small experimental beds, often referred to as research-managed trial which aimed at collecting crop produce: and super-imposed trial which aimed at studying crop's reactions to real farming's environments or treatments. The super-imposed trial offered a chance to study the economy, the assessment of cost and benefits, the feasibility of application and the farmers' acceptance.

Following are the types of research study in real farms:-

1) Cropping System Testing

This was the testing and development of a better cropping system from the traditional one, by considering physical and socio-economic determinants.

2) Component Technology Research

Component technology research or the so-called production technology was conducted to determine the management of different crops under specific conditions. The results of this research would be a recommendation in the form of a package for the farmers to apply.

3) Agri-Economic Monitoring

The agri-economic study would indicate whether the developed technology could be applied in the physio-economic conditions of the farmers. This study is

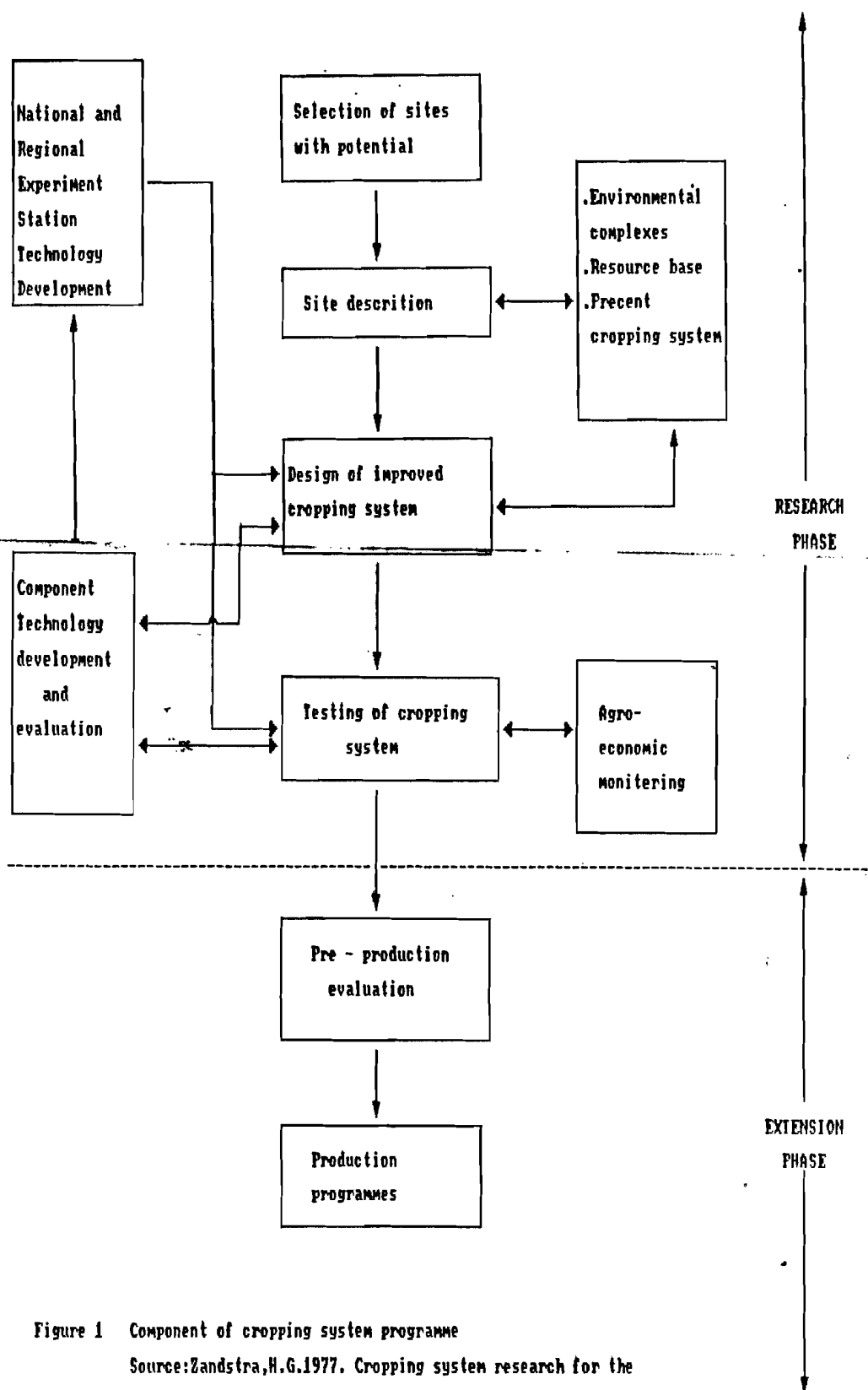


Figure 1 Component of cropping system programme

Source: Zandstra, H.G. 1977. Cropping system research for the Asian rice farmer. Proceeding of the Symposium on Cropping Systems Research and Development for the Asian Rice Farmer. International Rice Research Institute, Los Banos, Laguna, Philippines 454pp.

generally required at every stage of component technology research, especially in a super-imposed trial.

1.4.4 Research Results

The results of this research project could be concluded as follows:-

1) Ubonrajthani Site

- In Phase I, crops were planned in two sequences and it was found that the systems of long bean-rice, and rice-groundnut yielded good production and had a potential to replace only rice growing.

- In Phase II, it was found that upper paddy was suitable to grow crops before rice, eg., long bean before rice and groundnut after rice (a confirmation of Phase I); and in lower paddy, rice should be grown twice.

The overall results of the experiments here could not be used as a suitable system for the farmers. In the long bean-rice pattern, the long bean could not sell when production was big. In the rice-groundnut pattern, the groundnut took a long time to grow, ie., 110 days, which made the farmers unable to pick the groundnut before rain.

2) Pimai Site

- Phase I : It was found that the pattern of mung bean-rice was more suitable than only rice growing. The second priority was groundnut-rice.

- Phase II: the findings from Phase I were confirmed.

3) Inburi Site

Here, only one pattern was tried, ie., sweet corn-rice. Other cropping was introduced but no comparative analysis was made. Therefore, the result could not be concluded.

4) Prankratai Site

During Phase II, some patterns were tried out here, eg., direct seeding rice, or the pattern of mung bean-rice. However, the results could not show which pattern was appropriate.

5) Prae Site

The research conducted here included Phase II and III. The patterns tested were: sweetcorn-rice-groundnut and groundnut-rice-soybean, and cropping after rice growing which were easily accepted by the farmers. Another pattern which was accepted here was mungbean-rice pattern.

6) Nakornsritammarat Site

The research during Phase III started here with a trial of these patterns: mung bean-rice-sweet corn, groundnut-rice-glutinous corn, sweetcorn-rice-mungbean, and glutinous corn-rice-groundnut. These patterns had been tested again in various stations for 2 years. It could not be concluded which pattern was more suitable than only rice growing. Southern farmers did not like growing mung bean because rainwater resulted in too much growth of stems. The crops were then emphasized; however, the results have not been determined until now.

7) Bangpae, Rajburi Site

This site was under the control of Kasetsart University. The implementation from 1973 to 1975 comprised technology development in experimental stations. Phase I was conducted in the form of based-line survey to find information relating to cultivation, planting, environments, socio-economic conditions. There were experiments on the pattern of pre-rice crop-rice-post-rice crop, and on certain component technology.

Phase II

- 1979 - research-managed trial; component technology of mung bean and corn; economic study.
- 1980 - Super-imposed trial participated by 12 farmers; component technology test; plant nursing; insects; economic study.
- 1980 - Super-imposed trial participated by 30 farmers who managed their holdings using technology package; economic assessment.
- 1981 - pre-production program tests by Western Office of Agricultural Extension.

The results showed that crops growing could be done three times in a year in Bang Pae Site, depending on rain only. These patterns were obtained:-

- 1) sweetcorn-transplanted rice- mung bean
- 2) glutinous corn-transplanted rice-mung bean
- 3) mung bean-transplanted rice-mung bean

2. Evaluation Results and Recommendations

2.1 Importance of Research Project

To begin with, the importance and usefulness of the project will be presented.

2.1.1 The importance as a new project conducted in real farms.

The project was new and was emphasizing the implementation in real situations. Formerly research work was usually carried out at experimental stations which had a similar nature as the area where technology was going to be utilized. The technical experts had seen experiments in real situations as being heterogenous, none other factors nor imposed factors could be controlled.

This project had proved that the experiments conducted in real situations were very essential. Besides allowing the crops and technology to react in real situations, the researchers were also informed of real conditions both in terms of physical farm resources and socio-economic constraints, and hence could use these information to improve their work.

2.1.2 The importance as being the research on something required by the country.

The increase of population, the economic regression and the lower prices of some crops eg. rice, sugar canes made it necessary to find other crops to replace them so as to increase production and farmers' income. It had been necessary to carry out farming and

cropping and prevent the deterioration of soil, fertility and ecosystem. It was necessary to study the efficient cropping systems so that problems would not expand.

2.1.3. The importance in creating multi-disciplinary research.

The project had followed the procedures set up by the Asian Cropping System Network for component of cropping system. Therefore, work was integrated between cropping system testing and component technology testing even though not on a fullest scale. The cooperation of work among agricultural workers, economists and in certain cases, social workers was the origin of a multi-disciplinary research in Thailand.

2.1.4 The importance of procedures from technology development to promotion.

This project involved technology development steps from testing at the stations, in real farms, assessment of the feasibility of technology to tests on a wider area with different agro-ecological environments and to pre-production programs and production programs. These steps of research implementation became of interests among other researchers. At present, the emphasis of on-farm trial in various research projects, the studies of farmers' behaviours, constraints, decision, etc. before the testing of technology, demonstration and promotion all follow the model originated by the Cropping Systems Project.

2.1.5 General research results

2.1.5.1 Technical characteristics and intensity

The implementation of Cropping System Project by the Department of Agriculture lacked technical intensity. The results of experiments and tests in farmers' holdings had, in many cases a lot of variables, the tests were often damaged by natural phenomena and the conclusions were not in accordance with numerical data. These could be due to:-

1) The researchers, especially site coordinators, assistant researchers, site technical officers still lacked knowledge and skills and did not clearly understand the principles, theories relating to cropping systems and the importance of work.

2) Research work in real farms was new to them. Therefore, there were a lot of obstacles, eg., land rent, cooperation requests, watering and nursing of experimented plant beds in conditions unfamiliar to the farmers.

3) The technical officers and research team were unfamiliar with the site, the farmers and village life. This made them unreliable to the farmers.

4) The selection of site, etc. concerning site description and base lined survey were not adequate, making the experimental results inappropriate.

5) Often the technical officers were required to carry out administrative work. This lessened their time which should be allotted to site work.

2.1.5.2 The Project's Inter-disciplinary Trait

The project's interdisciplinary trait was not outstanding when compared to cropping system projects at Khon Kaen and Chiangmai University.

This economists who participated in the project carried out work during the base-lined survey and the assessment of cost/benefits. Their participations were based on survey and case studies rather than monitoring the cropping system and component technology testings, which would be more effective with their assistance and the assistance from sociologists and other specialists. Component technology studies required more integrated participations from many other disciplines. It could be seen that in the site work, economic and agronomic cooperation was inadequate and inconsistent.

2.2. Implementation of Research Results

The research results were implemented in three different areas, namely:-

2.2.1 Implementation by farmers and promotion by extension officers.

The transfer of technology, even though on a small scale, had truly promoted certain types of cropping systems among farmers, eg.,

1) The patterns : sweet corn-rice-mung bean and glutinous corn-rice-mung bean, which are still practised today at Bang Pae, Rajburi.

2) The pattern : rice-mungbean was promoted by the agricultural extension officers and was a price of technology derived from the pattern corn-rice-mung bean. This pattern has been practised on a wide scale in the central provinces.

3) The pattern: mungbean-rice was interesting to farmers in Nakornrajsima, was tested, and was afterwards practised widely in Prae.

4) The patterns: groundnut-rice, and rice-groundnut tested at Pimai and Ubon respectively are still found to be practised on a large scale in many areas of the Northeast.

5) The results from component technology testings have been applied extensively by farmers of many provinces.

2.2.2 Implementation in the teaching and learning, and research at a graduate level.

At present, many universities start to offer courses in cropping systems and open graduate field of agricultural system, farming system, crop production and agricultural economy. The teaching and learning in the mentioned fields and subjects have applied the research results of this project. The students also had a chance to participate in the project at different stages.

2.2.3 Implementation in terms of points of considerations for farming system research.

The results of cropping system project by the Department of Agriculture have been used as bases for considerations in the implementation of farming system projects or as bases for considerations towards the other components of a farmers and rural ecological systems. The important point to note here is the initiation of a working group for cropping system research. The working group had the Department of Agriculture as its center of activities and consisted of other institutions which conducted cropping system research. Many activities were arranged, most importantly, the organization of annual seminar. There was a consensus agreement between many institutions made in one of the annual seminars as to these points:-

- 1) The technology being transferred, even though carefully tested and assessed, was not accepted by the farmers.

- 2) The farmers accepted only a part of technology. For example when the pattern, sweetcorn-rice-mungbean was introduced, they would accept only rice-mungbean practice.

These observations showed that the limitation of acceptance was mostly due to socio-economic constraints. Therefore a study should be made on socio-economic conditions of the farmers, their non-farm careers, their decision making, etc.

2.3 Impact of Research Results

The following impacts arose from the research results:

2.3.1 The establishment of Farming Research Institute

Although it had long been the intention of the Department of Agriculture to set up various institutes, nobody could deny that Farming Research Institute was established from an impact of Cropping System Project. The studies which were carried out towards the farmers and their environments had gained a lot of interests from technocrats who saw the importance and usefulness of farming systems research, which had an impact on the establishment of the Institute.

2.3.2 The implementation of a continuing research project funded by an overseas agency

Another impact from Cropping System Project has been the initiation of the research project, "Crop-Livestock Integration Development Project" funded by IDRC, conducted by Farming System Research Institute, Department of Livestock Development and the Office of Agricultural Economics.

This project is the first multi-disciplinary research project which involves researchers from various institutions. It also gets an impact from the Cropping System Project because:-

- 1) It is the continuation from the Cropping System Project, and is supported by the IDRC.

- 2) The researchers from the Cropping System Project (The Department of Agriculture) conduct this research with other researchers.
- 3) It applies the methodology of Cropping System Project which included site selection, site description, cropping system design and testing, and component technology.
- 4) It is initiated from the methods of improving cropping system into farming research.

2.3.3 Assistance from other International Organizations on Farming Research

Apart from the IDRC, the Farming Research Institutes receives assistance from other international organizations to conduct research on farming. For example, the FAO and UNDP Integrated Rainfed Development Project assists in farming system research in the Northern area; The International Rice Research Institute also supports research on the role of women in farming system. This shows a positive impact on the initiation of other research projects with assistance from overseas agencies.

2.3.4 Manpower Development of Cropping System Project

Another impact of this project concerned staff development activities. The researchers and project implementers had a chance to continue their studies in and out of the countries. At first the IDRC allocated the scholarships and afterward, other funding agencies such as SEARCA and ACNARPP realized the importance of the project and started to authorize more grants for staff development purposes.

The International Rice Research Institute offered short training courses, eg., Rice Production training Course, and Multiple Cropping Training Course. The Asian Vegetation Research and Development Centre offered a course "Legume Production Training Program" Kasetsart University and the Department of Agriculture have sent technical workers who need more experiences to these trainings, which increase their knowledge as well as experiences, useful for their future research work.

2.3.5 The Increase of Knowledge and Experiences of Technical Workers Through Seminars or Monitoring Tours abroad.

Technical workers of the project obtained a lot of chances to participate in seminars, conferences and workshops abroad which were arranged on topics related to cropping systems. Monitoring tours were also organized for them in which there was an exchange of knowledge and experiences.

2.3.6 The Alertness Towards Cropping and Farming Systems in Thailand

The alertness towards research on cropping and

farming systems could be seen in :-

- 1) Seminars on cropping systems and afterward farming systems where technocrats could present their work and exchange ideas.
- 2) The understandings of various departments and organizations towards the principles of cropping and farming systems; and the desire to develop their work into farming systems.
- 3) The development of various technologies of farming systems, eg., site description which now applies rapid rural appraisal technique and agro-ecological zonation technique.
- 4) The results of annual seminars made the Department of Agricultural Extension become alert in the extension of cropping systems and integrated cropping and livestock farming, by sending its officers to training programs.

2.4 Recommendations for Project Improvement

The following recommendations are made:

2.4.1 There should be more cooperation of work among institutions.

1) From the stage of site selection, the research work on cropping system had been separated thereafter. The Department of Agriculture was responsible for certain areas while Kasetsart University controlled other parts. In fact each section was competent in different aspects. The university had a good capacity to develop technology both at station level and at farm level whereas the Department of Agriculture had adequate manpower, experimental stations, government officials of different levels who could work and collect information in large farming plots. Thus, the two sections should work together; for example, the testing of cropping system could be conducted by the Department of Agriculture following the design of cropping pattern. For component technology, the university would be responsible for research managed trial whereas the DA conducted the super-imposed trial.

2) Supports from University's administrators were inadequate. Before the beginning of this project, the IDRC used to support other university project which, when completed, had certain weak points concerning technical aspects and project administration which expended rather too much money. During the implementation of Cropping System Project, experts from overseas had paid a visit and there was a monitoring tour to the project site at Bang Pae. The administrators never visited the site and never paid attention to the work of the project. Moreover, the assistant researchers who were trained in Taiwan and the Philippines under this project were not recruited as permanent Government Officials. There was no encouragement towards multi-disciplinary research because no honorarium was given to researchers. During research

implementation a fund was allocated for the project to buy 4 vehicles. When the project was completed, these vehicles were no longer used for research purposes. And after the completion of this project the Faculty of Agriculture and Kasetsart University has no longer been granted a scholarship to conduct research in cropping/farming system.

3) The Farming Research Institute should act as the center of the research work.

Because the implementation of farming system project required participation from various sections, e.g., the different faculties of Kasetsart University, the Farming Research Institute, the Department of Agriculture, Field Crop Research Institute, the Department of Fishery, etc. The implementation processes must involve both basic and applied research, specific research including economic and social aspects. The extension work must commence from technology transfer at village and local levels to pre-production and production stages. As for the survey for site description and planning of cropping patterns, a team of technical workers should work together.

The evaluator believes that the Farming Research Institute should set up an integrated researcher teamwork consisting of researchers from different sections as already mentioned. The team would then meet to select at least one site where everyone would participate following the procedures. The work of this site would be used as a model of an integrated technological research and development on farming systems. At the same time, it would provide practical experiences for all researchers.

The division of governmental departments had a characteristic which completely separates work from department to department. It is therefore difficult for each department to conduct the research in the same way as the Farming System Project. However, the Farming System Research Institute has a direct duty on the study of farming systems which involves interdisciplinary work. It should therefore act as the central body which provides opportunities for integration of work, so that the utilization and application of research results would be beneficial to all.

4) The Farming System Research Institute should emphasize the trainings for practical officers.

From the evaluation, it was found that most of the research results varied, or the experimental results were not in agreement with the recommendation, or the recommendations did not arise from research results. These showed that the practical workers still lacked knowledge and understanding of farming and cropping systems. The senior research implementers of the Farming System Research Institute and of Cropping System Project had knowledge, understanding, and had obtained experiences from the project. However, the senior implementers often had to take charge of project administration. The

experimental planting, the interviews with farmers became the duties of practical workers. The Institute should thus promote the capacity of these workers by sending them to trainings, etc. in order to increase the efficiency of farming and cropping system research work in the future.

Part III Conclusion

The Conclusion of Impact Evaluation and Observations from the Evaluation of Agricultural Projects

1. Introduction

This report has been produced by the International Development Research Center (IDRC) and the Department of Technical and Economic Cooperation, in order to evaluate the IDRC-funded research projects. The projects being evaluated were "Vegetable Seed Production in Opium and Rice-Based Agriculture Project", Groundnut Sheller and Stripper Project", "Home Processed Legume Project", "Cassava Nutrition Project", and "Cropping System (Thailand) Project".

The Department of Technical and Economic Cooperation has assigned Associate Professor Dr. Apipan Pookpakdee, from the Department of Field Crops, Faculty of Agriculture, Kasetsart University to evaluate the above projects.

2. Objectives

The main aim of this evaluation was to evaluate the impacts of the completed research projects to determine whether the research impacts, results, and procedures were beneficial to technocracy, social, environment; and whether they were related to other newly-initiated programs. Nevertheless, the detailed objectives included:-

2.1 To evaluate the project in terms of the research importance towards existing social problems, research procedures, efficiency, and achievement.

2.2 To evaluate the direct, and indirect impacts of the research projects. The direct impacts referred to the capacity of research results in creating useful technologies, Indirect impacts referred to the positive and negative characteristics of the research results and implementation.

2.3. To evaluate whether or not such project should be continued provided it is important to do so, what should be improved, what working model should be like.

3. Evaluation Results

3.1 Importance of Research Projects

3.1.1 Justification of the Projects

In general, the initiation of the five projects was in accordance with the country's problems. All of the projects were planned, and the sub-topics of each project determined, to meet with and solve the problems of Thailand. Some projects might aim at solving current problems, and thus when the crisis of the problems passed, the results could no longer be used

widely, eg., Cassava Nutrition Project which was initiated when the price of cassava was very low.

3.1.2 The Implementation of the Five Projects

In conclusion, the implementation of all projects had properly followed the technical procedures, eg., research planning, implementation, extension research, technical and economic evaluation. It can be noted here that the research projects carried out by universities tended to be technically intense. Technically speaking, the disseminated research findings and the recommendations were derived from real experimentation stages provided the project was conducted by a university team. Not all of the research results presented by the Department of Agriculture were directly obtained from experiments. In fact, they were presented because the researchers were certain and confident since they were carried out many times.

3.1.3 The Project Leaders and Their Roles in the Projects.

In the projects "Cassava Nutrition", "Vegetable Seed Production", "Home Processed Legume", and "Groundnut Sheller and Stripper Project"; the leaders had a role in, and an influence on the determination of research directions. They were able to control research quality and variation. Whenever there was a chance, they would not hesitate to disseminate the research work, eg., in seminars, technical conference, training and teaching. It could be said that these projects were conducted in the universities, therefore, they were highly technical. The leaders had a major role, the number of researchers was small, and the project site was limited.

As for Cropping System (Thailand) Project, the leader acted more like a coordinator. He supervised the research work so that the steps were followed correctly at each project site. However, the directions and quality of research at each site depended on the researchers there. The effectiveness was based upon the knowledge and experiences of the researchers.

The nature of the last research project was different from the first four projects; it was not as highly technical as the first four. The presentation documents showed varied experimental results. However, the project sites covered a larger area.

3.1.4 Integration of disciplines

As a whole, all of the projects' interdisciplinary characteristics were not at a satisfactory level. This could be seen from:-

- Cropping activities carried out by some projects without any competence in the field.
- The study of seeds and seedling in a project on machinery development where researchers were not in the field of seed technology.
- The economic studies and cost-benefit ratio

carried out by many projects without any assistance from economists.

- The non-integration of disciplines in a project which should be interdisciplinary and which already possessed integrated stages.

The above characteristics could be due to the fact that:-

- 1) The researchers did not want participation from others, being uncertain of the allocated budget.
- 2) Other researchers felt they should not participate because they did not have a share.
- 3) Other researchers wanted to participate only when there was an honorarium for them.
- 4) Some working units and their systems did not favor any participation from outside researchers.

3.1.5 Support from the head of the affiliation

Generally, it could be seen that the departments or institutions where the projects were affiliated supported the project while a minority of the projects did not receive attention from administrators. At Khon Kaen University, the projects were initiated because the administrators realized their importance. The Department of Agriculture also saw the importance of Cropping System Project. As for Vegetable Seed Production Project, the work should have been carried out without conflicts if the department where the project was affiliated paid more attention.

3.1.6 Relationships with other departments and organizations

The evaluator sees that the first four projects related to other research projects in terms of information exchange and cooperation. The Vegetable Seed Production Project was outstanding in this respect because there had been an exchange of information with other universities and institutions.

The last project had a direct relationship with many institutions because it was a master program of cropping system research. The relation was obvious when seminars were organized and at the final stage, there was also an exchange of information.

3.1.7 Relationships with organizations abroad.

It could be said that every project had formed a relationship with an organization abroad apart from the IDRC. Chiangmai University's Project was connected with FAO and AVRDC, resulting in the exchange of breeding materials. In the project "Home Processed Legume", the researchers obtained assistance and advices from New Zealand's experts. IDRC also provided technical assistance in terms of technical advisers which made a lot of benefits to the project. In "Cassava Nutrition" and "Groundnut Sheller and Stripper", the IDRC experts contributed a great deal in improving implementation procedures.

3.2 Implementation of Research Result

The achievement of all of the projects was satisfactory. Every project created good results as had been expected. Nevertheless, the results which would be beneficial to and applicable by villagers were not immediate because :-

- In the Home-Processed Legume Project, the use of cowpea products was not widespread because of 1) lack of raw materials; 2) difficulty in changing the eating habits; and 3) a necessity to study the socio-economic conditions of villagers.

- In the Cassava Nutrition project, the technology was not transferred on a large enough scale because of the increased cassava price at present.

- The dissemination of machinery in the project "Groundnut Sheller and Stripper" was saturated because if too many villagers used the machinery, there would be a competition of occupation market and raw materials among themselves.

- The Project "Vegetable Seed Production" needed more extensions and trainings to efficiently transfer technology to the farmers.

- The farmers could only partially accept the technology from the Cropping System Project due to socio-economic constraints.

Still, every project had achieved its goal. Most of the impacts were in abstract forms, eg., seed production technology, menu of cowpea products, technology of cassava products as animal nutrients. Only the Groundnut Sheller and Stripper Project produced workable machinery, the performance of which could be measured.

To conclude, two types of research results were produced:-

- 1) The results which could be applied by the farmers under certain conditions, but profitable to them.

- 2) The results which indicated continuation of implementation of the impacts or technology, which would be entirely useful.

3.3. Impacts of Research Results

Various impacts were produced, namely:-

1) Staff Development

One of the obvious impacts was staff development. Researchers and project implementers had a chance to continue their studies. They were sent to trainings and many were recruited as permanent government officials.

2) Teaching and Learning

All IDRC-funded projects created a lot of benefits towards the teaching and learning in the universities. The teachers and the researchers used knowledge and experiences obtained from the research to teach their students. The students realized the procedures and the importance of research, and could use the idea to develop their dissertation topics.

3) New Projects and Work

The results of these projects made research institutions in Thailand and abroad see the abilities of Thai researchers. Hence, they started to give more support for different projects, eg., Crop-Livestock International Program of the Department of Agriculture which is assisted by the IDRC, and the Groundnut Mechanization Project which is also IDRC-supported, conducted by Khon Kaen University. The establishment of Farming Research Institute is also another impact of the projects.

4) Coordination with Organizations Abroad

The projects coordination and relations with organizations abroad have stabilized the status of Thai technocrats and researchers, opening more chances for the country to conduct more research studies in the future.

The impact on socio-economic conditions of the country was not evident, owing to the constraints in technology transfer. Nevertheless, it could be said that the villagers and farmers benefited in terms of their ways of life, quality of life, and increasing incomes.

3.4 Recommendations

The recommendations from the evaluation can be classified into 3 types:-

3.4.1 Researchers and Project Coordinators

1) The researchers and coordinators should design their project in such a way that it incorporates multiple disciplines.

2) Most defects encountered in the implementation of each project were due to the fact that the projects lacked an integration of disciplines.

3) The researchers, especially the leaders should induce a working system for their team. All researchers should be involved at every stage of implementation so that they would be able to make decisions whenever the leaders were not present. Often it was found that the relationships between the researchers and the leader were not on a good term. This is a very important factor because it can influence many aspects of work. It was evident from this evaluation that other researchers could not answer any questions or could not give adequate answers. The evaluator therefore believes that the leader should create a democratic atmosphere in their work, assigning a representative every time he is not going to be present.

4) For some cases, it is necessary for researchers to obtain detailed information before starting the work.

3.4.2 The Organizations where the Projects were Affiliated

1) The organizations or departments should build some sorts of incentives for the researchers and co-workers for their security. They should also be more

flexible in order to streamline the research work.

2) The organizations or departments should encourage multidisciplinary research, by enabling the researchers to see the importance of the idea, or by inviting other organizations to cooperate.

3) The organizations or departments should supervise the research work by coordinating with the IDRC officers in evaluating the projects at intervals, by cooperating and assisting the researchers in problem solving and in improving the efficiency of the research work.

4) The organizations or departments should initiate dissemination programs and promote technology transfer at a wider scale. They could contact the Department of Agricultural Extension in order that its representatives will be involved.

5) The organizations or departments should supervise the administrative work of the projects. The projects' expenditures should be supervised so that they are really for research purposes.

On the completion of the projects, all equipment and durable articles procured during the research period should be kept for use in future research projects.

3.4.3 Recommendation for the IDRC

1) The IDRC should continue its support for future research projects in similar fields because all of the five projects have produced useful technology for Thailand, especially when they were advised by technical officers of the IDRC.

2) The IDRC should support the extension work of these five projects, especially in the organizations of seminars, trainings and workshops, so that research results could be disseminated on a larger scale.

3) At the preliminary consideration or screening of the research projects, the IDRC should emphasize multi-disciplinary characteristics of the projects in order that the research results will be more accurate, reliable, and hence more beneficial to the country development.

4) The IDRC should encourage a workshop or monitoring tour for all research participants so that the overall directions of the projects will be viewed by all personnel concerned. They will thus realize the appropriate directions, scopes, and channels for the development of each technological component.

5) The IDRC should support the project which is affiliated with an understanding department which will act in favor of the implementation of the research. The IDRC should encourage these departments to pay more attention to the administration and supervision of research projects by cooperating with the IDRC.

APPENDIX I List of projects funded by IDRC for evaluation
June 1987-March 1988

project I
 Title : Home Processed Legumes (Thailand)Phase III
 Working agency : Khon Kaen University, Faculty of Agriculture
 Project leader : Dr. Tipwanna Ngarmsak
 Funding : IDRC Cdn \$ 124,430
 Thailand Cdn \$ 125,100
 Duration : 1983-1985

Project II
 Title : Vegetable Seed Production in Opium and Rice
 based Agriculture (Phase I)
 Working agency : Chiangmai University, Department of
 Horticulture
 Project leader : Dr. Manee Wivutvongvana
 Funding : IDRC Cdn \$ 208,800
 Duration : 1982-1984

 Title : Vegetable Seed Production in Opium and Rice
 based Agriculture (Phase II)
 Working agency : Department of Horticulture, Chiangmai
 University
 Project leader : Dr. Manee Wivutvongvana
 Funding : IDRC Baht 4,509,700
 Duration : 1985-1987

Project III
 Title : The improvement of the nutritive and economic
 value of cassava root product (phase II)
 Working agency : Department of Animal Science
 Khon Kaen University
 Project leader : Dr. Sarote Khajareon
 Funding : IDRC Cdn \$ 233,640
 Thailand Cdn \$ 233,760
 Duration : 1979-1981
 Remark : Phase I project conducted between 1975-1977

Project IV
 Title : Development of Peanut Shelling Machine
 Working agency : Development of aGricultural Engineering
 Faculty of Engineering
 Khon Kaen University
 Project leader : Dr. Winit Chinsuwan
 Funding : IDRC U.S \$ 21,120
 Thailand Baht 120,000
 Duration : 1980-1982

Project V
 Title : Cropping system (Thailand)project
 Working agency : Farming System Research Institute
 Department of Agriculture
 Project leader : Dr. Damkeong Chantrapanya
 Funding : Phase I Phase II Phase III
 1977-79 1979-81 1982-85
 IDRC Cdn \$ 236,751 281,450 90,157
 Thailand 241,360 240,100 268,300

Appendix II Schedule of Field Survey

No.		Destination	Project (abbrev.)
1	5-June-87	Kampangsaen	Cassava
2	7-10 June-87	Chiangmai	Vegetable
3	13-17 June-87	Chiangmai(site visit)	Vegetable
4	3 Jul-87	Rachaburi	Cassava
5	4 Jul-87	Rachaburi	Cassava/Cropping
6	14-16 Jul-87	Nakornrajasima	Cassava/Cropping
7	19-20 Jul-87	Bangpae,Rachaburi	Cropping
8	26 Jul-87	Nakornrajasima	Cassava
9	30-31 Jul		
	1 Aug-87	Khon Kaen	Groundnut
10	5 Aug-87	Bangpae,Rachaburi	Cropping
11	8-9 Aug-87	KhonKaen Roiet	Groundnut/home legumes
12	20-23 Aug-87	Khon Kaen,Mahasarakarm	Cropping
13	10-12 Sept-87	Nakornsawan,Supanburi	Cropping
14	29-30 Sept- 1 Oct-87	Khon Kaen	Home legumes/ Cassava
15	2-4 Oct-87	Chiangmai	Vegetable/Cropping
16	30 Oct-1 Nov-87	Chiangmai,Phrae	Vegetable/Cropping
17	6-8 Nov-87	Chiangmai	Vegetable
18	5 Dec,87	Nakornpathom	Cassava
19	10 Dec,87	Kampangsaen	Cassava
20	11 Dec,98	Bangpae,Samutprakarn	Cassava
21	12 Dec,87	Nakornrajasima,Pakchong	Cassava
22	15 Dec.87	Chonburi,Banbugh	Cassava
23	17 Dec,87	Kampangsaen	All project
24	19-20 DEc,87	Chiangmai	Vegetable

APPENDIX III TERM OF REFERENCES

1. Review objectives

The following are the objectives of the review to be carried out by the reviewer in evaluating the IDRC funded project.

- (a) assess project performance in term of efficiency and effectiveness
- (b) assess primarily as to the project impact and determine the requirements for a more comprehensive assessment of benefits, environmental impact and economic efficiency
- (c) Consider whether it is an appropriative that the project would be given a renewal

Specific matters to be addressed

Since there will be 6 projects to be reviewed altogether, the review scope for each of the project varies accordingly, the following are the review scope for each of the project to be reviewed.

I. Home processed legumes

- 1.1 Look into the impact, effectiveness of introduction of 7 day menu and whole cowpeas to 27 villages in Khon Kaen province
- 1.2 Assess in the effectiveness of the project in cowpea flour development as an industrial raw materials.
- 1.3 Assess into the method of introducing cowpeas to some of the unco-operative villagers.
- 1.4 Make a preliminary assessment on the method of information dissemination.

II. Vegetable seed production in opium and rice based agriculture

- 2.1 Make a preliminary assessment on the method of improve seed development and technology knowledge and how these methods are transfered to local farmers.
- 2.2 Assessment of the project on the method of crop managements and horticulture aspects of some vegetable in which the project had researched and how these methods can be adopted by farmers.
- 2.3 Assessment of the project on how vegetable are grown more for home and commercial consumption in those areas, whether the production of vegetable are improved.
- 2.4 Assess on the effectiveness of training, how are the trainee utilizing their knowledge in vegetable seed production, could they improve their quality of life much better

III. The improvement of the nutritive and economic value of cassava root product

- 3.1 Look into the outcome of public acceptance of the accomplished technology in quality improvement and enhance consumption of cassava feed stuffs.
 - a) Whether the project be able to establish a criteria to classify cassava chips and pellets according to the nutritive quality.
 - b) Whether the price index of each cassava products set by the project can be used effectively and will be accepted by market.
- 3.2 Make a primary assessment on the method and the result of the biological evaluation of cassava products.
- 3.3 Study and review the methods and outcome of way in which the biological value of cassava be improved.
- 3.4 General review on the impact of the project, comprehensive benefit, economic significance and environmental efficiency.

IV. Development of peanut shelling machine

- 4.1 Making a preliminary assessment on how a low price and efficient peanut shelling machine which developed and be economically and beneficially utilized.
- 4.2 Assessment into the information dissemination of introducing peanut shelling machine of farmers and how are the public acceptance of this project.

V. Cropping system (Thailand) project

- 5.1 Make a primary assessment on how a research in cropping system is formed, conducted and review on how the outcome and results of the project will be.
 - a) Target area selection and the need for such particular areas for the cropping system to be developed.
 - b) Methodology in which cropping system researches is formed. This will include the research management aspects and super imposed methods, level of farmer participation, economic monitoring.
- 5.2 Assess on the impact of cropping system project on the village and district level. Look into the potential possibility of extension of such cropping system. Assess on the effectiveness and efficiency of the projects and how the results of the program affect the routine life manner of village.
- 5.3 Determine on the efficiency and responsibility of staff who had received training under IDRC sponsored and their impact to the project, and their respective institute.

The review should assess proposals and options for project extension activities and, if further activities are proposed, provided a recommended package of inputs and activities for such an extension.

The reviewer is expected to liaise closely with the staff of the six different projects personnel on information gathering activities. Early discussions with the staff of the project on review activities are desirable.

It is also not intended that this review should make definitive studies of the realization of benefits (socio-economic impacts) nor of the environmental impact as such studies are likely to be too time consuming.

(Appendix I, II, and III are original copy, not translated by the translator.)