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COOPERATIVE AGREEMENT AID 492-CA-1707
PROJECT NO. 498-0265

ANNUAL PROGRESS REPORT

September 1, 1983

PDAAN 883

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Cooperative Agreement AID 492-CA-1707
Project No. 498-0265

Annual Progress Report
September 1, 1983

Project Title: Extension of Small-Scale Agricultural Equipment
The International Rice Research Institute

During 1982-83 progress has been made in all countries included in the project: the Philippines, Indonesia, India, and Thailand. There have been changes of personnel in headquarters and in Thailand.

India has initiated the project activities in Coimbatore and have appointed a Project Engineer. IRRI has offered the position of IRRI representative to an experienced engineer but as of the date of this report word has not been received as to whether or not he has accepted.

Mr. Ray Fischer, the Industrial Engineer in Thailand, retired in February of 1983 and Dr. Billy Cochran has been appointed to replace him. Dr. Cochran began his work on September 1, 1983 and is developing a new Strategy Statement and Work Plan for 1984.

The economies of the Southeast Asian Countries are still in a depressed state and this has affected the farm equipment industry; in general. However, the statistics from the cooperators with whom we work show an increase in the production of IRRI designed machines for the small rice farmer. The Philippines has recently experienced an extreme devaluation and this is expected to cause shortages of raw materials during 1984.

Headquarters Activities

1. *Staffing*

The staffing of the Agricultural Engineering Department as of 1 September 1983 is as follows:

Dr. C. W. Bockhop, Head of Department, and Project Leader of Industrial Extension.

Mr. M. Ariyoshi, Agricultural Engineer with major responsibility in Test and Evaluation.

Mr. Bart Duff, Associate Agricultural Economist in charge of the Economics Section.

Dr. Amir Khan, Agricultural Engineer with major responsibility in the development of machines for the Deep Placement of Fertilizer.

Changes

Dr. John Wicks departed on April 30, 1983. The Consequences of Mechanization project terminated in August 1983. Dr. Wicks was on a project appointment.

Support staff include 27 research assistants, 7 secretaries, and 29 field aides and laborers. The research assistants are engaged in numerous research projects in addition to the design, development, and testing of equipment, management of the prototype shop, and the conduct of economic studies.

Outreach Staff

Dr. Robert E. Stickney, Agricultural Engineer, Adviser to the Industrial Extension program in the Philippines stationed in Manila.

Dr. Billy Cochran, Agricultural Engineer, Adviser to the Industrial Extension program in Thailand; stationed in Bangkok.

Mr. V.R. Reddy, Agricultural Engineer, Adviser to the Industrial Extension Program in Indonesia; stationed in Jakarta.

Although not a part of the USAID project, the following are assigned to programs in which IRRI is involved:

Mr. Marvin Parker was assigned to the Egypt Rice Project as Agricultural Engineer and was stationed in Cairo. This project is cooperative with the University of California at Davis and is supported by USAID.

Mr. Malcom Hammond was assigned to Burma as Agricultural Engineer and is stationed in Yezin. This project is supported by CIDA of Canada.

2. *Training*

The department has two Post-doctoral fellows in residence. Dr. Banshi D. Shukla from India has major responsibility in Crop Drying; and Dr. Jeon Yong Woon, from Korea, has major responsibility in Crop Drying

The departmental senior staff have been supervising the research programs of the following scholars:

Mr. Felipe Santos, Philippines, UPLB; major subject: Fertilizer Placement. Adviser: A. U. Khan. Graduated with an MS in May 1, 1983.

U Mya Thein, Burma, UPLB; major subject: Seedling Preparation for Transplanters. Graduated with an MS from UPLB in June 1983. Advisor: C. W. Bockhop.

Mr. Mozzamil Haq, Bangladesh, UPLB; major subject - Comparison of draft of selected Animal Drawn Plows. Advisor: C. W. Bockhop.

Mr. Eulito Bautista, Philippines, UPLB; major subject - Metering for Fertilizer Placement. Graduated with an MS in May, 1983.

Mr. Zahid Mahmood, Pakistan, UPLB; major subject - Deep Placement of Fertilizers. Advisor: A.U. Khan.

Ms. Blanquita Reyes, Philippines, UPLB; graduated March 1983; advisor: Dr. John Wicks.

Mr. Yusuf Maamun, Indonesia, UPLB; graduated May 1983, advisor: Bart Duff.

Mr. Yusuf Saefudin, Indonesia, UPLB; graduated May 1983; advisor: Bart Duff.

Mr. Dermot Shields, Great Britain, fellow; advisor: Bart Duff.

Mr. Ajay Markanday, Great Britain, fellow; advisor: Bart Duff.

Mr. Zaldy Caledrilla, Philippines, University of Malaysia; advisor: Bart Duff.

Ms. Somporn Saitan, Thailand, Kasetsart University; advisor: Bart Duff.

The department conducted two courses during the past year. A two-week course was held December 6 - 17, 1982; and a three-week course, July 25 - August 12, 1983. Most students and all instructors believed that the two weeks was insufficient time to cover all material properly. Thus, the second course was extended to three weeks. Since the experience with the three-week course was most favorable, we will continue the three-week courses in the future. A course will be held November 28 - December 16, 1983; and May 28 - June 15, 1984.

A copy of the program for the July 25 - August 12, 1983 course is attached as Appendix A. Attendance for the two courses is shown in table 1.

Table 1

Attendance at Agricultural Engineering Courses

Country	December 6-17, 1982	July 25 - August 12, 1983
Bangladesh	2	
Burma		2
China	2	
Egypt	1	
India		3(a)
Indonesia	2(a)	3(b)

(continued)

Country	December 6-17, 1982	July 25 - August 12, 1983
Korea	1	
Madagascar		1
Malaysia		1
Pakistan		1
Philippines	5(a)	1(a)
Sri Lanka		2
Thailand	1(a)	2(a)
USA		1
Vietnam		1
Total	14	18

(a) Received support from Industrial Extension project.
(b) Two from Indonesia supported by Industrial Extension Project; one, supported by RNAM.

All without subscript supported from other sources.

In addition to the organized training courses IRRI has had one man from Indonesia and two from China for an informal training program.

3. *Design and Development*

Priorities for Design and Development are established by a Project Review Committee that includes representatives of the Departments of Agricultural Economics, Agronomy, Entomology, Soil Physics, Multiple Cropping, and Technology Transfer and Training. Inputs to this committee come from the senior staff and junior staff of the department, and from the staff in Industrial Extension of the Outreach program.

The work for the past year in order of priority was as follows:

a. *The Reaper*

The reaper was introduced in February, 1982. Two workshops were held in the Philippines to introduce the reaper to manufacturers. As a result of the workshops at least 27 firms have fabricated 161 units as of May 1983. It is estimated that at least twice that number have now been manufactured.

A survey of all manufacturers who attended the workshops was conducted in early 1983. A second survey is planned for 1984. A copy of the report on the Introduction of the CAAMS-IRRI Mechanical Reaper in the Philippines is included in Appendix B.

The reaper has been introduced in India, Thailand, Indonesia, Egypt, Pakistan, and Burma. The results vary in the different

countries but reports from Pakistan indicate that over 1,000 have been manufactured. A wider model (2 meters) was developed in Pakistan to operate in front of a 4-wheel tractor. The 2 meters wide unit is more useful when harvesting the taller crops since there is overlap of windrows when using the 1 meter reaper in such conditions.

As a result of field experience, some modifications of the reaper have been made. These modifications were sent to all outreach program staff and included in all blueprints sent out to cooperating manufacturers.

b. *PT-5 Power Tiller*

After a year of experience with the small power tiller, we feel that basically it is a good design. It is comparable to the Landmaster power tillers that were imported into Southeast Asian countries. The cost of the PT-5 is about one-half the cost of a Landmaster. The PT-5 is ideal as a power unit for the 1 meter reaper, but needs to have matching implements for other operations such as plowing and harrowing.

The design engineers are cooperating with the Multiple Cropping Department and the Training and Technology and Transfer Department in improving the PT-5 and testing it under their conditions.

c. *Fertilizer Placement*

The Agronomy Department has demonstrated that up to 60% of the nitrogen applied as urea in the traditional way of broadcasting on the surface of a wet field can be lost through volatilization. To prevent this loss, urea needs to be placed beneath the surface of the mud and covered to prevent the introduction of water which will dissolve the nitrogen.

The Agricultural Engineering Department design group have been testing several machines to accomplish the task. There are three machines that are promising. These machines will be tested during 1984 to determine their effectiveness and it is hoped that introduction of the machines to manufacturers can be accomplished soon. This has been a top priority in the department in 1983. A copy of a report on the "Deep Placement of Fertilizer Applicators for Wet Paddies" is included as Appendix C.

d. *Crop Drying*

The development of low cost drying facilities for the humid tropics is one of the urgent needs in Southeast Asia and is another top priority item in 1983. Two approaches have been followed the "Heated Floor Dryer" and "The Warehouse Dryer".

Papers relating to the details of the two systems are included as Appendix D and E.

The Heated Floor Dryer concept makes it possible to dry grain under a roof on days when traditional sun-drying is not possible. Heat is supplied by a furnace using straw, rice hulls, or any biomass material as a fuel source. The furnace heats water which in turn heats the drying floor. The project provided much useful data but was terminated because the system proves to be not economical under the present conditions.

The Warehouse Type Dryer can be used for drying crops, vegetables, or fish. It utilizes rice hulls or other materials as a source of fuel and uses a unique wind machine to move air through the structure. The wind machine utilizes a "vortex" principle which creates a vacuum and develops suction to move air. The "warehouse" structure constructed for the research was fabricated of rice straw and mud.

e. *The Rotary Injection Planter*

This planter developed at IITA, continues to create interest in all countries although commercial manufacture has not begun in any country. The Design Section has modified the design to make it easier to manufacture and to simplify the changing of seed rolls. The staff in the Multiple Cropping and Training and Technology Departments are testing the unit in their experimental areas. The Multiple Cropping Department staff have also sent units to other countries for trials.

f. *Transplanter*

The Manual Transplanter was introduced in 1980. Although an excellent machine which is economical for the small farmer to use, the unit has not been produced in great numbers except in Burma.

The Ministry of Agriculture in Burma initiated a program to fabricate transplanters, train extension workers to operate the machines and to raise seedlings. As a result over 6,000 transplanters have been fabricated and are in use in the country.

The transplanter has been simplified and improved and an extension project is being initiated in the Philippines to introduce the transplanter in the Bicol area. Farmers and manufacturers are being trained together. We believe the transplanter will increase in popularity as farmers experience labor shortages.

g. *TH-6 Modifications*

Manufacturers have been producing the portable thresher for some years and some have introduced improvements to the original

design. IRRI engineers have been testing some improvements in the concave and plan to have the blueprints with modifications available in 1984.

h. *Pumps*

The Industrial Extension group in Indonesia have been requesting designs for an axial flow pump with more lift than the present axial flow pump design. The design group have developed a two-stage pump and are presently testing the unit. The unit will provide additional lift at relatively high efficiency . Results should be available in 1984.

A 14-inch axial flow pump was developed for very low lift and will be tested in 1984.

i. *Upland Tools*

The Institute has initiated a research program to assist farmers in the production of rice under upland conditions. The design engineers are studying the equipment needs for the production of rice for upland conditions. The greatest need is for low cost planters and seeders and for land preparation equipment.

4. *Industrial Extension Meeting*

A meeting of all Industrial Extension Engineers was held in Los Baños on November 21-22, 1983. Mr. V. R. Reddy was unable to attend because of the illness of Mrs. Reddy.

Each country representative discussed their country strategy and some of the problems encountered.

While the Outreach staff were in Los Baños, they participated in a Technical Congress which was held in conjunction with the "Technology for the People" Fair in Manila. The fair continued from 20-27 November. The Industrial Extension meeting was held in Los Baños 21-22 November and the Technical Congress was held 23-25 November in Manila. IRRI engineers participated in the Technical Congress. The theme of the Congress was Technology Transfer. IRRI had an excellent display at the fair which has attracted considerable attention. This is the third "Technology for the People" Fair in which the Agricultural Engineering Department has participated.

5. *Studies*

The "Consequences of Small-Farm Mechanization" study has been completed. A series of workshops have been held which discussed the results of the study with those involved in policy decisions in the Philippines, Indonesia, and Thailand.

6. *Other Activities*

In addition to the administration of the Agricultural Engineering Department and the supervision of the Industrial Extension Outreach Program, C.W. Bockhop served as a member of the Technical Advisory Committee of the Regional Network for Agricultural Machinery (RNAM) which met in Sri Lanka October 25-31, 1983. He also attend the RNAM Workshop on Policy formation for Agricultural Mechanization held in Suweon, Korea August 24-30, 1983.

The Agricultural Engineering Department participated in the "Technology for the People" Fair held in Manila on 20-27 November. The department had a display which included a cut-a-way of the thresher and the reaper, and a video tape of IRRI designed machines. The Publications Department of IRRI had a book display in the IRRI booth.

Outreach Programs

1. *Philippines*

There has been good progress with the introduction of the reaper in 1982. Currently there are 30 cooperators fabricating the reaper and it is estimated that 500 units have been produced.

The project has initiated work on seed and fertilizer applicators primarily for corn production. An extension activity on machinery for root crops is also planned.

There has been increased interest in the transplanter. A program to train farmers in the operation of the transplanter and train manufacturers in the fabrication of the unit is being initiated in the Libmanan area. This area has experienced a shortage of labor for transplanting and the farmers have expressed considerable interest in the educational effort. A training program is planned for the farmers. Eighteen farmers will undergo one month of training in raising seedlings and operating the transplanter. After one month a second batch of eighteen will be trained.

The project is trying to encourage equipment development capabilities at the Regional level. This will be a major activity for 1984.

Two problems have developed during 1983. The proposed National Farm Mechanization Committee has not been approved and the Deputy Minister of Agriculture who was the Chairman of the MA-IRRI Project Advisory Committee resigned from government service. It is hoped that the National Farm Mechanization Committee will become a reality in 1984.

The resignation of the Deputy Minister of Agriculture left a void in our leadership of the Advisory Committee. We will try to get the Advisory Committee moving again in early 1984.

Although the Philippines is experiencing a serious depression as a result of devaluation of their currency, the manufacturers with whom we have been cooperating report a small increase in sales of equipment. We believe this is primarily due to the lower cost and the proximity of the manufacturer to the farmer customer.

The total production of manufacturers in the Philippines and a detailed report of the activities for the Philippines is included in Appendix F.

2. *Indonesia*

The total number of threshers fabricated in West Sumatra has increased to 450 by 14 manufacturers. Increasing competition between manufacturers is lowering the selling price by 30%. As a result of the development in this area, ILO is planning a field research study of the impact of mechanization upon the area.

The project in the Luwu district has been completed and has resulted in increased interest in locally manufactured equipment. Because of lack of service and spare parts, the number of imported tractors is declining.

There is an increase in the number of axial flow pumps fabricated in the swampy areas of South Kalimantan; and an increase of pumps in West Java. Voluntary organizations are assisting in the promotion of small equipment in West Java.

The government of Indonesia is formulating a long range policy on mechanization. The IRRI consultant is assisting in this policy development.

A detailed report of the Work in Indonesia is included in Appendix G.

3. *Thailand*

Mr. Ray Fischer, the IRRI representative in Thailand, retired at the end of February, 1983, and Dr. Billy Cochran was appointed on September 1, 1983. A new strategy statement is being prepared by Dr. Cochran and will be submitted soon after January 1, 1984.

Production has started on rotovator attachments in Chieng Mai and the Reaper, all of IRRI design. In addition, work has started on a buffalo powered water pump and a cyclone seeder. Both of these have potential for commercial production.

The buffalo plow previously redesigned is now becoming accepted as the benefits of the new design are demonstrated. Two different firms have been producing the plows introduced in 1982. One firm fabricated 55 and the other 15. Three other firms started production in 1983 but we have no statistics on the number.

The project is concentrating on the North Eastern area and through demonstrations and exhibitions at fairs, the equipment is brought to farmers' attention.

A detailed report of activities in Thailand is included in Appendix H.

4. *India*

Because of long delays of approval of the project in India by the government little progress has been made. The project was first approved by the government of India in July 1982. We began recruiting for an advisor immediately and submitted his file to the Indian Council of Agricultural Research in December 1982. We did not receive approval of the individual until August 1983. The work with India has been very frustrating because of the cumbersome procedures necessary to get approvals. We will also have difficulty in recruiting an expatriate for the project because of the government restrictions on importation of household appliances, and automobile.

The project has been established at Tamil Nadu University, Coimbatore and two buildings have been allocated for the project. A project engineer has been appointed. Additional personnel will be appointed in 1984.

5. *Burma*

Although the project in Burma is not supported by USAID, it is reported here since it is an active part of the outreach program. The support for Burma comes from the Canadian government.

The transplanter has been most successful in Burma and 7000 were manufactured in 1982 and 1983. The success is due to the fact that the Ministry of Agriculture was enthusiastic about the transplanter and ordered their fabrication and use on farmers fields. Extension personnel were trained and the transplanting was done for the farmers. Farmers can buy the transplanters at a cost of US$120 in 1983.

The Burma project has entered its second phase and the Agricultural Engineering staff are being moved from Rangoon to Yezin where a new facility is being built for the Agricultural Research Institute. This next phase will concentrate on institution building since there are no facilities for mechanization studies at Yezin presently.

A detailed report on the Burma project is included in Appendix I.

Budget and Expenditures

A summary of expenditures is included in Appendix J.

PROGRAM SCHEDULE

Three-Week Agricultural Engineering Training Course
November 28 - December 16, 1983

FIRST WEEK

November 28, Monday

8:00 - 8:15	Welcome (Seminar Room A, Chandler Hall)	M. D. Pathak
8:15 - 8:45	IRRI Agricultural Engineering and Industrial Extension Program	C. W. Bockhop
8:45 - 9:15	Slide Show on "The Rices of IRRI"	Visitors' Bureau
9:15 - 9:30	Preparation for introduction of Trainees	Move to Ag. Eng. Conference Room
9:30 - 10:00	Introduction of Trainees and IRRI Staff	R. E. Stickney
10:00 - 10:30	Coffee Break	
10:30 - 12:00	Farm Economics: Partial budget analysis of alternative technologies	D. Shields
12:00 - 1:00	Lunch	
1:00 - 2:30	Farm Economics: Typical cost and returns for different levels of technology	Z. Toquero
2:30 - 2:45	Coffee Break	
2:45 - 5:00	IRRI Engineering Drawing System	F. C. Jalotjot

November 29, Tuesday

8:00 - 9:45	Farm Economics: Undiscounted Techniques for Investment Appraisal, Breakeven Analysis and Payback Period	D. Shields
9:45 - 10:00	Coffee Break	
10:00 - 12:00	Power and Rotary Tillers	I. Manalili
12:00 - 1:00	Lunch	
1:00 - 5:00	Field Practice -- Transplanter, Reaper, Thresher, Axial-flow Pump, and Power Tiller (with plow, rotavator, and harrow)	A. Vasallo

November 30, Wednesday (No Training Classes -- Public Holiday)

December 1, Thursday

8:00 - 9:30	Machinery Safety	M. Ariyoshi
9:30 - 9:45	Coffee Break	
9:45 - 12:00	Jigs & Fixtures	L. Kiamco
12:00 - 1:00	Lunch	
1:00 - 5:00	Shop Work: Power and Rotary Tillers	I. Manalili/E. Dungo

December 2, Friday

8:00 - 9:30	Threshers	M. Diestro/A. Caballes
9:30 - 9:45	Coffee Break	

-continued-

9:45 - 12:00	Threshers (continued)	M. Diestro/A. Caballes
12:00 - 1:00	Lunch	
1:00 - 5:00	Threshers: Shop Work	M. Diestro/E. Dungo

SECOND WEEK

December 5, Monday

8:00 - 9:30	Threshers: Economic Analysis	F. Juarez
9:30 - 9:45	Coffee Break	
9:45 - 12:00	Threshers: Field Test and Measurements	A. Caballes
12:00 - 1:00	Lunch	
1:00 - 3:00	Farm Economics: Discounted Techniques for Investment Appraisal -- NPV, B/C and IRR	D. Shields
3:00 - 3:15	Coffee Break	
3:15 - 3:30	Photograph of Course Participants	CPD/Photography
3:30 - 5:00	Tillers: Economic Analysis	C. Maranan

December 6, Tuesday

8:00 - 10:00	Manual Transplanter	G. Salazar
10:00 - 10:15	Coffee Break	
10:15 - 12:00	Transplanter: Field Test and Measurements; Seedling Preparation	A. Vasallo
12:00 - 1:00	Lunch	
1:00 - 2:00	Transplanter: Economic Analysis	L. Ebron
2:00 - 5:00	Transplanter: Shop Work	G. Salazar/E. Dungo

December 7, Wednesday

8:00 - 10:00	Reaper	M. Diestro/A. Caballes
10:00 - 10:15	Coffee Break	
10:15 - 12:00	Reaper (continued)	M. Diestro/A. Caballes
12:00 - 1:00	Lunch	
1:00 - 5:00	Reaper: Shop Work	M. Diestro/E. Dungo

December 8, Thursday

8:00 - 9:30	Reaper: Economic Analysis	F. Juarez
9:30 - 9:45	Coffee Break	
9:45 - 12:00	Reaper: Field Test and Measurements	A. Caballes
12:00 - 1:00	Lunch	
1:00 - 5:00	Open time for individual interests and making outside contacts	

December 9, Friday

8:00 - 9:45	Economics of Manufacturing	N. Langam
9:45 - 10:00	Coffee Break	
10:00 - 12:00	Seeders and Fertilizer Applicator	L. Kiamco/I. Camacho
12:00 - 1:00	Lunch	

-continued-

1:00 - 2:30	Rolling Injection Planter	M. Aban
2:30 - 2:45	Coffee Break	
2:45 - 5:00	Seeders, Fertilizer Applicators and Rolling Injection Planter: Shop and Field Work	M. Aban/L. Kiamco/ E. Dungo

December 10, Saturday

	Field Trip to Cooperating Manufacturers and Farmers	N. Langam

THIRD WEEK

December 12 - Monday

8:00 - 9:00	Rolling Injection Planter: Economic Analysis	L. Ebron
9:00 - 10:00	Machinery Testing & Evaluation	A. Caballes
10:00 - 10:15	Coffee Break	
10:15 - 12:00	Summary Discussion on Farm Economics	D. Shields
12:00 - 1:00	Lunch	
1:00 - 3:00	Axial Flow Pump	G. Salazar
3:00 - 3:15	Coffee Break	
3:15 - 5:00	Axial Flow Pump: Shop Work	G. Salazar/E. Dungo

December 13, Tuesday

8:00 - 12:00	Small Engines for Farm Machinery	Honda Representative
12:00 - 1:00	Lunch	
1:00 - 5:00	Shop Work	Honda Representative

December 14, Wednesday

8:00 - 9:00	Axial Flow Pump: Economic Analysis	C. Maranan
9:00 - 10:00	Shop Tools and Plant Layout	N. Langam
10:00 - 10:15	Coffee Break	
10:15 - 12:00	Rice Drying	L. Halos
12:00 - 1:00	Lunch	
1:00 - 3:00	Rice Milling	I. Camacho
3:00 - 3:15	Coffee Break	
3:15 - 5:00	Drying & Milling: Laboratory Work	I. Camacho/L. Halos

December 15, Thursday

8:00 - 9:00	Extension Program: Overview	C. W. Bockhop
9:00 - 10:00	Extension Program: Past Experiences in the Philippines	R. E. Stickney
10:00 - 10:15	Coffee Break	
10:15 - 12:00	Cost Estimating for Small and Medium Scale Equipment Manufacturers	N. Langam
1:00 - 2:00	Consequences of Mechanization Studies	B. Duff
2:00 - 3:00	Individual Country Report	N. Langam

-continued-

3:00 - 3:15	Coffee Break	
3:15 - 5:00	Individual Country Report (continued)	

December 16, Friday

8:00 - 10:00	Course Examination	N. Langam
10:00 - 10:15	Coffee Break	
10:15 - 12:00	IRRI Tour	Visitors' Bureau
12:00 - 1:00	Lunch	
1:00 - 2:00	Special Program	
2:00 - 2:45	Questionnaire on Course Evaluation; Free Time for Discussion on Machines of Particular Interest	
2:45 - 3:00	Closing Remarks	C. W. Bockhop
3:00 - 3:30	Coffee Break	

NL/ecs
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14

Report No. IEP-8
September 30, 1983
Revised

INTRODUCTION OF THE CAAMS-IRRI MECHANICAL REAPER IN THE PHILIPPINES[1/]

C.P. Fernandez, H.T. Manaligod
and R.E. Stickney

MA-IRRI Industrial Extension Program
for Small Farm Equipment[2/]

ABSTRACT

In 1982 the MA-IRRI Industrial Extension Program for Small Farm Equipment introduced the CAAMS-IRRI mechanical rice reaper to interested manufacturing firms in the Philippines. The principal advantages of this reaper over existing machines are: low cost; light weight; attaches to a hand tractor which may also be used for plowing and harrowing; locally produced (all other existing reapers are imported); availability of parts; simplicity of operation and repair.

This paper provides a description and evaluation of the reaper extension project of the MA-IRRI Program. The extension activities included field demonstrations, training courses, technical assistance visits, prototype testing, and marketing assistance. A survey was carried out to evaluate these activities and to obtain information on the manufacturers (e.g., capital assets, personnel, location, production) and on problems which have been encountered during introduction of the reaper. The results suggest modifications and/or improvements which should be made to the extension activities and to the reaper design.

1/ A preliminary version of this paper was presented at the 33rd Annual Convention of the Philippine Society of Agricultural Engineers, April 28-29, 1983, at the Visayas State College of Agriculture, Baybay, Leyte.

2/ Address:

MA-IRRI Industrial Extension Program
for Small Farm Equipment
Agricultural Engineering Division
Bureau of Plant Industry
San Andres Street, Malate
Metro Manila
Philippines

1. INTRODUCTION

In September, 1981, the Ministry of Agriculture (MA) of the Philippines and the International Rice Research Institute (IRRI) initiated a collaborative effort to promote the development and extension of agricultural equipment which is appropriate for small farms and may be produced in the Philippines. The MA-IRRI Industrial Extension Program for Small Farm Equipment has grown out of an informal extension effort initiated by IRRI about 15 years ago, and its objective is to institutionalize the Program within the Ministry and related organizations. The central office of the MA-IRRI Program is located at the Agricultural Engineering Division of the Bureau of Plant Industry (BPI), of the Ministry of Agriculture in Manila.

As of May, 1983, 161 manufacturers had become cooperators in the MA-IRRI Program by signing a memorandum of agreement. These cooperators are located throughout most of the Philippines (see Figure 1) and range in size from small blacksmith and metalcraft shops to large-scale industries. Special attention is given to manufacturers located in agricultural areas, thereby ensuring availability of parts and service, creating rural employment, and stimulating innovations and adaptations to local conditions and farmer preferences. The MA-IRRI Program provides them with designs of agricultural equipment, together with training and technical assistance. In turn, the cooperators agree to provide annual production statistics and to sell units only after testing and authorization by MA-IRRI.

The most recent equipment design to be promoted by the MA-IRRI Program is the CAAMS-IRRI reaper shown in Fig. 2. It is a low-cost unit[3/] which attaches to a lightweight two-wheel hand tractor, both of which may be manufactured in small shops. (See references 1 and 2 for more details). Because of its light weight and low cost, it should minimize problems encountered previously with imported reapers which have failed to be accepted by rice farmers in the Philippines. It should also be competitive with similar reapers now being imported from Japan and China but with higher sales prices and limited availability of parts and service.

2. EXTENSION ACTIVITIES

Selection of Target Areas

The first task was to identify areas in the Philippines where the reaper might be appropriate; i.e., areas where labor shortages result in significant delays of harvesting. The result was that Mindanao and the Cagayan Valley (principally Isabela) were selected as the priority areas for reaper extension. It was decided that the MA-IRRI Program would not promote the reaper in labor-surplus areas (e.g., Bicol and Central Luzon) even though some farmers in these areas complain of labor shortages during peak harvest times.

3/ Approximate average sales prices are ₱4,000 (US $400) for the RE2 reaper, ₱4,000 (US $400) for the PT5 hand tractor, and ₱2,000 (US $200) for a 5HP gasoline engine.

Field Demonstrations/Evaluations/Trials

The second step was to conduct field demonstrations and evaluations of the reaper in the major rice-producing areas of Mindanao and the Cagayan Valley. The MA-IRRI Regional Project Engineers[4/] who live in the areas were vital to the coordination of these demonstrations, particularly with respect to insuring that the group present included outstanding farmers, leaders of cooperatives, local manufacturers, agricultural extension technicians, and rural bank officials.

The major results of these demonstrations were:

1. In evaluation sessions held at the field demonstrations, the majority of the farmers stated that the reaper would be appropriate and beneficial in their areas;

2. By observing the enthusiasm of farmers for the reaper, many manufacturers became interested in fabricating the unit;

3. The MA-IRRI engineers became better acquainted with the manufacturers of the area, thereby recruiting new cooperators and initiating on-going technical assistance to those interested in fabricating the reaper.

An intensive test of the performance and durability of the reaper and hand tractor was carried out in Mindanao on a 370 ha. farm where rice is grown continuously during the year. The advantage of this farm was that reapers generally could be utilized regularly on up to 2.5 ha per day, 6 days per week throughout the year. The test results served as the basis for modifying the reaper and hand tractor to improve operation and durability.

Training Courses

A two-day intensive training course on fabricating the reaper and hand tractor was given twice during 1982 at BPI in Manila for cooperating manufacturers and MA-IRRI engineers. The course was designed to help trainees to understand: (a) the blueprints for the reaper and hand tractor; (b) the main steps of fabrication and assembly; (c) operation, maintenance, and repair; and (d) the economics of fabrication and utilization of the reaper.

At the time of the first course (February 1982), there was a total of 68 cooperators in the MA-IRRI Program and all were invited to attend the course. Twenty four (35%) of these cooperators actually attended first course. Ten (42%) of these attendees have successfully fabricated at least one reaper and hand tractor by the end of the present survey (May 1983).

By the time of the second course (August 1982), the total number of cooperators had increased to 110, of which 86 had not attended the first course and therefore were invited. Nineteen (22%) of these 86 attended

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4/ These engineers are regular employees of the Ministry's regional offices and experimental stations, and they devote only part of their time to the MA-IRRI Program.

the second course, and 6 (32%) of these attendees have successfully fabricated at least one unit by the end of this survey. (Note: As will be discussed in Section 4, 11 cooperators who did not attend either training course have also fabricated at least one reaper and hand tractor.)

It may be concluded that manufacturers will devote their time and money to attend training courses if the topic is of sufficient interest to them. In the present case, many of the attendees were from small-scale firms (Table 1) located in provinces far from Manila (see Fig. 1), the site of the two training courses. The attendees paid for their transportation and lodging expenses, while the MA-IRRI Program covered the cost of providing each attendee with blueprints and instruction materials.

Technical Assistance and Prototype Testing

MA-IRRI Project Engineers make periodic visits to cooperating manufacturers in their area. The purpose of the visit is to provide whatever technical assistance might be needed by the cooperator in fabricating the reaper or other equipment promoted by the Program (e.g. threshers and pumps). In cases where the engineer is not capable of providing the needed technical assistance, he contacts the MA-IRRI central office for information and/or for the help of an engineer who is familiar with the specific problem.

Regarding technical assistance on the reaper, the most common activities are:

1. To help manufacturers understand the blueprints and to find suppliers of special components (e.g., reaper blades).

2. To loan a reaper and hand tractor to manufacturers who have difficulty with reading blueprints.

3. To perform the prototype test of the first unit fabricated by a manufacturer, utilizing a special test procedure and form. The purpose of the test is to determine that the unit has been fabricated and assembled correctly and that it functions properly in the field. It is also an opportunity to advise the manufacturers regarding critical adjustments and operating procedures. After passing the prototype test, the manufacturer is authorized by MA-IRRI to proceed with commercial production of the reaper and hand tractor.

4. To assist manufacturers with field demonstrations for farmers (often at the meetings of farmer organizations) and, in a few instances, with applications for loans.

5. To maintain two-way communication with manufacturers on both problems and improvements that arise in relation to the design, fabrication, or operation of the reaper and hand tractor.

3. SURVEY METHODOLOGY

The MA-IRRI Program carried out a survey for the purpose of answering the following questions:

a) Which of the methods used by the Program in the extension of the reaper (i.e., methods used in field demonstrations, training courses, technical assistance, loaning units, prototype tests, etc.) were most useful to cooperators?

b) Why have some cooperators successfully fabricated the reaper and hand tractor while others have not?

c) What factors have been most important with respect to facilitating and/or hindering acceptance and sales of the reaper?

d) What innovations or modifications have been made or suggested by cooperators with respect to the design, fabrication, or operation of the reaper and hand tractor?

e) How might we improve future extension of the reaper, hand tractor, or similar equipment?

Questionnaires were developed, pre-tested, and finalized for different groups:

1. *Trained Cooperators*, i.e., those persons (firms) who attended one of the reaper training courses. This group is subdivided into:

   a) *Trained Reaper Manufacturers*, i.e., those trained cooperators who have successfully fabricated at least one unit of reaper and hand tractor by the time of the survey.

   b) *Trained Non-Manufacturers*, i.e., those trained cooperators who have not yet fabricated a unit.

2. *Untrained Reaper Manufacturers*, i.e., firms who did not attend the course but have successfully fabricated at least one unit of the reaper and hand tractor by the time of the survey.

3. *Reaper Owners*, i.e., farmers or contact groups who have purchased a reaper and hand tractor.

The survey was carried out from January through April 1983 by two MA-IRRI engineers who attempted to visit and interview all of the cooperators in groups 1 and 2 above. The survey of the reaper owners (group 3) was postponed because it was found that the first owners who were contacted had not yet utilized their units for more than 5 ha. This survey of owners should be carried out in 1984.

4. SURVEY RESULTS

The accepted classification of industries in the Philippines is:

Scale	Capital Assets[5/]
Cottage Industry	below ₱100,001
Small Industry	₱100,001 to ₱1,000,000
Medium Industry	₱1,000,001 to ₱4,000,000
Large Industry	above ₱4,000,000

This classification is used in Table 1 to compare the different survey subgroups with one another and with all cooperators enrolled in the MA-IRRI Program at the time of the survey. Notice that the distributions of capital assets do not differ substantially from one group to another, thereby indicating that capital assets are not the dominant factor influencing cooperators' decisions to attend the training course or to fabricate the reaper and hand tractor. Moreover, in Table 1 it can be observed that: (a) the training course attracted many cooperators (77%) from cottage and small industries; and (b) the majority (about 70%) of the cooperators who have successfully fabricated reapers are cottage and small industries. Labor force data are also included in Table 1, and the results show that most of the cooperators who attended the training course (73%) and who have fabricated the reaper (54%) have less than 15 employees. These results demonstrate that the reaper and tiller can be fabricated successfully by firms which are small in terms of capital assets and labor force.

Based on the survey results, the characteristics of the 27 reaper manufacturers are varied:

1. 22% had not fabricated any type of agricultural equipment before the reaper. Some had been repairing agricultural equipment, while others were repairing or fabricating vehicles (tricycles, cars, trucks).

2. 78% were already fabricating agricultural equipment, with the principal equipment being threshers (86%) and hand tractors (38%). Note: 88% of those fabricating hand tractors were also fabricating threshers.

3. 70% had become cooperators of the Program since September 1981 when it was transferred from IRRI to MA-IRRI. It is estimated that 60-70% of these new cooperators were attracted to the Program by the reaper.

5/ At the time of the survey, the conversion rate was approximately ₱10 per US dollar.

Of the 27 reaper manufacturers, 11 (41%) had not attended either of the two training courses. Five (45%) of these 11 untrained reaper manufacturers had been invited to the first training course but did not attend because: (a) two were well-established cooperators located near IRRI, one of which had been contracted previously by MA-IRRI to fabricate reaper demonstration units; (b) two were small firms (less than 5 employees) located far from Manila but benefitting from borrowing a MA-IRRI demonstration unit and receiving frequent technical assistance from the Project Engineer; and (c) one was a unique case of a mechanical engineer with only one employee. Another five (45%) had become cooperators after the first course but several months before the second course, and therefore had progressed substantially with fabrication of their first units by the time of the second course. Three of these had reapers available to facilitate fabrication, one hired a consultant who was an experienced reaper fabricator, and one was capable of building the first unit solely from the blueprints. The last of the 11 untrained reaper manufacturers became a cooperator after the second training course, but benefitted from having a mechanical engineer who attended the IRRI Agricultural Engineering Course, as well as from borrowing a reaper from MA-IRRI and hiring workers who had fabricated reapers for another firm.

The 11 untrained reaper manufacturers are not noticeably different from the 16 trained reaper manufacturers with respect to capital assets, labor force, past experience, ability to read blueprints, or geographical location. Both groups include firms having a wide range of these characteristics, and it appears that there is not any simple means for distinguishing them from one another. It is concluded that although the training course may be advantageous to manufacturers, firms can fabricate the reaper without the course if they either have the technical capability (e.g., blueprint reading, fabrication skills and equipment) or are able to hire experienced personnel, borrow or buy a reaper unit, or obtain adequate technical assistance from the MA-IRRI Program.

It is also interesting to consider the reasons why 63% of the cooperators who attended the training course have not yet fabricated a reaper unit. The results given in Table 2 indicate that the main reasons were that the firms were either too busy with orders for other equipment or lacked the necessary capital. It should be mentioned that 24% of these trained non-manufacturers have partially fabricated the reaper or hand tractor, and 29% have either borrowed or purchased a reaper unit to facilitate fabrication.

Table 3 provides a summary of the relative degrees of utilization of blueprints, reaper units, and experienced personnel by reaper manufacturers. It should be pointed out that all of these manufacturers were given a set of blueprints from the MA-IRRI Program, and 78% received direct technical assistance (e.g., training course and/or visits by MA-IRRI engineers). It is expected that all of the manufacturers would have utilized reaper units loaned by MA-IRRI if the Program had offered units to all rather than limiting them to the target areas (Cagayan Valley and Mindanao).

The survey obtained information from each reaper manufacturer on the number of reaper units they had fabricated and the number of these which had been sold. The average number of units fabricated was six per manufacturer, while the average number sold was 3.3 per manufacturer (i.e., 55% of the units produced). However, the data in Table 4 illustrate that 37% of the

21

manufacturers had fabricated only one unit thus far, and 59% had not yet sold any units. These manufacturers generally were very small with respect to capital assets; a few had only recently completed fabricating their first units.

Only four firms had sold more than 10 units per firm, and their combined sales amounts to 80% of the total sales to date. Three of these four were able to fabricate their first reaper units within three months after the first training course, and two of them attended the course. Three of the four are small; i.e., they are classified as cottage or small-scale industries with respect to capital assets, and none of the three has more than 10 employees. Perhaps the most important characteristic of these three manufacturers is that they all have well-established relationships with IRRI.

Reaper manufacturers reported that the most common method used to promote sales was field demonstrations to farmers. Several have also used other promotional methods: four manufacturers have printed and distributed leaflets describing the reaper, four have published advertisements in newspapers (two in national newspapers and two in a popular farmers' periodical), one mailed announcements to previous customers, and one advertised by radio.

Reaper manufacturers were asked for their opinions on: "what are the main problems encountered in selling the reaper?" According to the results listed in Table 5, the two main problems are that farmers generally lack capital for purchasing equipment and are hesitant to buy a new machine with unproven performance or durability. A third problem mentioned was that the reaper will reduce employment of laborers who are now contracted to harvest rice fields, and this could lead to destructive reactions by the laborers.

It is relevant to mention that, during the past three years, sales of farm equipment in the Philippines has fallen off markedly because of a prolonged period of economic recession and inflation, with the price of rice failing to keep up with rising costs of inputs. The situation has been aggrevated recently by a severe drought.

A related question to the reaper manufacturers was: "In your opinion, what would farmers consider to be the most attractive (positive) and unattractive (negative) features of the reaper?" The responses are summarized in Table 6. The attractive features are those which we would expect, and the unattractive features include the labor and durability problems discussed before in relation to Table 5. A primary complaint is that the reaper is difficult to maneuver, but we have found that this problem diminishes as reaper operators gain experience with handling the machine.

Table 7 lists the manufacturers' views on what are the most common service and repair problems of the reaper. Many manufacturers (37%) said that the reaper was so new that they could not yet respond to this question. Problems with the cutter blades are serious because the hardened steel blades and ledger plates are among the most costly components of the reaper and generally are imported. Thus far, most locally-made blades and ledgers have

either been too hard (thereby easily chipping) or too soft (thereby wearing and becoming dull). The MA-IRRI Program is collaborating with the Metals Industry Research and Development Center (MIRDC) and other institutions in an effort to promote local production of blades and ledgers.

Other service and repair problems listed in Table 7 can be minimized in the following ways:

1. The V-belt from the hand tractor to the reaper wears rapidly because it is twisted 90° in order to drive the vertical reaper shaft from the horizontal tractor shaft. This problem can be minimized by proper adjustment of the belt tension.

2. Several manufacturers have come up with an innovative means for increasing starwheel life: they fabricate starwheels from an inexpensive plastic chopping board that is widely available in local supermarkets.

3. Wear of the conveyor belt may be reduced to an acceptable level by proper adjustment.

4. Loosening of bolts by machine vibration may be reduced either by using fine-threaded bolts with locking washers or nuts (which are often difficult to find in rural areas) or by using rivets in place of bolts.

Manufacturers were requested to give their suggestions regarding what improvements of the reaper and hand tractor would be most useful or desirable. (See Table 8.) Seven manufacturers suggested that the width of the cutter bar (tool steel) be increased from 19 mm (3/4 inch) to 25 mm (1 inch) because the 25 mm bar is more commonly available in the provinces and also improves the rigidity and strength of the cutter assembly. Several manufacturers have already incorporated this change in their reapers. Some have also made changes associated with the other suggestions in Table 8, five of which are related primarily to improving the convenience of reaper operation, while three are related to overcoming problems of wear and breakage. These suggestions and innovations[6/] by reaper manufacturers are being considered by the MA-IRRI Program and the IRRI Agricultural Engineering Department with the objective of proposing modifications that will improve the present design of the reaper and hand tractor. After testing, the modifications will be given to manufacturers for their evaluation and possible use or adaptation.

5. SUMMARY AND CONCLUSIONS

The main results of the survey are:

1. Introduction of the CAAMS-IRRI reaper to manufacturers in the Philippines has been a rapid process: 27 firms have successfully fabricated at least one unit within the first 12 to 15 months.

6/ A few manufacturers have already applied for patents on their improvements of the reaper, and the MA-IRRI Program will not promote these particular improvements. Many manufacturers are eager to patent improvements because the Philippine Government exempts manufacturers from paying income tax on sales of products patented by them.

2. Fabrication of the reaper and hand tractor is sufficiently simple that it can be done by small manufacturing firms having limited capital and equipment.

3. Many firms were willing to devote time and money to attend the reaper training course, including firms which are small and located in agricultural areas far from Manila.

4. Although the training course facilitated introduction of the reaper to interested firms, it was not absolutely essential because 41% of the present reaper manufacturers did not attend the course. However, many of the untrained reaper manufacturers either have close relationships with IRRI or have experienced technical personnel.

5. Since most of the reaper manufacturers have difficulty in fabricating the first unit solely from the blueprints, they benefitted from either borrowing a unit from MA-IRRI, buying a unit, or employing technicians who are experienced in fabricating the reaper.

6. Initial sales of the reaper have been slow, primarily because of the depressed economic conditions of rice farmers in the Philippines. Sales have also been limited by the understandable reluctance of farmers to buy a new machine of unproven performance and durability, along with concern that the reaper may lead to problems with hired farm workers.

7. Manufacturers have identified aspects of the reaper design, fabrication, and operation which should be improved. Several manufacturers have already introduced innovations to achieve these improvements.

8. Based on the data in Table 6, we suspect that it would have been possible to facilitate initial sales of the reaper by helping farmers to become more familiar with the machine, thereby alleviating their concerns about maneuverability, shattering losses, passing over paddy, and durability. For this reason, it is recommended that future extension of the reaper (or other equipment that is new to farmers) would benefit by arranging for intensive on-farm utilization of at least one unit in each of the major target areas. This would provide a site where farmers and manufacturers could observe the equipment being used on a sustained basis by experienced operators.[7/]

Since the present survey was carried out at about only one year after the initial introduction of the reaper, it provides only preliminary information on sales and no information on the buyers (farm size, location, cropping intensity, etc.) or on utilization (e.g., used only on owners'

[7/] This type of trial was carried out in Bukidnon and it allowed farmers and manufacturers to observe the reaper under conditions of intensive use.

farms; contract work on other farms; costs and returns; utilization rate (hectares/year); and labor displacement). A second survey will be conducted in 1984 to obtain data on buyers and utilization, including a study of the positive and negative impacts of the machine on those who own reapers, those who hire reapers, and those who are displaced by reapers. Information will also be obtained on the reaper's effects on losses and timeliness of harvesting, while also determining the reaper's limitations with respect to harvesting crops that are either weed-infested, poorly drained, or lodged. Another limitation to be considered is that the length of the straw of a crop harvested by the reaper generally is longer than that harvested by hand, with the result being that the capacity of mechanical threshers may be greatly reduced.

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R E F E R E N C E S

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2. Manalili, I., Ma Ji and B. Duff. 1981. *Technical and economic factors in adapting mechanical reapers to small rice farms*, in Proceedings of Regional Seminar on Appropriate Mechanization for Rural Development with Special Reference to Small Farms in the Asean Countries, January 26-31, 1981, Jakarta, Indonesia, pp. 96-108.

Table 1. Classification of cooperating firms according to assets, labor, reaper training, and reaper manufacturing[a] - data expressed as percentages -

Range	All Cooperators (124)[b]	Trained Cooperators (30)[b]	Reaper Manufacturers	
			Trained (16)[b]	Untrained (11)[b]
CAPITAL ASSETS				
≤ ₱100,000[c]	44	40	31	45
₱100,001 to ₱1,000,000	44	37	38	27
₱1,000,001 to ₱4,000,000	10	13	25	9
> ₱4,000,000	2	10	6	18
LABOR (Number of employees)				
≤ 5	29	20	31	36
6 to 15	45	53	31	18
16 to 50	21	13	19	36
> 50	6	13	19	9

a/ Data as of March 1, 1983

b/ Number of firms in sample

c/ Approximate conversion rate: ₱10 per US dollar.

Table 2. Most common reasons why some participants of reaper training course have not yet fabricated a unit.

Reasons	Frequency[a/]
Busy with orders for other equipment	7
Lack of sufficient capital	6
Lack of skilled personnel necessary for fabricating reaper	2
Firm no longer manufacturing agricultural equipment	2

a/ Frequency represents the number of participants who mentioned the particular reason.

Table 3. Principal methods used by reaper manufacturers in fabricating their first prototype unit.

Methods	Number of Manufacturers	Percentage
Followed blueprints provided by MA-IRRI	11	41
Utilized reaper loaned by MA-IRRI	8	30
Utilized reaper purchased by firm	6	22
Hired services of experienced reaper fabricator	2	7
Total	27	100

Table 4. Production and sales of reaper units[a]

Range (number of units)	Number of firms	Percentage of firms
UNITS PRODUCED[b]		
1	10	37
2-5	8	30
6-10	3	11
> 10	6	22
	27	100
UNITS SOLD[b]		
0	16	59
1-5	6	22
6-10	1	4
> 10	4	15
	27	100

a/ Data based on survey conducted from January to May 1983.

b/ At the time of the survey, a total of 161 reaper units had been fabricated, and 88 of these had been sold.

Table 5. Manufacturers' opinions on most common problems encountered in selling the reaper[a]

Problem	Frequency[b]
Farmers lack capital to purchase reapers	5
Harvest laborers oppose the use of reapers	3
Manufacturer lacks marketing organization	1

[a] Based on responses of 20 reaper manufacturers, some who mentioned more than one problem

[b] Frequency represents number of manufacturers who mentioned the particular problem

Table 6. Manufacturers' opinions of farmers' views on the most attractive and unattractive features of the reaper[a]

Features	Frequency[b]
ATTRACTIVE FEATURES	
Fast reaping or harvesting	16
Uniform windrowing	8
Reduces labor requirements	4
Leaves a clean field after reaping	3
UNATTRACTIVE FEATURES	
Difficult to maneuver	5
Displaces labor	4
Suspect shattering losses will be high	2
Tendency to pass over cut paddy	2
Suspect durability will be poor	2

a/ Based on responses of 27 reaper manufacturers, some of whom gave more than one response.

b/ Frequency refers to the number of manufacturers who mentioned the particular point.

Table 7. Most common service and repair problems of reaper[a/]

Problems	Frequency
Cutter blades chip or become dull	4
Short life of V-belt between PTO and reaper	3
Starwheels wear out	3
Conveyor belt wears out	2
Several bolts often become loose	2

[a/] Based on responses of 27 reaper manufacturers, 37% of whom did not give any comments because of limited experience thus far.

Table 8. Manufacturers' suggestions on improvements of the reaper and hand tractors[a/]

Suggestions	Frequency[b/]
Increase width of cutter bar to 25 mm. (1 inch)	7
Provide clutch to disengage reaper from hand tractor PTO	5
Modify reaper skid to reduce bumping and facilitate turning	4
Improve maneuverability of machine	3
Change hand tractor clutch lever to motorcycle type	3
Increase diameter of vertical shaft of reaper	3
Modify transmission or pulley ratios to reduce forward speed of machine	2
Eliminate need for twisted V-belt between PTO and reaper	2
Reduce problem of straw wrapping around starwheel shaft	2

a/ Based on responses of 27 reaper manufacturers, some of whom have made more than one suggestion.

b/ Frequency represents the number of manufacturers who have either suggested the particular improvement or actually incorporated the improvement in their unit.

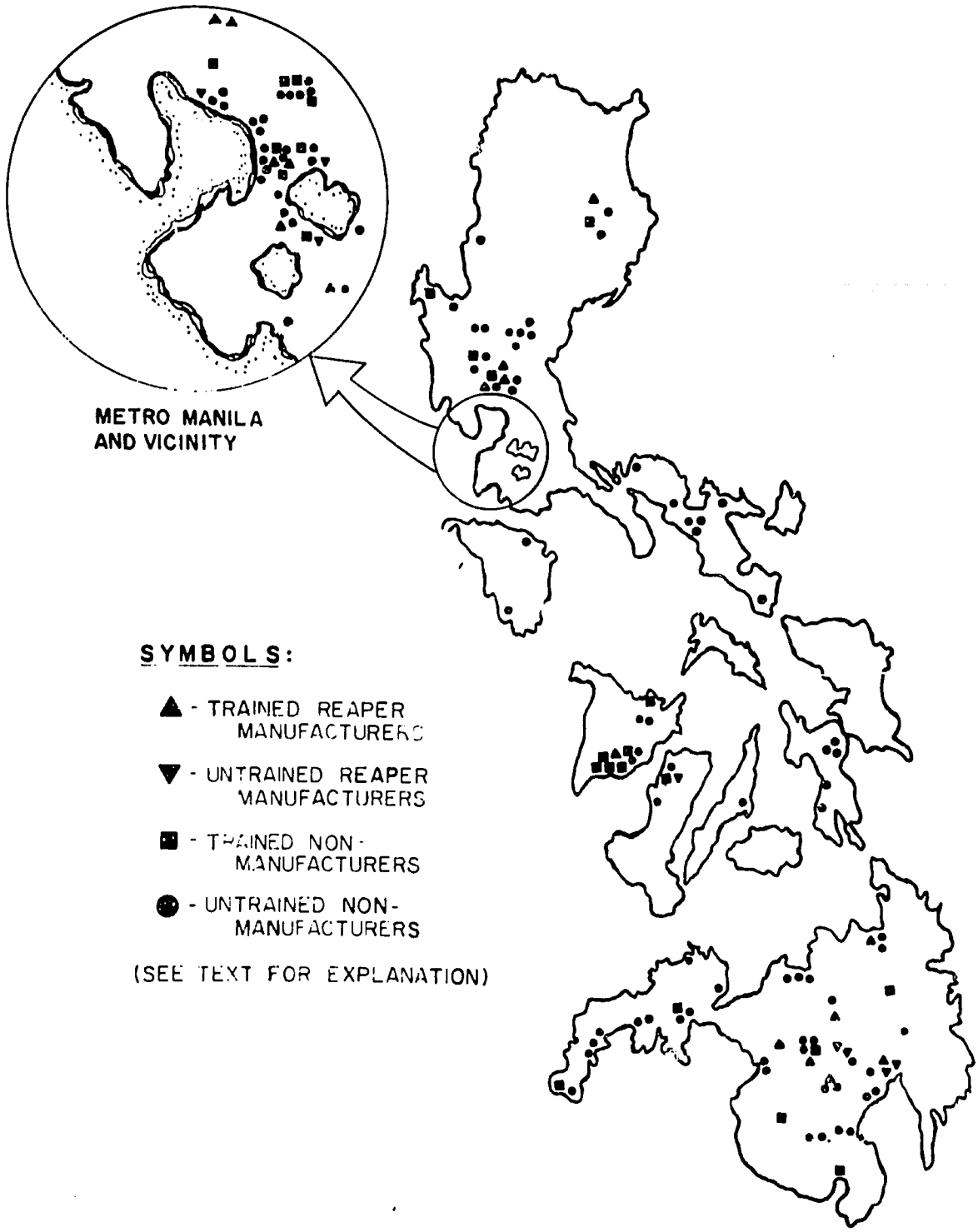

Figure 1. Geographical Location of Cooperating Manufacturers of the MA-IRRI Industrial Extension Program for Small Farm Equipment.

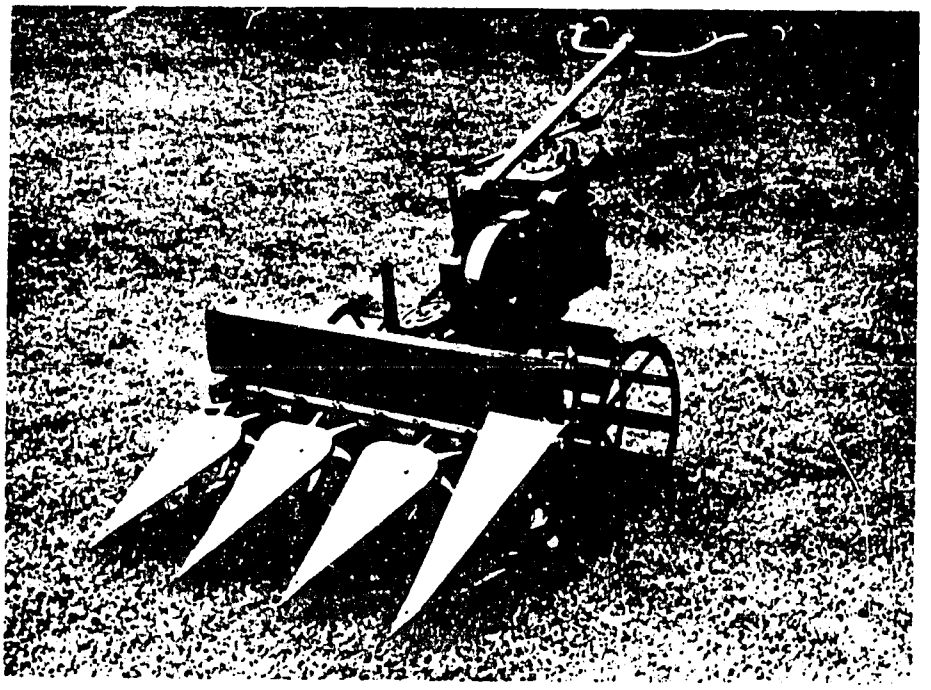

Figure 2. CAAMS-IRRI 1.0 m Reaper.

DEEP PLACEMENT FERTILIZER APPLICATORS FOR WET PADDIES

By

*Amir U. Khan**

INTRODUCTION

Paddy farmers in Asia have not been able to make full use of fertilizer to boost their yields due to poor fertilizer use efficiencies. As early as 1941, Shioiri in Japan explained the mechanics of loss of surface applied ammonia in flooded soils and recommended the deep placement of ammonium fertilizers. Many studies at IRRI and other institutions have consistently demonstrated that fertilizer use efficiency in wetland rice production could be almost doubled by placing fertilizer in the reduced soil layer at depths ranging from 5 to 15 cm. A lack of suitable deep placement applicators however, has not permitted the transfer of these findings to the farm level.

Prilled urea is the most popular fertilizer material used for rice production in Asia. Over the last decade an unusually large number of deep placement applicators have been developed (Kiamco, 1982 & Liu Chung-chu, 1982) for prilled urea in Japan, China and at IRRI. Field performance of these machines however have been rather inconsistent. This has led to the belief that prilled urea is not a suitable fertilizer material for deep placement and consequently briquettes and urea supergranules** have been experimentally developed.

The Institute is fully aware of the immense benefits that could accrue to rice farmers in Asia through deep placement of fertilizer and is placing a high priority on the development of such fertilizer applicators. In September 1982, the author was assigned to IRRI to concentrate on the development of deep placement applicators. A special engineering team*** was organized by the author in the Agricultural Engineering Department to work on this critical problem.

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***Urea Briquettes & Urea Supergranules are essentially large size granules of 1 gram weight that were developed to facilitate deep placement in flooded soils.*

****The engineers who have been associated from time to time with this special task force are: Larry Kiamco, Val Tiangco, Gil Espiritu, Iñigo Camacho, Lito Diestro, Research Assistants, & Lito Bautista, Felipe Santos & Zahid Mahmood, Research Scholars of the Agricultural Engineering Department, IRRI, Los Baños, Laguna, Philippines.*

As an initial step, a review of the deep placement applicator development worldwide were undertaken to gain a better understanding of the deep placement problem. This led to the development of a set of criteria (Table 3) for technical and commercial acceptability of applicators (Khan, September 1982). In order to gain a better understanding of the deep placement phenomenon, a series of laboratory experiments were conducted, which led to the significant findings that under flooded conditions, placement of fertilizer in open furrows followed by furrow closing results in a large transfer of fertilizer to floodwater. The technical criteria for applicators were subsequently revised to reflect the new findings. Efforts were then made to separately optimize the designs of the three major components of applicators in the laboratory, i.e., the fertilizer metering, conveying and furrow closing mechanisms.

Twenty new deep placement applicator concepts were then proposed (Khan, November 1982) out of which six were selected for intensive design and development efforts. This led to the eventual development of three new applicators. These applicators, two for prilled urea and one for USG were designed for minimum N transfer to floodwater. A brief discussion of the research study on N transfer to floodwater, which served as the basic foundation for the successful development of deep placement applicators, is included in this paper.

MECHANICS OF N TRANSFER TO FLOODWATER

Fertilizer use efficiencies in upland farming (unflooded conditions) have been reported to be 50 to 60% (Craswell & Velk, 1979) when those obtained under wetland farming conditions are generally 30 to 50% (Prasad & De Datta, 1979). The reasons of this wide difference in fertilizer use efficiencies have not been well understood. Experiments conducted in Pakistan (Ross, 1980) indicate a 60% recovery of applied nitrogen by rice crop when fertilizer was incorporated in dry condition and followed by flooding. More recently, Bhatti et al (1983) report that fertilizer incorporated in dry soil and followed by flooding increases paddy yields by 1 to 2 tons/ha over conventional broadcasting of fertilizer in flooded soils. One can conclude from the results of these two studies that flooding, after the fertilizer has been incorporated, is not the cause for reducing fertilizer use efficiencies in wetland farming. Since fertilizer use efficiencies under upland farming (unflooded) conditions are quite high, it was hypothesized that the low fertilizer use efficiencies in wetland farming had something to do with the presence of water during the time the fertilizer was being applied. It was suspected that some fertilizer was being transferred to floodwater during application. Since ammonia volatilization losses are related to floodwater N levels, minimizing floodwater N level seemed a logical approach for reducing fertilizer losses.

In flooded soils, there are four possible ways that fertilizer could be transferred to floodwater during or immediately after placement (Fig. 1a): 1) By dissolution while fertilizer transits through floodwater to the furrow bottom. 2) By upward movement of fertilizer granules or solution due to displacement effect of the furrow closing operation. 3) By convectional movement of fertilizer solution through poorly sealed furrow walls, and 4) By diffusion through water entrapped in puddled soils or between poorly closed furrows. A set of hypothetical curves indicating possible channels of fertilizer transfer to floodwater and the experimental methods which were used to isolate these effects are given in Fig. 1b.

The above considerations led to two laboratory studies in the IRRI Agricultural Engineering Department which permitted the assessment of the different avenues of N transfer to floodwater during deep fertilizer placement. Prilled urea was used in the first study (Khan et al, April 1983) as this material was considered to be most susceptible for N transfer to floodwater due to its small granule size. Similar experiments were later repeated with both prilled urea and urea supergranules (Mahmood et al, 1983). Fig. 1c summarizes the magnitude of N transfer to floodwater during placement when prilled urea is placed in 5 cm deep furrows.

The findings of these two studies confirmed that the applicators developed in the past were not properly depositing fertilizer as most of it was transferred to floodwater during placement. The two major channels of fertilizer transfer to floodwater during deep placement were: a) Dissolution of fertilizer during transit from the water surface to the furrow bottom (43-76%); b) Upward movement of fertilizer granules or solution to the floodwater during furrow closing (up to 29%). If the furrow was properly closed, transfer through the closed furrow walls was generally less than 10%. Transfer due to diffusion through flooded soils was less than 5%.

On the basis of the N transfer studies, it was concluded that the key to improving fertilizer use efficiency in wetland cultivation was to minimize N transfer to floodwater during the fertilizer placement operation. Such a strategy would maximize retention of fertilizer in the soil where it would be less vulnerable to volatilization losses and would be available for plant use. It was thus concluded that minimizing fertilizer-water contact during the three phases of fertilizer application; transit, placement and covering, were the most critical considerations in the development of deep placement applicators.

This general stragegy was followed in the development of the following three new applicators (Khan et al, June 1983) at IRRI:

1) Straight auger applicator for prilled urea (Fig. 2).
2) Oscillating plunger applicator for prilled urea (Fig. 3).
3) Press-wedge applicator for urea supergranules (USG) (Fig. 4).

COMPARATIVE PERFORMANCE OF APPLICATORS

During development, most machines must undergo a phase in which machines are repeatedly evaluated and improved. In the past, performance of deep placement applicators were evaluated at IRRI through yield experiments. This required a five to six month cycle, between design improvement and performance evaluation, which seriously delayed the applicator development process. The level of urea and Ammonium N concentration in floodwater, after the fertilizer has been applied, is generally related to volatilization losses. It was felt that floodwater N level* could be used to obtain an approximate idea of the machine placement efficiency. This technique was used for quick preliminary evaluation of applicators which helped to accelerate the applicator development process at IRRI.

Last December, three deep placement applicators were evaluated in Maahas clay plots at IRRI by measuring the amount of N transfer to floodwater. The plots were settled for ten days after puddling. The results of this test, which are summarized below, indicated that the straight auger applicator for prilled urea was performing considerably better than the deep plunger (USG), and rolling presswheel (forestry grade) applicators.

Machine	Fertilizer material	Total N (ppm) in flood water - 24 hours after application	Machine performance rating
Straight auger	Prill	16.47	1
Deep plunger* (intermittent)	USG	34.37	2
Rolling presswheel	Forestry grade	38.63	3

*This machine was developed earlier and had given best performance in tests conducted during 1981-82. However it has some drawbacks which limit its commercial acceptability.

*Subsequent experience tells us that floodwater N level only gives an indication of the amount of N transferred to floodwater during the process of fertilizer application. It fails to give any indication of how the rest of the fertilizer will be available to plants during the rest of the cropping season. Thus the floodwater N level, at placement time, may not necessarily give an indication of fertilizer use efficiencies which is more a function among others of how effectively fertilizer was sealed in the furrow at the time of placement.

During the 1983 dry season, three of the new applicators, the Deep Plunger (USG) and hand placed (USG) methods were evaluated at the IRRI Research Farm in yield trials under a collaborative project between the IRRI Agronomy and Agricultural Engineering departments. The results of these tests were as follows:

PRELIMINARY YIELD TESTS, 1983 DRY SEASON, IRRI AGRONOMY DEPT.

Machine	Fertilizer material	Fertilizer Kg/N ha	Grain yield	Efficiency Kg rough rice / kg N
1) Straight auger 3/4"	Prill	78	5.9	28
2) Auger with transplanter	Prill	82	5.6	23
3) Rolling presswheel	Forestry grade	84	6.0	26
4) Deep plunger (intermittent)*	USG	84	5.5	21
5) Hand placed	USG	87	5.9	24

*This machine was developed earlier and had given promising performance in tests conducted in 1981-82. This machine, however, has some drawbacks which limit its commercial acceptability.

The performance of the three machines, Nos. 1, 2 & 3, in the above tests compared favorably with hand placement of USG, which had so far been considered to be the most efficient deep placement method at IRRI.

All the five new machines were again tested at the IRRI Research Farm in May 1983 by the Agricultural Engineering Dept. by evaluating the N transfer to floodwater. The results were as follows:

Machine	Fertilizer material	Total N (ppm) in floodwater - 24 hours after application	Machine performance rating	Fertilizer rate kg N/ha
1) Straight auger 3/4" surface closure	Prill	3.3	3	58
2) Straight auger 3/4" with underground closure	Prill	2	1	58
3) Rolling presswheel with underground closure	Forestry grade	11.6	7	58
4) Rollimg presswheel with underground closure	USG	6.7	5	58
5) Inclined press-wedge	USG	14.8	8	57
6) Oscillating plunger with underground closure	Prill	2.4	2	58
7) Auger 3/4" on transplahter	Prill	8.7	6	58
8) Deep plunger (intermittent)*	USG	6.2	4	58
9) Hand placement	USG	6.7	5	58

*This machine was developed earlier and had given promising performance in tests conducted in 1981-82. However, it has some drawbacks which limits commercial acceptability.

These tests indicate an encouraging performance of all five machines as the N transfer values were less than 25 ppm, a level that was agreed upon by scientists at IRRI to be acceptable. The two prilled urea applicators, the Straight Auger and the Oscillating Plunger, resulted in a lower N transfer to floodwater than hand placement of USG. This was convincing proof that prilled urea could be as effectively deep placed as USG. The performance of the Rolling Presswheel was satisfactory however this machine was dropped from further development as it was felt to be too costly for commercial introduction. The Inclined Press-wedge indicated a relatively high N transfer value and hence the wedge and opener was redesigned with a narrow profile for more effective sealing and reduced pushing force.

The three new machines, the Straight Auger (prill), the Oscillating Plunger (prill) and the modified Press-wedge (USG) were simple in design and offered excellent possibilities for commercial introduction. These three machines can be easily manufactured in most developing countries and could be marketed to farmers at a reasonable price of about US$50 to US$60. It was decided to further test and improve these machines through yield trials during the 1983 wet season in cooperation with the following groups:

a) The IRRI Agronomy Department at the IRRI Farm and at the Maligaya Research Station.

b) The IRRI Training & Technology Transfer Department at various research stations and farmers' fields in the Philippines.

c) The Ministry of Food & Agriculture, Govt. of the Philippines at various research sites.

d) The IRRI Agricultural Engineering Department in nine progressive farmers' fields in Laguna Province.

The three machines are now undergoing continuous improvements on the basis of feedback being received from field trials. As of this writing, yield data from the nine cooperating farmers in Laguna has been obtained by the IRRI Agricultural Engineering Department. The results are presented in Tables 1 and 2.

The farmer trials indicate that in all nine cases, a single application by any of the three machines increased fertilizer use efficiency in every case when compared to farmers' traditional practice of split surface broadcast application. The average increase in fertilizer use efficiencies for the three machines on clayey soils at the nine farm locations in Laguna were as follows:

1)	Straight Auger Applicator	Prill	49.82%
2)	Oscillating Plunger Applicator	Prill	44.49%
3)	Press-wedge Applicator	USG	51.29%

Each of the nine farmers were pleased with the wet season results and have requested to use these machines in the coming dry season.

Results from the other IRRI departments and outside agencies who are testing these applicators in different parts of the country are expected to be available by the end of this year. On the basis of the experience gained so far, one can conservatively estimate that fertilizer savings of approximately 35% could be easily achieved through the use of these machines. Hopefully, by the end of this year, we will have additional results from other test sites and more precise estimates on fertilizer savings that could be achieved.

It is not clear at this moment whether farmers would prefer to save on fertilizer costs or go for maximization of yields. The nine cooperating progressive farmers in Laguna were used to applying fairly high fertilizer rates. They expressed a preference for increased yields rather than fertilizer savings. Since fertilizer efficiencies generally show greater increases at low fertilizer rates, perhaps the less progressive farmers would prefer to save fertilizer rather than increase yields. The rapidly increasing prices of fertilizer in the Philippines and farmers capital constraints may automatically force an input saving rather than a yield maximizing strategy for the near future.

At this stage, it would be appropriate to compare the three new applicators with the original target specifications that were developed in consultation with concerned IRRI scientist at the start of this crash program to develop deep placement applicators. Table 3 lists the Essential, Desirable and Undesirable Target Specifications along with an assessment of how the new machines have been able to meet the original objectives. The table includes a fourth machine, the Deep Plunger Applicator (USG), which was the best performing applicator in 1982. It is interesting to note that the three new machines have not only met all the essential specifications but exceeded three of these beyond their desired limits.

It is hoped that by the end of 1983, the three machines would have been sufficinetly tested and improved under different soil and water conditions for limited commercial production release in the Philippines and for extensive farm trials in other Asian countries. If these trials prove conclusive, the designs of these applicators will be released by late 1984 to selected manufacturers in Asia for regular commercial production.

CONCLUSIONS

The machine reported here have demonstrated a rather encouraging performance in the various tests and field trials that have been conducted so far. We are confident that with the development of these three applicators, the primary hurdle of deep placement of prilled and supergranular urea has essentially been overcome. What remains now, is the extensive evaluation and adaptation of these applicators to suit farmer preferences, varying site, soil and cultural differences in the major rice growing countries of Asia.

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Introduction of these machines to farmers through normal manufacturing and commercial channels will require substantial agricultural and industrial extension efforts from IRRI, National Agricultural Agencies and Fertilizer Manufacturers in the rice growing countries. While the introduction of deep placement applicators seems to be the solution for improving fertilizer use efficiencies, there is little doubt in my mind that these machines will be used mostly by the more affluent farmers. Majority of the small subsistent farmers will not have the resources to purchase machines. Such farmers will either have to rent these machines or alternate non-mechanical methods must be developed to improve their fertilizer use efficiencies. Use of irrigation water to deep place fertilizer and low cost fertilizer coatings such as clay, starch, oil, etc. to momentarily arrest fertilizer dissolution, offer some interesting possibilities for improving fertilizer use efficiencies without resorting to special machines.

The progress achieved during the last one year at IRRI on the development of deep placement applicators, specially for prilled urea, has been most challenging and satisfying to those of us who have been associated with this project. There are a number of strategic steps which led to the rapid development of the deep placement applicators that are reported in this paper. These steps included, the precise definition of the deep placement applicator problem; the prioretization of the technical and market criteria for applicators; the better understanding of the N transfer to floodwater during deep placement; the separate optimization in the laboratory of the individual components of applicators, the shortening of the applicator evaluation process through floodwater N measurement; the development of a large number of the applicator concepts which led to the design of the three promising machines and finally the dedicated efforts of the Design engineers and staff of the IRRI Agricultural Engineering Department who helped in the development of these applicators.

The assistance provided by the IRRI Agronomy Department, the Training & Technology Transfer Department and the Test Section of the Agricultural Engineering Department in testing and evaluation of the applicators, the IRRI Analytical Service Laboratory in analyzing floodwater samples and informal suggestions of some of my IRRI colleagues which helped in many ways is gratefully acknowledged.

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Table 1

DEEP PLACEMENT FERTILIZER APPLICATOR TRIALS[1] IN FARMERS' FIELDS
CALAMBA & CALAUAN, LAGUNA - 1983 WET SEASON
IRRI AGRICULTURAL ENGINEERING DEPT.
NOVEMBER 1983

No.	Farmer-Cooperator Name & Address	Variety	Application Method[2]	Fertilizer		Projected Yield[3] Tons/ha	Fertilizer Efficiency[4]	
				Material	Rate Kg N/ha		Kg Rough Rice/kg N	% Change Over Control
1	Mr. V. Oruga Bo. Mabacan Calauan, Laguna	Sinang-Domeng (HYV)	Farmer Practice (no machine - control)	Prill	90	4.87	54.11	-
			Spring Auger	Prill	47	4.42	94.04	+ 73.79
			Oscillating Plunger	Prill	48	3.95	68.10	+ 25.85
			Press-wedge	USG	48	3.82	79.58	+ 47.07
2	Mr. P. Macatangay Bo. Mabacan Calauan, Laguna	Sinang-Domeng (HYV)	Farmer Practice (no machine - control)	Prill	76	4.98	63.85	-
			Spring Auger	Prill	55	5.03	91.45	+ 43.22
			Oscillating Plunger	Prill	58	5.17	89.14	+ 39.61
			Press-wedge	USG	48	5.03	109.79	+ 64.12
3	Mr. J. Espinill Bo. Mabacan Calauan, Laguna	Sinang-Domeng (HYV)	Farmer Practice (no machine - control)	Prill	78	6.87	88.08	-
			Spring Auger	Prill	42	5.46	130	+ 47.59
			Oscillating Plunger	Prill	41	5.01	122.20	+ 38.74
			Press-wedge	USG	42	5.01	119.28	+ 35.42
4	Mr. S. Ilagan Bo. Mabacan Calauan, Laguna	IR-42	Farmer Practice (no machine - control)	Prill	78	4.76	61.02	-
		C-4	Spring Auger	Prill	52	3.42	65.77	+ 7.98
		IR-42	Oscillating Plunger	Prill	39	4.42	113.33	+ 85.73
		IR-42	Press-wedge	USG	41	4.30	104.88	+ 71.88
5	Mr. C. Pabro Bo. Mabacan Calauan, Laguna	IR-42	Farmer Practice (no machine - control)	Prill	80	4.28	53.5	-
			Spring Auger	Prill	66	4.92	75.54	+ 39.33
			Oscillating Plunger	Prill	58	4.03	69.48	+ 29.87
			Press-wedge	USG	45	4.06	90.22	+ 68.64
6	Mr. R. Vergara Bo. Mabacan Calauan, Laguna	IR-42	Farmer Practice (no machine - control)	Prill	78	4.66	59.74	-
			Spring Auger	Prill	47	4.28	91.06	+ 52.43
			Oscillating Plunger	Prill	50	4.20	84.00	+ 40.61
			Press-wedge	USG	44	4.38	99.54	+ 66.62
7	Mr. L. Casubha Bo. Parian Calamba, Laguna	IR-42	Farmer Practice (no machine - control)	Prill	67	5.47	81.64	-
			Spring Auger	Prill	40	5.19	129.75	+ 58.93
			Oscillating Plunger	Prill	53	5.03	94.91	+ 16.25
			Press-wedge	USG	51	4.58	89.80	+ 10.00
8	Mr. R. Isip Bo. Parian Calamba, Laguna	IR-42	Farmer Practice (no machine - control)	Prill	78	5.74	73.59	-
			Spring Auger	Prill	40	5.25	131.25	+ 78.35
			Oscillating plunger	Prill	46	5.21	113.26	+ 53.91
			Press-wedge	USG	47	5.37	114.26	+ 55.26
9	Mr. C. Oleta Bo. Parian Calamba, Laguna	IR-42	Farmer Practice (no machine - control)	Prill	68	5.71	69.26	-
			Spring Auger	Prill	45	4.58	101.78	+ 46.95
			Oscillating Plunger	Prill	47	5.53	117.66	+ 69.88
			Press-wedge	USG	48	4.74	98.75	+ 42.58

[1] Except for application methods & fertilizer rates each farmer applied his own traditional cultural practices on all of 4 treatments.

[2] With machine applications, all fertilizer was applied as a single dose at 10 to 18 days after transplanting. Farmer practice varied but generally included 2 to 3 split broadcast applications.

[3] Based on 4 sampling sites (projected value at 14% m.c.).

[4] For lack of better methods of assessment, fertilizer efficiencies at different fertilizer rates have been compared.

Table 2

SUMMARY RESULTS OF INCREASES IN FERTILIZER USE EFFICIENCIES[1/]
WITH DEEP PLACMENT APPLICATORS ON NINE COOPERATING FARMERS
IN LAGUNA, PHILIPPINES

IRRI Agricultural Engineering Department
November 1983

		Percent Increase Over Farmer Split Broadcast Practice		
		Straight Auger Applicator Prill	Oscillating Plunger Applicator Prill	Press-Wedge Applicator USG
1	Mr. V. Oruga Bo. Mabacan Calauan, Laguna	73.79[2/]	25.85[2/]	47.07[2/]
2	Mr. P. Macatangay Bo. Mabacan Calauan, Laguna	43.22	39.61	64.12
3	Mr. J. Espinili Bo. Mabacan Calauan, Laguna	47.59	38.74	35.42
4	Mr. S. Ilagan Bo. Mabacan Calauan, Laguna	7.98[3/]	85.73	71.88
5	Mr. C. Pabro Bo. Mabacan Calauan, Laguna	39.33[4/]	29.87[4/]	68.64
6	Mr. R. Vergara Bo. Mabacan Calauan, Laguna	52.43[4/]	40.61[4/]	66.62[4/]
7	Mr. L. Casubha Bo. Parian Calamba, Laguna	59.93[4/]	16.25	10.00
8	Mr. R. Isip Bo. Parian Calamba, Laguna	78.35	53.91	55.26
9	Mr. C. Oleta Bo. Parian Calamba, Laguna	46.95	69.88	42.58
	Average Increase	49.82	44.49	51.29

[1/] Due to lack of better methods for comparative assessment, efficiencies at different fertilizer rates have been compared.

[2/] Plots were affected by stemborer infestation.

[3/] C-4 variety was used with this machine only & the crop lodged.

[4/] Deep-placed plots recovered from field submergence of 2 to 3 days during typhoon.

Table 3

COMPARATIVE DESIGN FEATURES OF IRRI DEVELOPED DEEP PLACEMENT FERTILIZER APPLICATORS

TARGET SPECIFICATIONS 1/	STRAIGHT AUGER (PRILL) COMPARATIVE ASSESSMENT 2/				OSC. PLUNGER (PRILL) COMPARATIVE ASSESSMENT 2/				PRESS WEDGE (USG) COMPARATIVE ASSESSMENT 2/				DEEP PLUNGER (USG) COMPARATIVE ASSESSMENT 2/			
	EX.	W.M.	P.M.	N.M.	EX.	W.M.	P.M.	N.M.	EX.	W.M.	P.M.	N.M.	EX.	W.M.	P.M.	N.M.
ESSENTIAL																
• MUST APPLY PRILLED FERTILIZER 5 to 10 CM DEEP		✓				✓				✓				✓		
• CONTINUOUS (NON-INTERMITTENT) OPERATION		✓				✓				✓						✓
• MUST APPLY COMM'L GRADE FERTILIZER W/O GRADING		✓				✓				✓						✓
• RATE 45 & 75 KG N/HA (2 to 3 BAGS)		✓				✓			✓	✓					✓	
• MUST FUNCTION IN UP TO 5 CM DEEP STANDING WATER		✓				✓				✓				✓		
• MUST APPLY 5 to 20 DAYS AFTER TRANSPLANTING		✓				✓				✓					✓	
• LABOR INPUT 8-12 HRS/HA PER APPLICATION			✓				✓				✓					✓
• LIGHT (10-18 KG) FOR LIFTING AT END OF ROWS	✓				✓				✓						✓	
• APPROXIMATE SELLING PRICE - US $ 50-100	✓				✓				✓							✓
• MUST ADEQUATELY SEAL PLACEMENT OPENING	✓				✓					✓				✓		
• STURDY TO LAST AT LEAST 4-6 SEASONS		✓				✓				✓				✓		
• PULLING OR PUSHING FORCE OF 7 to 10 KG		✓				✓				✓				✓		
• SMOOTH UNIDIRECTIONAL MOVEMENT		✓				✓				✓						✓
DESIRABLE																
• COULD BE USED FOR BOTH PRILLED/USG OR FG/USG				✓				✓			✓					✓
• ROTARY RATHER THAN OSCILLATING MECHANISM		✓				✓				✓						✓
• ROLLING ON WHEELS RATHER THAN ON SKIDS				✓				✓				✓				✓
• PUSH-TYPE FOR POST-TRANSPLANT OPERATION		✓				✓				✓				✓		
• MULTI-ROW OPERATION - 2 to 4 ROWS			✓				✓				✓				✓	
• NON-FURROW OPENER TYPE				✓				✓				✓		✓		
• MECHANICAL INJECTOR TYPE		✓				✓						✓		✓		
• EASY TO MANUFACTURE BY SMALL SHOPS		✓				✓				✓				✓		
• NOT NEED HIGH PRECISION IN PRODUCTION		✓				✓			✓					✓		
• PULL TYPE FOR PRE-TRANSPLANT OPERATION				✓				✓				✓				✓
• CAN ALSO BE USED FOR RANDOM SEEDED CROP				✓				✓				✓				✓
UNDESIRABLE																
• INTERMITTENT OPERATION		✓				✓				✓						✓
• MULTI-DIRECTION ACTION DURING OPERATION		✓				✓				✓						✓
• USED OF LIQUID CONVEYING MECHANISM		✓				✓				✓				✓		
• COMPLEX MECHANISMS		✓				✓				✓				✓		
• DELICATE MECHANISMS		✓				✓				✓				✓		

1/ THE TARGET SPECIFICATIONS WERE DEVELOPED IN NOV. 1982 AFTER CONSULTATION WITH CONCERNED IRRI SCIENTISTS.

2/ EX. = EXCEEDED; W.M. = WELL MET; P.M. = PARTIALLY MET; N.M. = NOT MET

DATE: NOV. 10, 1983

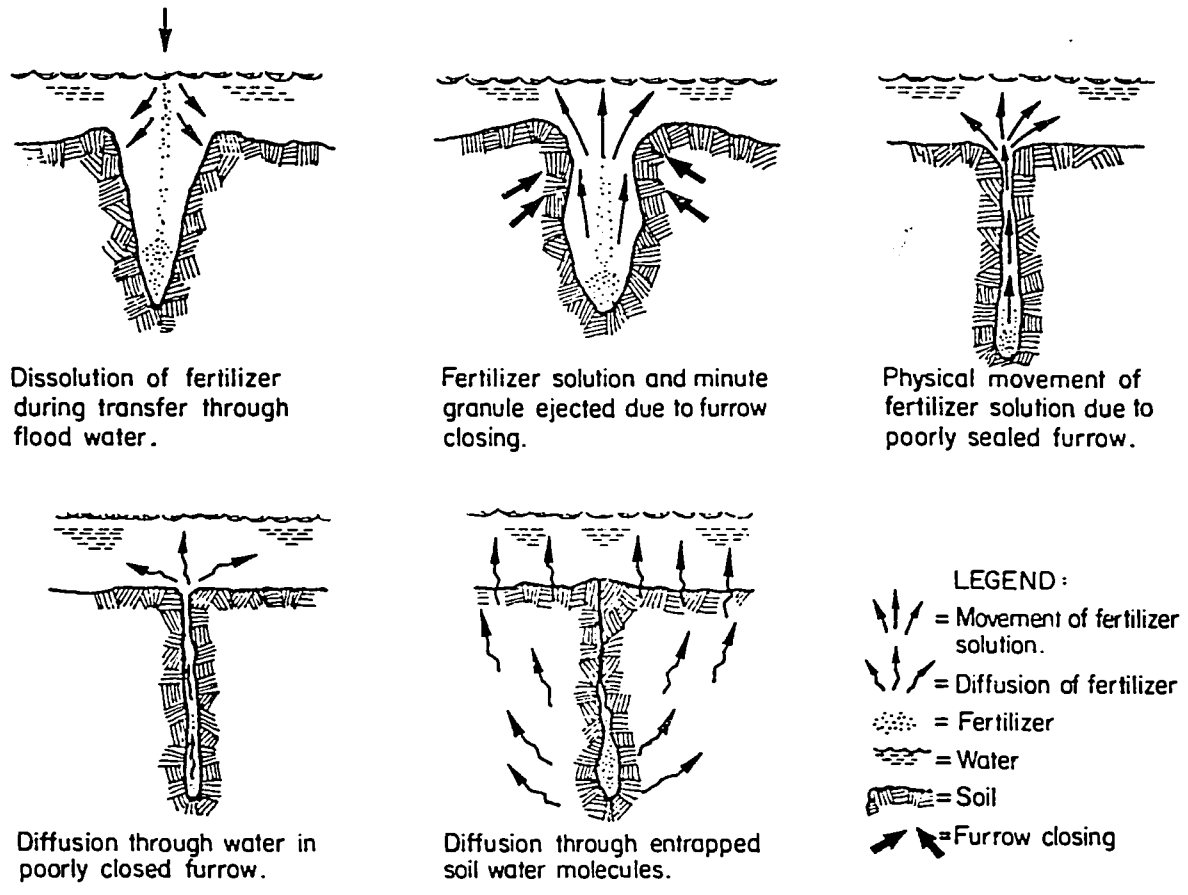

Fig. 1a. Avenues for fertilizer transfer to floodwater during deep placement

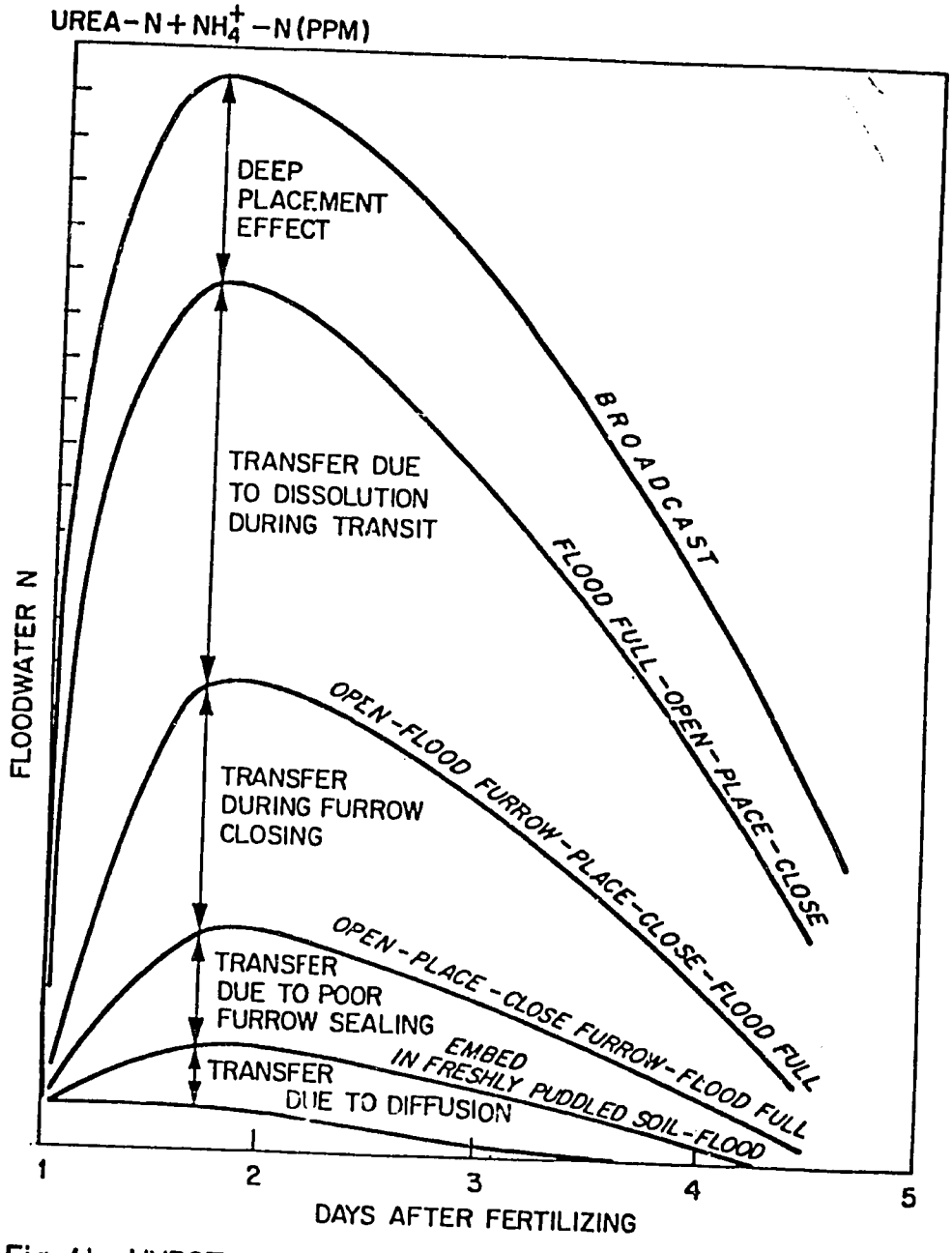

Fig. 1b. HYPOTHETICAL CURVES SHOWING POSSIBLE AVENUES AND EXPERIMENTAL TECHNIQUES FOR EVALUATING FERTILIZER TRANSFER TO FLOODWATER DURING PLACEMENT.

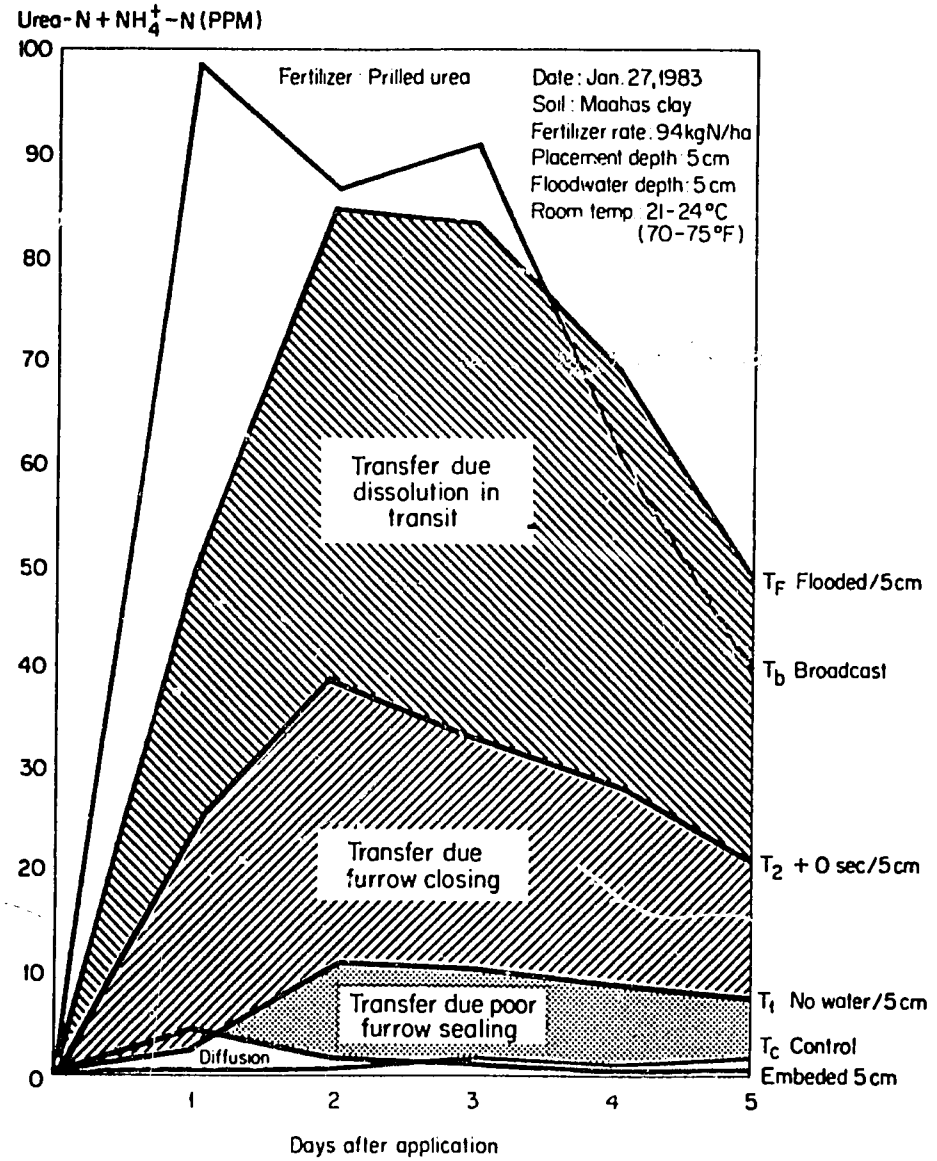

Fig. 1c. Major avenues for N transfer to floodwater during prilled urea placement at 5 cm depth in flooded Maahas clay. (Ag. Eng'g.)

Fig. 2 Straight auger applicator for prilled urea.

Fig. 3 Oscillating plunger applicator for prilled urea.

Fig. 4 Press-wedge applicator for urea supergranules (USG).

HEATED FLOOR DRYER[1] AND STUDY ON HEAT TREATMENT PROCESSES FOR REDUCING DETERIORATION OF MOIST PADDY

ABSTRACT

A heated floor dryer (HFD) was designed, developed and tested as a complement for sundrying of paddy when cloudy and rainy weather prevails during the harvest time. The main components of HFD are: (1) a furnace in which rice straw or hull are burned to heat water to the desired temperature (e.g., 90°C); (2) a pump for circulating the water from the furnace water-jacket to the drying floor; (3) a metal dryer floor heated internally by the circulating water; (4) a roof to protect the floor from rain. The dryer was located near the conventional drying floor so that it was convenient to push the paddy from sundrying floor to heated floor dryer when clouds appear.

The test results indicate that the drying rate was related to floor temperature, frequency of mixing ("raking"), thickness of paddy layer and initial and final moisture contents of paddy. The percent broken grains were lower in heated floor dried paddy than in the conventional drying even at HFD temperature of 90°C. The drying rate was not affected noticeably by the increase of atmospheric humidity during heavy rain.

Preliminary tests were also carried out to explore the feasibility of using a brief heat treatment of moist paddy to reduce fungus and grain activity which contribute to deterioration of grain quality. The initial results indicate that all of the observed fungi were inactivated by heating paddy above 100°C for 5 minutes. The reduction of fungi was also observed by heating the wet paddy (in jute bags) in hot water at 80-99°C for 5 minutes.

INTRODUCTION

Paddy drying is a growing problem in the Philippines for harvests during the wet season when traditional sundrying is often delayed because of clouds and rain. Sundrying of paddy is the traditional practice because it is inexpensive and convenient. For this reason we have attempted to develop a mechanical dryer which would complement sundrying rather than totally replace sundrying. This focus has led to the present studies of the heated floor dryer and heat-treatment processes.

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[1]Project report prepared for annual internal review. Agricultural Engineering Department, The International Rice Research Institute, Los Baños, Philippines, December 1983.

Heated Floor Dryer

The dryer was designed and developed at the Agricultural Engineering Department, IRRI, and was installed and tested at the Philippine Packing Corporation (PPC) Rice Farm in Mindanao.

Since this dryer would be used only during those days when sundrying would not be possible (during cloudy and rainy weather), the dryer was installed adjacent to an existing sundrying pavement at the PPC Rice Farm (Fig. 1a). A roof was provided to protect the dryer and workers from rain. The concrete floor beneath the roof had two levels (Fig. 1b) so that the paddy being sundried on the pavement could be quickly gathered in the event of impending rain by raking it up on the slightly raised portion of the floor and dumping it unto the lower portion, where four drying plates were laid.

Each of four identical sections of the heated floor was a welded sandwich-like structure consisting of two iron plates (gauge 16, 1220 x 2240 mm) separated by 6 x 20 mm flat bars to provide a gap for the flow of hot water (see Fig. 2). A wooden support was provided under the dryer plates to keep them off the concrete floor and thereby minimize the heat loss. The total drying area of the heated floor was approximately 12 m^2, which gave a capacity of 0.40 m^3 of paddy if a 40 mm layer was placed on the HFD. At the bulk density of the paddy, roughly 500 kg/m^3, the capacity of HFD would be 240 kg per load.

The four drying plates were connected in parallel to the incoming and outgoing pipelines (25.4 mm I.D.) with flexible hoses (Fig. 1c). A truck engine water pump driven by a 1/2 HP electric motor was used to circulate the hot water to the plate and then back to the heater.

The water heater was a barrel type boiler (Passat boiler) imported from Denmark. It has an excellent draft regulator for efficient burning of the fuel and for controlling the water temperature. It can use wood, shavings, straw, hulls, chaff and other agricultural wastes as fuel. The boiler design is simple and could be fabricated using indigenous materials.

Test Results for HFD

The most essential function of the HFD was the pre-drying of paddy, i.e. reducing the moisture content (MC)[1] of the harvested grain to about 18%, thereby allowing it to be stored for several days until the weather was suitable for sundrying the grain to the desired final MC of approximately 14%. Thus, the HFD was used only to reduce deterioration of paddy during unfavorable weather for sundrying. The drying method was similar to sundrying. The floor was heated to around 90°C by circulating the hot water, and the paddy was raked in a manner similar to that of sundrying.

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[1]Unless otherwise stated, all moisture content used in this paper is expressed in wet basis (w.b.)

For a 40 mm thick layer of grain on the dryer floor, about 2 tons of paddy could be dried in a day (10 hours) from an initial MC of approixmately 25% to 18%. When the weather was suitable for sundrying, this paddy was dried to a MC of approximately 14%. For comparison, paddy samples were collected from the traditional sundrying method practiced at the PPC Rice Farm. A control sample of paddy was dried in the shade to compare with the results of the heated floor dried paddy. The dried paddy was milled with a Satake laboratory mill, and the percent brokens based on the total milled rice was obtained. The results are presented in Fig. 3.

Paddy dried by the HFD had almost the same percentage of brokens as the shade dried paddy. It indicates that by drying the paddy with the HFD, the head rice recovery increased substantially above that of the traditional sundrying method.

Fig. 4 presents data obtained for a range of floor temperatures (60-90°C) and initial MC (22-27%) of paddy. The corrected drying time is the actual drying time (i.e., the time required to reduce the MC from the initial value to 18%) divided by the change in MC. This correction procedure has been used as an approximate method to bring together data for different initial MC.

As observed in Fig. 5, the time decreases markedly with increasing floor temperature. This temperature dependence is examined in Fig. 6 when the data of Fig. 5 have been replotted in the Arrhenius form (logarthim of time versus the recipocal of temperature). The solid line has been drawn with slope equal to that corresponding to the enthalpy of evaporation of water. Since the experimental data appear to have approximately the same slope as the solid line, it may be concluded that the HFD drying process was controlled primarily by the rate of evaporation of water rather than by diffusion processes.

Other results of the HFD test are (Shukla et al 1983, and Stickney, Shukla and Manalili, 1983):

1. The drying time is reduced by increasing the frequency of mixing (raking) of the paddy layer.

2. The drying time increases approximately in direct proportion to the thickness of paddy layer for the range investigated (20-60 mm thickness).

3. The drying process appears to be satisfactory under conditions of high relative humidity (66-99%) of ambient air. No noticeable effect of relative humidity was observed during the test of the dryer, even during heavy rain.

4. Grain breakage was much lower for the HFD than for the traditional sundrying method.

5. Although the plate temperature of the dryer was 90°C, no parboiling effect was observed in paddy dried by the HFD.

6. The HFD was also found suitable for drying paddy from the initial MC to 14%, in one run, thereby eliminating sundrying completely.

The performance of the Pssat Boiler was also evaluated using different agricultural waste fuels. It was found that boiler worked satisfactorily with dry straw, hull and chaff. The results are shown in Table 1.

Recommendations for HFD

Although the cost of the HFD could be reduced significantly by using a locally-manufactured furnace, we believe that farmer acceptance would be low because of the high labor requirements for raking and handling the paddy, and because of the difficulty of detecting when the grain has reached 18% MC. Consequently, we recommend that further development of the HFD concept be postponed until other options have been explored.

Preliminary Study of Heat Treatment Processes for Reducing Deterioration of Moist Paddy

When paddy with high moisture content is stored for several days before drying, deterioration of grain quality occurs as a consequence of biological activity of the grain itself (i.e., respiration) and of microorganisms (bacteria, yeasts, fungi) which infect the grain (Teter, 1981; Quitco and Ilag, 1982; Mendoza et al, 1982). Therefore, if a simple and inexpensive process for reducing the biological activity of the grain and microorganisms were available, this might provide a practical means for decreasing deterioration of paddy when drying is delayed.

It is known that the biological activity of paddy may be reduced by brief "heat treatments" at moderate temperatures (60°C or above) which are sufficient to "kill" the grain and many of the dominant microorganisms (Joarder and Mohunder, 1981; Rukunudin and Man, 1982). Therefore, we have initiated a study to attempt to answer the following questions:

1. What types of heat-treatment processes (e.g., temperature, time, and heating mechanism) are effective in minimizing the biological activity of paddy and its dominant microorganisms?

2. Could one of these heat-treatment processes provide an acceptable method for reducing deterioration of paddy when drying is delayed?

Thus far we have concentrated on preliminary experiments relating to the first question. These tests utilized paddy grown on the IRRI Farm. Samples of freshly harvested paddy were heated either

on a hot metal plate or in an air oven to temperatures in the range 90°-125°C for times of 1-5 minutes. Samples were subjected to fungal analysis[1] before and after heat treatment to determine the effectiveness of heat treatment in killing fungi.

Table 2 presents the results for heat treating paddy for 5 minutes on a laboratory hot plate with surface temperature varying between 105° and 125°C during the run. The paddy was IR36 with moisture content of 24% (wet basis) at harvest. A sample was sent for fungal analysis without heat treatment or drying, and the results are given in the column entitled "Before heat treatment". Notice that 18 species of fungi were detected on the paddy, with the number of infected grains ranging from 1 to 50%. Several of these species (e.g., Curvularia, Drechslera, Fusarium) are common to other studies in the Philippines (Quitco and Ilag, 1982), but some of the dominant species observed in other studies were not detected in our test. This matter warrants careful consideration in future experiments.

As seen in Table 2 the heat treatment was very effective in destroying fungi. Data are reported for two samples, one which was sent for fungal analysis immediately after heat treatment, and the other (in parentheses in Table 2) which was stored in a clean cloth bag for 5 days. These preliminary results indicate that handling and storage may not cause the heat-treated paddy to be severely reinfected with fungi. However, this point needs to be studied under field conditions.

Table 3 presents the results of a similar test in which paddy was heated for 5 minutes in an air oven at 100°C. The fungal data reported for "Before heat treatment" differ somewhat from corresponding data in Table 2, which is to be expected because the two samples are for paddy harvested from different fields on different days. The data for "After heat treatment" appear to indicate that the air oven at 100°C may not be as effective as the hot plate at 105-125°C.

Based on these preliminary results, the study was extended to test a potentially practical process in which bagged paddy is heat treated in hot water. Figures 6 and 7 show the flow diagrams of paddy samples in Experiments 1 and 2. The paddy (IR36) from two different fields of the IRRI Farm was harvested on two different days. Immediately after threshing, a sample was taken and sealed in a plastic bag for fungal analysis. This was considered a control sample for the experiment. The remaining paddy was placed in jute bags.

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[1]Fungal analyses were generously provided by M. Bonman and V. Merca of IRRI's Plant Pathology dept., using the standard blotter technique of the International Seed Testing Association.

The paddy in jute bags was immersed in a pre-heated hot water bath for 5 minutes at 80°C and 95-98°C in Experiments 1 and 2, respectively. Samples for fungal analysis were taken from the top, middle and bottom of the bags with the help of a sphere type sampler. The treated paddy of Experiments 1 and 2 was stored in the same bags for 120 and 140 hours respectively under shade. For comparison, the untreated (freshly harvested wet) paddy in jute bags was also kept in the same store for the same period. At the end of storage period, samples from the treated and untreated bags were taken in the same way as before storage and sent for fungal analysis.

Results of Experiments 1 and 2 are shown in Tables 4 and 5. It was observed that most of the fungi were reduced by the heat treatment. In a few cases it was observed that there was further growth of fungi after the heat treatment and during storage. For example, the Fusarium semitectum (Table 4) was not detected in freshly harvested paddy sample, but found in the hot water treated sample and during storage. As shown in Table 4, Fusarium semitectum was at 3% after the heat treatment and increased to 14% and 34% at the end of the storage period for the treated and untreated paddy, respectively. This is a special type of fungi which grows even in dry environments. It is not understood why their growth increases during the storage period even after the hot water treatment. There could be several reasons for it, e.g. improper sampling and analysis, non-uniformity in treatment of paddy in hot water, types of paddy, varying field conditions, etc. Similarly, Aspergillus Spp. (Table 4) was not visible in fresh paddy (control sample) but was observed at 1% after the hot water treatment and 12% at the end of storage period in treated paddy. Why it was not found in untreated paddy at the end of storage time is not known. This is a storage fungus, i.e., one that grows under storage conditions. Curruloria Spp. also appear to be unaffected with the hot water treatment. In general, it was observed that the treated paddy was less infected by fungi at the end of storage period than was the untreated paddy.

In Experiment 2, the temperature of the heated water was higher than in Experimental 1, but the reduction of fungi is not noticeably better than in Experiment 1 (see Tables 4 and 5). This may be a result of the fact that the samples for Experiments 1 and 2 were not equivalent because they were taken from different fields and have different initial degrees of infection.

The treated paddy has higher MC than the untreated paddy throughout the storage period. Hence, some fungi encountered favorable environments (due to high MC) in the treated paddy for their growth. However, fungi were observed to be reduced by the treatment with hot water and the growth rates during storage were retarded more than for untreated paddy. No discoloration of paddy grains was visible after the end of storage period in both the treated and untreated samples. Hence, by providing a suitable, convenient and inexpensive mechanism to farmers for the hot water treatment, the storageability of wet harvested paddy may be increased.

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Table 1. Performance of Passat Boiler

Fuels/ Water Temperature °C	M.C. of Fuel % db	Time required to raise the Water Temp to 95°C min	Fuel required to raise Water Temp to 95°C kg	Feed rate of fuel to maintain 95°C of water kg/hr	Combustion efficiency %
Fire wood 28 - 95	23.97	83	48.00	3.84	93.36
Dry Hull 27-95	16.73	95	45.75	21.24	76.23
Wet Hull	68.54	No burning was possible			
Chaff 54 - 95	10.70	35	19.00	8.62	79.31
Wet Straw 37 - 70	93.19	120	56.5	Not possible to continue	
Dry Straw 67 - 95	13.68	25	17.8	10.00	77.97
Rolled Dry Straw 33 - 95	14.95	95	58.6	8.57	89.95

Table 2. Effect of Heat Treatment on Fungi Detected on Paddy: Heat Treatment on hot plate at 105°-125°C for 5 minutes.

FUNGI	INFECTED GRAINS (%)	
	BEFORE HEAT TREATMENT	AFTER HEAT TREATMENT
Alternaria longissima	8	
Alternaria tenuis	1	
Anguillospora sp.	3	
Aspergillus sp.		(1)*
Cercospora oryzae	2	
Cercospora sp.	1	
Cladosporium sp.	50	(2)*
Curvularia spp.	11	(2)*
Drechslera oryzae	1	
Drechslera sp.	1	
Fusarium semitectun	17	1 (1)*
Gerlachia oryzae	1	
Nigrospora oryzae	15	(2)*
Penicillium sp.	1	1 (2)*
Phoma sp.	1	(1)*
Pyricularia oryzae	1	
Sarocladium oryzae	23	
Trichoconiella padwickii	18	
Verticillium cinnabarinum	1	(1)*

*Numbers in parentheses are for a sample which was stored for five days after heat treatment (see text).

Table 3. Effect of Heat Treatment on Fungi Detected on Paddy: Heat Treatment in oven at 100°C for 5 minutes.

FUNGI	INFECTED GRAINS (%)	
	BEFORE HEAT TREATMENT	AFTER HEAT TREATMENT
Alternaria longissima	19	
Anguillospora sp.		(1)*
Cercospora oryzae	3	
Cladosporium sp.	27	3 (4)*
Curvularia spp.	21	(5)*
Drechslera oryzae	2	(1)*
Drechslera sp.	1	
Fusarium semitectun	24	2 (3)*
Gerlachia oryzae	3	(1)*
Nigrospora oryzae	13	2 (6)*
Penicillium sp.	1	1 (2)*
Phoma sp.	1	(1)*
Pithomyces sp.	2	1
Sarocladium oryzae	24	1 (5)*
Trichoconiella padwickii	61	1 (1)*
Verticillium albo-atrum	2	
Verticillium cinnabarirum	3	(1)*

*Numbers in parentheses are for a sample which was stored for five days after heat treatment (see text).

Table 4. Types of fungi detected for Experiment 1 samples which were treated with hot water at 80°C for 5 min and then stored for 5 days. (IR 36 with initial moisture content of 26%)

	Fungi,%	Fresh harvested paddy CONTROL	Fresh harvested paddy, stored for 120 hrs	Hot water treated paddy	Hot water treated paddy stored for 120 hrs
(1)	Alternaria longissima	16 *	7	1	
(2)	Alternaria tenuis				
(3)	Anguillospora Spp.	1	1	1	
(4)	Aspergillus Spp.			1	12
(5)	Bactria			2	
(6)	Botrytes Spp.				1
(7)	Cephalosporium		1		
(8)	Chaetomium Spp.				
(9)	Cercospora Oryzae	7	1	1	1
(10)	Cercospora Spp.				1
(11)	Cladosporium Spp.				
(12)	Cardana Spp.				1
(13)	Corynespora Spp.				
(14)	Curvuloria Spp.	22	23	3	1
(15)	Drechslera oryzae	3	2	1	1
(16)	Drechslera rostrata	1			
(17)	Drechslera sorokiniana		1		
(18)	Drechslera Spp.		1		
(19)	Epicoccum purpurascons				
(20)	Fusarium equiseti	4		1	1
(21)	Fusarium lorgipes				
(22)	Fusarium moniliforme	40	2	6	
(23)	Fusarium semitectum		34	3	14
(24)	Gerlachie oryzae		1		
(25)	Nuerospora crassa		1		1
(26)	Nigrospora oryzae	8	4	1	1
(27)	Pacecilomyus Spp.				
(28)	Penicillium Spp.		1	1	18
(29)	Periconia Spp.		1		
(30)	Phoma Spp.	4	2	1	

Table 4 (continued)

(31)	Phyllosticta glumarum	1	6		1
(32)	Pethomyus Spp.	1			
(33)	Pyricularia oryzae			2	6
(34)	Rhizopus Spp.				
(35)	Sarocladium oryzae	12	17	4	4
(36)	Trichonicella padwickii	21	8	1	
(37)	Verticullium cinnabarinum				
(38)	Verticillium Spp.				

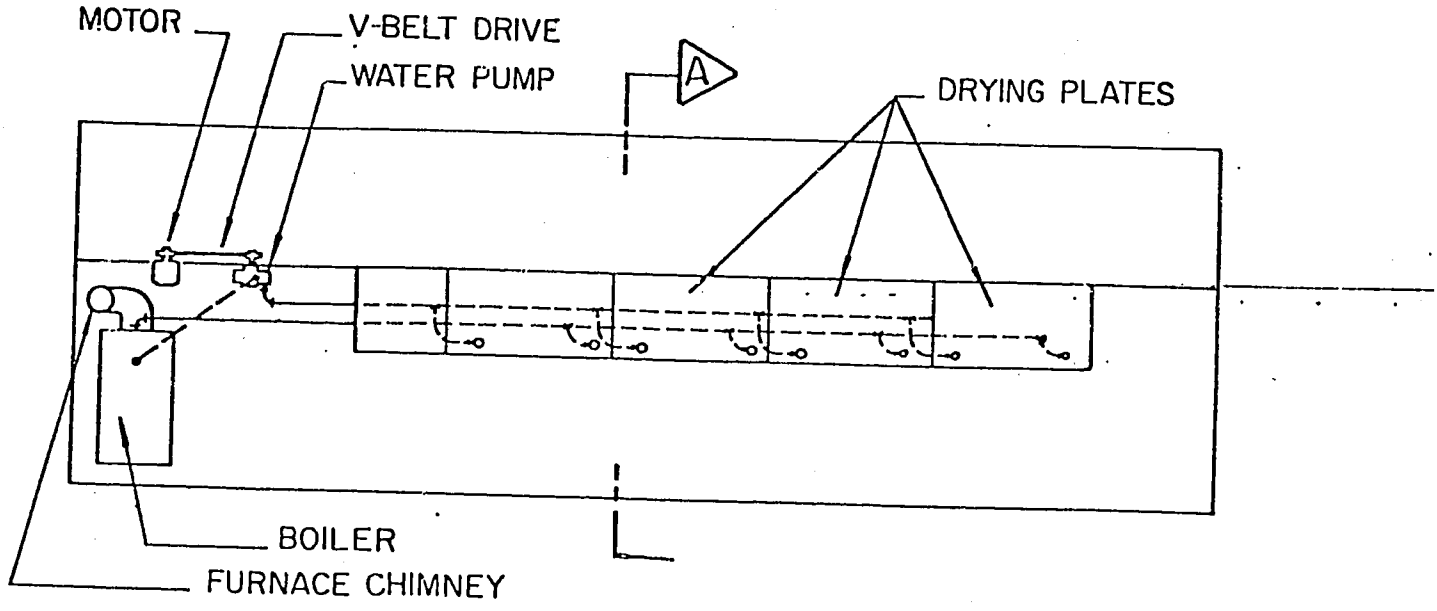
*Data are expressed as percentage of sample grains that are infected.

Table 5. Results of experiment 2. Types of fungi shown in % for hot water treated paddy and untreated paddy. The paddy was treated for 5 min in hot water at 95-98°C in sacks and then stored for 5 days. (IR36 with initial moisture content of 23%)

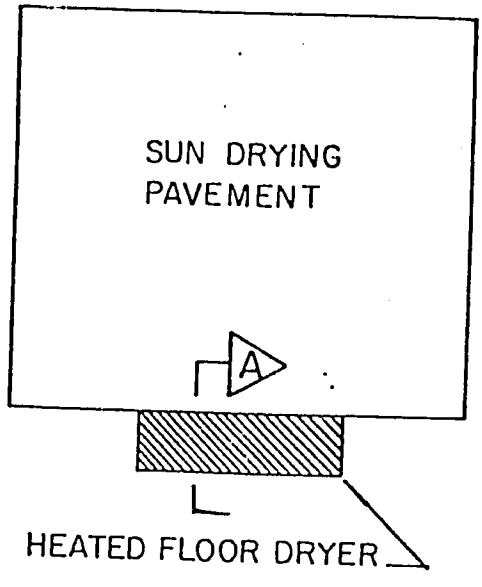
	Fungi, %	Fresh paddy CONTROL	Fresh paddy stored for 140 hrs	Hot water treated paddy	Hot water treated paddy stored for 140 hrs
(1)	Alternaria longissima	16	21	1	2
(2)	Alternaria tenuis				
(3)	Anguillospora Spp.				
(4)	Aspergillus Spp.			6	15
(5)	Bacteria				
(6)	Botrytes Spp.				2
(7)	Cephalosporium			1	
(8)	Chaetomium Spp.			1	
(9)	Cercospora oryzae	1	2		
(10)	Cercospora Spp.				
(11)	Cladosporium Spp.				
(12)	Cordana Spp.				
(13)	Corynespora Spp.				
(14)	Curvuloria Spp.	28	28	9	3
(15)	Drechslera oryzae	1	4	1	
(16)	Drechslera rostrata	1	2		
(17)	Drechslera sorokiniana			1	
(18)	Drechslera Spp.		1	1	
(19)	Epicoccum purpurascons	2		1	
(20)	Fusarium equiseti	1	5	2	2
(21)	Fusarium lorgipes		1		
(22)	Fusarium moniliforme	1	1	1	
(23)	Fusarium semitectum	29	33	16	12
(24)	Gerlachie oryzae	1		2	
(25)	Nuerospora crassa		1	1	
(26)	Nigrospora oryzae	3	4	1	1
(27)	Pacecelomyces Spp.				
(28)	Penicillium Spp.			10	26

Table 5. (continued)

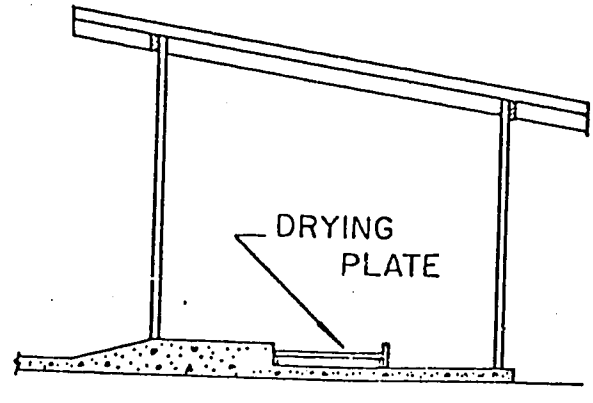
(29)	Periconia Spp.				
(30)	Phoma Spp.	1	2		1
(31)	Phyllosticta glumarum	2			
(32)	Pithomyces Spp.		2		
(33)	Pyricularia oryzae				
(34)	Rhizopus Spp.			8	23
(35)	Sarocladium oryzae	12	13	4	6
(36)	Trichoniella padwickii	24	30	1	1
(37)	Verticillium cinnabarinum				
(38)	Verticillium Spp.			1	1



PLAN OF HEATED FLOOR DRYER
(c)



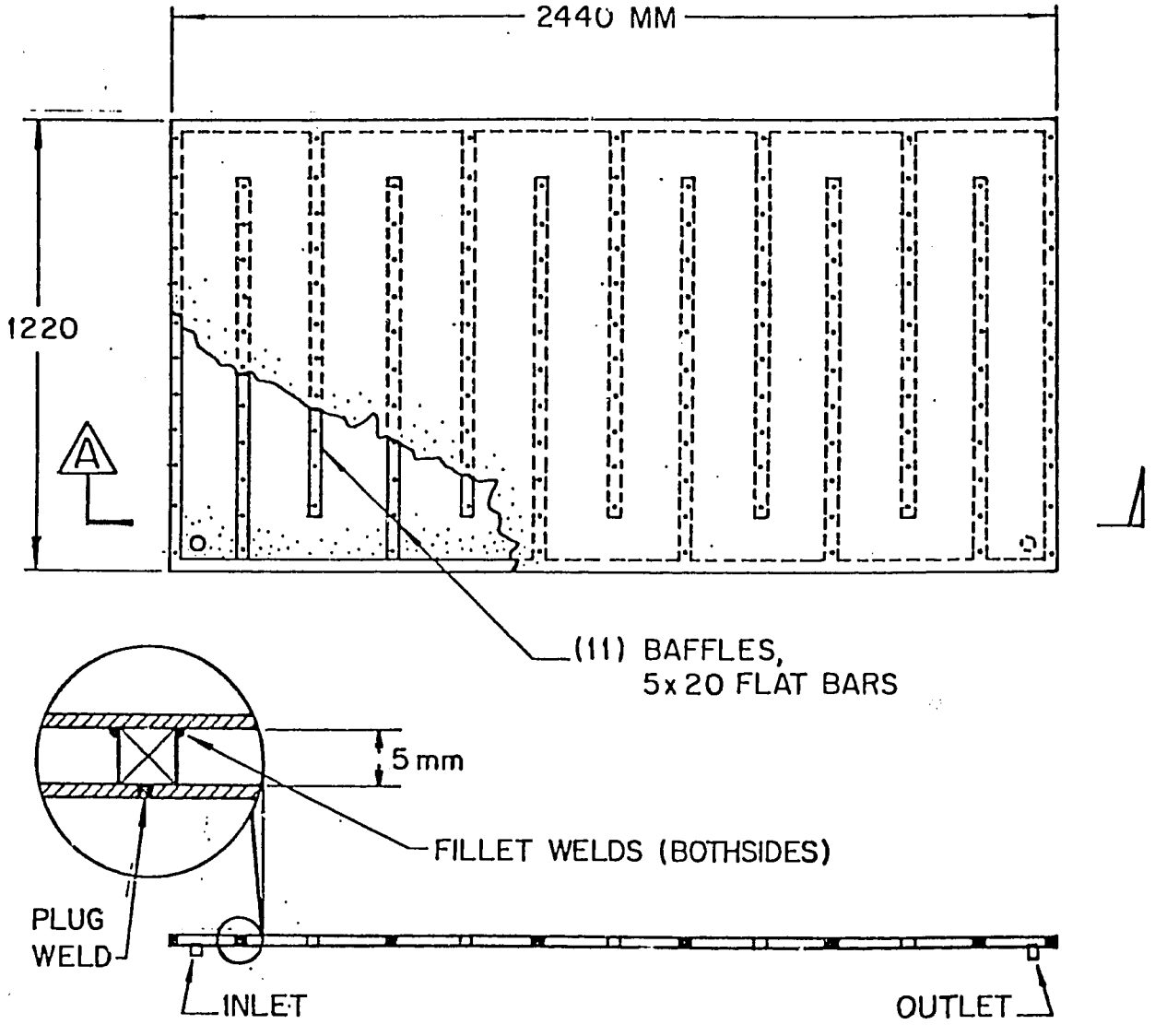
LOCATION PLAN
(a)



SECTION THRU-A
(b)

Fig. 1.

TOP VIEW



SECTION THRU-A

Fig. 2

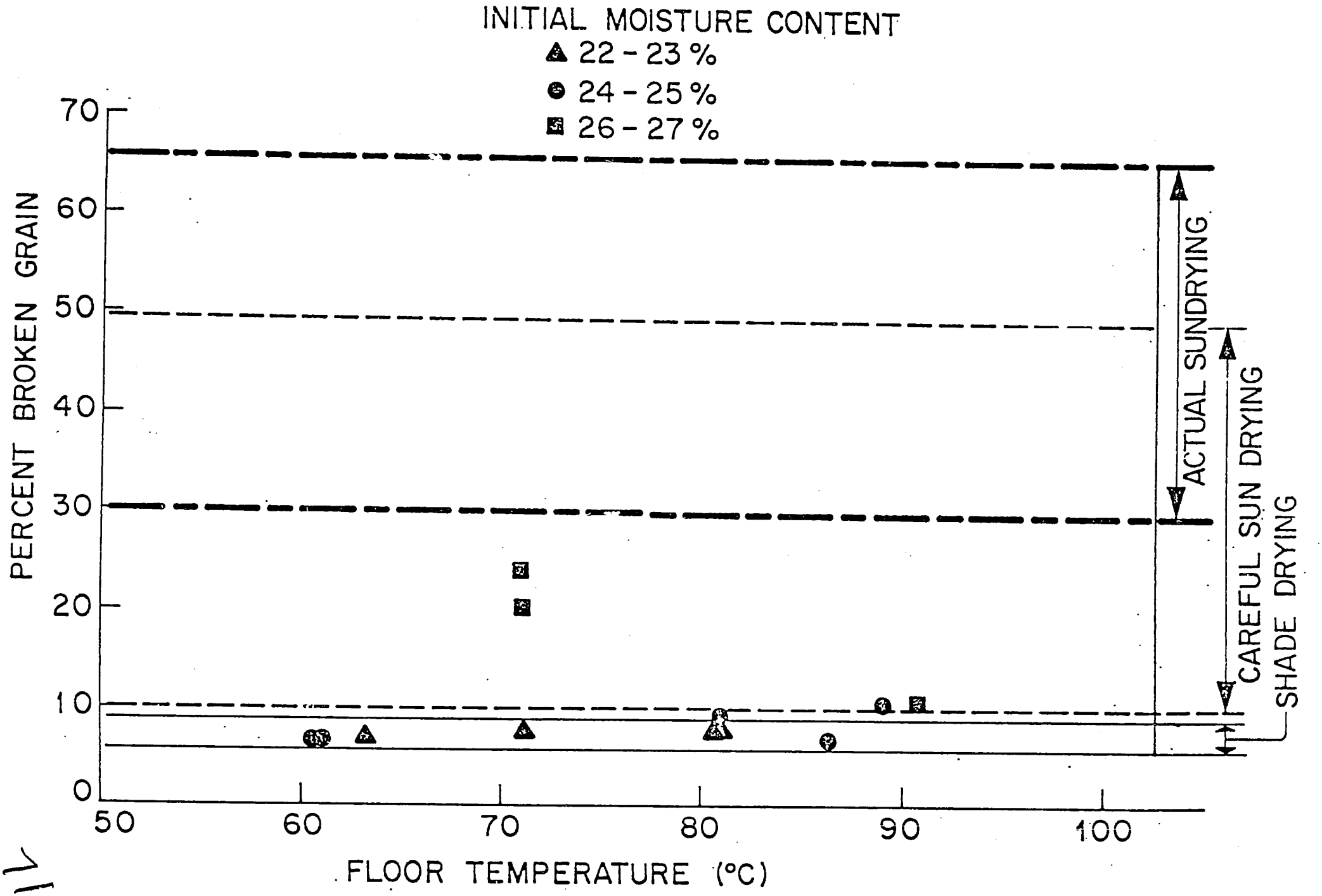


FIGURE 3. COMPARISON OF GRAIN BREAKAGE BY HEATED FLOOR DRYER WITH SUN AND SHADE DRYING.

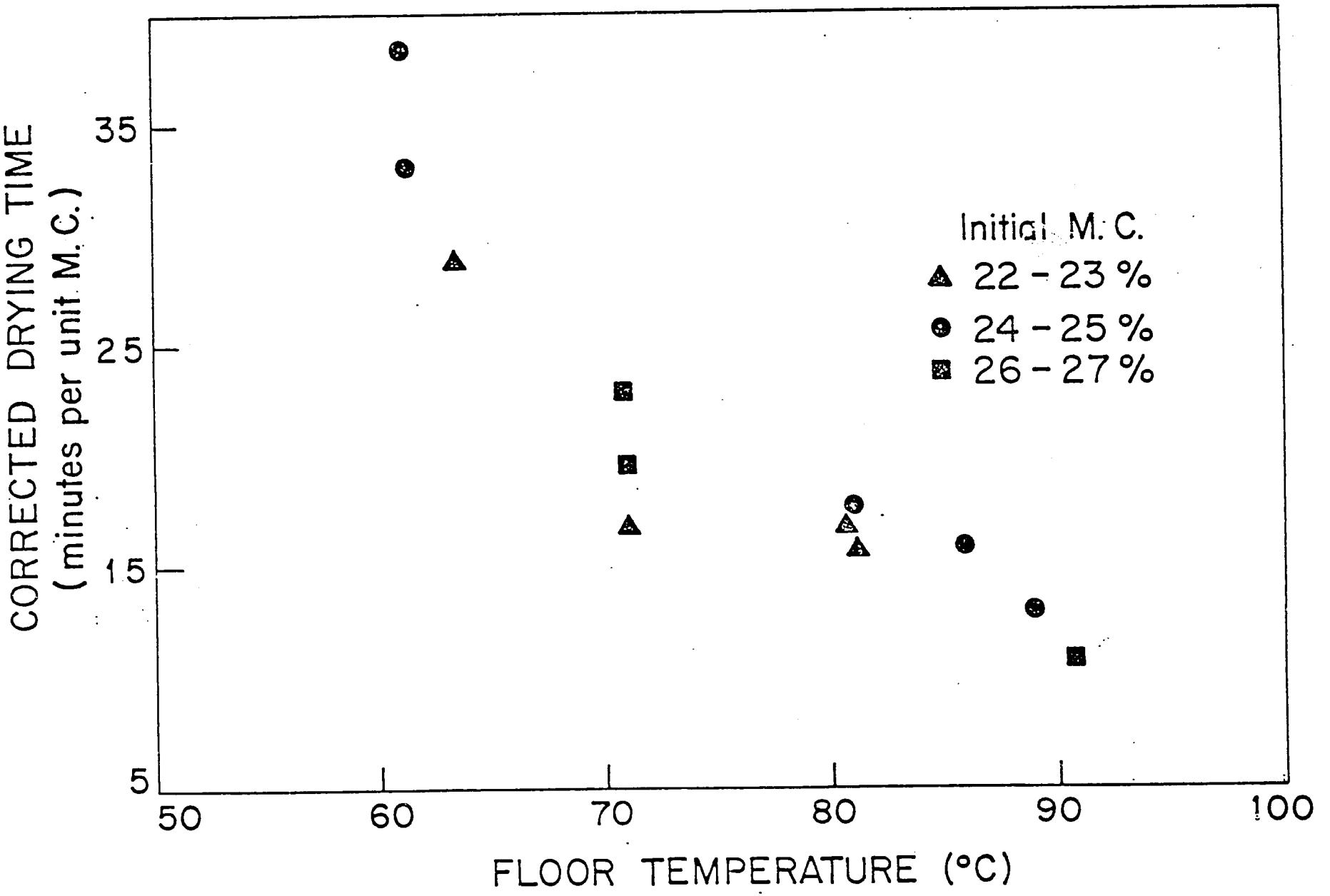


FIGURE 4. APPROXIMATE CORRECTION OF DRYING TIME DATA TO ACCOUNT FOR DIFFERENCES IN INITIAL MOISTURE CONTENT (MC) OF PADDY.

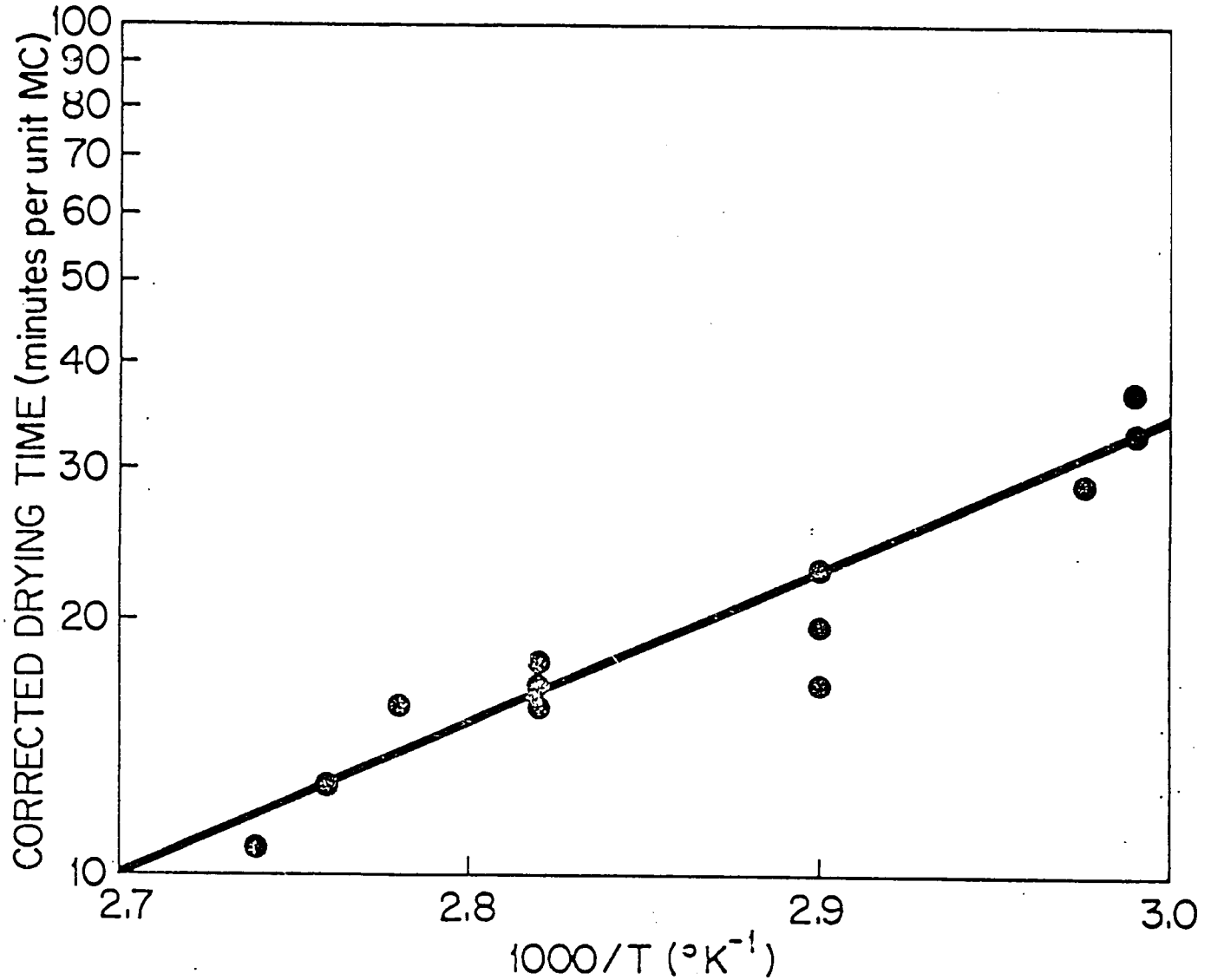


FIGURE 5. SEMI-LOGARITHMIC PLOT OF CORRECTED TIME VERSUS THE RECIPROCAL OF THE FLOOR TEMPERATURE. CONDITIONS ARE IDENTICAL TO THOSE IN FIGURE 4. THE SOLID LINE IS DRAWN WITH SLOPE CORRESPONDING TO THE ENTHALPY OF EVAPORIZATION OF WATER.

EXPERIMENT NO. 1

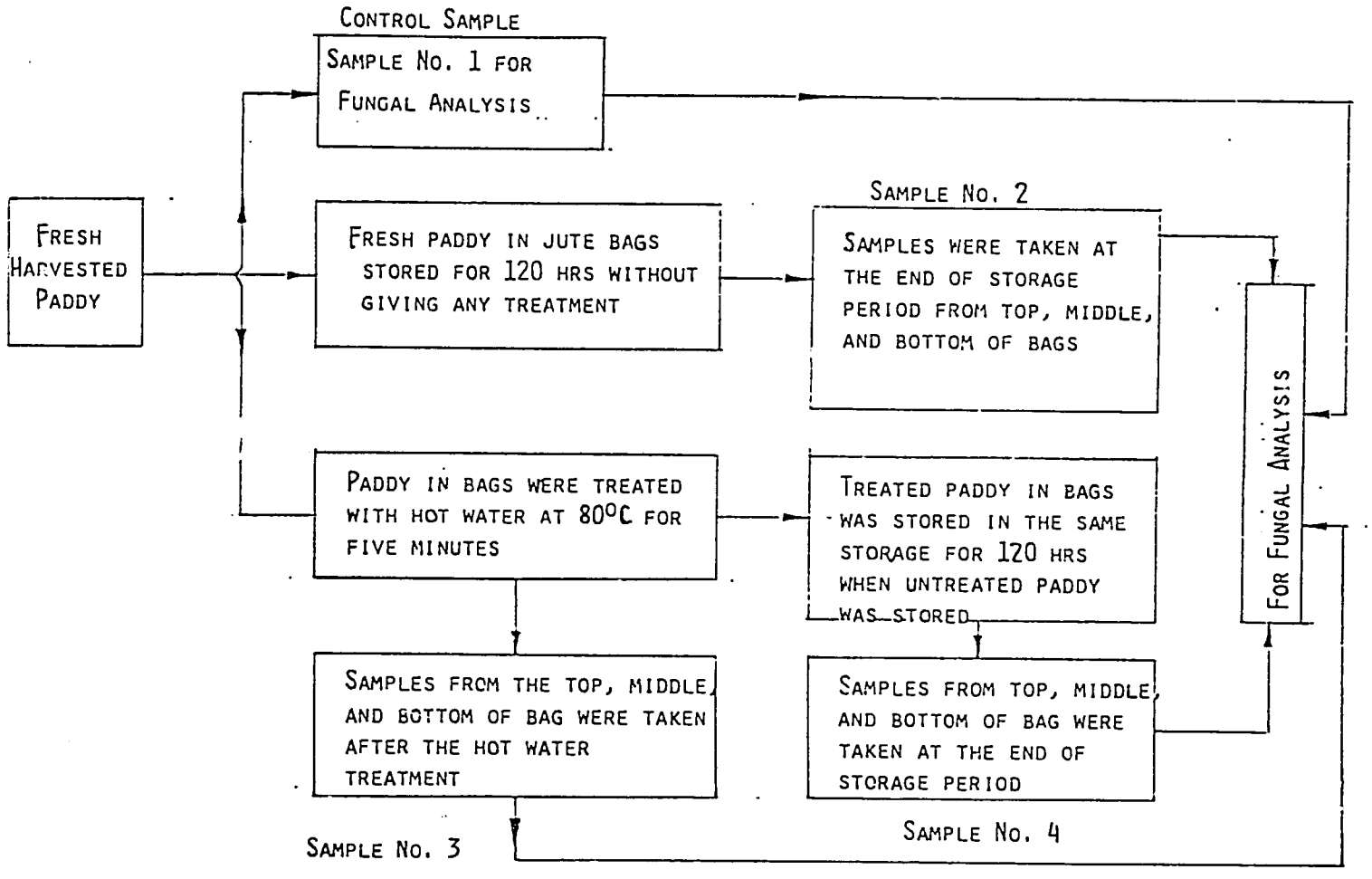


FIG. 6. THE FRESHLY HARVESTED WET PADDY WAS TREATED IN HOT WATER AT 80°C FOR 5 MINUTES AND THEN STORED FOR 120 HRS.

EXPERIMENT NO. 2

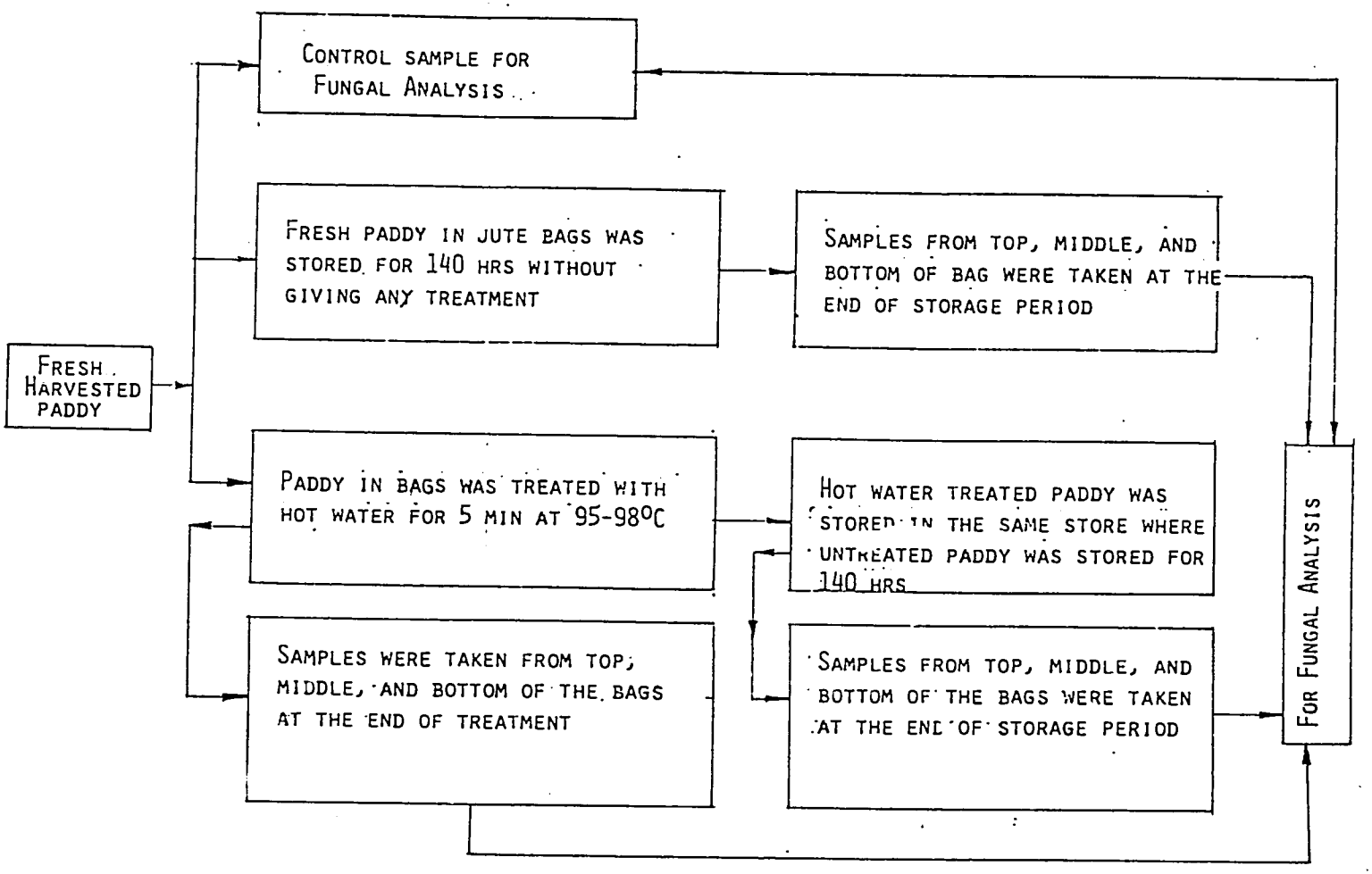


FIG. 7. FRESH HARVESTED PADDY WAS TREATED IN HOT WATER AT 95-98°C FOR 5 MIN & STORED FOR 140 HRS.

DESIGN AND PERFORMANCE OF A MULTI-PURPOSE DRYER USING NON-CONVENTIONAL ENERGY SOURCES

Leonides S. Halos, Yong Woon Jeon
and Clarence W. Bockhop

ABSTRACT

A warehouse type dryer using non-conventional energy sources was designed. A center-tube furnace fueled with combustible agricultural residues was developed as heat source for drying and a vortex wind machine was designed as power source for moving air inside the warehouse.

Tests were conducted to find alternative construction materials like soil bricks for furnace and soil-straw blocks for warehouse wall. Water proofing material for the warehouse wall was also found.

A vertical tray drying system was adapted for higher energy efficiency and maximum space utilization.

The drying system was evaluated by drying paddy, corn, coconut meat and fish. Results of evaluation presented in this paper describe the drying phenomena in a warehouse dryer and a physical description of the dried material.

Cost analysis revealed that using the dryer, a ton of paddy will be dried from 25 to 14 percent moisture content at a fee of ₱13.37 to ₱14.08.

INTRODUCTION

Drying of farm crops presents a complex problem especially in the grain-producing regions. Most of these crops are harvested with moisture contents usually in excess of 25 per cent (wet basis), and if it is stored without further drying, the crop will deteriorate due to insect attack, mold growth and respiration which would consequently reduce quality.

Sundrying is a common practice of reducing crop moisture content. The snag, however, is that in tropical countries, like the Philippines, air relative humidity is often high and the sun cannot be relied upon to shine with any consistency at harvest time. Natural drying in the field is possible only during the very dry months of March to May. Because of the high humidity conditions during harvest, it is necessary that there be an added source of heat energy provided to supply the heat of vaporization and an air moving device to blow the heated air through the mass of drying materials. Thus, drying becomes an energy intensive agricultural operation.

Many mechanical dryers had been developed thoroughly but had not been successfully introduced into tropical and sub-tropical regions not only because of climatic differences but also because of the technological gap existing between temperate and tropical and sub-tropical regions and the very small land holdings that tend to be typical of tropical farmers.

On-farm facilities (dryers) can allevlate this critical situation. Recent researches had been geared towards the development of these facilities. Alternative energy sources had also gained a considerable interest in these days of energy crisis. A well-designed grain drying system using non-conventional sources of energy could reduce drying costs as it can be developed along the concept of an intermediate technology wherein the system is simple in construction, low cost, makes use of materials available in the region and can be used for multi-purpose end.

DESIGN CONSIDERATION AND BASIC INFORMATION OF THE DESIGN

Of prime consideration in the development of the dryer is the analysis of the weather condition and the general trend in agriculture of the locality where the dryer will serve. It was assumed that the conditions studied were normal mean values for the tropical regions.

Typical weather conditions at UPLB and IRRI (1970-1980 records) and the general trends in agriculture (Appendix 1) were analyzed. An extensive review of drying literatures and personal interview with farmers were also carried out and resulted to the conceptualization of a drying system which can be described as simple, easy to operate, versatile and economically feasible. Appendix 2 gives a capsuled description of the dryer requirement.

The dryer is a warehouse type which was constructed from locally available materials requiring a simple construction technique. The dryer had been designed to meet requirements for high capacity of a group of farmers operating in a cooperative or village level and to provide multiple utilization for drying and storing different materials in separate lots

METHODOLOGY

Procedure

Drying literatures were searched and analyzed and were used as baseline information in the development of the warehouse dryer. Design activities were planned and carried out accordingly using the PERT schedule.

A separate activity for the design, development and evaluation of the dryer components was undertaken which gave a basis for the most efficient design feature.

Th designed furnace, vortex wind machine and material holding chamber were housed in a structure similar to a warehouse and eva uated based on its potential as a dryer and a store house.

In majority of the tests conducted paddy had been used as drying material. Coconut meat and fish were placed in separate trays and dried simultaneously.

Evaluation Parameters

The inter-relationship of the drying parameters were analyzed in the warehouse drying system. These included evaluation of the ambient and drying air conditions, heat flow and air movement in the warehouse, and the material moisture contents.

The main objective of the experimentation was to examine the feasibility of drying materials in the warehouse where air movement is effected only by natural draft of air and by the suction pressure created by the swirling motion of wind striking the vanes of the vortex wind machine. Heat is supplied in the system by burning rice hull in a center-tube furnace. Other fuel materials like coconut husks and corn cobs were also tried.

The variables considered in the analyses were the fuel material feed rate, temperature distribution, airflow rates and weather conditions. Quality of end products were assessed based on their physical form. Time constrained further analysis of the effect of drying on the chemical composition of the dried materials.

SYSTEM DESIGN DESCRIPTION AND DEVELOPMENT

Warehouse

Existing farm storage buildings are made either of solid concrete wall or concrete hollow blocks and corrugated G.I. sheet roofing.

A conservative construction material for wall from rice straw and ordinary paddy soil (about 50% clay), Fig. 1 and 2, had been adapted in the warehouse dryer to possibly increase system efficiency in terms of energy utilization by minimizing heat and mass transfer through walls while sustaining sufficient strength to support load. The structure rests on a 3-layer concrete hollow block (CHB) foundation and reinforced with round steel bars (1.2 cm dia.).

Soil-straw block mechanical testing revealed compressive and bending strength equivalent to 3.7 and 1.6 tons (per 15 x 15 cm), respectively, which is comparable to a concrete hollow block of the same dimension. Test conducted on coating material revealed that lime-cement-soap water mixture is an excellent water proofing material for the wall. Heat transfer value through soil-straw wall was calculated to be 1.19 kcal/m^2 hr°C (Jeon et al., 1983).

Roof was designed as solar collector. It was constructed from corrugated G.I. sheets with optimum tilt angle of 14 degrees and a collector area of 54 m^2. This gives a mean daily rate of solar energy absorption of 753.96 W/m^2 (8:00 a.m. to 4:00 p.m., solar time).

Material Holding Chamber

Horizontal drying trays (perforated flatbaskets) proved efficient. It allows materials to dry in a manner similar to thin layer drying, however, the problem of loading and unloading restricted its further development especially for drying small grains. The set-up is most appropriate for drying fish and vegetables.

A vertical tray holding bin constructed from wood and mesh wire was tested (Fig. 3). Sundrying tests for a tray capacity of 300 kg of paddy and 400 kg of corn gave a drying rate of about twice that of the floor drying at 7 cm thickness. Consequently, loading and unloading problems are minimized and the drying process resembles that of a counter-flow drying system.

Strip hangers were also designed to hold materials like tobacco (Fig. 4).

A continuous rectangular rail was provided to support the different material holding systems in a hanging position. Rollers enable movement of material from the main drying chamber to the pre-drying chamber without difficulty.

Center-tube Furnace

The center-tube furnace constructed from commercial and oil drums (Fig.5) was modified for higher capacity and longer service life by using soil brick materials (Fig. 6). Soil bricks were constructed from paddy soil and rice hull ash at 4 percent proportion by soil weight. Compressive strength of this proportion (50 kg/cm^2) were found superior over the rests of combinations tested. Coefficient of thermal expansion was found to be $4.8 \times 10^{-7}/°C$ which is lower compared to commercial bricks and concrete blocks.

The center-tube furnace can burn any kind of combustible agricultural residues with minimum adjustment. Due to the provision of adjustable air supply gate, black smoke during combustion was eliminated and ash recovered is almost negligible for coconut husks and sawdust and only about 16 percent by weight for rice hull. The furnace can generate heat requirement for a 10-ton dryer capacity.

Vortex Wind Machine

Features of the vortex wind machine were published in 1982 (PSAE Journal). A modified wind machine (Fig. 7) with inner-side vanes curved outward allows the wind entering the system to move in a smooth circular path at the side of the tower wall creating a more distinct and efficient low-pressure zone for suction.

The furnace chimney positioned directly beneath the wind machine increases the difference of temperatures between the ambient swirling air and the exhausting air resulting to an increased air suction. Tests observations gave a high system efficiency even without the conical frustum venturi.

DRYER SET UP AND THE DRYING PROCESS

The warehouse dryer (Fig. 8) measuring 10 x 5 x 3 m consisted of the material holding chamber, the center-tube furnace and the vortex wind machine. It is divided into two sections based on temperature gradient; the main drying chamber which is adjacent to the furnace, and the pre-drying chamber, which is located farther half-way of the structure.

Two lines of circular flue ducts inclined at 4 degrees which emanate from the furnace are laid under the trail of drying material trays and finally connected to the vertical chimneys located directly beneath the vortex wind machine. The chimneys are provided with dampers to permit variation of warehouse temperature.

Two vortex wind machines are positioned at the top center of the drying chambers. Jute sacks are provided around the tray rail which can be suspended down or rolled up depending on airflow and temperature requirements.

Air inlet doors are located at the bottom of the warehouse wall adjacent to the flue ducts while air vents at the top serve as air inlet when considering solar heat for drying. Openings of these air inlet doors and windows are made adjustable.

Drying proceeds in a manner such that the heated air is moved upwards from around the heat exchangers accross or through the layer of the drying materials. Saturated drying air is

exhausted at the wind machine tower. The pressure drop resulting from the circulating motion of wind entering through the tower blade clearances causes this upward movement of air.

RESULTS AND DISCUSSION

System Design Evaluation

The warehouse dryer is a new concept in drying which provides for higher capacity and multiple utilization. It makes use of non-conventional energy resources. It has an indirect heating feature which accounted for a better quality product.

The set-up resembles a counterflow dryer which allows drying at varied conditions. The rail system for the hangers enables movement of batches around the warehouse without difficulty. The drying/stored material can also be moved or circulated within the tray whenever deemed necessary. The zigzag movement of discharging materials permits mixing within the batch allowing the material to equilibrate. Occasional turning of trays can also be done to expose drying materials to varying conditions.

The design of trays and hangers maybe varied depending on the kind of materials to be dried/stored. The vertical trays allows a faster drying rate and maximum utilization of space, while the horizontal trays minimizes crushing of materials due to packing.

Temperature and airflow conditions can be controlled with the provision of a regulated fuel feed rate, adjustable airflow guide around the rail, air inlet doors and windows, and dampers in the chimney. The system can therefore be operated with low or high temperature allowing the materials to dry uniformly and therefore results to a better quality of products.

Previous investigators reported that high-low temperature drying resulted to an increased capacity and reduced energy consumption in addition to improved quality. A further advantage of the system is the ease in loading and unloading of materials.

Performance Evaluation

Drying conditions. Ambient air conditions recorded in this report were for the dry season harvest, 1983, Los Baños, Laguna and the adjoining locality. Generally, fair weather condition prevailed over the area with average range of relative humidity falling within 65-76 percent. Dry bulb temperature was recorded between 25 and 35°C. Wind blows from the S-W direction at velocities varying from a soft morning breeze to a gust amplitude of 5 m/sec in the mid-day which lasts for at least 3 hours.

Drying air temperature was maintained at 40-42°C for drying paddy and 48 to 51°C for drying corn, coconut meat and fish.

The total air suction rate gave an average of 63 m^3/min for the two wind machines.

Drying phenomena. The drying behavior of paddy, corn, coconut meat and fish materials in the warehouse dryer is shown in Fig. 9. Generally, the constant-rate drying period was not exhibited by the drying materials even the high-moistured corn and coconut meat, It is noticeable that moisture removal proceeds slowly at uniform rate as drying progresses. This can be accounted by the fact that while temperature inside the warehouse is maintained at a certain level, (40-42°C for paddy and 48-51°C for other materials) the air movement is effected by the natural draft of incoming ambient air and the suction created due to the low-pressure zone formed at the center of the wind machine.

Another striking characteristic of the drying curve is that moisture continues to rescind and does not seem to be asymptotic to the equilibrium moisture until after operation is terminated

Fish drying behavior, however resembles that observed for drying heavy salted codfish (Strømmen, 1980).

Figure 10 reveals material advantage of drying paddy in the warehouse dryer over that of sundried on concrete floor and flat bamboo tray. Sundrying lags 1 to 4 hours behind that observed from warehouse drying Obviously, this has been caused by the modified drying air condition.

A characteristic tri-dimensional curve can be derived from observations of the effect of drying temperature and wind velocity on the drying rate of paddy (Fig. 11). It will be observed that temperature does not significantly affect the drying rate at low wind velocities, although in general drying rate increases with an increase in temperature. The effect of wind velocity and temperature is increasingly important at high levels. A high drying rate, however is not always desirable. It may be deleterious to the drying materials especially paddy where thermal stress and moisture diffusivity are critical conditions affecting crack generation.

Quality Assessment

Copra and fish. The quality of copra (dried coconut meat) and dried fish was observed superior over that of sundried materials. Observations however were limited to visual characterization of the dried products. A clean and desirable product smell is attributable to the controlled drying condition in addition to the fact that the dryer has an indirect type of heating system. Results would entail higher quality copra-oil yield and a more nutritious foodstuff.

Paddy. Milling analysis undertaken for the dried paddy revealed that warehouse drying is a potential system which yield comparable milling recovery with that obtained from sundrying technique. Paddy and milled rice analyses results are presented in Table 1.

Note however that from the results it cannot be disclosed that the potential milling yield is attained. Although comparisons were done with the warehouse-dried and sun-dried paddy with other conditions being held constant, there are a lot more factors affecting the milling recovery; variety, degree of maturity, purity, initial mechanical damage resulting from operations prior to drying and to a certain extent the milling system.

Table 1. Milled rice analysis after 24 hours of drying of warehouse-dried and sun-dried paddy (IR-42).

BROWN RICE COMPONENTS	% BY WEIGHT
Immature kernels	19.5
Fermented/chalky/grains	5.6
Damaged grains	1.7
Other varieties	0.5

MILLING YIELD	WAREHOUSE DRIED	SUNDRIED	
		Concrete Floor	Flat Bamboo Tray
Total milling recovery	67.5	65.7	65.2
Head rice	83.6	72.7	69.6

SUMMARY AND CONCLUSION

- The dryer is simple and low cost technology requiring minimum operational maintenance and adjustments.

- The dryer can be constructed from cheaper and locally available materials as rice straw and rice hull ash in correct proportion with paddy soil.

- It is most applicable for drying and storing different materials in one batch in separate lots and maybe used by farmers' groups operating in a cooperative or village level, and rice mill owners.

- In general, the venting rate or airflow rate during drying has more influence on the drying efficiency of the system than any other management variables. The airflow rate control was found more critical than temperature control especially so that the drying operation is highly weather dependent.

- Quality assessment was limited to visual observation of the physical appearances of dried material. For paddy, the determination of broken grain; for some other materials, which were tested to a little extent due to time constraint, observation of mold growth and color changes.

- An intensive aerodynamic analysis of airflow rate in the system had not yet been established due to lack of instrumentation. Results discussed were based mainly on measurements of air velocities and suction rates but the exact behavior of the direction of air movement had not been predicted.

- The concept of this dryer design would obviously be acceptable as intermediate technology but the context of application vary widely as weather condition as well as agronomic practices differ from one region to another; thus may hinder the full adaptation of the dryer design in some strategic locations where the need for dryers and store houses are even more serious.

ECONOMIC ANALYSIS

One of the most important decision that a farmer makes is to determine whether his investment for a dryer will be reasonable. His decision should be based on a sound economic analysis of the system he uses. He takes into account all opportunity costs that will reduce his drying cost with optimum efficiency.

In analyzing the feasibility of investing in a warehouse dryer, two alternatives were considered: (a) construction management is done by the farmer himself, and (b) the farmer hires a master carpenter for the construction. Further, the analysis undertaken considered paddy drying, although the dryer can be used for drying and storing other crops. Cost analysis information are summarized on the accompanying table . It will be noted that using the warehouse dryer, a cavan of paddy (50 kg) can be dried from 25 to 14 per cent moisture content with a nominal fee of ₱0.67 to ₱0.70.

Benefit cost analysis revealed that it is worth investing in a warehouse dryer as evidenced by the benefit cost ratio (BCR) equal 1.8 and the investment can be recouped in 2.04 years (or after drying 2040 tons of paddy). Annual cost is also covered by drying at least 418.2 tons per year. A fair rate of return of investment can also be manifested by the multi-purpose application of the structure.

Basic information used in the calculation of the warehouse operating costs is given in Appendix 3.

Table 2. Cost analysis for the warehouse dryer, April 1983.

CAPITAL OUTLAY		₱ VALUES
Warehouse		7890.28
Furnace		1037.50
Wind machines (2 units)		2130.00
Attachments		6995.70
Construction labor[a/]		
a. Farmer based		3916.00
b. Commercial-based		7841.00
	Total a.	21969.48
	b.	25894.48
Fixed Cost Per year	a	b
Depreciation[b/]	3024	3024
Interest on ave. cap. inv.[c/]	2021	2610
Repair and maintenance cost, 3%	659	777
Total fixed cost/year	5704	6411
Variable Cost/Batch (7 tons paddy)		
Fuel[d/] rice hull	11.70	
Labor[e/]: loading/unloading	18.00	
dryer operator	24.00	
Total variable cost/batch (7 tons)	53.70	
Total variable cost/ton	7.67	
Annual Utilization[f/]: 1000 tons (paddy drying only)		
Total variable cost/year	7670	7670
Total fixed cost/year	5704	6411
TOTAL COST PER YEAR	₱13374	₱14081

Note: See Appendix 3 for the supersripts.

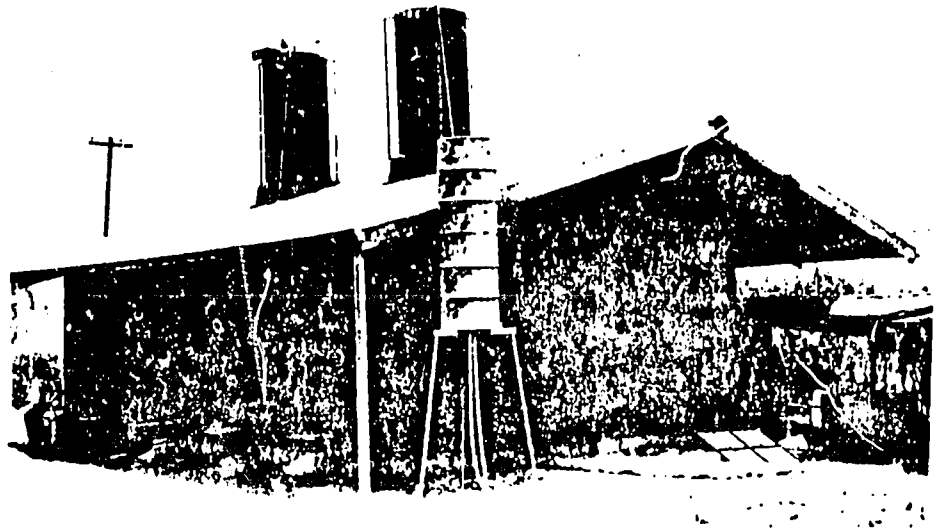


Fig. 1. Warehouse dryer with soil-straw wall.

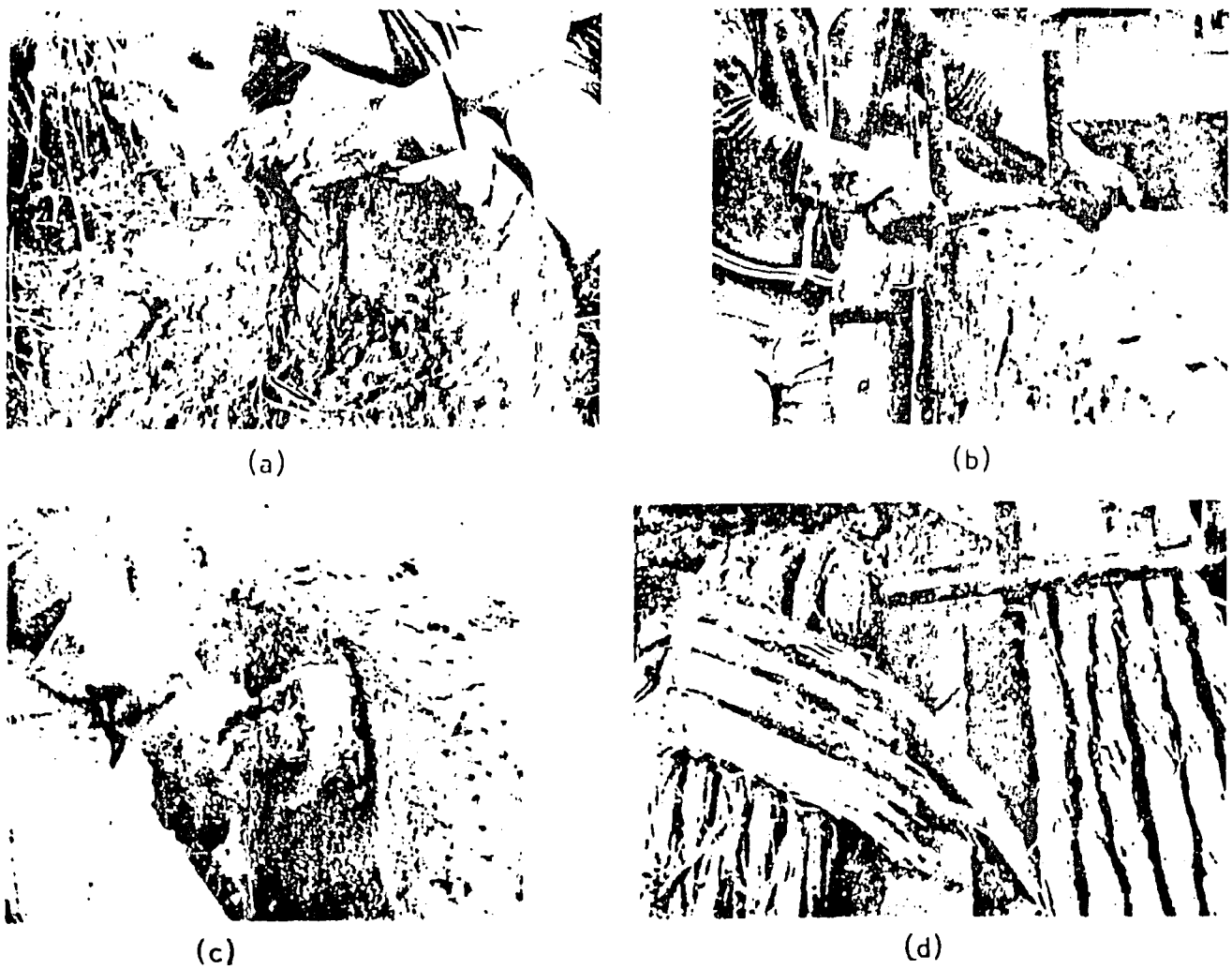
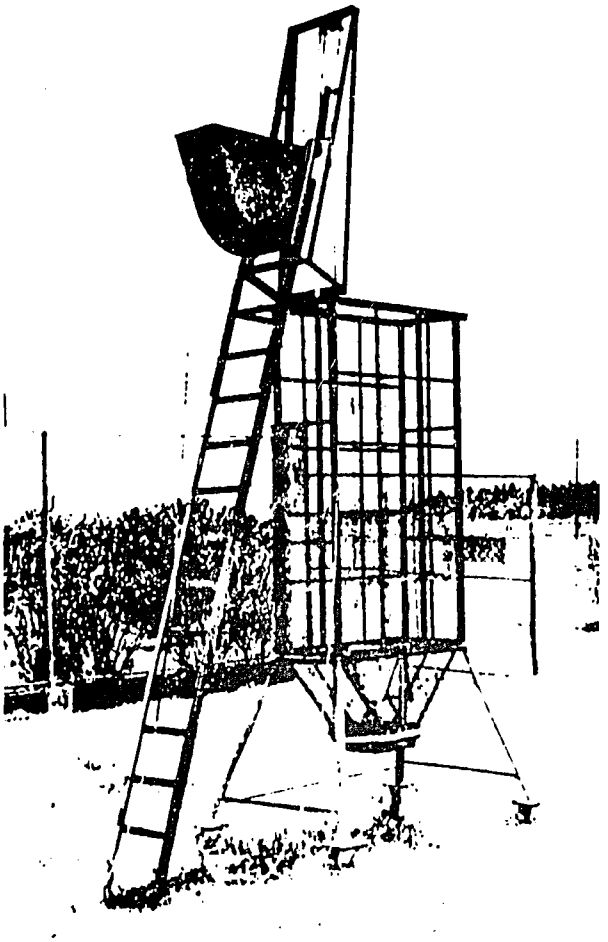
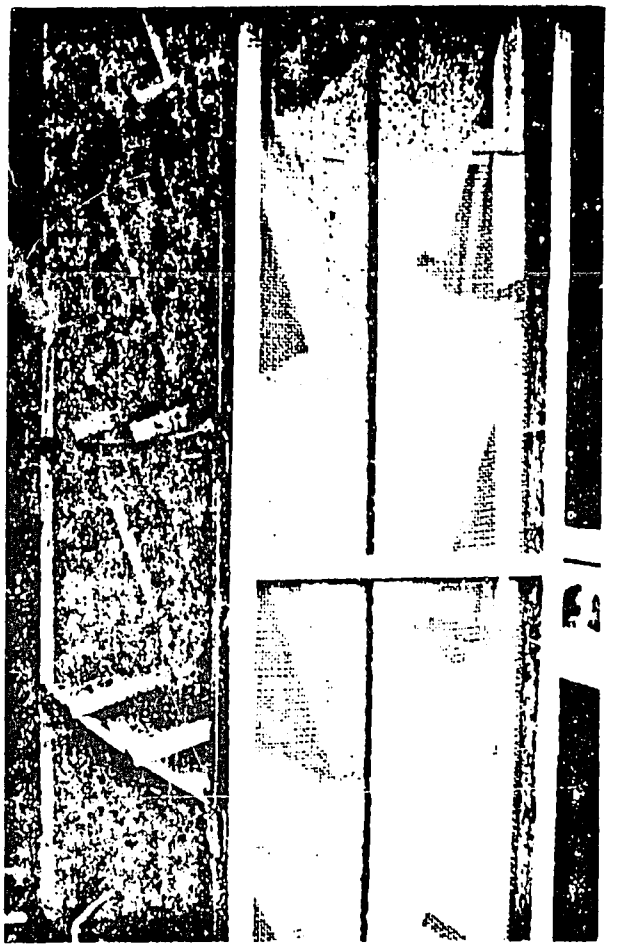


Fig. 2. Steps in constructing the soil-straw wall: a) mixing soil and straw, b) laying, compacting and regulating wall thickness, c) compacting and smoothing sides using a gable, d) methods of straw laying: cross and straight-laying.



(a)



(b)

Fig. 3. Vertical tray holding bin: a) for large size materials like ear corn and b) for small grains.

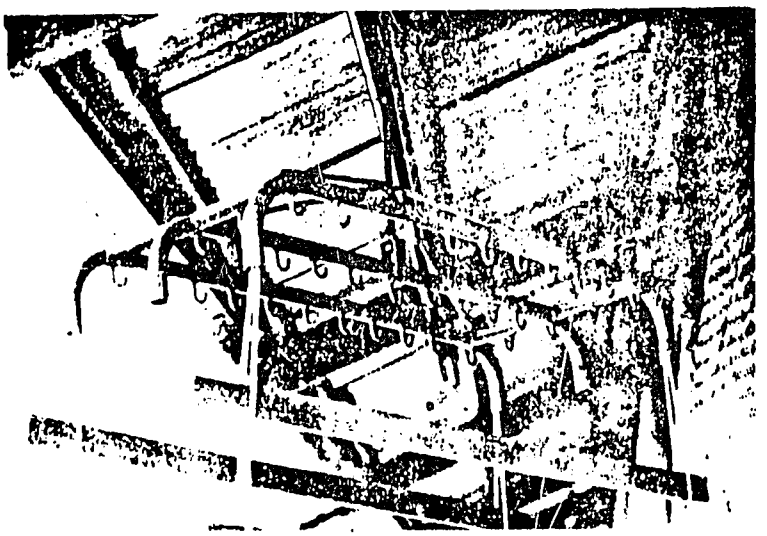


Fig. 4. Strip hangers for holding tobacco and similar material.

Fig. 5. Center-tube furnace constructed from commercial drum.

Fig. 6. Soil-brick made center-tube furnace.

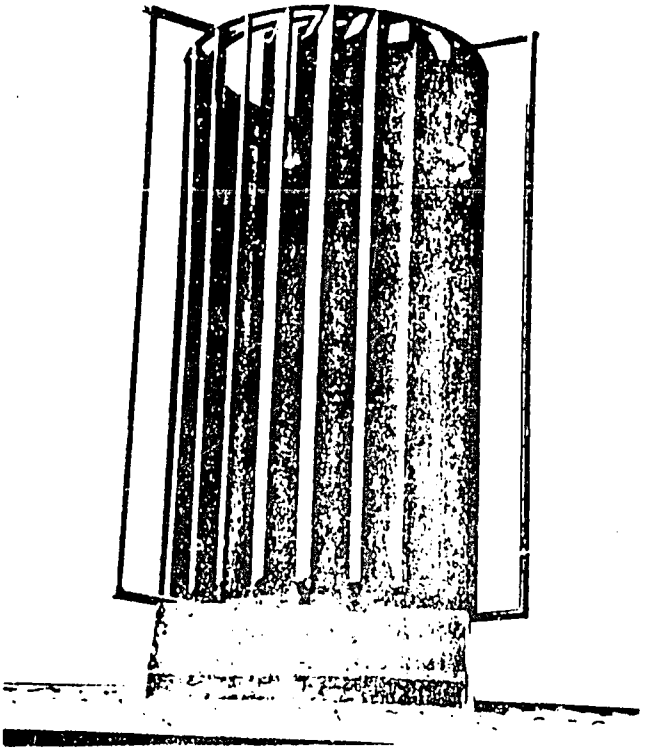


Fig. 7. Modified vortex wind machine.

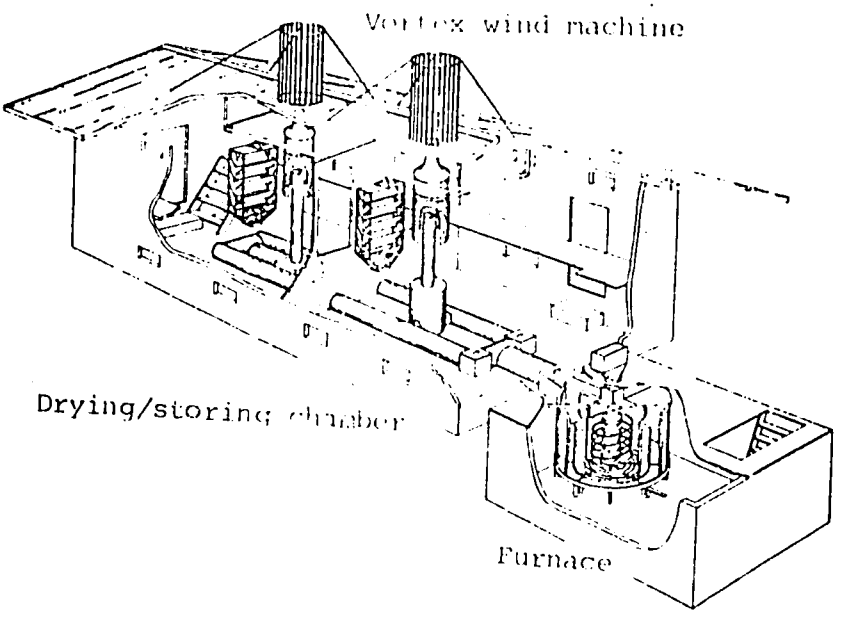


Fig. 8. Cut-out view of the warehouse dryer.

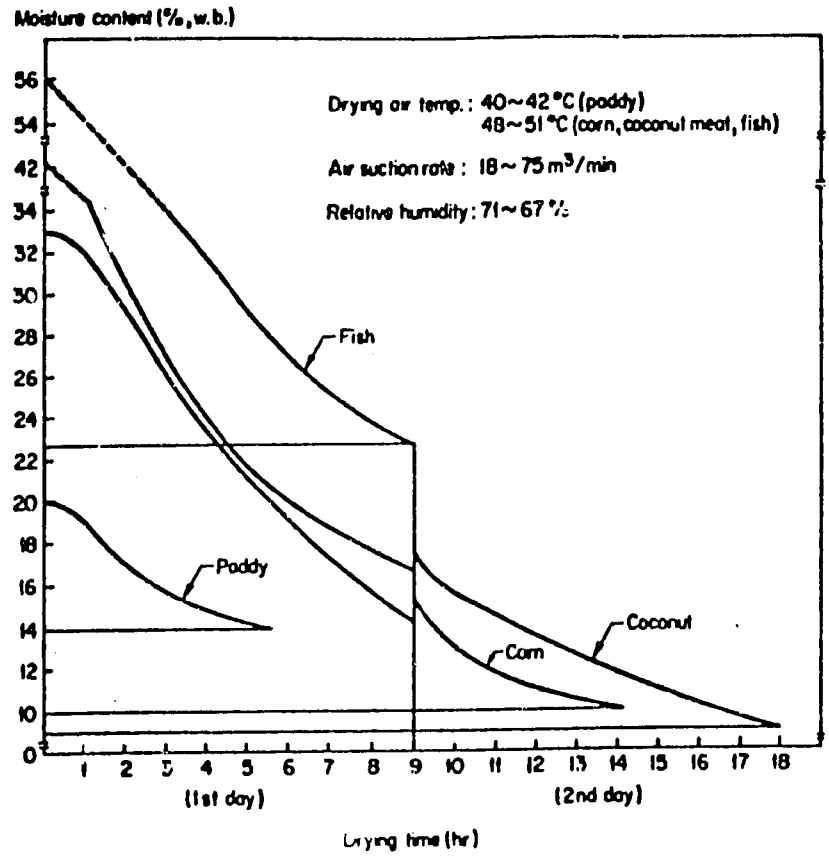


Fig. 9. Drying behavior of paddy, corn, coconut meat and fish materials in a warehouse dryer.

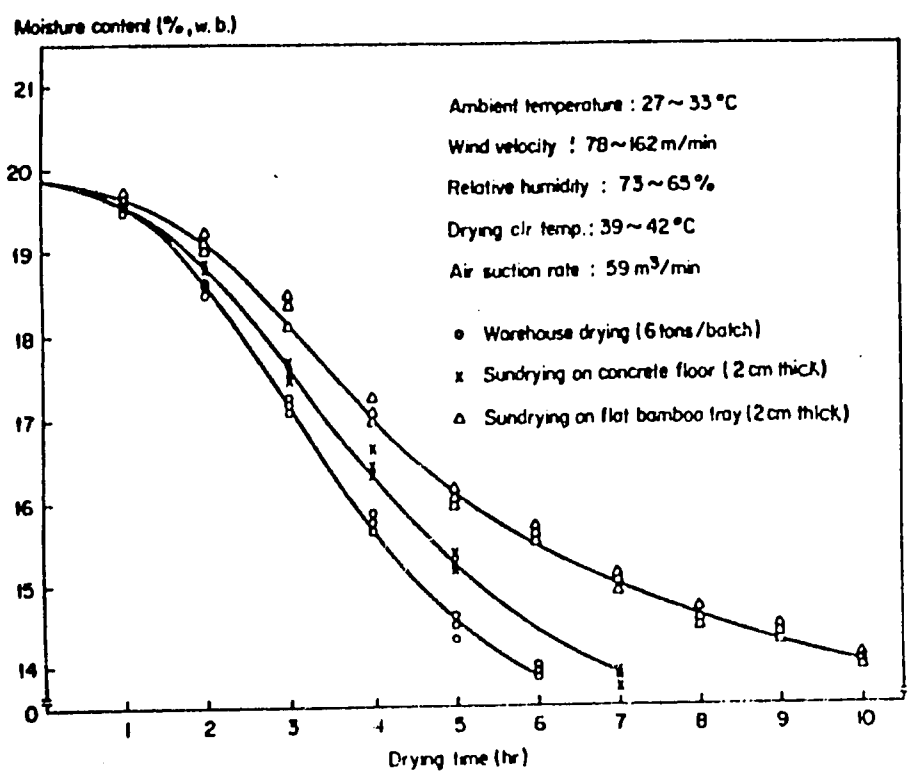


Fig. 10. Drying behavior of sun-dried and warehouse dried paddy.

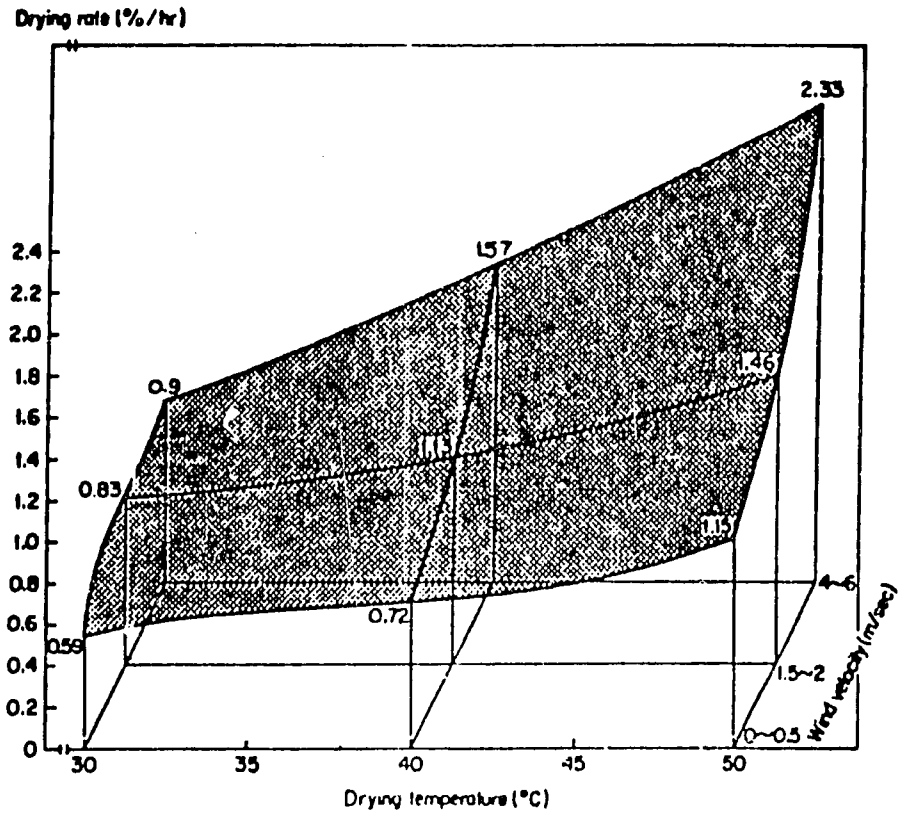


Fig. 11. Drying rate as affected by drying temperature and wind velocity.

Appendix 1. Typical weather conditions and general trends in agriculture (UPLB and IRRI, 1970-1980).

- Mean ambient air temperature : 29.4°C
- Mean relative humidity : 80 percent
- Average wind speed : 1.44 m/s
- Mean annual percent possible sunshine : 50 percent

  Highest (April) : 22.97 mJ/m . day
  Lowest (January) : 10.25 mJ/m . day

- Major crops grown : Rice and corn, with rice as the dominant and staple crop
- Average grain yields : 2.65 tons/ha (rice)
  2.94 tons/ha (corn)
- Harvest seasons

  Wet season : September to December
  Dry season : May to June

- Grain moisture content at harvest : 25 to 33 per cent, dry basis
- Farm size range : 1 to 10 hectares
- Agricultural wastes (i.e. rice hull, coconut husk and shell, sawdust, etc.) are available energy sources.
- Majority of farmers still dry their grains by spreading them on grounds or pavements under the sun
- Electricity is not available in most smaller towns and farms
- Most rural houses and farm storage buildings are constructed with corrugated galvanized iron (Cor. G.I.)sheets roofing materials.

Appendix 2. Basic design characteristics.

- **Type** : Warehouse type, non-conventional
- **Power source** : Wind
- **Heat source** : Sun and/or furnace fueled with agricultural wastes
- **Capacity** : Up to 8 tons per batch; suited for cooperative or village level operation of a group of farmers or rice mill operators
- **Versatility** : Use as DRYER and STORE HOUSE for different materials. Holds materials in SEPARATE LOTS
- **Technology** : Simple, intermediate, within farmers' capability
- **Construction materials** : Low cost, locally available

Appendix 3. Basic information; Warehouse dryer operating cost.

a/ Labor for construction of the warehouse dryer assumed 2 situations a: farmer based b: commercial based which employed a master carpenter.

b/ Depreciation was computed using the straight-line method and salvage values and life span for each component as follows:

a.	warehouse	:	5% SV - 15 years life
b.	furnace	:	10% SV - 8 years life
c.	wind machine	:	10% SV - 10 years life
d.	attachments	:	5% SV - 3 years life

c/ Interest on average capital investment at 15% interest rate per annum and computed as follows:

$$\frac{IC + SV}{2} \times 15\%$$

d/ Fuel used was rice hull at 21 kgs./hour or 2 bags of ₱0.65/bag (assumed a cost of ₱0.30/bag + ₱0.35/bag transport costs, 9 hrs/batch x ₱1.30 = ₱11.70). (Rice hull is available within 10-km radius of dryer location).

e/ Labor used:

- for loading and unloading, 3 men worked for 2 hours each with a wage rate of ₱3/hour.

- a dryer operator tends the furnace during the drying operation and paid at ₱3/hour.

f/ Annual utilization: 78 days (dryer capacity: 7 tons per batch).

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APPENDIX F

Report No. IEP-9
October 1, 1983

MA-IRRI INDUSTRIAL EXTENSION PROGRAM FOR SMALL FARM EQUIPMENT

Agricultural Engineering Division
Bureau of Plant Industry
San Andres Street, Malate
Metro Manila
Philippines

ANNUAL REPORT

(September 1982-September 1983)

and

PROPOSED WORKPLAN

(September 1983-September 1984)

I. INTRODUCTION

This is the third annual report for the MA-IRRI Program. The second report defined the goals, objectives, target groups, and organization of the Program. Consequently, these topics will not be repeated herein.

The present report provides both a progress report for the past 12 months (September 1982 to September 1983) and a proposed workplan for the coming 12 months (September 1983 to September 1984). By combining the two into a single document, it is possible to present a more coherent account of the past, present, and future status and activities of the Program.

As in previous reports, progress is evaluated primarily by referring to the time-phased schedule of activities which was included in the proposed workplan for September 1982 to September 1983. (See previous annual report.) This schedule permits us to compare actual progress with proposed progress for each activity.

II. COMBINED PROGRESS REPORT (September 1982-September 1983) AND PROPOSED WORKPLAN (September 1983-September 1984)

A. *Personnel and Facilities*

The central office of the MA-IRRI Program is located in the Agricultural Engineering Division of the Bureau of Plant Industry (BPI), Ministry of Agriculture (MA), in Manila. During the past 12 months, five BPI engineers have devoted from 25% to 100% of their time to the MA-IRRI Program, with the estimated total effort being three man-years. This effort needs to be increased, and there is a particular need for: (1) a mechanical design engineer, and (2) an inventor/innovator having extensive practical experience with small farm equipment. BPI has not been able to add personnel due to a freeze on hiring.

The Program also utilizes the part-time services of "Regional Project Engineers" who are regular employees of the Ministry's experimental stations or regional offices located in the agricultural areas of the country. Eight Regional Project Engineers have been devoting an average of 25% of their time to the Program, thereby contributing approximately two man-years of effort during the past 12 months.

It is proposed that a part of the equipment development work should be placed at the regional level rather than at the central office in Manila. This would be consistent with the general decentralization movement of the Ministry of Agriculture, and it would strengthen the Regional Project Engineers' roles in the Program and benefit from their proximity to farmers and cooperating manufacturers. Moreover, it is suggested that part of the work at the regional level should be done through direct collaboration with some of the outstanding cooperators, thereby benefitting from their practical experience with farm equipment and farmer preferences, their ability to innovate, and the availability of their shop facilities. This proposal is described in more detail in the workplan (Activity 14).

The MA-IRRI Program is providing the central office with a Program Co-Leader and a secretary, representing an effort of two man-years during the past 12 months. The Program has also hired two engineers on a temporary basis to carry out specific tasks relating to the seed and fertilizer applicator and the dryer study. During the past 12 months, their level of activity has been 1.1 man-years. Both have skills that are essential to the Program, and it is unfortunate that BPI cannot hire them.

Progress has been hampered by the limited capability of the BPI shop with regards to fabricating prototype equipment. The MA-IRRI staff have decided upon actions to improve: (a) the shop tools and machines; (b) the skills and workmanship of shop technicians; and (c) the assignment of tasks and supervision of personnel. A basic problem is that the BPI wages for shop technicians are low (e.g., ₱20 to ₱25 per day). The Advisory Committee will be asked to help resolve these problems.

The Program has one vehicle available on a full-time basis (1976 Ford Granada), and it often utilizes two BPI vehicles (a jeep and a pickup). It may be necessary to obtain a pickup truck on a full-time basis if the BPI pickup is not available for trips having durations of more than one day. In general, the Regional Project Engineers are able to use vehicles available at their experimental stations or regional offices; BPI has provided funds to some regions for vehicle expenses.

The Industrial Extension Section at IRRI has provided the MA-IRRI Program with approximately two man-years of engineering effort during the past 12 months, plus one secretary. The MA-IRRI staff agrees that the participation of these IRRI engineers is essential but their role should be that of assisting BPI engineers rather than leading them, especially with respect to visits to cooperating manufacturers when the visible program should be MA-IRRI, not IRRI.

During the past two years there have been some problems of communication and collaboration between the MA-IRRI Program and the Design, Test and Economics Section of the IRRI Agricultural Engineering Division. Several steps have been taken to improve the situation, such as the assignment of a top design engineer to Industrial Extension. Attempts are now being made to attain closer collaboration with regards to reaper and hand tractor modifications, transplanter testing, thresher development, fertilizer placement development, and dryer studies.

B. *Institutional Relationships*

A primary purpose of the Program is the establishment of institutional relationships and technical capabilities which will lead to a national capacity for developing, manufacturing, and marketing agricultural equipment appropriate for small farms. At the end of the 5-year period of this Program, an institutional structure similar to that shown in Figure 1 should exist and be functioning in an effective and sustained manner.

The components of Figure 1 were described in the last annual report and therefore will not be repeated here. Specific activities have been undertaken to establish the necessary relationships between the MA-IRRI Program and many of these components, as will be summarized in the following sections of this report. (The relationship with IRRI was covered in the preceding section.)

At present, the major problem of institutional relationships is with the Advisory Committee of the MA-IRRI Program. Initially, the committee members were the Deputy Minister of Agriculture, the head of the IRRI Agricultural Engineering Department, the director of the Bureau of Plant Industry, the director of the Institute for Agricultural Engineering and Technology (University of the Philippines at Los Baños), and representatives of the Central Bank, the Ministry of Industry and Trade, and the Agricultural Machinery Manufacturers' and Distributors' Association. The committee was to meet quarterly to review progress and plans, recommend corrective actions, and ensure that their institutions provide necessary collaboration. The committee was very effective throughout 1982 under the capable leadership of Deputy Minister Manuel Lim, Jr. However, he resigned from the Ministry in early 1983 and a replacement has not yet been designated.

A second problem is that the government has not yet approved the proposed creation of a National Agricultural Mechanization Council. There is now a proposal to form a lower ranking committee on agricultural mechanization, and it awaits approval by the Minister of Agriculture.

C. *Coverage*

Figure 2 shows the locations of the major rice areas in the Philippines. The MA-IRRI Program is giving special attention initially to two of these areas, the Cagayan Valley in northeastern Luzon and all of the provinces in Mindanao. These areas were selected because they are experiencing significant increases in rice production and have shortages of labor.

Figure 3 shows the locations of the cooperating manufacturers of the MA-IRRI Program. Notice that there are cooperators located in most of the major rice areas (which are shown in Fig. 2). This indicates that the Program is attaining its goal of establishing cooperators in the principal agricultural areas.

As may be seen in Fig. 4, the number of new cooperators joining the Program each year increased substantially in 1982. The number for 1983 is less than that for 1982 because the Program has already attracted many of the appropriate firms and is now concentrating more on the task of assisting existing cooperators rather than on recruiting new ones. We expect this trend will continue in the near future.

The annual production statistics of MA-IRRI cooperating manufacturers are summarized in Table 1. These data are considered to be underestimates of the actual production because cooperators generally tend to report lower sales than the true values. Although the production and sales of most manufacturers have declined during the past two or three years because of the economic recession, the statistics in Table 1 do not clearly exhibit this trend because it includes the production of a larger number of cooperators each year. It is extremely difficult to obtain reliable data on production for the MA-IRRI Program, but we will attempt to improve statistics in the future by means of an annual census of cooperators.

D. *Description of Activities*

A brief description of each activity of the MA-IRRI Program is presented below. Past progress is evaluated primarily on the basis of the schedule of activities included in the last annual report. The workplan for each activity is presented below and in the new schedule of activities (Annex B).

1. *Extension of Reaper and Power Tiller*

This activity has progressed very satisfactorily with no major deviations from the original schedule. A detailed report on the activity is included in Annex C. At the present moment (September 1983) there are approximately 30 cooperators who are manufacturing the reaper, and their total sales is currently estimated to be about 500 units.

The main tasks for the coming year are to improve the basic design, continue technical assistance to manufacturers, repeat the survey, promote the PT5 hand tractor for land preparation, and continue development of appropriate implements for the PT5.

2. *Extension of Axial Flow Pump*

Progress has fallen behind schedule, primarily due to the lack of personnel. The report comparing axial and centrifugal pumps has been completed and reproduced. Efforts have been made

to promote the axial flow pump for draining and filling fish ponds, in the hope that this will help increase the market for the pump. A promotional campaign will be carried out during the coming year.

The National Irrigation Administration has installed 10 units of the axial flow pump in Libmanan, Camarines Sur, to provide water to small areas that are slightly higher than the canals of the irrigation system. We will continue to assist this project and use it as a model for promoting similar applications of the pump in other irrigation systems.

3. *Development and extension of Thresher*

The progress of this activity has continued to be very slow, and is now one year behind schedule. At the request of the MA-IRRI Program, the IRRI Agricultural Engineering Division assigned an experience engineer to redesign the thresher last year. This resulted in an improved design for the concave of the thresher. We will now request a meeting at IRRI to decide how progress may be improved in the future. One possibility would be to have periodic meetings to evaluate progress and formulate tasks to be undertaken.

4. *Development and extension of Seed and Fertilizer Applicator (SFA)*

This activity has proceeded satisfactorily, except for delays of field trials as a result of the prolonged drought. We are now ready to initiate the extension phase of this activity, and the necessary promotional materials are being completed.

Since the SFA is the first implement to be developed entirely by the MA-IRRI Program, it is considered to be a high priority. Moreover, animal-drawn implements for corn farming are consistent with the priorities of the Ministry of Agriculture.

5. *Development and extension of Root Crop Equipment*

It is proposed that the MA-IRRI Program now initiate an extension activity on root crop equipment because: (1) root crops are important staples in several areas in the Philippines; and (2) BPI has developed root crop equipment through the efforts of a PCARRD-funded project. The first step of this activity is to plan the extension of the BPI cassava chipping machine through collaboration with suitable institutions located in cassava-producing areas, such as the Visayas State College of Agriculture (VISCA) in Leyte. Other equipment will also be identified, developed, and tested.

Since this is a new activity involving other institutions, it will be closely monitored and thoroughly evaluated in July 1984 to assess progress and determine how to improve the activity in the future.

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6. *Development of Transplanter*

The IRRI transplanter has not been accepted by farmers in the Philippines because of problems with operation and seedling production. Recently, a modified machine and seedling preparation procedure have been completed and will now be tested by farmers in Libmanan, Camarines Sur, and possibly in one other area. This test will be carried out primarily by IRRI, but the MA-IRRI Program will collaborate whenever possible. If the results are positive, as expected, an extension effort will be prepared.

We also plan to consider a transplanter attachment for the PT5 hand tractor, including a fertilizer deep-placement applicator. The AMDP group at UPLB is working on a similar machine, and we hope to arrange a collaborative effort with them.

7. *Development of Rolling Injection Planter (RIP)*

Although this activity has progressed quite satisfactorily with respect to field trials, the results indicate that a second year of field trials is necessary in order to determine if the RIP is ready and appropriate for extension. These on-farm trials will be carried out in collaboration with IRRI's Technology Transfer and Training Department and the Ministry of Agriculture during late 1983 and early 1984. A workshop will be held in August 1984 to review the results and decide upon the future of the RIP. This will involve the collaboration of other groups which are working on the RIP, including those at UPLB and ISU.

8. *Development of Dryer*

Testing of the heated floor dryer was completed as scheduled, but no further work on this dryer is planned because the preliminary results indicate that the concept would not be economically viable for individual or small groups of farmers. Studies of sun drying of paddy have indicated several potential improvements with respect to reducing breakage and deterioration of grain. Extension materials will be prepared for promoting these improved sun drying practices. The next tasks will be to evaluate a successful cooperative drying facility in Bukidnon and then attempt to develop a modified design that would reduce importation of components and result in a lower cost. If this design appears to be viable, it will be developed and tested.

9. *Evaluation of Low-volume Sprayer*

This activity has been almost completedly neglected due to lack of suitable personnel. A meeting was held at IRRI among the engineers, entomologists, agronomists, and economists to discuss the low-volume sprayer attachment designed by Ray Wijewardene but we were unable to come up with a definite workplan. Arrangements were made for the sprayer attachment to be evaluated by the Cyanamid Agricultural Research Foundation in Laguna. These results will be studied and additional trials will then be planned.

10. *Evaluation of Fertilizer Applicator*

This collaboration of the MA-IRRI Program with IRRI, the Ministry of Agriculture, and the Fertilizer and Pesticide Authority has yielded valuable information for evaluating fertilizer applicators, and it will be continued during the coming year. The Program is assisting IRRI in contracting cooperating manufacturers to fabricate prototype applicators for the next phase of testing in farmers' fields.

11. *Evaluation of One-wheel Hand Tractor*

The MA-IRRI Program purchased a one-wheel garden tractor to evaluate it as a potential machine for inter-row cultivation of corn and legumes. The evaluation and modification of the machine have proceeded very slowly, but it is expected that a final decision will be made by January 1984 regarding whether this activity should be continued or terminated.

12. *Evaluation of Corn-harvesting Hook*

In the Philippines, corn is generally harvested by hand, often with the aid of a pointed stick to help open the husk. An alternative is to replace the stick by a metal hook attached to a glove on one hand of the worker. The Program has undertaken on-farm evaluations but there have been many delays and the results are not yet complete. It is proposed that a decision be made by November 1983 on whether to continue or terminate this activity.

13. *Evaluation of Axial Flow Thresher for shelling corn*

Because of the recent increase in corn production in the Philippines, there is a great demand for corn shelling machines. We have initiated a preliminary study of the possibility of modifying the axial flow thresher so that it may also serve as a corn sheller. The immediate task is to request NFA for some financial support for this activity, which would consist primarily of a preliminary test of shelling corn with a modified TH6 thresher. In December 1983, the results of this test will be used as the basis for formulating a plan for further development and testing, if the concept appears to be promising.

14. *Establishment of Equipment Development Capabilities at Regional Level*

As discussed in Section IIA, we propose to test the idea of having equipment development projects that are located in agricultural regions. The first will be in Region 12, and a plan will be formulated by December 1983. In order to establish the regional project as a self-sustaining effort, we will help obtain funds specifically for it. Implementation will begin in 1984, with close monitoring and a thorough evaluation in August 1984 to assess progress and formulate a workplan for the coming year.

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15. *Promotion of R&D on Small Farm Equipment*

The MA-IRRI Program will continue to collaborate with PCARRD and ARO in promoting R&D on the equipment priorities of the Program. In October 1983, members of the Program will participate in a PCARRD workshop on identifying R&D priorities for agricultural engineering during the period 1985-1990. We also plan to organize a meeting of R&D institutions to promote specific activities on small farm equipment.

16. *Development of Innovation and Invention Capacities Related to Small Farm Equipment*

This activity has proceeded as scheduled and a brief summary of the MA-IRRI Design Contest is included in Annex A. The main problem encountered is the difficulty of obtaining donations from private firms for the prizes. If this problem cannot be overcome, we will have to discontinue the contests.

17. *Annual Meetings of Cooperating Manufacturers*

We propose to have annual meetings of the cooperating manufacturers of the MA-IRRI Program for the purpose of (1) introducing new equipment; (2) describing modifications of existing equipment; (3) hearing feedback from cooperators on problems with the fabrication, operation, durability, etc. of equipment; and (4) discussing how the MA-IRRI Program can improve its assistance to cooperators. This meeting will be repeated in three different locations in order to minimize the distance travelled by cooperators and thereby promote higher attendance.

18. *Assist Formulation of Policies on Farm Equipment*

As mentioned in Section IIB, the Agricultural Mechanization Committee is now being formed and we will continue to collaborate actively with it In addition, the Program will assist IRRI, NEDA, and Ministry of Agriculture with a workshop in December 1983 on the Consequences of the Mechanization Project.

19. *Training Course on Small Farm Equipment*

The IRRI Agricultural Engineering Training Course continues to be held two times per year, with its duration being increased to three weeks. This activity has proceeded according to schedule, and we will continue to send qualified persons from industry, government, and private institutions involved with agricultural equipment.

20. *Program Monitoring/Evaluation*

This activity has been carried out according to schedule and will be continued during the coming period. The principal task is to plan and prepare for a major evaluation of the MA-IRRI

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Program during 1984. The evaluation will be designed to identify the strengths and weaknesses of the Program and to indicate necessary changes and modifications to improve the Program's performance in the future.

21. *Preparation of Quarterly Progress Reports and Workplans*

These progress reports were temporarily discontinued during 1983 because of the lack of Advisory Committee meetings (see Section IIB). The present report covers all of that period. Preparation of quarterly reports will be resumed as soon as the Advisory Committee meetings are reestablished.

22. *Meetings of Advisory Committee to Review Progress and Plans*

This is discussed above under item 21 and also in Section IIB. It is proposed that these meetings be resumed in November 1983.

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Table 1. PRODUCTION STATISTICS. PHILIPPINES 1975-1982

EQUIPMENT	YEAR 1975	1976	1977	1978	1979	1980	1981	1982	TOTAL
1. Hand Tractor (PT5 and variations of PT3)	2178	2586	856	795	1337	978	1107	2310 1/	12147
2. Axial Flow Thresher (TH8)	275	552	494	689	1850	1059	1417	1689	8025
3. Portable Thresher (TH6)	-	-	827 2/	1746	2290	1218	1275	1113	8469
4. Batch Dryer: BD1, horizontal bin	33	93	64	34	47	66	102	41	480
BD2, vertical bin	-	-	-	-	-	16 3/	16	6	38
5. Seeder (RS2)	56	57	57	-	-	-	-	61	231
(RS3)	-	-	-	-	-	1	1		2
6. Chemical Applicator (CA2)	-	141	-	-	-	-	-	-	141
(CA6)	-	-	-	-	-	-	36	-	36
7. Axial Flow Pump (PU4)	-	-	-	-	13 4/	55	66	38	172
8. Grain Cleaner (GC7)	-	-	10	10	-	-	2	-	22
9. Transplanter (TR1)	-	-	-	-		17 5/	82	73	172
10. 1.0 m Reaper (RE2)	-	-	-	-	-	-	-	37	37
TOTALS	2542	3429	2308	3274	5537	3410	4104	5368	29771
No. of manufacturers reporting	14	19	17	20	21	31	33	55	

1/ PT5 hand tractor and 1.0 m reaper were introduced in early 1982.
2/ Portable thresher was released during later part of 1976.
3/ BD2 vertical-bin batch dryer was released during later part of 1979.
4/ Axial flow pump was released during 1979.
5/ Transplanter was released during later part of 1979.

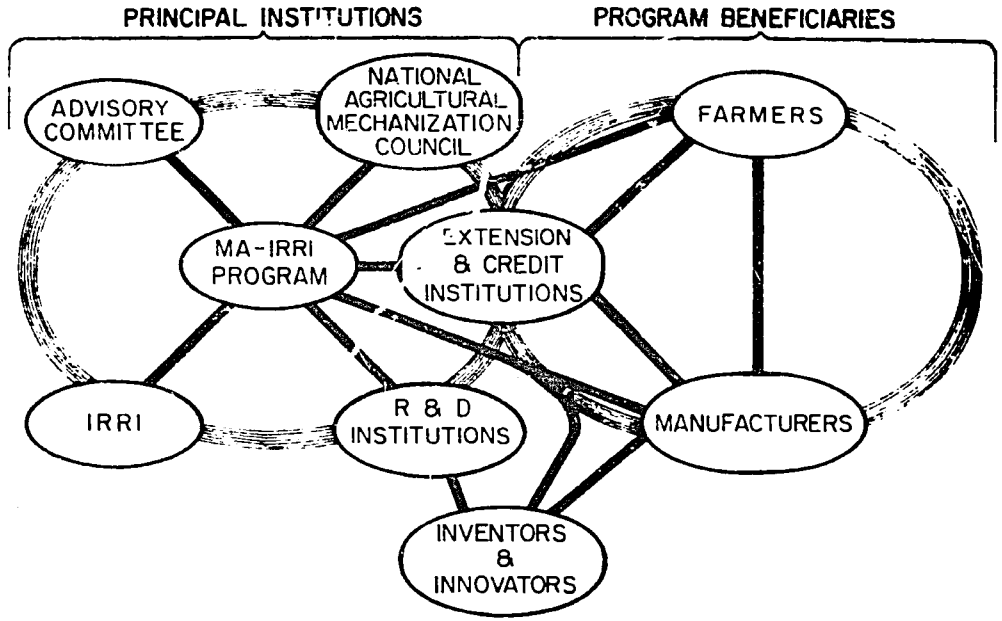

Fig. 1. PROPOSED INSTITUTIONAL RELATIONSHIPS FOR THE MA-IRRI INDUSTRIAL EXTENSION PROGRAM FOR SMALL FARM EQUIPMENT.

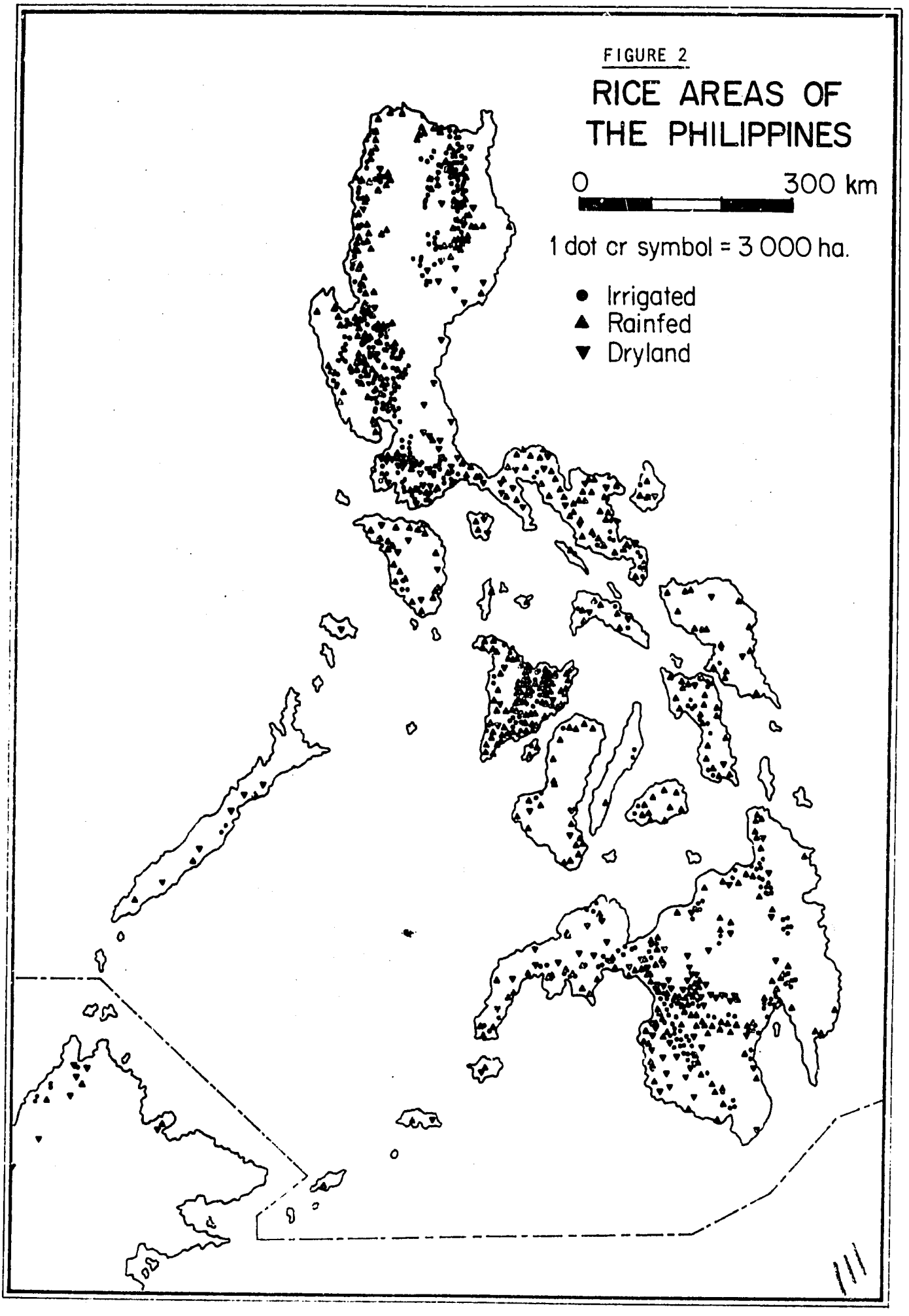
FIGURE 2
RICE AREAS OF THE PHILIPPINES
0
300 km
1 dot or symbol = 3 000 ha.
Irrigated
Rainfed
Dryland

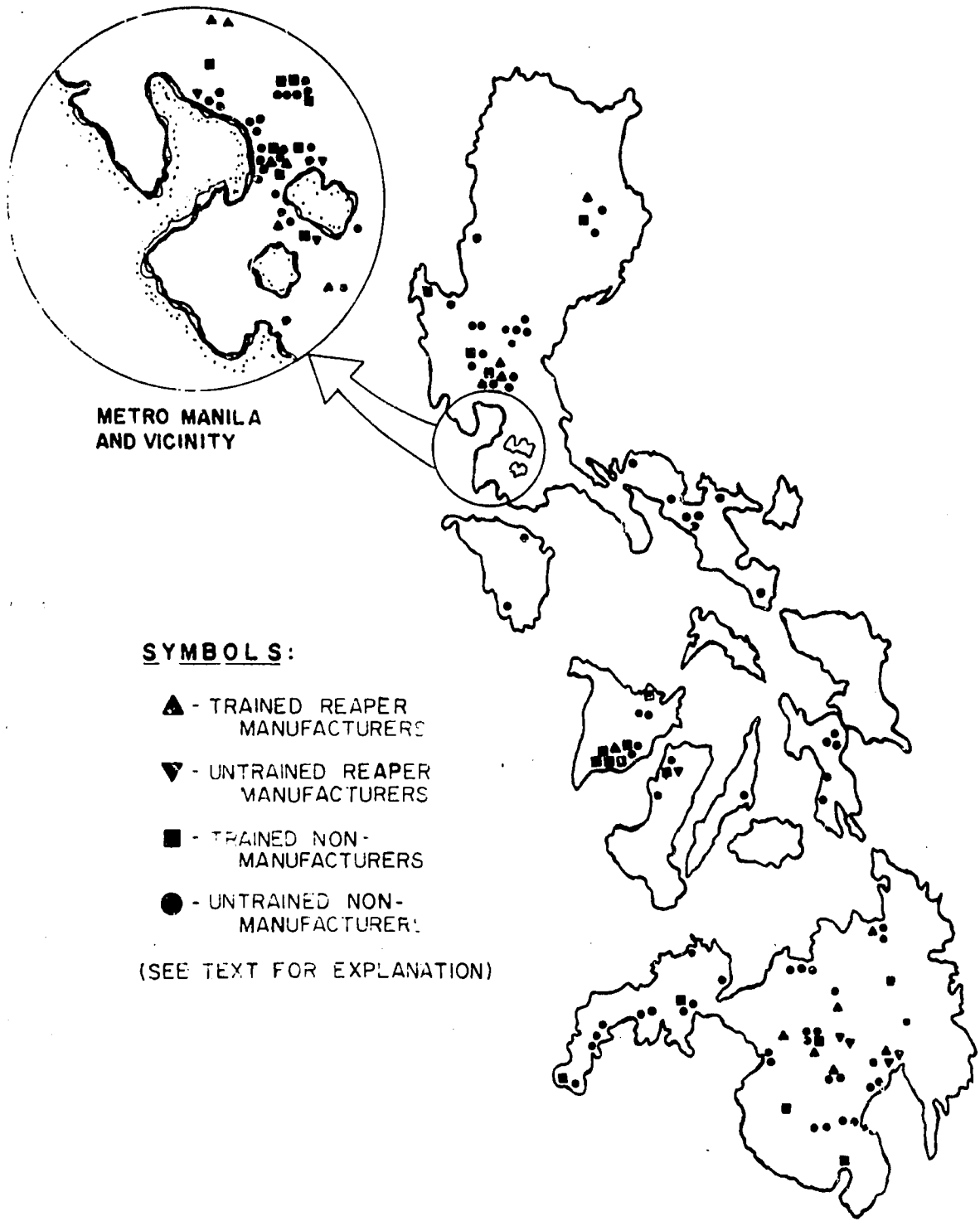

Figure 3. Geographical Location of Cooperating Manufacturers of the MA-IRRI Industrial Extension Program for Small Farm Equipment.

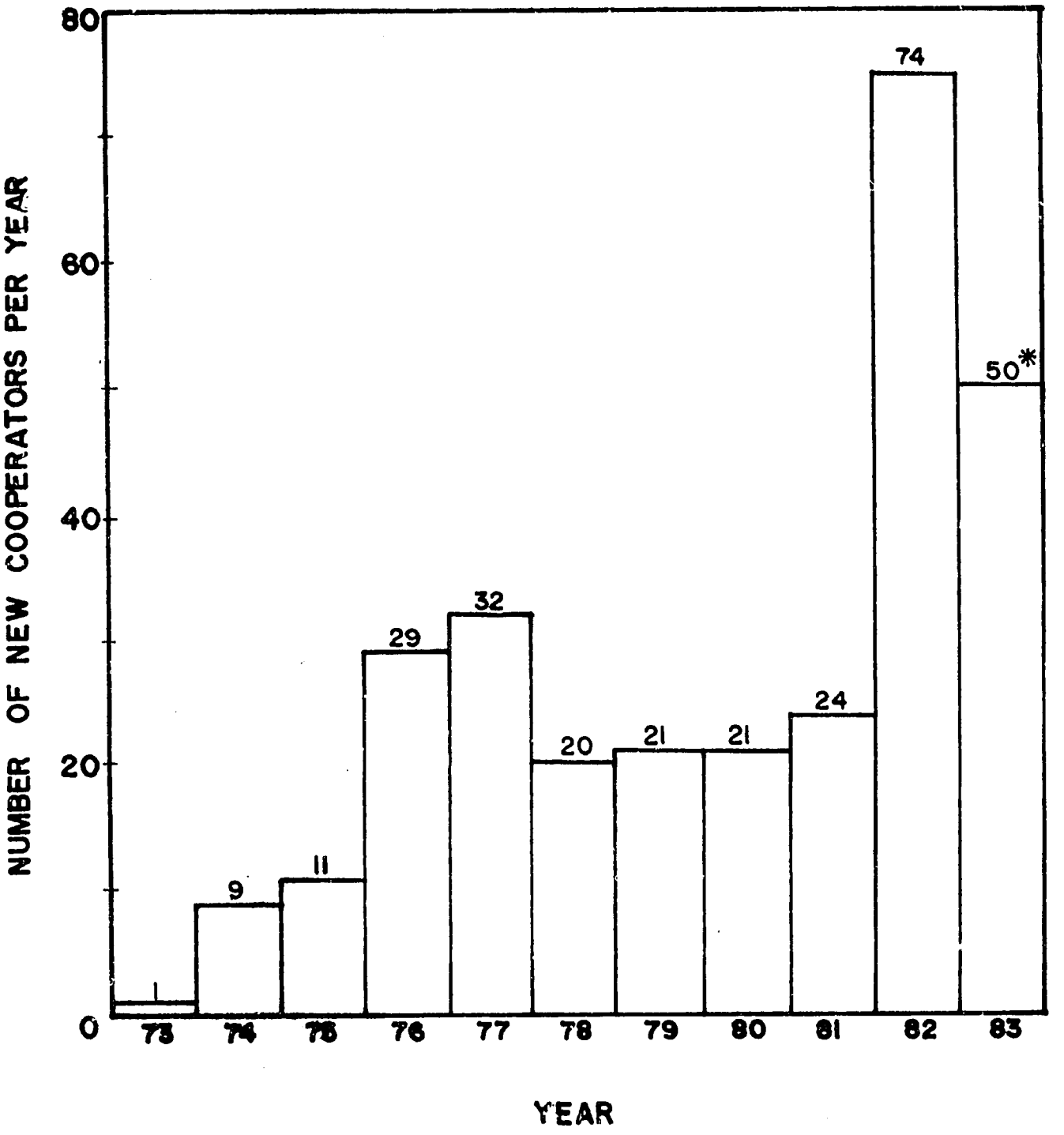

Figure 4. Annual increase in number of cooperating manufacturers in the MA-IRRI Industrial Extension Program. (*Note: The figure for 1983 is an estimate based on an extrapolation of the data as of September.)

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ANNEX A

MA-IRRI Design Contest – A Challenge to Aggie Engineers and Agricultural Engineering Students

By
Teresita C. Silva

The Ministry of Agriculture (MA) and the International Rice Research Institute (IRRI) have recently initiated a collaborative extension program on agricultural equipment for small farms producing rice plus other food crops. In general terms, the program's objective is to promote the development, production, and utilization of equipment that will increase the profitability and productivity of small farms in the Philippines. A wide range of equipment such as hand tools, animal-drawn implements, and small machinery will be considered, for operations ranging from land preparation to post-harvest processing. The extension effort will involve the collaboration of existing public and private institutions which are now providing technical and/or financial assistance to small equipment manufacturers or the farmers.

One of the objectives of this program is to strengthen the national capability to develop farm equipment which is: (1) appropriate for local agricultural conditions and needs; (2) produced by small manufacturing shops in rural areas; (3) low cost; (4) designed to minimize the use of imported parts, materials, and fuels. To achieve this objective, the program collaborated with the Science Promotion Institute (SPI) formerly the Science Foundation of the Philippines and the Philippine Invention Development Institute (PIDI), formerly the Philippine Inventors Commission, in giving MA-IRRI Special Awards to participants to the National Science Fair and the Inventors Week, respectively, who have entries related to the program's theme every year.

For two consecutive years, i.e. 1982-83 and 1983-84, the theme has been "Search for Improved Technology on Palay Drying." The drying equipment should have the following characteristics:

- Appropriate for use on small farms (or groups of small farms)
- Simple in design and acceptable to farmers with respect to cost, operations, etc.
- Locally available materials and fabrication techniques
- Renewable energy sources (e.g. sun, wind, straw, hulls, etc.

MA-IRRI Project Co-leader Benito C. Gonzalo awarding the P5,000 cash award to Messrs. Dennis Arboleda and Mark Arboleda during the Inventors Week.

During the National Science Fair, sponsored by the Science Promotion Institute and held in Tacloban City last January 24-28, 1983, two special prizes of P1,000 each were given to outstanding participants with entries on palay dryer. Mr. Noel Laylo, a senior college student of Marawi State University (MSU), Iligan Institute of Technology (IIT), won the cash award of P1,000 with his entry "Palay Dryer." The other P1,000 cash award went to Mr. Joselito Bacolor, a high school student of Jose Panganiban High School, Camarines Norte for his entry "Reinforced Solar Grain Dryer."

In the recently concluded 1983 Inventors Week sponsored by the Philippine Invention Development Institute (PIDI) and held last February 20-26 at the Philippine Trade Exhibits (PHILTRADE), Roxas Blvd., Manila, three special prizes were given by the MA-IRRI Extension Program. The first prize cash award of P5,000 donated by Planters Products Inc. went to Messrs. Dennis Arboleda and Mark Dondi Arboleda, both third year high school students for their entry "High Speed Drying of Palay." The second prize cash award of P3,000 went to Mr. Edgar S. Virina, a commerce graduate for his entry "Combination Solar and Dendrothermal Dryer" and the third prize cash award of P1,000 went to Mr. Ruperto Elnacin, a farmer, for his entry "Elnacin Universal Grain Dryer."

The panels of judges of both contests composed of selected grain specialists from among the members of the Philippine Society of Agricultural Engineers were as follows:

SPI's National Science Fair:

1. Engr. Felix V. Quero, Jr.
   Project Director

(over)

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Farming Systems Development Project-Eastern Visayas
Tacloban City
Chairman of the Board of Judges

2. Engr. Benito C. Gonzalo
Chief, Agricultural Engineering Division
BPI, Manila

3. Engr. Teresita C. Silva
Supervising Agricultural Engineer
BPI, Manila

4. Engr. Carlito P. Fernandez
Agricultural Engineer
BPI, Manila

5. Engr. Carlos Macabenta
Agricultural Engineer
Gandara Seed Farm
Gandara, Samar

PIDI's Inventors Week:

1. Engr. Pedro N. Laudencia
Consultant
University of Life
Chairman of the Board of Judges

2. Engr. Teofilo Vergara
Chief, Food Processing Division
National Food Authority, Metro Manila

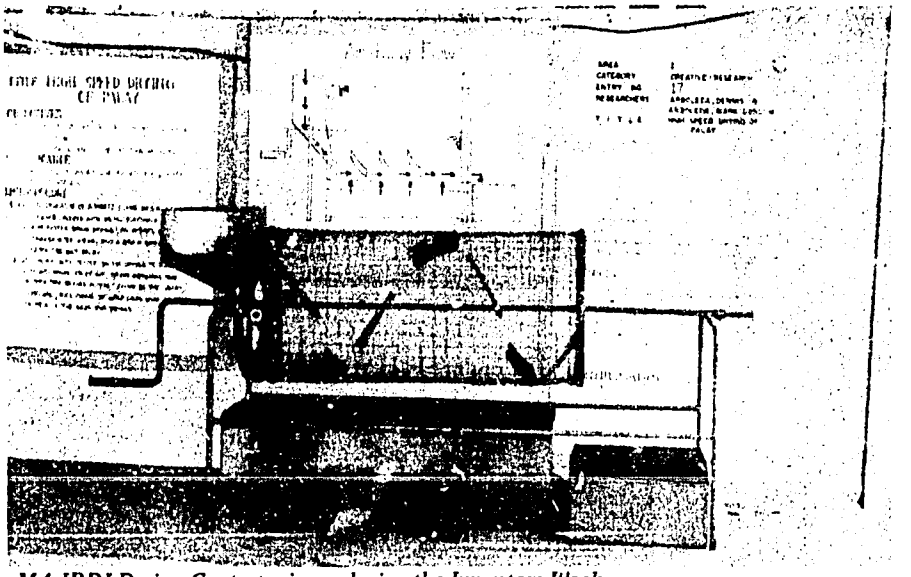
3. Engr. Crestituto C. Mangaoang
Chief of Extension Division
National Food Authority
Metro Manila

4. Engr. Teresita C. Silva
Supervising Agricultural Engineer
BPI, Manila

Cash prizes provided for the above mentioned contests and for the succeeding contests were solicited from the following:

1. Agricultural machinery Mfg. & Dist. Association
2. Alpha Machinery & Engineering Corporation
3. Ayala Agricultural Development Corporation
4. C & B Crafts
5. Delta Motors Corporation
6. Galzon Construction
7. Norkis Trading Company
8. Philippine Packing Corporation
9. Planters Products Inc.
10. R & D Tuazon Construction
11. Warner Barnes and Co. Inc.

The MA-IRRI Industrial Extension Program for Small Farm Equipment undertook this design contest in order to stimulate the interest and efforts of students, inventors, instructors, farmers and manufacturers in undertaking creative investigations and innovative designs relating to small farm equipment. The contest with the Science Promotion Institute is open only to elementary, high school and college students who are members of their school science clubs.



MA-IRRI Design Contest winner during the Inventors Week.

MA-IRRI booth during the Inventors Week at Philtrade.

For the contest of the Philippine Invention Development Institute during its annual Inventors Week at the PHILTRADE, any individual may participate including agricultural engineering students, college and high school students, professional agricultural engineers, inventors, farmers and manufacturers. Cash prizes given each year are no less than P2,000.

Persons wishing to participate in any of the contests are advised to communicate with the following:

1. MA-IRRI Industrial Extension Program
c/o BPI, Agricultural Engineering Division
San Andres, Manila – Tel. 59-81-14

2. Science Promotion Institute
PTRI Bldg., Bicutan, Taguig, Metro Manila

3. Phil. Invention Development Institute
Bicutan, Taguig, Metro Manila

The PSAE encourages its members to participate in the MA-IRRI Design Contests.

MA-IRRI INDUSTRIAL EXTENSION PROGRAM FOR SMALL FARM EQUIPMENT

SCHEDULE OF ACTIVITIES: SEPTEMBER 1983-SEPTEMBER 1984

ACTIVITIES	1983				1984							
	9	10	11	12	1	2	3	4	5	6	7	8
1. EXTENSION OF REAPER & HAND TRACTOR:												
(a) Continue to provide technical assistance to manufacturers on fabrication and marketing the reaper and hand tractor												
(b) Modify original designs on the basis of feedback from manufacturers and farmers												
(c) Collaborate with IRRI in developing and testing implements for PT5 hand tractor (e.g., off-set plow, combined harrow-leveler, improved cage wheels, trailer)												
(d) Promote PT5 hand tractor for land preparation												
(e) Conduct second survey of reaper manufacturers, owners, and users												
2. EXTENSION OF AXIAL FLOW PUMP:												
(a) Prepare promotional materials on utilization of axial flow pump for irrigation, drainage, and fish ponds												
(b) Meetings with agencies which are potential promoters of pump												
(c) Formulation and implementation of extension efforts with collaborating institutions												
3. DEVELOPMENT & EXTENSION OF THRESHER:												
(a) IRRI to fabricate prototype of improved TH6 thresher and perform preliminary test												
(b) Conduct intensive on-farm tests, making improvements as needed												

- CONTINUED -

ACTIVITIES	1983				1984							
	9	10	11	12	1	2	3	4	5	6	7	8
EXTENSION OF THRESHER (cont'd)												
(e) Develop final design: blueprints, operator's manual, promotional materials												
(d) Initiate extension of improved thresher by means of a workshop for manufacturers and field demonstrations in regions												
4. DEVELOPMENT AND EXTENSION OF SEED AND FERTILIZER APPLICATOR (SFA):												
(a) Continue field trials and on-farm demonstrations of SFA												
(b) Prepare technical drawings, operator's manual, and other materials for extension of SFA												
(c) Plan extension activities with appropriate public and private institutions												
(d) Implement extension of SFA, in collaboration with other institutions (e.g., NFAC, Maisagana, seed producers, equipment manufacturers and distributors)												
5. DEVELOPMENT AND EXTENSION OF ROOT CROP EQUIPMENT:												
(a) Plan extension of root crop equipment developed by BPI												
(b) Implement extension project in pilot area												
(c) Develop and test other root crop equipment												
(d) Evaluate results of (b) and (c), and formulate workplan for the following year												

- CONTINUED -

ACTIVITIES	1983				1984							
	9	10	11	12	1	2	3	4	5	6	7	8
6. DEVELOPMENT OF TRANSPLANTER:												
(a) Collaborate with IRRI in on-farm tests of new transplanter												
(b) Assist IRRI to develop extension materials on fabrication, seedling preparation, operation, and economic considerations												
7. DEVELOPMENT OF ROLLING INJECTION PLANTER (RIP):												
(a) Collaborate in conducting on-farm trials of RIP in different areas of Philippines												
(b) Conduct second workshop on RIP to review results of 1982-84 trials and plan future trials and extension												—
(c) Preparation of materials for extension of RIP (if results of trials indicate that RIP should be promoted)												
8. DEVELOPMENT OF DRYER:												
(a) Complete study of sun drying and prepare report with results and recommendations												
(b) Develop extension materials for promoting improved sun-drying practices												
(c) Evaluate cooperative dryer at Kitobo, Bukidnon		—										
(d) Collaborate with Jeon of IRRI in development and testing of rice hull furnace for 10 ton vertical bin dryer												
(e) Install prototype 10-ton dryer at cooperative for intensive testing and economic evaluation												

- CONTINUED -

ACTIVITIES	1983				1984							
	9	10	11	12	1	2	3	4	5	6	7	8
9. EVALUATION OF LOW-VOLUME SPRAYER:												
(a) Review results of Dr. Calora's test of low-volume sprayer												
(b) Plan and carry out additional trials and evaluations												
(c) Organize meeting to review results and decide if sprayer warrants further study and/or extension												
10. EVALUATION OF FERTILIZER APPLICATORS:												
(a) Continue to collaborate with IRRI, MA, and FPA in evaluating fertilizer applicators												
(b) Coordinate fabrication of prototype applicators by cooperating manufacturer												
11. EVALUATION OF ONE-WHEEL HAND TRACTOR:												
(a) Modify tractor to improve traction and stability												
(b) Test modified tractor and decide if project should be continued or terminated												
12. EVALUATION OF CORN-HARVESTING HOOK:												
(a) Complete on-farm evaluations												
(b) Review results and decide if project should be continued or terminated												
13. EVALUATION OF AXIAL FLOW THRESHER FOR SHELLING CORN:												
(a) Prepare proposal to NFA for corn shelling study												
(b) Conduct preliminary tests of shelling corn with TH6 thresher												
(c) Review results of preliminary tests and formulate workplan for further development and testing												

- CONTINUED -

ACTIVITIES	1983				1984							
	9	10	11	12	1	2	3	4	5	6	7	8
14. ESTABLISHMENT OF EQUIPMENT DEVELOPMENT CAPABILITIES AT REGIONAL LEVEL:												
(a) Formulate plan for establishing equipment development projects in at least two regions												
(b) Seek funds for proposed regional projects												
(c) Implement projects												
(d) Evaluate progress and formulate workplan for following year												
15. PROMOTION OF R&D ON SMALL FARM EQUIPMENT:												
(a) Collaborate with ARO and PCARRD in promoting R&D on priority equipment by agricultural colleges and R&D institutions												
(b) Assist in the organization and implementation of a meeting of R&D institutions to promote specific activities on small farm equipment (perhaps following the annual meeting of PSAE)												
16. DEVELOPMENT OF INNOVATION & INVENTION CAPACITIES RELATING TO SMALL FARM EQUIPMENT:												
(a) Coordinate three annual contests on the design of small farm equipment (PIC, SPI, BPI)												
17. ANNUAL MEETINGS OF COOPERATING MANUFACTURERS:												
(a) Plan annual meetings of cooperators in three convenient locations												
(b) Distribute invitations to cooperators												
(c) Prepare presentations and materials for meetings												
(d) Carry out meetings												

- CONTINUED -

ACTIVITIES	1983				1984							
	9	10	11	12	1	2	3	4	5	6	7	8
18. ASSIST FORMULATION OF POLICIES ON FARM EQUIPMENT:												
(a) Participate in meetings of Agricultural Mechanization Committee; collaborate in activities												
(b) Assist IRRI with workshop on Consequences of Mechanization Project; follow-up on recommendations		–										
19. TRAINING COURSE ON SMALL FARM EQUIPMENT:												
(a) Assist IRRI with the three-week agricultural engineering course, presented twice per year			—						—			
20. PROGRAM MONITORING/EVALUATION:												
(a) Maintain on-going monitoring of progress												
(b) Annual survey of cooperating manufacturers			—	—	—	—						
(c) Annual evaluation of MA-IRRI Program												—
21. PREPARATION OF QUARTERLY PROGRESS REPORTS AND WORKPLANS		—			—			—			—	
22. MEETINGS OF ADVISORY COMMITTEE TO REVIEW PROGRESS AND PLANS			–			–			–			–

ANNEX C

Report No. IEP-8
September 30, 1983

INTRODUCTION OF THE CAAMS-IRRI MECHANICAL REAPER IN THE PHILIPPINES[1/]

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MA-IRRI Industrial Extension Program
for Small Farm Equipment[2/]

ABSTRACT

In 1982 the MA-IRRI Industrial Extension Program for Small Farm Equipment introduced the CAAMS-IRRI mechanical rice reaper to interested manufacturing firms in the Philippines. The principal advantages of this reaper over existing machines are: low cost; light weight; attaches to a hand tractor which may also be used for plowing and harrowing; locally produced (all other existing reapers are imported); availability of parts; simplicity of operation and repair.

This paper provides a description and evaluation of the reaper extension project of the MA-IRRI Program. The extension activities included field demonstrations, training courses, technical assistance visits, prototype testing, and marketing assistance. A survey was carried out to evaluate these activities and to obtain information on the manufacturers (e.g., capital assets, personnel, location, production) and on problems which have been encountered during introduction of the reaper. The results suggest modifications and/or improvements which should be made to the extension activities and to the reaper design.

1/ A preliminary version of this paper was presented at the 33rd Annual Convention of the Philippine Society of Agricultural Engineers, April 28-29, 1983, at the Visayas State College of Agriculture, Baybay, Leyte.

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1. INTRODUCTION

In September, 1981, the Ministry of Agriculture (MA) of the Philippines and the International Rice Research Institute (IRRI) initiated a collaborative effort to promote the development and extension of agricultural equipment which is appropriate for small farms and may be produced in the Philippines. The MA-IRRI Industrial Extension Program for Small Farm Equipment has grown out of an informal extension effort initiated by IRRI about 15 years ago, and its objective is to institutionalize the Program within the Ministry and related organizations. The central office of the MA-IRRI Program is located at the Agricultural Engineering Division of the Bureau of Plant Industry (BPI), of the Ministry of Agriculture in Manila.

As of May, 1983, 161 manufacturers had become cooperators in the MA-IRRI Program by signing a memorandum of agreement. These cooperators are located throughout most of the Philippines (see Figure 1) and range in size from small blacksmith and metalcraft shops to large-scale industries. Special attention is given to manufacturers located in agricultural areas, thereby ensuring availability of parts and service, creating rural employment, and stimulating innovations and adaptations to local conditions and farmer preferences. The MA-IRRI Program provides them with designs of agricultural equipment, together with training and technical assistance. In turn, the cooperators agree to provide annual production statistics and to sell units only after testing and authorization by MA-IRRI.

The most recent equipment design to be promoted by the MA-IRRI Program is the CAAMS-IRRI reaper shown in Fig. 2. It is a low-cost unit[3/] which attaches to a lightweight two-wheel hand tractor, both of which may be manufactured in small shops. (See references 1 and 2 for more details). Because of its light weight and low cost, it should minimize problems encountered previously with imported reapers which have failed to be accepted by rice farmers in the Philippines. It should also be competitive with similar reapers now being imported from Japan and China but with higher sales prices and limited availability of parts and service.

2. EXTENSION ACTIVITIES

Selection of Target Areas

The first task was to identify areas in the Philippines where the reaper might be appropriate; i.e., areas where labor shortages result in significant delays of harvesting. The result was that Mindanao and the Cagayan Valley (principally Isabela) were selected as the priority areas for reaper extension. It was decided that the MA-IRRI Program would not promote the reaper in labor-surplus areas (e.g., Bicol and Central Luzon) even though some farmers in these areas complain of labor shortages during peak harvest times.

[3/] Approximate average sales prices are ₱5,000 (US $500) for the RE2 reaper, ₱5,000 (US $500) for the PT5 hand tractor, and ₱2,000 (US $200) for a 5HP gasoline engine.

Field Demonstrations/Evaluations/Trials

The second step was to conduct field demonstrations and evaluations of the reaper in the major rice-producing areas of Mindanao and the Cagayan Valley. The MA-IRRI Regional Project Engineers[4/] who live in the areas were vital to the coordination of these demonstrations, particularly with respect to insuring that the group present included outstanding farmers, leaders of cooperatives, local manufacturers, agricultural extension technicians, and rural bank officials.

The major results of these demonstrations are:

1. In evaluation sessions held at the field demonstrations, the majority of the farmers stated that the reaper would be appropriate and beneficial in their areas;

2. By observing the enthusiasm of farmers for the reaper, many manufacturers became interested in fabricating the unit;

3. The MA-IRRI engineers became better acquainted with the manufacturers of the area, thereby recruiting new cooperators and initiating on-going technical assistance to those interested in fabricating the reaper.

An intensive test of the performance and durability of the reaper and hand tractor was carried out in Mindanao on a 370 ha. farm where rice is grown continuously during the year. The advantage of this farm was that reapers generally could be utilized regularly on up to 2.5 ha per day, 6 days per week throughout the year. The test results served as the basis for modifying the reaper and hand tractor to improve operation and durability.

Training Courses

A two-day intensive training course on fabricating the reaper and hand tractor was given twice during 1982 at BPI in Manila for cooperating manufacturers and MA-IRRI engineers. The course was designed to help trainees to understand: (a) the blueprints for the reaper and hand tractor; (b) the main steps of fabrication and assembly; (c) operation, maintenance, and repair; and (d) the economics of fabrication and utilization of the reaper.

At the time of the first course (February 1982), there was a total of 68 cooperators in the MA-IRRI Program and all were invited to attend the course. Twenty four (35%) of these cooperators actually attended first course. Ten (42%) of these attendees have successfully fabricated at least one reaper and hand tractor by the end of the present survey (May 1983).

By the time of the second course (August 1982), the total number of cooperators had increased to 110, of which 86 had not attended the first course and therefore were invited. Nineteen (22%) of these 86 attended

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4/ These engineers are regular employees of the Ministry's experimental stations, and they devote only part of their time to the MA-IRRI Program.

the second course, and 6 (32%) of these attendees have successfully fabricated at least one unit by the end of this survey. (Note: As will be discussed in Section 4, 11 cooperators who did not attend either training course have also fabricated at least one reaper and hand tractor.)

It may be concluded that manufacturers will devote their time and money to attend training courses if the topic is of sufficient interest to them. In the present case, many of the attendees were from small-scale firms (Table 1) located in provinces far from Manila (see Fig. 1), the site of the two training courses. The attendees paid for their transportation and lodging expenses, while the MA-IRRI Program covered the cost of providing each attendee with blueprints and instruction materials.

Technical Assistance and Prototype Testing

MA-IRRI Project Engineers make periodic visits to cooperating manufacturers in their area. The purpose of the visit is to provide whatever technical assistance might be needed by the cooperator in fabricating the reaper or other equipment promoted by the Program (e.g. thresher and pumps). In cases where the engineer is not capable of providing the needed technical assistance, he contacts the MA-IRRI central office for information and/or for the help of an engineer who is familiar with the specific problem.

Regarding technical assistance on the reaper, the most common activities were:

1. To help manufacturers understand the blueprints and to find suppliers of special components (e.g., reaper blades).

2. To loan a reaper and hand tractor to manufacturers who have difficulty in reading blueprints.

3. To perform the prototype test of the first unit fabricated by a manufacturer, utilizing a special test procedure and form. The purpose of the test is to determine that the unit has been fabricated and assembled correctly and that it functions properly in the field. It is also an opportunity to advise the manufacturers regarding critical adjustments and operating procedures. After passing the prototype test, the manufacturer is authorized by MA-IRRI to proceed with commercial production of the reaper and hand tractor.

4. To assist manufacturers with field demonstrations to farmers (often at the meetings of farmer organizations) and, in a few instances, with applications for loans.

5. To maintain two-way communication with manufacturers on both problems and improvements that arise in relation to the design, fabrication, or operation of the reaper and hand tractor.

3. SURVEY METHODOLOGY

The MA-IRRI Program carried out a survey for the purpose of answering the following questions:

a) Which of the methods used by the Program in the extension of the reaper (i.e., methods used in field demonstrations, training courses, technical assistance, loaning units, prototype tests, etc.) were most useful to cooperators?

b) Why have some cooperators successfully fabricated the reaper and hand tractor while others have not?

c) What factors have been most important with respect to facilitating and/or hindering acceptance and sales of the reaper?

d) What innovations or modifications have been made or suggested by cooperators with respect to the design, fabrication, or operation of the reaper and hand tractor?

e) How might we improve future extension of the reaper, hand tractor, or similar equipment?

Questionnaires were developed, pre-tested, and finalized for different groups:

1. *Trained Cooperators*, i.e., those persons (firms) who attended one of the reaper training courses. This group is subdivided into:

   a) *Trained Reaper Manufacturers*, i.e., those trained cooperators who have successfully fabricated at least one unit of reaper and hand tractor by the time of the survey.

   b) *Trained Non-Manufacturers*, i.e., those trained cooperators who have not yet fabricated a unit.

2. *Untrained Reaper Manufacturers*, i.e., firms who did not attend the course but have successfully fabricated at least one unit of the reaper and hand tractor by the time of the survey.

3. *Reaper Owners*, i.e., farmers or contact groups who have purchased a reaper and hand tractor.

The survey was carried out from January through April 1983 by two MA-IRRI engineers who attempted to visit and interview all of the cooperators in groups 1 and 2 above. The survey of the reaper owners (group 3) was postponed because it was found that the first owners who were contacted had not yet utilized their units for more than 5 ha. This survey of owners should be carried out in 1984.

4. SURVEY RESULTS

The accepted classification of industries in the Philippines is:

Scale	Capital Assets[5/]
Cottage Industry	below ₱100,001
Small Industry	₱100,001 to ₱1,000,000
Medium Industry	₱1,000,001 to ₱4,000,000
Large Industry	above ₱4,000,000

This classification is used in Table 1 to compare the different survey subgroups with one another and with all cooperators enrolled in the MA-IRRI Program at the time of the survey. Notice that the distributions of capital assets do not differ substantially from one group to another, thereby indicating that capital assets are not the dominant factor influencing cooperators' decisions to attend the training course or to fabricate the reaper and hand tractor. Moreover, in Table 1 it can be observed that: (a) the training course attracted many cooperators (77%) from cottage and small industries; and (b) the majority (about 70%) of the cooperators who have successfully fabricated reapers are cottage and small industries. Labor force data are also included in Table 1, and the results show that most of the cooperators who attended the training course (73%) and who have fabricated the reaper (54%) have leass than 15 employees. These results demonstrate that the reaper and tiller can be fabricated successfully by firms which are small in terms of capital assets and labor force.

Based on the survey results, the characteristics of the 27 reaper manufacturers are varied:

1. 22% had not fabricated any type of agricultural equipment before the reaper. Some had been repairing agricultural equipment, while others were repairing or fabricating vehicles (tricycles, cars, trucks).

2. 78% were already fabricating agricultural equipment, with the principal equipment being threshers (86%) and hand tractors (38%). Note: 88% of those fabricating hand tractors were also fabricating threshers.

3. 70% had become cooperators of the Program since September 1981 when it was transferred from IRRI to MA-IRRI. It is estimated that 60-70% of these new cooperators were attracted to the Program by the reaper.

5/ At the time of the survey, the conversion rate was approximately ₱10 per US dollar.

Of the 27 reaper manufacturers, 11 (41%) had not attended either of the two training courses. Five (45%) of these 11 untrained reaper manufacturers had been invited to the first training course but did not attend because: (a) two were well-established cooperators located near IRRI, one of which had been contracted previously by MA-IRRI to fabricate reaper demonstration units; (b) two were small firms (less than 5 employees) located far from Manila but benefitting from borrowing a MA-IRRI demonstration unit and receiving frequent technical assistance from the Project Engineer; and (c) one was a unique case of a mechanical engineer with only one employee. Another five (45%) had become cooperators after the first course but several months before the second course, and therefore had progressed substantially with fabrication of their first units by the time of the second course. Three of these had reapers available to facilitate fabrication, one hired a consultant who was an experienced reaper fabricator, and one was capable of building the first unit solely from the blueprints. The last of the 11 untrained reaper manufacturers became a cooperator after the second training course, but benefitted from having a mechanical engineer who attended the IRRI Agricultural Engineering Course, as well as from borrowing a reaper from MA-IRRI and hiring workers who had fabricated reapers for another firm.

The 11 untrained reaper manufacturers are not noticeably different from the 16 trained reaper manufacturers with respect to capital assets, labor force, past experience, ability to read blueprints, or geographical location. Both groups include firms having a wide range of these characteristics, and it appears that there is not any simple means for distinguishing them from one another. It is concluded that although the training course may be advantageous to manufacturers, firms can fabricate the reaper without the course if they either have the technical capability (e.g., blueprint reading, fabrication skills and equipment) or are able to hire experienced personnel, borrow or buy a reaper unit, or obtain adequate technical assistance from the MA-IRRI Program.

It is also interesting to consider the reasons why 63% of the cooperators who attended the training course have not yet fabricated a reaper unit. The results given in Table 2 indicate that the main reasons were that the firms were either too busy with orders for other equipment or lacked the necessary capital. It should be mentioned that 24% of these trained non-manufacturers have partially fabricated the reaper or hand tractor, and 29% have either borrowed or purchased a reaper unit to facilitate fabrication.

Table 3 provides a summary of the relative degrees of utilization of blueprints, reaper units, and experienced personnel by reaper manufacturers. It should be pointed out that all of these manufacturers were given a set of blueprints from the MA-IRRI Program, and 78% received direct technical assistance (e.g., training course and/or visits by MA-IRRI engineers). It is expected that all of the manufacturers would have utilized reaper units loaned by MA-IRRI if the Program has offered units to all rather than limiting them to the target areas (Cagayan Valley and Mindanao).

The survey obtained information from each reaper manufacturer on the number of reaper units they had fabricated and the number of these which had been sold. The average number of units fabricated was six per manufacturer, while the average number sold was 3.3 per manufacturer (i.e., 55% of the units produced). However, the data in Table 4 illustrate that 37% of the

manufacturers had fabricated only one unit thus far, and 59% had not yet sold any units. These manufacturers generally were very small with respect to capital assets; a few had only recently completed fabricating their first units.

Only four firms had sold more than 10 units per firm, and their combined sales amounts to 80% of the total sales to date. Three of these four were able to fabricate their first reaper units within three months after the first training course, and two of them attended the course. Three of the four are small; i.e., they are classified as cottage or small-scale industries with respect to capital assets, and none of the three has more than 10 employees. Perhaps the most important characteristics of these three manufacturers is that they all have well-established relationships with IRRI.

Reaper manufacturers reported that the most common method used to promote sales was field demonstrations to farmers. Several have also used other promotional methods. four manufacturers have printed and distributed leaflets describing the reaper, four have published advertisements in newspapers (two in national newspapers and two in a popular farmers' periodical), one mailed announcements to previous customers, and one advertised by radio.

Reaper manufacturers were asked for their opinions on: "what are the main problems encountered in selling the reaper?" According to the results listed in Table 5, the two main problems are that farmers generally lack capital for purchasing equipment and are hesitant to buy a new machine with unproven performance or durability. A third problem mentioned was that the reaper will reduce employment of laborers who are now contracted to harvest rice fields, and this could lead to destructive reactions by the laborers.

It is relevant to mention that, during the past three years, sales of farm equipment in the Philippines has fallen off markedly because of a prolonged period of economic recession and inflation, with the price of rice failing to keep up with rising costs of inputs. The situation has been aggrevated recently by a severe drought.

A related question to the reaper manufacturers was: "In your opinion, what would farmers consider to be the most attractive (positive) and unattractive (negative) features of the reaper?" The responses are summarized in Table 6. The attractive features are those which we would expect, and the unattractive features include the labor and durability problems discussed before relation to Table 5. A primary complaint is that the reaper is difficult to maneuver, but we have found that this problem diminishes as reaper operators gain experience with handling the machine.

Table 7 lists the manufacturers' views on what are the most common service and repair problems of the reaper. Many manufacturers (37%) said that the reaper was so new that they could not yet respond to this question. Problems with the cutter blades are serious because the hardened steel blades and ledger plates are among the most costly components of the reaper and generally are imported. Thus far, most locally-made blades and ledgers have

either been too hard (thereby easily chipping) or too soft (thereby wearing and becoming dull). The MA-IRRI Program is collaborating with the Metals Industry Research and Development Center (MIRDC) and other institutions in an effort to promote local production of blades and ledgers.

Other service and repair problems listed in Table 7 can be minimized in the following ways:

1. The V-belt from the hand tractor to the reaper wears rapidly because it is twisted 90° in order to drive the vertical reaper shaft from the horizontal tractor shaft. This problem can be minimized by proper adjustment of the belt tension.

2. Several manufacturers have come up with an innovative means for increasing starwheel life: they fabricate starwheels from an inexpensive plastic chopping board that is widely available in local supermarkets.

3. Wear of the conveyor belt may be reduced to an acceptable level by proper adjustment.

4. Loosening of bolts by machine vibration may be reduced either by using fine-threaded bolts with locking washers or nuts (which are often difficult to find in rural areas) or by using rivets in place of bolts.

Manufacturers were requested to give their suggestions regarding what improvements of the reaper and hand tractor would be most useful or desirable. (See Table 8.) Seven manufacturers suggested that the width of the cutter bar (tool steel) be increased from 19 mm (3/4 inch) to 25 mm (1 inch) because the 25 mm bar is more commonly available in the provinces and also improves the rigidity and strength of the cutter assembly. Several manufacturers have already incorporated this change in their reapers. Some have also made changes associated with the other suggestions in Table 8, five of which are related primarily to improving the convenience of reaper operation, while three are related to overcoming problems of wear and breakage. These suggestions and innovations[6/] by reaper manufacturers are being considered by the MA-IRRI Program and the IRRI Agricultural Engineering Department with the objective of proposing modifications that will improve the present design of the reaper and hand tractor. After testing, the modifications will be given to manufacturers for their evaluation and possible use or adaptation.

5. SUMMARY AND CONCLUSIONS

The main results of the survey are:

1. Introduction of the CAAMS-IRRI reaper to manufacturers in the Philippines has been a rapid process: 27 firms have successfully fabricated at least one unit within the first 12 to 15 months.

6/ A few manufacturers have already applied for patents on their improvements of the reaper, and the MA-IRRI Program will not promote these particular improvements. Many manufacturers are eager to patent improvements because the Philippine Government exempts manufacturers from paying income tax on sales of products patented by them.

2. Fabrication of the reaper and hand tractor is sufficiently simple that it can be done by small manufacturing firms having limited capital and equipment.

3. Many firms were willing to devote time and money to attend the reaper training course, including firms which are small and located in agricultural areas far from Manila.

4. Although the training course facilitated introduction of the reaper to interested firms, it was not absolutely essential because 41% of the present reaper manufacturers did not attend the course. However, many of the untrained reaper manufacturers either have close relationships with IRRI or have experienced technical personnel.

5. Since most of the reaper manufacturers have difficulty in fabricating the first unit solely from the blueprints, they benefitted from either borrowing a unit from MA-IRRI, buying a unit, or employing technicians who are experienced in fabricating the reaper.

6. Initial sales of the reaper have been slow, primarily because of the depressed economic conditions of rice farmers in the Philippines. Sales have also been limited by the understandable reluctance of farmers to buy a new machine of unproven performance and durability, along with concern that the reaper may lead to problems with hired farm workers.

7. Manufacturers have identified aspects of the reaper design, fabrication, and operation which should be improved. Several manufacturers have already introduced innovations to achieve these improvements.

8. Based on the data in Table 6, we suspect that it would have been possible to facilitate initial sales of the reaper by helping farmers to become more familiar with the machine, thereby alleviating their concerns about maneuverability, shattering losses, passing over paddy, and durability. For this reason, it is recommended that future extension of the reaper (or other equipment that is new to farmers) would benefit by arranging for intensive on-farm utilization of at least one unit in each of the major target areas. This would provide a site where farmers and manufacturers could observe the equipment being used on a sustained basis by experienced operators.[7/]

Since the present survey was carried out at about only one year after the initial introduction of the reaper, it provides only preliminary information on sales and no information on the buyers (farm size, location, cropping intensity, etc.) or on utilization (e.g., used only on owners'

7/ This type of trial was carried out in Bukidnon, and it allowed farmers and manufacturers to observe the reaper under conditions of intensive use.

farm; contract work on other farms; costs and returns; utilization rate (hectares/year); and labor displacement). A second survey will be conducted in 1984 to obtain data on buyers and utilization, including a study of the positive and negative impacts of the machine on those who own reapers, those who hire reapers, and those who are displaced by reapers. Information will also be obtained on the reaper's effects on losses and timeliness of harvesting, while also determining the reaper's limitations with respect to harvesting crops that are either weed-infested, poorly drained, or lodged. Another limitation to be considered is that the length of the straw of a crop harvested by the reaper generally is longer than that harvested by hand, with the result being that the capacity of mechanical threshers may be greatly reduced.

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R E F E R E N C E S

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2. Manalili, I., Ma Ji and B. Duff. 1981. *Technical and economic factors in adapting mechanical reapers to small rice farms*, in Proceedings of Regional Seminar on Appropriate Mechanization for Rural Development with Special Reference to Small Farming in the Asean Countries, January 26-31, 1981, Jakarta, Indonesia, pp. 96-108.

Table 1. Classification of cooperating firms according to assets, labor, reaper training, and reaper manufacturers[a] - data expressed as percentages -

Range	All Cooperators (124)[b]	Trained Cooperators (30)[b]	Reaper Manufacturers Trained (16)[b]	Reaper Manufacturers Untrained (11)[b]
CAPITAL ASSETS				
≤ ₱100,000	44	40	31	45
₱100,001 to ₱1,000,000	44	37	38	27
₱1,000,001 to ₱4,000,000	10	13	25	9
> ₱4,000,000	2	10	6	18
LABOR (Number of employees)				
≤ 5	29	20	31	36
6 to 15	45	53	31	18
16 to 50	21	13	19	36
> 50	6	13	19	9

a/ Data as of March 1, 1983

b/ Number of firms in sample

Table 2. Most common reasons why some participants of reaper training course have not yet fabricated a unit.

Reasons	Frequency[a]
Busy with orders for other equipment	7
Lack of sufficient capital	6
Lack of skilled personnel necessary for fabricating reaper	2
Firm no longer manufacturing agricultural equipment	2

[a] Frequency represents the number of participants who mentioned the particular reason.

Table 3. Principal methods used by reaper manufacturers in fabricating their first prototype unit.

Methods	Number of Manufacturers	Percentage
Followed blueprints provided by MA-IRRI	11	41
Utilized reaper loaned by MA-IRRI	8	30
Utilized reaper purchased by firm	6	22
Hired services of experienced reaper fabricator	2	7
Total	27	100

Table 4. Production and sales of reaper units[a]

Range (number of units)	Number of firms	Percentage of firms
UNITS PRODUCED[b]		
1	10	37
2-5	8	30
6-10	3	11
> 10	6	22
	27	100
UNITS SOLD[b]		
0	16	59
1-5	6	22
6-10	1	4
> 10	4	15
	27	100

a/ Data based on survey conducted from January to May 1983.

b/ At the time of the survey, a total of 161 reaper units had been fabricated, and 88 of these had been sold.

Table 5. Manufacturers' opinions on most common problems encountered in selling the reaper[a]

Problem	Frequency[b]
Farmers lack capital to purchase reapers	5
Harvest laborers oppose the use of reapers	3
Manufacturer lacks marketing organization	1

a/ Based on responses of 20 reaper manufacturers, some who mentioned more than one problem

b/ Frequency represents number of manufacturers who mentioned the particular problem

Table 6. Manufacturers' opinions of farmers' views on the most attractive and unattractive features of the reaper[a]

Features	Frequency[b]
ATTRACTIVE FEATURES	
Fast reaping or harvesting	16
Uniform windrowing	8
Reduces labor requirements	4
Leaves a clean field after reaping	3
UNATTRACTIVE FEATURES	
Difficult to maneuver	5
Displaces labor	4
Suspect shattering losses will be high	2
Tendency to pass over cut paddy	2
Suspect durability will be poor	2

a/ Based on responses of 27 reaper manufacturers, some of whom gave more than one response.

b/ Frequency refers to the number of manufacturers who mentioned the particular point.

Table 7. Most common service and repair problems of reaper[a]

Problems	Frequency
Cutter blades chip or become dull	4
Short life of V-belt between PTO and reaper	3
Starwheels wear out	3
Conveyor belt wears out	2
Several bolts often become loose	2

[a] Based on responses of 27 reaper manufacturers, 37% of whom did not give any comments because of limited experience thus far.

Table 8. Manufacturers' suggestions on improvements of the reaper and hand tractors[a]

Suggestions	Frequency[b]
Increase width of cutter bar to 25 mm. (1 inch)	7
Provide clutch to disengage reaper from hand tractor PTO	5
Modify reaper skid to reduce bumping and facilitate turning	4
Improve maneuverability of machine	3
Change hand tractor clutch lever to motorcycle type	3
Increase diameter of vertical shaft of reaper	3
Modify transmission or pulley ratios to reduce forward speed of machine	2
Eliminate need for twisted V-belt between PTO and reaper	2
Reduce problem of straw wrapping around starwheel shaft	2

a/ Based on responses of 27 reaper manufacturers, some of whom have made more than one suggestion.

b/ Frequency represents the number of manufacturers who have either suggested the particular improvement or actually incorporated the improvement in their unit.

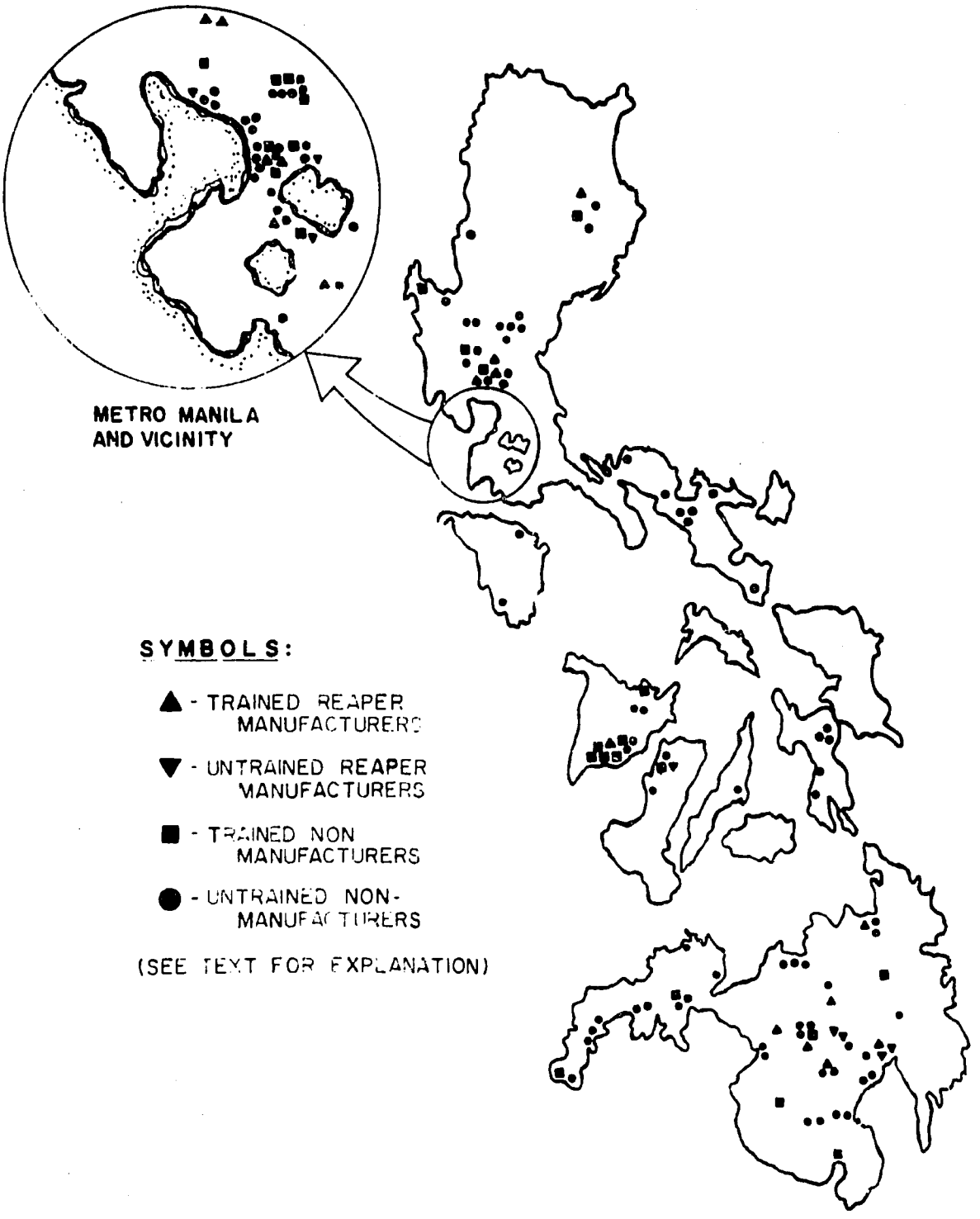

Figure 1. Geographical Location of Cooperating Manufacturers of the MA-IRRI Industrial Extension Program for Small Farm Equipment.

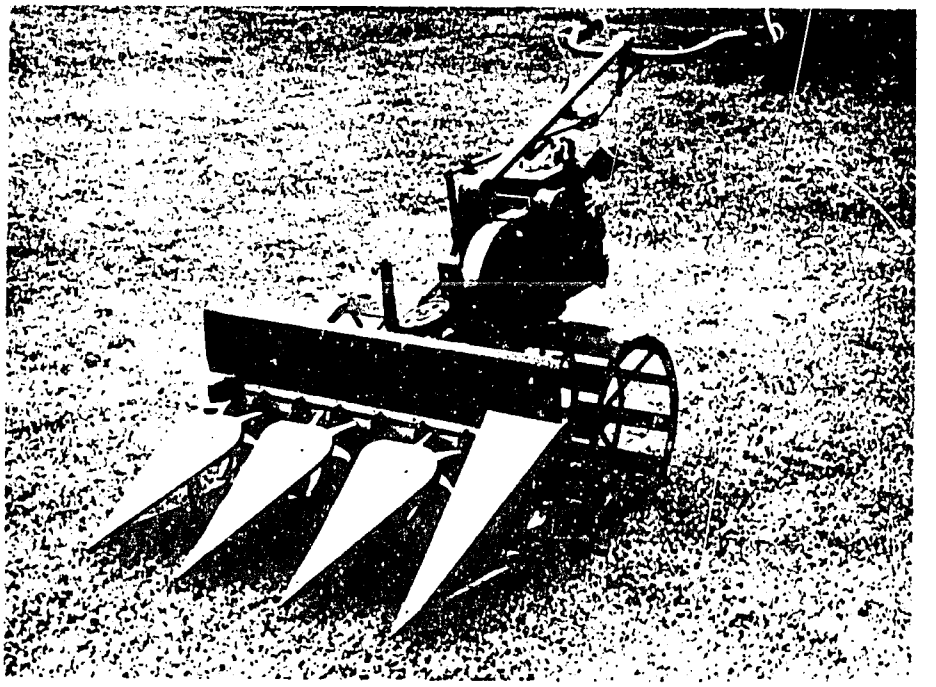

Figure 2. CAAMS-IRRI 1.0 m Reaper.

ANNUAL REPORT OF IRRI-INDONESIA INDUSTRIAL EXTENSION-PROJECT FOR THE YEAR SEPTEMBER '82 THRU AUGUST'83.

During this year the number of proto-types built, modification and field testing work carried out in Jakarta workshop are as under :

NO	Description	Q'TY	REMARKS
1.	PT-5 Hand tractor (5 HP-gasoline kerosine engine) with iron cage wheels, mold-board plough, puddler, leveller harrow and trailer(1/2-ton capacity) attachments.	2	Several modifications carried out in the implements to improve the performance in different types of soils. In the coming year these two sets will be tested with all the attachments monitored in the farmers'fields for a full season.
2.	P.T.5 transmission gear box	2	To be sent to West-Sumatera for their completion and field testin work.
3.	Axial flow pump 6 "dia	3	Performance testing for vertical application and with two and single propellor testing is under progress.
4.	Transplanter	2	With several modifications using local materials available. Preliminary tests quite satisfactory. Will be field testing in farmers'fields during the coming season.
5.	Fixture for the transplanter	1	To be used for the fabrication of new transplanter to improve the quality and consistency.

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6.	Weeders for upland conditions	4	Different types for field trials. Not yet satisfactory results.
7.	Thresher TH-6	2	Further modifications carried out and tested to improve the cleanliness of threshed paddy. Results satisfactory.
8.	Pedal threshers	2	Various modifications and field testing work is still under progress.
9.	Pedal Winnower	1	Modification work under progress.
10.	Reaper 1,0 meter	1	One more proto-type completed and successfully field tested.
11.	Reaper 1,6 meter	1	One completed but needs improvements and modification work
12.	Fixture for the reaper 1 meter	1	For using the subsequent production of the above models.
13.	Fixture for the reaper 1,6 meter	1	

One young volunteer from VSO Britain has been selected to be attached (starting from November'83 until August'85) to our Tanjung-Barat workshop. We are hopeful with his joining the productivity of building proto-types and the training to Indonesian staff will increase further.

The progress of our field extension work in the four provinces is as following :

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WEST SUMATERA

As on August'83 end, the total number of paddy threshers produced has increased to 450 by about 14 manufacturers. Some of the active dealers in this province have started exporting these paddy threshers to the neighbouring provinces of Aceh, Jambi, Riau, etc. Another interesting development we observe is that due to increasing competition, the selling price has decreased from $ 450 (without engine) to $ 300 while the quality of threshers has improved considerably, specially increasing the cleanliness of the threshed paddy.

In view of the success attained in the spread of paddy threshers in this province, ILO is proposing to fund a field research study shortly. A copy of the detail proposal is enclosed herewith.

However, this rapid growth phenomena of paddy threshers is concentrated only in the three districts of the province. The provincial agricultural department is taking steps not only to promote the use of these paddy threshers to the other potential districts of the province, but also to promote the use of IRRI-type hand-tractors as the next priority in this province since the uncultivated area (due to the shortage of agricultural labour and cattle) is increasing.

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We have prepared a background paper (the copy enclosed) to intensify the promotion of hand tractors listing the immediate steps to be undertaken. Further a meeting was organised by the provincial Government on August 24, 1983 which was attended by the senior representatives of Bank - Indonesia, B.R.I., Industries Department, cooperatives and the local manufacturers to discuss the various steps to be taken to popularise the hand tractors during the year 1983/1984. It was decided to conduct a special training programme for the manufacture of hand tractors by the local manufacturers in the month of December 1983 in collaboration with the industries department at the centre and involving the provincial staff. Meanwhile DIPERTA will intensify the demonstrations in the potential areas to create the demand. It has been emphasised that the role of credit is greater in the popularisation of hand tractors as the selling price with all the accesories including the trailer comes to around $ 2.000/unit.
One more VSO volunteer has been selected to be placed in West-Sumatera to train the provincial Government staff in the modification work of proto-types and to assist the local manufacturers.

SOUTH SULAWESI

DIPERTA (Agricultural Department of the Province) with our guidance have manufactured in their workshop one hand-tractor, one axial flow pump and 10 paddy threshers (TH 6),

which are added to the earlier fleet of equipment that we have sent from here and are being used for the demonstration purposes in the farmers' fields. The first priority in this province seems to be tractors for the land preparation.
In view of their bad experience with the imported mini-tractors (more than 2.500 during the last 4/5 years and most of them are idle due to improper and expensive service after sales) they are now more favourably inclined towards IRRI type hand tractors.

As reported last year, ten IRRI type hand-tractors introduced in Luwu district are continuing to perform very satisfactorily and now more than 100 farmers from this district alone have indicated to purchase them.

One local manufacturer at Palopo with our assistance has successfully produced two hand tractors with the attachments including trailers and has just started selling them also.

However, the banks have not yet come forward to provide the necessary credit inspite of our follow-up. This is infact the major constraint coming in the way of the further progress of local manufacture in addition to the lack of enthusiasm and the initiative of the concerned departments in this province.

SOUTH KALIMANTAN

Axial flow pumps have caught up in this province. Three small fabricators have produced and sold more than 60 pumps, during the last year. Mostly these are being used in the swampy regions during the summer season not only to irrigate the additional crop but also for a novel application of filling

up narrow water canals for the small boat transportation which is proving increasingly more economical and very popular.

Seeing this successful application, the Government of Indonesia is planning to introduce these pumps in the other predominantly swampy areas such as provinces of Jambi, Riau, South Sumatera and West Kalimantan. On the special request of the director general of food crop production we have despatched two axial flow pumps and assisted a fabricater in Jambi to produce these pumps. Recently the central Government has budgeted 200 of such pumps to be distributed for popularisation by the provincial agricultural departments in the above mentioned provinces with large swampy areas.

One of the more active workshops among the above mentioned three units is being assisted to manufacture hand-tractor and paddy thresher.

WEST JAVA

Inspite of our keeness to monitor 25 pumpsets lying with Jati Luhur authority (through World Bank funding) we were simply unable to, since the department has stored them away on the excuse that they donot have the operating budget for them!

However, in addition to one large manufacturer (PT. New-Ruhaak) in Jakarta who have produced more than 300 Pumpsets (as indicated in the production statement) during last year mainly to cater to the Government tenders, one more small workshop in Subang district has produced 6 axial flow pumps and sold to the near by farmers. Infact this district has a good potential for the pumpsets since several rivers criss-cross the district and large areas are under rain fed cultivation.

We have identified one local Voluntary Organisations, Bina-Swadaya (which is working intensively with one Community in a village in this district) to try out the following equipment for a period of one year or so in the farmers fields.

1. 4/5 H.P. Hand Tractor (PT5) with all the attatchments including the trailer
2. Pedal thresher
3. Pedal winnower
4. Axial flow pump
5. Bellow pump

Since this project is short of field staff, we are now looking for well motivated and organised voluntary organisations to introduce the above farm equipment to the small farmers.

We have been able to successfully test and show during the last year the usage of IRRI type hand tractors and the reaper to the Government seed farm. Please refer to the quarterly report (April-June '83) for the details. The management, however, seems more inclined to use bigger size of equipment for their big farm in order to decrease their managerial supervision even at a high cost !

Strategy for the country's farm mechanisation

The Government of Indonesia is now engaged in formulating a longterm development strategy for the farm mechanisation in Indonesia.

We have prepared our sugestions mainly drawing from the experience of our project as an input to the above important task. We are planning to organise a seminar during this year to consider/discuss in depth the development strategy proposals.

Enclosing the project budget for the year '83/84 in Indonesia.

Encl.- Quarterly report
- Suggestions for A Development Strategy of Farm-Mechanisation in Indonesia
- Tractor training in West Sumatera
- ILO proposal

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VRR/TH
Oct. '83

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BUDGET 1983/1984

	1982/1983	1983/1984
Sechedule 1 - Salaries and wages		
a. Local Staff	$ 6,562.33	$ 7,500.-
b. Ditprod personnel	$ 7,194.31	$ 7,500.-
c. Two volunteers (from VSO)	-	$ 6,000.-
Sechedule 2 - Overhead	$ 2,249.66	$ 2,500.-
Sechedule 3 - Fringe benefits and Allowance		
Local Staff	$ 3,667.72	$ 4,500.-
Sechedule 4 - Travel & Transportation		
a. Local Travel	$ 14,062.12	$ 15,000.-
b. Repairs & Maintenance of Vehicle	$ 2,151.99	$ 3,000.-
c. Trip to Los Banos	$ 1,031.39	$ 1,200.-
d. Home leave	-	-
e. Professional trip to U.S.A.	-	-
Sechedule 5 - Equipment, Materials and Supplies		
a. Office rent, supplies & other expenses	$ 8,835.47	$ 10.000.-
b. Machines, raw materials, and shop supplies	$ 16,907.00	& 20.000.-
c. Subscriptions, books & publications	$ 329.27	$ 500.-
d. Shipping & delivery charges for various machines	$ 6,672.63	$ 5,000.-
e. Local purchases	$ 12,000.00	$ 15,000.-
Sechedule 6 -		
a. Training in Pillippines	$ 3,000.00	$ 3,000.-
b. Local training *(Major training programme planned in West Sumatera & Jakarta this year)	$ 841.80	$ *5,000.-
Sechedule 7 -		
Audio visual set (projector slides) to show the progress made by the project (To be prepared by professionally qualified persons)	-	$ 10,000.-
T O T A L	$ 85,505.69	$ 115,700.-

IRRI-DITPROD INDUSTRIAL EXTENSION PROJECT
P.O. BOX 18/KBYPM. PASAR MINGGU, JAKARTA SELATAN INDONESIA TELEPHONE : 782557

April 6, 1983

To : Dr. J.R. Cowan
IRRI-Liaison Scientist

From : V.R. Reddy
Agricultural Engineering Consultant

Subject : Quarterly Report
January through March 1983

T r i p s :

Jan. 22th - Jan. 26th	: To visit Ujung Pandang to monitor Luwu Sub-project.
Feb. 24th - Feb. 26th	: To visit Padang to monitor our project extension work.
March 7th	: To visit Sukamandi with Mr. Bart Duff to discuss about workshop consequency project..
March 9th - March 10th	: To visit Ujung Pandang with Mr. Bart Duff to discuss about workshop consequency project.
March 26th - March 29th	: To visit Semarang, Yogyakarta and Klaten to visit cooperative manufacturers Kubota and Kubota Kwik.

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Received a very disturbing letter from the project leader of Luwu, regarding the performance of our sub-project in Bone-Bone. Immediately I rushed to Palopo and Luwu. The detail report of the trip submitted to USAID is enclosed herewith.

It may be noted from this report that their letter was highly exaggerated in what they have stated to be various short comings. The majour short coming was that our assistant site supervisor after getting married in October, has not been staying at Bone-Bone and attending the job properly.

While this development has created few irregularities and improper functioning of the office, the interest of the farmers in the hand-tractors has not decreased as reported in their complaint letter. On the contrary the number of farmers showing interest in hand-tractors is continuously increasing. The one manufacturer at Palopo who has been assisted to make two hand-tractor units, have been tested successfully. FCC is anxious to take the role of distributor and provide after sales service, and coordinate the credit required from banks to farmers and also assist manufacturer by placing orders in advance.

During Bart Duff's recent visit on March 8, the detail report of this subproject for the first two

seasons was presented. The list of people attended from USAID, Luwu project, BPLPP and DITPROD is enclosed. It has been agreed that under the circumstances, the majour emphasis to be changed from record keeping to the promotion of manufacture and sales of these hand-tractors within Luwu. However, the record collection of land preparation alone from 33 respondents will be continued until the end of the 4th season Sept.'83, by one record keeper who will be working under the supervision of Manager FCC-Bone-Bone. The servicing will be provided by the FCC-on commercial basis. For more details , the detail letter to the head of project Luwu by Dr. J.R. Cowan maybe referred.

Meanwhile two more small workshops were identified in Masseppe and Rappang (in Sidrap district, S. Sulawesi) and were assisted to manufacture TH 6 threshers. After some modifications they will be tested during the coming harvesting season starting from April '83. Also the workshop of DIPERTA at Ujung Pandang has taken up the fabrication of 10 paddy threshers to be distributed to various districts for demonstration purposes. With one gear-box we have sent, this Goverment workshop has built the hand-tractor which was successfully tested at Sidrap. We are planning to assist the workshop in Masseppe to fabricate hand-tractor as the interest in this machine is steadily increasing.

In West Sumatera, the production and sales figures of TH 6 threshers is continuing to increase. The latest count shows 14 fabricators and about 300 threshers in the Province. Now we are focussing our attention to promote hand-tractor in this Propvince. 4 numbers of small hand-tractors gear-boxes have been supplied to three local fabricators for building the hand-tractor and testing with various attachments. Two staff members from IRRI-DITPROD Jakarta have assisted them in fabrication during the 2nd week of March. On the suggestion of Inspector DIPERTA of West Sumatera, we have prepared a note (enclosed) for promoting these hand-tractors on priority basis.

In South Kalimantan, the manufacture and sales of axial flow pumps from two local manufacturers has gone up to more than 30 numbers. During this coming harvesting season , locally manufactured threshers will be tested. We are planning to organise a demonstration of hand-tractor, pump and thresher in one of their districts to be followed up with a meeting consisting of staff from DIPERTA, Perindustrian and Bank Indonesia and BRI.

At Tanjung Barat workshop here, following items have been taken up for fabrication during this quarter

1. Hand Tractor 6-8 HP (Implement)
   - Cage Wheel (modification).....1 pair's
   - Mold Board plow Thai'type.....1 pieces

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- Leveller.....1 piece
- Mold Board plow (modification).....1 piece
- Triangle Harrow..... 1 piece

2. Hand Tracktor 4-5 HP
   - Mold Board Plow ..... 2 pieces
   - Transmission Box..... 1 piece
   - Cage Wheel ..... 2 pieces
3. Transplanter..... 1 piece
4. Grain Cleanner..... 1 piece
5. Jig & Fixture
   - Reaper 1,o m ..... 1 piece
   - Reaper 1,6 m ..... 1 piece

During this period we have taken up the testing of hand-tractor with various attachments at Sukamandi seed farm and transplanter at Tanjung Barat workshop. Not yet satisfied with the performance of transplanter which are locally fabricated. . Continuing with modifications and testing work.

IRRI-DITPROD INDUSTRIAL EXTENSION PROJEC
P.O. BOX 18/KBYPM. PASAR MINGGU, JAKARTA SELATAN INDONESIA TELEPHONE : 78255

May 18, 1983

To : Dr. J.R. Cowan
IRRI-Liaison Scientist

From : V.R. Reddy
Agricultural Engineering

Subject : Quarterly Report
April through June 1983

T r i p s :

April 5th - April 7th	: To visit Padang with Mr. C.W. Bockhop to see the progress of project extention work in West-Sumatera
April 16th - April 18th	: To visit M.I.D.C., I.T.B. and D.T.C. Centres in Bandung.
April 22nd	: To see the field trials (with Sdr. Zaidir) of IRRI equipment in Seed-farm and visit B.P.T.P. at Sukamandi.
April 25th - April 27th	: To visit Banjarmasin with Sdr. Zaidir and Sdr. Suwardi to attend demonstration of IRRI equipment and hold discussions with Provincial Government officials.
May 5th	: To visit B.P.T.P. and see the field trials of IRRI equipment.

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May 3rd - May 4th	:	To visit Puncak to attend the Post-harvest seminar with Mr. Bob Stickney.
May 6th - May 11th	:	To visit Bali to hold discussions with Provincial Government and Bank Indonesia officials who showed interest in IRRI equipment.

Dr. Clarence Bockhop, Mr. Kevin Rushing and myself had a good visit with the Junior Minister of Agriculture Mr. Wardoyo and Director Mr. Jafri Jamaluddin at Salemba. Mr. Wardoyo expressed his general satisfaction with the progress of this project work in Indonesia. However, he expressed due to the general policy of tightening of Government's expenditure this year, the budget contribution from G.O.I. for this project will be less than last year and wanted IRRI/USAID to bear with it.

The Junior Minister expressed the hope that due to devaluation and the Governments policy to decrease imports, the indigenously produced farm equipment should get a spurt in meeting the rising local demand.

He advised us to approach cooperatives in the Provinces whose financial liquidity is being considerably improved due to the recent Government decision and they should be in a better position to purchase the equipment and rent it out to their members.

Visited several cooperative manufacturers in West-sumatera with Dr. Clearence Bockhop. In general their

production and sales are continuing to rise. Three manufacturers have received orders from two dealers to export TH 6 threshers to Aceh, Jambi and Riau Provinces. More than 15 numbers were already despatched and 30 were on order. At the same time the interesting development that has taken place(mainly due to the dealers coming into the picture) is that while the quality of the product has improved but the price has come down due to competition from Rp. 450.000,- to Rp. 300.000,- (without engine). We estimate at this price also there is sufficient profitability(more than Rp. 100.000,-/pce) to the manufacturers.

We met Mr. Nurmawan Inspector of DIPERTA at Padang. He has stressed the need to acclerate the promotion of hand tractors and water pumps in W. Sumatera during the coming months. We have prepared a background note for promoting hand tractors in W. Sumatera, a copy of the same is enclosed herewith. It may be noted.we are planning to conduct a special training programme for fabricating hand tractors by the potential manufacturers in that province.

In South Kalimantan DIPERTA has organised a majour demonstration of IRRI equipment in Kabupaten Hulu Sungai Selatan on April26th. Senior provincial Government and district officials of Agriculture, Industries, Planning (BAPEDA), Bank Indonesia and Bank Rakyat Indonesia along with two of our counterpart staff and myself were present.

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More than 60 leading farmers from nearby districts and three cooperative manufacturers were also present at this occasion. After demonstration of hand tractor, TH 6 paddy thresher, pedal thresher and axial flow pump, discussions were held among those present. Many farmers there seemed quite satisfied with the performance of the equipment that was demonstrated and indicated their readiness to purchase such locally fabricated equipment provided the credit was made available from the Banks. The Bank officials present responded favourably and expressed their willingness to consider few cases to start with in certain potential areas with the recommendations of local DIPERTA officials. Meanwhile Bank Indonesia Consultant has taken all the necessary information from us to make the proposal with feasibility studies. The most interesting development (in Kecamatan Negara of this district) that is taking place is that the demand for axial flow pumps is rapidly rising. Already one local manufacturer there has produced 20 pumps to pump into water channels used for transporting with small boats. This manufacturer has shown his interest in taking up the manufacture of hand tractors also.

During this period 1 meter reaper that has been produced in TAnjung BArat workshop is being tested at Sukamandi seed farm. Also various attachments like plough, puddler, harrow, small trailer(1/2 ton capacity) are being tested with the small hand tractor so that this

unit can be used not only for harvesting but also for land preparation, and transporting also.

At present 4 Agricultural Engineering college students are undergoing practical training mainly in testing of pump, hand tractor, thresher and reaper in preparation for their thesis. Previously six students from I.P.B. Bogor, Gajah MAda University also used our facilities and equipment for their thesis work.

Visited Denpasar on receiving special request from the consultant to Bank Indonesia to advise them with regard to the introduction of IRRI type farm equipment in Bali and Lombok islands. Detail tour report is enclosed.
The main findings of our visit are as following :
In the province of Bali, extention of pedal thresher and pedal winnower is to be taken up on priority. The usage of hand weeders also needs to be popularised as at present mostly hand weeding is done taking more than 3 times the cost and the time to weed. In the two areas where some imported hand tractors are finding increasing use can be encouraged to take up IRRI type hand tractors.

It appears the need for IRRI type farm equipment in N.T.B. is greater seeing the higher wages prevailing and the scarcity of Agricultural labour there. However, for taking up this province also for extention work in addition to the existing 4 provinces, the project needs the consent of G.O.I. and also more staff and more budget.

Leaving Jakarta on May 28th for attending ASAE meeting at Montana and also going on home leave until July 12th'83.

IRRI-DITPROD INDUSTRIAL EXTENSION PROJEC
P.O. BOX 18/KBYPM. PASAR MINGGU, JAKARTA SELATAN INDONESIA TELEPHONE : 78255

September 30, 1983

To : Mr. Walter C. Tappan
IRRI Liaison Scientist

From : V.R. Reddy
Agricultural Engineering Consultant

Subject : Quarterly Report
July through September 1983

Trips

July 27th		: To visit Sukamandi with Sdr. Zaidir (for attending seminar consequences of Mechanisation).
July 28th	- July 29th	: To attend RNAM workshop in Yogyakarta.
August 1st	- August 5th	: To attend seminar and visit Luwu district with Sdr.Koes.
August 22th	- August 24th	: With Sdr. Zaidir to monitor the progress of our project work in West Sumatera.
September 27th	-September 28th	: To visit Subang and Bandung with Sdr. Zaidir to study the potential for IRRI type equipment.

After attending the ASAE meeting (June 26th - 29th) and the annual leave resumed the duty at Jakarta on July 14th.

Attended the series of conclusive seminars (consequences of mechanisation survey) organised on July 27th at Sukamandi, at Maros on August 1st and 2nd and the final one at Jakarta on August 8th. In addition to our active participation in the above series of seminars, we were able to arrange the field demonstations of IRRI type farm equipment at Sukamandi and Maros. This generated considerable interest among the Provincial Government staff including Bhupatis and the farmers'representatives who were present on the above occasions and witnessed the equipment, for the first time. As a result two IRRI hand tractors were specially requested by the Bhupatis of Sidrap and Pinrang (where maximum number of imported mini tractors are operating!) from the DIPERTA of South Sulawesi to be demonstrated in their districts. They are presently being used in the farmers'fields and the initial reactions are quite favourable.

In the above seminars it has come out clearly that there is a definite need for mechanisation for certain agricultural operations (specially for the land preparation and pumping in West Java and South Sulawesi) and

that the imported tractors were not suitable and economical to the local conditions. Also in the final seminar at Jakarta, the need for preapring a national strategy for the future development of farm mechanisation in Indonesia has been stressed.

As input to the above national strategy formulation, we have prepared a paper on "Suggestions for a Development Strategy of Farm Mechanisation in Indonesia" a copy of the same is enclosed. We are planning to organise a seminar inviting the representatives from the various departments/agencies connected with the Agricultural mechanisation in the country to discuss and consider the suggestions made in the above paper.

During this quarter the work plan for building proto-types of farm equipment, their testing and modification work at Tanjung Barat workshop is enclosed. Three more students from ITB & IPB were assisted in their testing and modification work (for their thesis) during this period.

In Luwu, five hand-tractors sold through the FCC to the farmers and three out of the four hand tractors

of REC are being continuosly used for the land preparation and the transportation. The remaining two are under repair at the workshop (Sidodadi) in Palopo. We have assisted this workshop to build two new hand-tractors which are completed. As earlier reported the major constraint now is providing the credit to the farmers. So far more than sixty farmers have applied for the credit to the FCC at Bone-bone to purchase this type of hand tractors with trailers.

We have assisted FCC in preparing the feasibility report to BRI to enable them to provide the necessary credit to the needy farmers. Since then we have approached the BRI officials at Palopo and Ujung Pandang along with the FCC officials, but so far without much success. We are now pleading with the FCC to take the initiative by providing credit to start with at least to the few selected(among their member farmers)so that the enthusiasm/interest generated among the farmers in Bone-bone and the workshop at Palopo is not dampened.

The two paddy threshers manufactured at Massepe and Rapang are under field test under the guidance of DIPERTA officials.

Unfortunately this year no budget has been provided for the DIPERTA staff of South Sulawesi to conduct field demonstrations and to monitor the progress. We are therefore having to provide small budget for one field-trip/month so that this activity does not come to a grinding halt.

In WEst Sumatera the growth of paddy threshers' manufacturing and sales continues to rise rapidly. The last reported figures (as of August'83) are 450 paddy threshers produced by the fourteen manufacturers. Seeing the rising demand of this type of threshers the minister for cooperatives recently announced that the Government will provide funds for 200 pieces to be manufactured and sold to the local cooperatives. As reported earlier these paddy threshers are finding their market in the S. Sumatera and Aceh.

One of the local manufacturer Mr. Asparmin (of Tembok-Jaya) has been sent for the three weeks training at IRRI Los Banos and has just returned. He has also received the Bank Credit from BPD (through our recommendation) about $ 13000 to build new shed and add workshop equipment.

With this growing successful experience, the DIPERTA officials of this province are now enthused to give a push to the introduction of hand tractors during the comming season. Through this project assistance four hand tractors with the attachments were built in their Bukit Tinggi workshop which are now being demonstrated in three Kabupatens to generate the awareness/interest among the farmers. Meanwhile we are preparing the training materials and the necessary hardware etc. required to conduct two-week intensive training (for the local-workshops) in cooperation with M.I.D.C. of Bandung during the month of December '83.

In South Kalimantan the growth of axial flow-pumps is quite encouraging. More than 60 pumps have been fabricated by the two local manufacturers. The second manufacturer is being assisted to build hand tractor and thresher for the first time. One of the DIPERTA staff members Mr.Suhardi has been also sent recently to IRRI Los-Banos for the three week training programme.

In the coming months with the full involvement of this trained staff member, the project activities are likely to be intensified further.

Currently we are building modified versions of pedal-threshers and pedal winnowers suitable for the small-farmers in West Java. Planning to field test them in several farmers'fields during the coming harvesting season. Also we are pushing the use of axial flow-pumps in this province for the rain-fed areas with water resources. In the district of Subang there seem lot of potential for such pumps. Already one small work-shop at Jati Barang has produced and sold six axial flow pumps. We are collaborating with an active non-Government organisation, Bina Swadya to field-test and monitor in West Java pedal threshers/winnowers, Rolling injection planter, PT-5 Hand-taractor with attachments and axial-flow pump with two propellors during the coming year.

In Indonesia voluntary service organisation (supported by the Government of Britain) is very active and has more than 150 young volunteers presently working with the various Government organisations in the country. We felt the need for two volunteers to assist our project, one in Jakarta in building proto-types and developing production aids and the other one for West Sumatera to assist the DIPERTA staff to carry out the local modification work there and in training the local workshops

to increase their quality and productivity. As per their rules the local expenses required for their boarding and lodging and transport which would come to about $ 200/month are to be met from this projects budget to which we have agreed.

The two selected candidates have already come to Indonesia and are now in Yogyakarta undergoing the language training. They will start working with the project from November '83 onwards until August '85. Copy of their bio-data is enclosed.

CC : Mr. C.W. Bockhop

BPPI - DITPROD
MENUJU SWADAYA DAN SWASEMBADA
BADAN PENGEMBANGAN ALAT-ALAT PERTANIAN

SUGGESTIONS

FOR

A DEVELOPMENT STRATEGY OF FARM MECHANISATION IN INDONESIA

BY

V.R. Reddy

(Consultant IRRI)

P.O. BOX 18/KBYPM

Jakarta-Indonesia

September 1983.

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Background Information :

During the final seminar (on August 8,'83) organised by IRRI at the end of its 3 year survey on "Social Consequences of Mechanisation", the need for a national strategy for the future development of farm mechanisation has been stressed and a team has been appointed by the chairman* to prepare the guide lines for a long term strategy and to suggest an action programme for the Government's consideration.

Having gained valuable experience in the implementation of our (IRRI-DITPROD) industrial extension project during the last five years (Since May'78) in the four selected provinces (West Sumatera, West Java, South Kalimantan, South Sulawesi) we wish to put forward our views/suggestions to the above team (as input material) for their consideration in the preparation of development strategy of farm mechanisation in Indonesia.

Learning Approach and not a Blue-print Approach :

In all such centralised planning efforts, there is a tendency to make major and most of the decisions at the top by the few "Knowledgeable" people (at the centre) thus, a blue-print (top-down) approach is most often adopted. As a result, we find many plans (specially in the developing countries) are seldom successful in their implementation. Adopting a learning approach by starting on a pilot/small scale basis has taught us a great deal about the local priorities of equipment and the extension methodology that is more effective.

* Mr. Syarifuddin Baharsja Secretary General of Agriculture-Ministry Government of Indonesia.

This bottom-up approach may seem a slow process in the early stages, but is likely to spread more rapidly and will prove cost-effective, according to our experience.

Choice of Technology :

Again from our experience, to achieve a wide spread effect at the grass-roots level, the technology chosen has to be simpler and be fabricatable locally by a myriad of small workshops spread throughout the interiors of the country. This concept is finding favour with many developing countries. Government of Indonesia also seems now convinced of this approach and has started laying greater stress on local manufacturing programmes, as a national policy.

The next question is what are all the farm tools/machinery that are appropriate for Indonesian conditions. We have made an attempt to list (enclosed herewith) such farm equipment (for food crop-production) indicating their present stage of development and future priorities for different areas of the country.

Determining Priorities :

What are the priorities for taking up the research and development work (until they are ready to be released for

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extension work) and which organisations in the country (like Subdirectorate PAMP or BPTP Sukamandi, BPTP Maros, IPB/ Gajah Mada/ITB, LIPI, M.I.D.C., etc.) can be assigned with this assignment and under what time-frame ?
Here we may add, from our experience, that even after bringing the tested designs and technical detail drawings from IRRI-Phillippines, a lot of modifications and changes had to be made here, in order to use locally available materials, and a completely new set of drawings were made ready for distribution to local manufacturers. In this local standardisation effort, and in making production aids we have taken the assistance of M.I.D.C. Bandung. Infact we have been able to develop a close cooperative working relationship with M.I.D.C. and Provincial Perindustrian offices in training and assisting small workshops in South Kalimantan and West Sumatera provinces.

For determining research and development priorities we feel the above mentioned appropriate farm equipment list needs to be expanded after careful deliberation, specially with the agricultural departments in provinces who are in touch with local farmers and are aware of their constraints and needs. For exemple, we find the first priority now in South Sulawesi is for land-preparation, in South kalimantan for water pumping, and in West Sumatera (after paddy threshers havebeen successfuly introduced) land preparation equipment is needed on priority.

We, are aware that with the limitation of trained man power and financial resources, it is very important to choose the priorities correctly. We found it to be a better strategy to concentrate in few selected priority areas and carry out the extension work in a concerted manner until a "take-off: Sustainable growth" stage is reached.

However, we have to be clear about the criteria and the methodology in selecting priority areas for the introduction of new farm equipment.

A few important factors/reasons that could determine the selection of priority areas are :

1. Actual food crop production compared to the potential of the area. Higher the difference, greater the priority could be.
2. Major constraints, like insufficient availability of labour resulting in high local wages, (as in outer islands compared to inner islands), resulting in large areas of cultivable land not being cultivated (as being reported from South Sulawesi and West Sumatera).
3. To increase the cropping intensity, by decreasing the turn around time between the crops as identified in Jatiluhur irrigation area of West Java, or by providing lift irrigation can increase one more crop (and also assured crop) in swampy areas of Jambi, South Kalimantan and West Kalimantan, etc.

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These are only few examples cited here. For national planning, a detail exercise has to be carried out involving provincial governments to prepare a map showing priority areas and the type of farm equipment required in each contiguous area and their order of priority. To carry out this function satisfactorily, the existing secondary data alone may not be adequate. More detailed economic surveys are perhaps needed, to be carried out in certain potential areas with the help of institutions like Agro Economic Survey at Bogor involving the concerned provincial government staff.

Field Extension Methodology :

The major experience that we gained through our project (IRRI-DITPROD ; ATA 220) implementation has been in developing the field extension methodology to a successful "take-off -Sustainable growth stage", which we think West Sumatera has reached in the case of paddy threshers. In other words, the production and sales of these threshers is continuously expanding there on its own momentum without further assistance /support from the Government or outside agencies. The latest production figures in West Sumatera show that 14 small workshops are engaged in the fabrication which have produced more than 450 threshers (from'79 until August'83) and continuing to increase in geometric progression. Their quality has improved, while their selling price has decreased (from Rp.-550.000,- to Rp. 350.000,- without engine).

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Infact through a few active-dealers, some of the local manufacturers have started exporting their products to the neighboring provinces like Jambi, Riau, Äceh, etc. We are now intensifying our efforts in this province to introduce Hand Tractors with all its attachments not only for land preparation but also for harvesting and rural transportation(with a trailer). This model Hand Tractor with the attachments has started showing promising results in kabupaten Luwu of South Sulawesi. Similarly in South Kalimantan axial flow pumps are gaining momentum.

These cases are mentioned only to show the effectiveness of the extension methodology we have pursued. Briefly the extension methodology that has evolved from our work is as following :

1. Before we introduce any new farm equipment in a new area, it is very important to make sure that the equipment is thoroughly tested and is found suitable under local conditions. Necessary training to operate and repair the equipment is to be imparted to the local DIPERTA staff who are going to be involved in the extension work.
2. Creating the initial demand for such farm equipment is very crucial. For this purpose extensive demonstrations in farmers'fields are to be carried

out initially. We found that due to the limitation of staff and budget in DIPERTA offices, one of the effective ways to create demand is to identify a few progressive farmers/cooperatives in the area(to be popularised)and encourage them to use the equipment for a season or two in their fields and also allow them to lease the equipment to their neighbouring farmers. However, it is important to monitor and support this activity carefully by the staff of DIPERTA. From our experience in West Sumatera and South Sulawesi this creates the chain reaction of interest among the farmers.

In areas where local initiative is lacking, it may be helpful to form commercially oriented public organisations (like P.T. Tani Makmur under Bank - Pembangunan Daerah in West Sumatera) or Non Government organisations (NGO) to hire/lease out farm equipment to needy farmers and later to initiate the local manufacturing process. This may be necessary for example in transmigration areas where the Government feels the need to introduce such equipment to increase the full utilisation of the land allotted and the income of the transmigrants.

3. Simultaneously to identify a few (at least 2 or 3 to start with) potential fabricators (with the participation of Perindustrian staff) in the province

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and assist them technically and financially (by providing a sample and for purchasing the materials) to fabricate the first proto-types. They need to be carefully nursed in initial stages. They should infact be encouraged to lease out the first pieces of equipment to nearby farmers for a season or two under their close supervision so that they learn about few modifications/ quality improvements they may have to carry out in their products. Also this should help them in creating their own market. We have successful examples of this approach in West Sumatera and South Kalimantan.

4. We found two kinds of training for the field extension work useful

   i). For the provincial staff engaged/connected with field extension work in departments like DIPERTA, Perindustrian, Koperasi, Banks, Local Government and also non-government organisations(NGO) which are working actively with the farmers,a training programme for about a week's duration preferably at the centre to be organised. It's main objective is to acquaint the staff with the farm equipment (to be introduced in their areas), and to discuss their feasibility studies and the extension methodology to be adopted.

   ii). The second type of training is for local fabricators at the provincial level. These are to be conducted as detail technical training

programmes lasting for 2/3 weeks, mainly to train them in the fabrication, repairing and operation of the farm equipment, preferably in collaboration with the industries department.

5. Coordination/networking functions with the various concerned agencies can best be done by organising periodically (at least once a year) a field day exhibiting/demonstrating improved farm equipment, to be followed by a group discussion /seminar to exchange useful information both at the centre and at the provincial level.

   At the centre this opportunity can be very well utilised (in addition to informing high Government officials of the various ministries to show the progress made) for networking/coordinating with agencies like Subdirectorate PAMP, Directorate of small industries development, M.I.D.C., B.P.T.P., I.P.B., I.T.B., Gajah Mada, B.I., B.R.I., BULOG, Koperasi, Alsintan, etc. Agenda of such a meeting/seminar/workshop could review the progress made in the implementation work and discuss future plans, priorities and policy recommendations to be made to the National Farm Mechanisation Council (NFMC).

   At the Provincial level such an annual opportunity (preferably on farmers'day, "Krida Tani") can bring the leading farmers'representatives, local manufacturers,

concerned government officials from various departments like DIPERTA, Perindustrian, Bank, Koperasi, etc., face to face and exchange very useful information like the farmers'response and priorities and their difficulties in the popularisation work of the farm equipment. This useful information can be fed back to the Secretariat of NFMC at the centre.

We found one follow up meeting after every seminar/workshop is a very useful exercise to keep up the continuity both at the centre and at the regional level.

6. We feel it is very important to synchronize all activities budgeted through DIP towards specific goals set for the year not only within the department but also between the coordinating deparments. In order to make this point clear, may we illustrate it with an example. If certain number of provinces/areas have been chosen to introduce selected farm equipment on priority basis, the activities of say Subdirectorate PAMP (such as providing materials/equipment, conducting training and guidance visits to the areas, etc.) are directed towards attaining the specific goals, at the same time the other coordinating agencies like DIPERTA, Perindustrian both at the centre and at the provinces should also have similar activities which are budgeted through their DIP. In other words at the time of DUP preparation also, close coordination is required between the departments/agencies of the Government which have to work together to synchronize their activities in the field.

7. We are all aware of the vital role an inhouse Newsletter can play in networking with several agencies/individuals involved in this task. Recently Subdirectorate PAMP has taken the initiative in this direction, and has brought out two issues. In order to make it into a two-way communication media, we perhaps need to up grade it by taking professional advise and assign it to professionally qualified /trained personnel who can devote sufficient time for it. Circulation list in addition to several agencies mentioned above may desirably include PPLS and LKMD in the selected provinces. Well prepared technical brochures/leaflets and service manuals also play an important role in the extension process.

National Policy Making/Coordinating Body :

To prepare the background material/reports for NFMC meetings and to advise them on policy decisions to be taken by the Government of Indonesia, it is essential (as-advised by RNAM) to have a technical committee/coordinating body with a small but effective permanent secretariat (which is yet to be formed). For the integrated and rapid development of farm mechanisation in Indonesia, there is no doubt that this proposed technical committee has to play the key role of a "dynamo" specially in the early stages.

Summary of the above Suggestions :

1. Learning approach through pilot scale trials in the initial stages is likely to be more successful and cost effective than a large scale "Blue-print" approach in the introduction work of new farm equipment at the "Grass-roots"level in the new areas.

2. Choosing simpler technology of farm equipment which can be locally fabricated by small workshops are likely to spread more rapidly in the rural areas.

3. Preparation of a list of farm equipment (at different levels of technology such as manual/animal/power-driven) showing their order of priority which are to be developed/adapted within the country. (detail-note enclosed).

4. Networking the local R & D institutions and guide/coordinate their priorities and their output by the technical committee of NFMC.

5. To prepare a map of the country showing the priority areas for introducing new farm equipment (and-their priority) for taking up intensive field extension work.

6. Socio-economic surveys to be conducted, in order to determine farmers 'Constraints" and the priority needs

of farm equipment and later their impact keeping in view the walfare of small farmers and land-less labour.

7. With the given man power and financial resources available, it is better to concentrate and continue the programme until the "take off-Sustainable growth" stage is reached.

8. Effective field extension methodology that has evolved from IRRI-DITPROD industrial extension project is briefly as following :

   a). Initial farmers'demand is to be created through extensive demonstrations of the new farm equipment being introduced in farmers'fields.

   b). At least 2 or 3 potential fabricators in the selected provinces are to be identified amd assisted initially until their production and sales steadily rise.

   c). Training programme to be conducted one for the provincial Government extension staff (preferably at the centre with the participation of similar provinces) and the other to the operators/repairers/ fabricators of the farm equipment at the provincial level.

   d). Annual field days to be organised both at the centre and at the provinces and conduct group meeting/ seminars not only to exchange useful information, but also to review and evaluate the progress made so far in implementation and in making plans for the future.

e) Synchronizing the activities funded through DIP among the various Government agencies which have to work in an integrated manner is quite essential. (Gudeliness suggested in enclosure II)

f). Professionally a well-done periodical Newsletter as a media for a two-way communication can play a vital role to strengthen national networking and keep up the tempo of farm mechanisation in the country.

9. Formation of a strong technical committee/coordinating body supported by a small permanent secretariat to advise NFMC and to act as the "dynama" in the development of farm mechanisation in Indonesia is the first important step to be taken.

10. The above technical committee to take the initative to prepare the detail plans for the proposed National Farm Mechanisation Development Institute which is essential in view of the increasing important role the farm mechanisation will have to play in the long term development of the country's ecenomy.

Finally a long term plan of this nature to be successful has to be cpntinuous process integrated with its implementation and with a built in feed back loop for continuous renewing and amending the course as it may necessitate.

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VRR/T
Sept.'83

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THE RESEARCH & DEVELOPMENT PRIORITIES FOR THE FARM EQUIPMENT IN INDONESIA

This is an attempt to describe the present status and suggest further research and development work that needs to be carried out on each category (including manual, animal & machine power) of appropriate farm equipment required for the various agricultural operations by the farmers in the country.

I. Land Preparation :

a). Manual :

At present various types of hoes (cangkul) are used in different parts of the country which are produced locally by the hundreds of thousands of blacksmiths spread all over the country. It has been reported that since past several years a fairly large percentage of the country's requirements of hoes are also being imported.

In view of this being a basic implement and that this implement is likely to be used for quite some time to come, it would be advisable to improve the present types and standardise them into fewer types. It would seem highly desirable to encourage the local blacksmiths

/fabricators to produce the desired quality of hoes to meet the full requirements within the country itself.

At the same time it may be desirable to exreriment with a few manually pulled puddlers (gelobak type) to increse the farmer's productivity for the land preparation.

b). Animal Drawn Implements :

Scope for improving and standardising ploughs, cultivaters, puddlers and levellers that are simple and can be fabricated locally also exists. The present trend is to build a basic "tool carrier" which can be fitted with the above mentioned attachments, including a rubber-tyred cart. To our knowledge, no adaptative work in this regard has yet been taken up in Indonesia. It therefore deserves priority, especially in the provinces where animal power is more often used for example in Sulawesi, Sumatera, Bali, Madura, etc.

c). Tractors :

Four to five sizes of tractors are recommended for standardisation in order to meet the entire range of needs of the country.

i). Small light weight hand tractor with 4/5 H.P. petrole/kerosene engine with complete set of attachments (mold board plough, harrow, puddler, including 1,0 meter reaper for harvesting and 1/2 ton trailer for rural transportation.) Four proto-types of IRRI designed models have been built at Tanjung Barat workshop and one in West Sumatera, and they are now under extensive field testing stage. Within a year this model should be ready to be released for the extension work.

Since this model is a multipurpose, simpler, and inexpensive machine (about Rp. 900.000,- including engine and attachments for the land preparation) to build locally, it has great potential to become popular in the various parts of the country, especially for the the terraced rice and vegetable cultivation.

ii). Hand tractor with 6/7 H.P. diesel engine, with a complete set of suitable attachments as mentioned above. This model (IRRI-design) has been used for the extension purposes during the last 3 years. With the assistance of M.I.D.C., standardisation of components using local mate-

rials available along with the production aids was accomplished and the detail drawings are released to the interested manufacturers.

So far about 180 units IRRI type and 650 units Bangkok type (mainly in Java) have been manufactured by about* 10 manufacturers. Presently intensive field extension drive is being under taken (by IRRI-DITPROD Project) in West Sumatera, South-Sulawesi and West Java. However, greater inputs in terms of extension staff and money are required to accelerate and make a bigger impact not only in these three provinces but in the other provinces where the onstraints for the land preparation exist.

iii). Riding tractor (4 wheels) with 16/18 H.P. diesel engine, a simpler and an inexpensive model which can be locally fabricated. This type is being manufactured in Thailand very successfully.

We recommend that some of these models (with various-attachments including a reaper for harvesting and a 3 ton capacity trailer for transportation) are imported for extensive field testing.

* Refer "table progress of manufacture of IRRI designed small equipment in Indonesia" enclosed here.

This tractor type can be manufactured only by the medium sized and fairly well equipped workshops unlike the above mentioned hand tractors which can be produced by smaller workshops. Even collaboration arrangements between Thai-manufacturers and Indonesian entrepreneurs for the local manufacturing programme could be encouraged by BKPM, after these models are successfully field tested in the country.

iiii). Bigger H.P. tractors (above 35 H.P.) probably have to be imported for some time to come. After identifying the suitable types, these could be encouraged for gradual local assembly/manufacturing programmes if there is likely to be sufficient demand mainly by the large plantations, estate farmers etc.

II. Seed Drilling/Transplanters and Fertiliser Applicators :

a). Manual :

1). Proto-types of manually pushed rolling injection planters (RIP) single row, two row, three row have been fabricated at Tanjung Barat, Ragunan workshops at Pasar Minggu and are under field tests by SURIF at Sukamandi and at Lampung in FAO assisted project.

This implement RIP for seed drilling paddy and secondary crops (palawija) looks very promising in sandy loam soils for upland conditions, therefore needs to be

taken up on priority for the extension work (in such soil/crop conditions) specially in gogo-ranca fields and transmigation areas and for seed drilling palawija crops.

ii). Proto-types of manually operated low land paddy transplanters (IRRI-design) have been built and tried out at Tanjung Barat workshop. The modified version is functioning satisfactorily. It needs field testing for one or two seasons in the farmers' fields before releasing it for field extension.

iii). IRRI at Phillippines is presently field testing a few models of manually operated fertiliser placers in wet paddy fields which are showing great promise. Few proto-types of them will be imported and tested here in Indonesia by IRRI-DITPROD project in the near future.

b). Animal Drawn Seeders/Fertiliser Applicators :

Several successful designs of animal drawn seed cum fertiliser applicators for upland soils have been developed and are being used by large number of farmers in India and Pakistan. These models can be imported along with the tool carriers from the above countries (perhaps with the assistance of RNAM) and could be taken up for field testing by SURIF and MORIF.

For low land conditions plow sole fertiliser applicator has been developed by IRRI, which needs to be tested further under local conditions before releasing for extension.

c). Power Driven Transplanters/Seeders/Fertilisers :

For low land transplanters, several high technology and expensive models are available from Japan/Taiwan, which may not yet be suitable for Indonesian conditions. Besides (to our knowledge), it is not yet reported as the major constraint in the country.

For upland conditions, however, there are many successfully tested tractor attachments of different sizes which can be readily adapted for the local needs.

III. Weeders :

a). Manual :

Low land weeders of different types are being used in different parts of the country. Even simple rotary weeders which are found to be quite efficient have yet to be popularised in several parts of the country. A major constraint seems to be that transplanting at present is still not being done in rows in many areas of the country specially in the outer islands.

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We found the cost of hand hoeing (one to three times to be done in the paddy fields during the crop) is quite substantial and sometimes as high as the cost of land preparation (as reported from South Kalimantan). Therefore the introduction of row transplanting and weeding are substantial could be taken on priority.

A successful design of an upland weeder, to our knowledge is still not available. In thailand, however, we believe recently a manuaaly operated upland weeder has been successfully field tested. These drawings can be procedured and after building proto-type and field tested locally, it can be released for the extension work on a priority basis in the areas where the need is felt to be more urgent.

b&c). Animal Drawn and tractor drawn weeder attachments are simple to attach to "tool carrier" and tractor wherever their need is felt.

IV. Sprayers :

a). Hand sprayer :

This type of sprayer is already being used in large numbers in several parts of the country. Also these are sucessfully being manufactured locally by the small-scale industries mainly in Java.

Considering the total area under cultivation in the country, the present number of sprayers being used in the country is still very small. Therefore exists much potential for further field extension work and encourage many more small-scale manufacturers to take up the manufacture of these simple hand-sprayers with better quality. To our knowledge, M.I.D.C. has already taken the initiative to develop the production process with the necessary production aids to train the interested small-scale units.

b). Power Sprayers :

Since the average farm holding size is quite small, the need for the power sprayers is not so large at present. However, for the requirement of estate farms, horticuultural plantations, and to fight the large state insect/pest atlacks during certain seasons, the power sprayers are perhaps required which are presently being imported. Fewer types could be standardised and can be encouraged for the local assembly and manufacture in collaboration with well-known makes as the demand steadily increases.

V. Harvestors :

a). Manual :

Lighter and more efficient hand sickles from Taiwan and Japan have been imported and tried out in the fields.

However, thorough field studies are yet to be undertaken as to the productivity differences and the post-harvest losses if any between the old and the new sickle-harvesting. This new design sickle unfortunately does not lend itself to be manufactured by the local blacksmiths as it needs. special dies and heat-treatment. To our knowledge two units (one in Bandung and the other in Jakarta) have produced the proto-types and gearing up htemselves for the mass production. While this is in one way a desirable development, but at the same time this tendency may add to the under-employment of hundreds and thousands of balcksmiths all over the country. Therefore it would be desirable to investigate if the present type sickles could be standardised and simpler improvements to be incorporated which could be produced by the blacksmiths.

b). Animal drawn reapers are not common because they have not proved economical.

c). Tractor drawn reapers/harvestors, however, are increasingly becoming popular and successful in other countries. As mentioned earlier proto-type of 1 meter reaper attachment for 4/5 H.P. small hand tractor and 1,6 meter reaper attachment for 6/7 H.P. hand tractor have been built at Tanjung Barat workshop and are now under the field testing stage. Within a years'period these will be released for the extension work. A great deal of interest is being

shown from several provinces like West Sumatera, Aceh, South Sulawesi, etc.

VI. Threshers :

a). Pedal type :

Considering that the vast majority of farmers are still threshing and winnowing in the age old traditional manner which is not only less productive (more drudgery) but also causing substantial post harvest losses, the first priority could be given to popularise pedal threshers and pedal winnowers, through out the country and specially in densenly populated inner islands.

These are several designs available (both within the country and from outside) but we believe there is scope to do some more development work to make them more productive, less expensive and simpler, so that they can be fabricated in the Desa by the carpenters/black smiths and are readily accepted by the traditional farmers.

Few proto-types have been built at Tanjung Barat and Ragunan workshops which need to be field tested after minor modifications. After testing them successfully in the farmers'fields for one or two seasons, in view of the present national priority to reduce post-harvest losses a campaign ought to be launched to popularise them (pedal threshers and pedal winnowers) specially in Java/Bali/Madura where the present high unemployment/under employment that exists in their rural areas.

b&c). Animal / Power Threshing :

In certain countries animal trampling is done to assist in threshing, (as also tractors are used) but this practise is neither efficient nor so common.

As mentioned earlier a small thresher (IRRI design, TH 6 model) driven by 5 HP engine has become very popular in West Sumatera and its use is spreading to the neighbouring province of Jambi, Riau, Aceh. As and when the need is felt for bigger threshers, IRRI model TH 8 which has proved quite popular in Phillippines and Thailand, can also be introduced here at a later stage.

VII. Dryers :

Several batch dryers of 1 ton, 2 ton and now 4 ton capacity, are being fabricated in the country commercially. Earlier several proto-types were built by DITPROD and tested in the field conditions. While they seem to function satisfactorily as per their technical specifications, they have not yet proved to be very popular amongst the users (farmers, rice millers, cooperatives etc.). The reasons could be many, being too big and too expensive it may not be yet economical for the commercial use.

It appears to us, the logocal sequence to be followed in this case is first to conduct survey/market research and ditermine if there is a clear need and by whom, for what

capacity and at what price ? Only after that some more hard-ware research and the field extension work could be taken up justifiably.

VIII. Agro Processing Machinery :

In this category, rice milling units are the predominant need of the country and to a great extent it seems to have been fulfilled by the imported small rice milling units. For replacement of imported milling units and for the future expansion locally procedured rice milling units need to be encouraged and included as a policy measure. For the local manufcture, adaptation and standardidation work, the initiative could be taken up by M.I.D.C./Perindustrian department.

IX . Rural Transportation :

a). Manual :

There is a need to improve and standardise one wheel barrows and two wheel carts (manually pushed) that could be popularised in the rural areas. Industries/ transports departments could perhaps take the initiative to build standard models and encourage small industries to produce them in the remote parts of the country.

b). Animal Drawn old carts are changing slowly to old automobile exles with rubber tyres. As mentioned earlier, standart animal drawn "tool cariier" that can be used

for attaching farm implements, can also be used to convert it into a cart. This versatile "tool carrier" with all the attachments deserves to be given greater attention.

c). Tractor trailers are not yet popular in Indonesia. Automobile trucks are very expensive for rural transportation considering the shortage of capital and the condition of the rural roads. Therefore we recommend simpler forms of mechanised transportation like hand-tractor-trailer to be encouraged for short distance haulage both in the rural areas and in the semi urban towns. The cost per ton per KM by the hand tractor-trailer comes to 1/3 of the regular automobile transportation cost. Tractor-trailers are a very common phenomena in developing countries like China, India, Korea, Taiwan, etc.

Our experience in Luwu where 10 hand tractors are used 3 to 4 months for the land preparation and the remaining 8 to 9 months for the transportation of farm-grain, construction materials, etc. is proving to be extremely popular. There is encreasing demand (more than 100 units presently) for such hand tractors with trailers from the district of Luwu alone.

This policy of encouraging such low cost transportation could give a spurt to the local informal sector dealing

in short-distance-transportation and encourage small workshops to take up fabrication and repair work in the rural areas. Therefore we strongly recommend the standardisation of such trailers, and launching a campaign for their popularisation and providing for the availability of credit from the Banks in order to increase the purchasing power of small entrepeneuer/ custom hirers/farmers in the rural areas.

X. Lift Irrigation :

At present two types of pumps (centrifugal type for over and above 4 meters head and axial flow type up to 4 meters head) are commercially produced in the country. Large number of low head pupms are being used presently in the coastal (brackish water) fish farms mainly with the Government supported funding.

Considering the lift-irrigation potential of the country for agriculture the present usage and manufacture of these pumps is rather insignificant. Most of these pumps in the field are donated to the cooperative and the farmer groups by the Government and these too (as we saw them in the field) are not being used optimally.
Therefore the greater priority we feel ought to be in carrying out more vigorous extension work.

As mentioned earlier a map of the country is to be prepared showing the lift irrigation potential and the

suitable types of pumps needed in those areas. In the selected priority areas, intensive field extension work to be carried out by creating the initial demand and simultaneously identifying and assisting small local workshops to fabricate them/ We have a successful example in South Kalimantan where the local fabrication and the usage of axial flow pumps is steadily increasing.

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VRR-Th

Oct'83

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GUIDELINES FOR PREPARING THE ANNUAL* WORKPLANS AND THE BUDGET (DUP/DIP)

I. Proto-type building, testing and modification work

The priority list of equipment to be taken up at the centre and regional centres to be prepared year wise.

Each proto-type needs perhaps approximately 2 to 3 functional tests and 1 to 2 modifications depending upon the complexity and the present stage of designs of the equipment available.

N.B. For budgeting purpose the cost of this development may come to about 3/4 times the cost of the equipment.

II. Sending the equipment to "farmers" fields for the demonstration cum field testing preferably for a season or two with Kelompok Tani/KUD/NGO, etc. (At least 3/4 pieces of the same equipment in to 3/4 areas is recomended). Monitoring atleast once/month by the local DIPERTA officials is essential.

III. To identify and assist atleast 2/3 local manufacturers in the province for the manufacture of the equipment, Perindustrian staff to be involved M.I.D.C. could help in giving production aids, drawings/samples wherever needed.

* (For the various agencies involved in Agricultural Mechanisation in Indonesia such as Subdit PAMP, SURIF, MORIF, Perindustrian, DIPERTA, M.I.D.C., SAE wherever applicable)

IV. 1). Training of the provincial extension staff to be conducted at the centre atleast once/year. One week duration may be adequate. Training material should be prepared before hand, mainly consisting of the feasibility studies of the equipment to be introduced in their areas and the extension methodology to be adopted and the feed back information to the centre.

The training participants to be advised to bring lot of the field information from the provinces such as inventories, local daily wages, costs of agricultural operations, prevailing raw material prices, successful cooperatives/non Government organisations working in their areas, etc.

2). Atleast one training in each selected province to be conducted, mainly for the fabricators-Perindustrian/ M.I.D.C. to take the major initiative and responsibility in organising this training programme. Detail fabrication methods, material lists, blue-print reading, production aids and their quality specification to be taken up. Field operation, repairs/maintenance could be included. Duration may extend 2 to/3 weeks depending upon the complexity of the product..

V. Yearly Seminar (with one-follow up meeting in between) is preferably conducted on a field day at the centre. An exhibition of the locally manufactured equipment, and the proto-type of new equipment under development could be displayed on this occasion. Representatives from the research and development centres, extension staff (including Perindustrian, DIPERTA, NGO, Koperasi), Alsintan &SAE, representative from farmers'organisation etc. are to be invited on this occasion to discuss the yearly evaluation/performance reports from each agency/province involved and deciding the work to be taken up for the coming year.

VI. Since an integrated approach is being recommended for the development of farm mechanisation in the country, it is important to hold annually. DUP preparation cum coordination meeting among the various agencies such as Subdirectorate PAMP, Perindustrian, M.I.D.C., SURIF, MORIF, Provincial DIPERTA/Perindustrian staff.

VII. The budget to be provided for the quarterly in-house news letter and its distribution to all the concerned including PPLS, L.K.M.D. in the provinces. A detail list of addresses to be prepared.

VIII. Socio-economic studies to be undertaken (atleast one in-each of the potential province) each year to determine the priority areas and the priority equipment needed, and also to study the impact of the technology introduced. Agency such as survey Agro Economy can play the leading role in such studies.

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VRR/th
Sept. 1983

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PROMOTION OF LOCALLY MANUFACTURED HAND TRACTORS IN WEST SUMATERA.

Background Information

West Sumatera is facing increasing shortage of Agricultural labour for growing food crops in the province. This is particularly so in West Sumatera because of the customary practice of young men of Minangkabau leaving their 'kampung' to towns/cities and even to other provinces seeking new and better careers. This phenomena (called-'merantau' in local language) is causing higher agricultural wages, now ranging between Rp. 1.500 to Rp. 2.500,- per day, and leaving several *thousands of hectares of sawah land uncultivated in certain areas of the province.

Therefore the provincial Government has been emphasising the need to introduce agricultural mechanisation on priority basis. Infact during '78/'79 a proposal was made to offer about 1.000 imported mini-tractors to cooperatives and leading farmers of the province through soft loans of Bank Rakyat Indonesia. This proposal was, however, turned down by Bank Indonesia due to the sudden increase of tractor prices after the devaluation in 1978. Also from the experience in South Sulawesi, it was found that due to the high cost and shortage of spareparts, and higher skills required for operation and maintenance of these imported tractors, large number of them were found

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* As per the Government and Inspector of DIPERTA of West Sumatera.

under repair and idle.

Therefore the introduction of locally manufactured simpler hand tractors and other small farm equipment seems to be more appropriate choice from a long range point of view and for the real "bottom-up" development process to take place. Comparative cost analysis between locally made hand tractor and imported mini-tractor is enclosed herewith.

The Progress of IRRI-DITPROD project in West Sumatera.

IRRI- designed small farm equipment has been introduced in this province from the year '78/80 onwards. Within the period of last three years, particularly the progress of weeders and paddy threshers'local production and sales has been quite impressive. Infact it is reported that presently more than 14 manufactures are producing paddy threshers. More than 300 threshers thus produced locally are being used by the farmers and most of them are renting to others farmers, as they find it very profitable both for the renter and the farmer using the equipment. Therefore the demand is steadily increasing.

However, the spread of IRRI-designed hand tractors has been delayed due to initial difficulties of getting transmission gear-box manufactured locally with the necessary quality and standardisation. This problem has

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been solved by developing necessary jigs and fixtures and training few local manufacturers in Java. They are now being successfully manufactured and supplied to outside Java provinces.

Out of the three hand tractors manufactured from the improved gear-boxes by DIPERTA workshop at Bukittinggi, one unit was tested during the last season in Muarobono, Sijunjung. They have been able to complete 12 Ha of sawah land ready for transplatation by using for about 180 hours within a period of six weeks. This successful demonstration cum testing has induced immediately about five-farmers in that area to purchase this type of hand tractors.

Plan of Action For Manufacturing Hand Tractors in West Sumatera

In view of the priority to meet the increasing needs of the land preparation equipment in this province, it is suggested a special programme of action be prepared to accelerate the tempo of this local manufacture along the following lines :

1. To identify two/three potential manufacturers (preferably in Kabupatens where need for such hand tractors is greater, for example Kabupaten Agam, Solok, Sijunjung, ...etc.) in addition to Bengkel DIPERTA at Bukittinggi for conducting a special training programme for the manufacture of hand-tractors.

Trainers from IRRI-DITPROD and MIDC will give practical training showing the actual fabrication of entire hand tractor (except engine and standard parts) and its accessories like plough, puddler, trailer, etc. with the help of jigs & fixtures etc. over a period of two weeks or so. One set of jigs and fixtures to be supplied to each of the selected manufacturers to enable them to fabricate in their workshops.

2. Meanwhile DIPERTA to identify atleast two/three more areas like Muarabono in Sijunjung for demonstration cum testing through local leader farmers to create interest among several farmers around there. Those interested farmers can be recomended for getting credit from B.R.I. as per the rules and conditions stipulated in the circular dated July 30, 1981 No.B-2531/KON1981.

In order ti stimulate the demand and accelerate the tempo of this whole scheme, it is important that there are atleast five/six farmers to start with, who are ready to purcase from each of the above selected and trained hand-tractor manufacturers. From our previous experience we feel this initial thrust will create proper climate for continuous growth as is happening in the case of paddy threshers in W. Sumatera . Since the cost of hand-tractor with important attachments like plough, puddler, harrow and one ton trailer will cost the farmer about Rp. 2.0×10^6, the role of Bank Credit is much more crucial than it has been in the case of paddy threshers costing only around Rp. 500.000,-

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Benefits of Local Production of Hand Tractors.

The cost analysis profitability for the manufacture and for the custom work of these hand tractors is enclosed herewith. It may be noted that it is profitable not only for the manufacturer, but to the custom hirer and to the farmer renting the equipment. Further this process will increase the skills of local manufacturers and provide increasing number of off-farm jobs, which as we all know is a necessary sign of economic growth.

Monitoring of The Programme during the Initial Period.

It is very important that during the initial period (may last for 6 to 9 months) proper supervision and technical support is given to both the manufacturers and the users of the equipment until all concerned are satisfied with the quality and performance of these locally produced hand tractors as is happening in the case of paddy thresher's production growth. The team taking this responsibility is suggested to consist of a representative from DIPERTA, Perindustrian, B.I./B.R.I. and IRRI-DITPROD.

In a meeting among these members, detail schedule, activities and additional budget required can be discussed and decided.

VRR/March '83.

**PROPOSAL FOR THE RESEARCH STUDY ON THE DIFFUSION OF SMALL FARM EQUIPMENT TECHNOLOGY IN W. SUMATERA

Back Ground information and justification for the study :

International Rice Research Institute in addition to developing biological technologies for growing High Yielding Varieties of rice, has also developed small farm equipment technology which is simple enough to be fabricated locally in the developing rice-growing countries of the world.

Indonesia is one of the four countries where IRRI industrial extension project (funded by U S A I D) is being carried outin collaboration with the ministry of Agriculture since May 1978 by providing the services of an Agricultural Engineering Consultant.

West Sumatera was the first pilot province chosen to carry out the field extension work since the year 1979/1980. Within these 3 years, more than 14 small fabricators have taken up the manufacture of paddy threshers.
More than *450 paddy threshers thus locally produced in these districts are being custom-hired to several other farmers. This seems to be happening at an increasing rate in some pockets of the province while several other areas are relatively untouched.

** For ILO.
* as on August'83.

In addition to this, another phenomena that can be noticed in this province is a manually operated winnower (costing around $ 75) which is locally developed and fabricated and is quite prevalent in certain areas of the province. This proposed survey would like to focus the diffusion process that is taking place in this province with regard to these above mentioned two pieces of farm equipment :

1. Winnowers through the local initiative.
2. Paddy threshers through the intervention of IRRI-DITPROD project.

Objectives :

1. To trace the history / background information on the development and propagation of hand-operated winnowers and engine driven paddy threshers.
2. To study the differences of some important variables between the users and non-users of the new technology with regard to their social status and Socio-Economic characteristics.
3. To find out the costs of prduction and the profitability of fabricators, custom-hirers, and the user farmers of the above equipment.
4. To determine the roles played by the various institutions and their linkages in the development

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and diffusion of this small farm equipment technology.

5. To find out if there is any socio-economic impact (in these pockets where relatively larger number of this equipment is being used) in terms of employment shifts, income-distribution etc. that can be measured through this study.

6. To identify the nature and magnitude of the constraints in the diffusion of these two implements and what are the farmers'priorities.

Methodology :

In evaluating the effects of introducing new technology into the agricultural systems of developing economies, there are basically four alternative approaches. One of these is the predictive engineering approach. Data is obtained from a detailed study of new technology operations. Of necessity, such studies are very disegregated since they tend to focus on the individual operations, and attempt to synthesize the overall effects of these basic components. As a consequence they may well result in the various inter dependencies in the operating system.

The second approach is comparative cross-section study. The essence of this method is to study a sample of farms that have adopted the particular technology and compare them point

by point with a sample of farms that still employ traditional methods ("with and without" method). While this seems to be a practical way to tackle the measurement problem, a number of considerations are critical to the validity of the method. If the differences are to be ascribed as the effect of new technology, then both groups of farms studied must be essentially homogeneous with respect to all other features. Thus samples tend to be purposively drawn so as to be homogeneous. This way is only valid if the introduction of the thresher/winnower has no effect on those variables in which homogeneity has been identified. It is argued that the very item that distinguishes the two groups, the presence or absence of the new technology, is itself indicative of a much wider range of fundamental but unmeasured differences such that any projection on the observed differences become hostage to fortune.

Another approach is the comparative time series method. It is directly measured by observing the situation prior to the arrival of the new technology and after the one has been adopted and adjusted to ("before and after" method). There are problems to be overcome with this method. First, the availability and accuracy of information relating to the "before" situation. Second, there is problem of specifying when the relevant "before" and" after" situation occured so that the appropriate information can be collected.

The fourth approach is the case study method, consisting of the detailed examination of usually a relatively few farms in the search for the nature and extent of the changes. The data may be collected either on a "before and after" basis or "with and without" basis. Normally the study farms are specifically picked to be "reprsentative" which generally means that the various different types and sizes of farms recognized are represented in the group study. This method is legitimate as a means for gaining an early assesment of program, for identifying hypotheses for more complete test sussequently, and especially for pilot testing in the preparation of a full evaluating study.

Aware of the weaknesses of each method, and considering that the new techniques (paddy thresher and winnower) are still relatively new in the area, the present study will employ the combination of "before and after" and "with and without" methods in evaluating the impact of the new techniques on income and employment aspects. It involves a comparison between before and after the use of the new technique for the users and a comparison between the users and non-users of the new techniques.

Sampling Procedure

The research sites in West Sumatera will be selected through a combination of random and purposive sampling procedures.

First, three districts with the greatest number of threshers will be selected and then a subdistrict in each district, with the greatest number of threshers will be drawn. Finally, a village with the greatest number of threshers will be selected from each selected subdistrict.

In each sample village, farmers using (and not using separately) thresher and winnower (30 samples each) will be drawn randomly.

The employment impact of these technologies will be investigated through two approaches. First, by comparing labor use between users and non users (and before and after using the techniques). Second, by comparing employment opportunities from the laborers who are previously involved in threshing and winnowing operations. For this purpose, 20 labourers will be selected randomly from each group of labor who previously involved in threshing and winnowing activities, respectively.

To evaluate the profitability of fabricators, custom-hireres and repairers of these two implements, the total respondents for each category will be selected randomly. The following table represents the respondents for each sample catagory.

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Table. Sample Size by Category

Catagory	Farm equipment	Total Sample
Workshops Fabricating	Thresher	10
	Winnower	20
Custom hirers of	Thresher	20
	Winnower	20
Workshops Not fabricating	Thresher	10
	Winnower	20
Farmer-Users of	Thresher	30
	Winnower	30
Farmer-Non Users	Thresher	30
	Winnower	30
Landless Labour		60
Total		280

Analytical Procedure

Several techniques of analysis will be employed in this study as indicated by particular objective and the nature of the data.

1. Historical analysis

This method will be applied to trace the history or background information on the development and adoption process of the new technology.

2. Two way table with t-test (student test)

To see the differences some important variables between users of new technology, simple two-way tables will be presented and test them using t-test. These variables are Socio-Economic characteristics, yield, input use, income and employment opportunities before and after introduction of the new technology.

3. Discriminant analysis

This method will be applied to test whether or not the users of new techniques have certain characteristics which are different with ones on the users. These characteristics are age, education, farming experience, assets owned, size of land holding, social status etc.

4. Factor and earner shares analysis

This analysis will be employed to analyze the consequences of the new technology on income distribution between the manufacturer, custom hirer, farmer user and farm labour.

5. Project evaluation analysis

To evaluate the profitability of fabricator and custom hirer, some economic criteria will be employed, These criteria are such as BCR (Benefit Cost Ratio), NPV (Net Present Value) and IRR (Internal Rate of Return).

6. Further to this we will be interviewing the concernet officials of

1. Agricultural Department 2. Industries Department

3. Credit Institutions 4. Dealers

To assess their role in this diffusion process.

In addition to this we will be collecting the relevant secondary data of the province and the facts regarding historical development of these two implements in this province.

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TIME SCHEDULE AND BUDGET

(For ILO Proposed Research Study in West Sumatera)

No,	Activities	# Date of completion	No.of persons (catagory)	No. of days	Estimate Budget
1.	Preparation of draft proposal and questionaries	'83 Oct. end	4 (A + 3B)	5	$ 800,
2.	Colecting data from secondary sources in West Sumatera	'83 Nov. end	3 (B + 2C)	3	$ 200,
3.	Conducting interviews	'84 Mid. Jan	9 (A+3B+5C)	30	* $ 7.000,
4.	Analysis and final-report	'84 March end	4 (A + 3B)	12	$ 2.000,-
	T O T A L				$10.000,-

Catagory of research staff :

	Perdiem :
A. Research Supervisor	$ 50/day + conveyance
B. Senior Research Assistant	$ 30/day + conveyance
C. Junior Research Assistant	$ 20/day + conveyance

* Inclusive of 9 air tickets Jakarta/Padang/Jakarta

\# Provided the contract is received by Oct. end from ILO.

For IRRI-DITPROD
Jl. Rawabambu 13 B, Ps.Minggu

IRRI - DITPROD

V.R. Reddy
Agricultural Engineering
Consultant

For Agro Economic Research
Jl. Ahmad Yani, Bogor

BADAN PENELITIAN DAN PENGEMBANGAN PERTANIAN
Pusat Penelitian Agro Ekonomi

Date: Oct 12, 83

DR. Ir. Faisal Kasryno
Director of the Centre
for Agro Economic Research

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IRRI-DITPROT
MENUJU SWADAYA DAN SWASEMBADA
PROYEK PENGEMBANGAN ALAT-ALAT PERTANIAN

SURVEY OF SMALL FABRICATORS IN WEST SUMATERA

Name of fabricator _____ Enumerator _____

Address _____ Date _____

I. General Information :

1. Type of ownership (Individual/Partnership/Limited)
2. Year started
3. Year began production of threshers/winnowers
   a. If yes, source for taking up the production of thresher/winnowers.
   b. If no, have you ever heard of these products
   c. Are you still interested in taking up these products
4. Did you have thresher/winnower model to copy
5. How well do you/or your employee can read blue-prints
6. Do you give any technical training/instructions at the time of sales

II. Social status of owner :

1. Age
2. Education
3. Property Income
   a. Rice field owned or cultivated _____ (Ha)
      Approximate value Rp. _____
   b. Dry land _____ (Ha)
      Approximate value Rp. _____
   c. Any other property Rp. _____
   d. Yearly income from workshop _____
      " " " Agricultural _____
      And other sources _____
      Total Income _____

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Yearly income from Agricultural _____

Any other source _____

Total Income _____

4. Social-status (Lurah, Kelompok Tani, etc)

III. Production and profitability, etc.

1. List and value of equipment

a. Value of workshop equipment _____

Mention major items of equipment

_____

_____

_____

b. Value of building/sted, etc. _____

Total value _____

2. Number of employee

	Before	After taking up thresher/ winnower product	Payment/Month	
			Before	After
a. Administrative				
b. Production				
c. Marketing/Servicing				
d. Family members from the above				
e. Any Others				
T o t a l				

3. Production cost thresher/winnower

a. Cost of raw materials Rp. _____

b. Cost of labour Rp. _____

c. Cost of administration Rp. _____

T o t a l Rp.

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4. Selling price Rp. _____

5. Number of distribution outlets _____

6. Product promotion through

   a. Dealers
   b. Salesman.

   } If yes, commission paid _____
   _____

   c. Hiring cum demontration, if yes, rental charges ___

   d. Field demonstration (how many _____ units

   since when _____)

7. Number of threshers/winnowers produced

Year	Production capacity	Actual production	Sold	Value sold
____	_____	_____	_____	_____
____	_____	_____	_____	_____
____	_____	_____	_____	_____
____	_____	_____	_____	_____

8. What is the maximum production capacity/month? _____

   _____

   You wish to reach production capacity in next 2 years

Units	Value
_____	_____
_____	_____
_____	_____

9. What other products you wish to undertake? _____

   _____

10. Other job work/production undertaken

	Units	Value
_____	_____	_____
_____	_____	_____

11. Have you made any modifications/innovation in these products ? _____

_____

12. Does this modification/innovation result in

    a. Less fabrication cost

    b. More out put/quality

    c. More durability

13. Percent of sales made for :

    a. Cash (self-financed by farmer) _____ %

    b. Cash (financed by bank) _____ %

    c. Installlment (self-finaced by farmer) _____ %

14. Describe your installment scheme ? _____

_____

15. Do you plan to continue with these prices in the near future ? _____

_____

16. How many are walk-in buyers ? _____

_____

17. What are your problems in selling threshers/winnowers ? _____

_____

_____

_____

18. What complaints do you receive from customers regarding the threshers/winnowers you sell ?

_____

_____

_____

19. Any constraints/problems in production of threshers/ winnower for present production capacity or future expansion, due to

a. Market

b. Capital

c. Skilled labour

d. Raw Materials (mention major items shortage)

_____

_____

_____

20. Any performance guarantee given (at the time of sales and for what period) ? _____

_____

21. What assistance have you received,

	So far	Further assistance required
from DIPERTA/DITPROD	_____	_____
Perindustrian	_____	_____
Koperasi	_____	_____
Bank	_____	_____
Anothers	_____	_____

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IRRI-DITPROD
MENUJU SWADAYA DAN SWASEMBADA
PROYEK PENGEMBANGAN ALAT-ALAT PERTANIAN

SURVEY OF CUSTOM HIRERS

Date : _____

Interviewer(s) : _____

_____

1. Name of equipment owner : _____
2. Name of person interviewed : _____
3. A d d r e s s : _____
4. A g e : _____
5. Number of mambers in the family _____
6. Education _____
7. Rice field (Ha) owned/cultivated _____
8. Number of crops/year _____
9. Dry land (Ha) owned/cultivated _____
10. Any other/property owned _____
11. Total yearly income occupation _____
12. Social status _____
13. How did you first learn about thresher/winnower ?
14. What were your main reasons for buying a thresher/winnower ?
    a. To decrease the cost of operation
    b. To decrease post harvest losses
    c. To save time
    d. Any other
15. Do you know any other person(s)/farmer(s) who own thresher/ winnower ? _____

    Owner : _____ Address : _____
16. Where did you buy your thresher/winnower ?

    ddress _____

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b. Manufacturer's address _____

c. D a t e _____

d. Price _____

e. Did you purchase it by :

Cash _____

Installment (specify) _____

Through financing (specify bank interest rate) _____

_____

Other scheme _____

17. Total hectare(s)/tons and/or machine hours of operation ?

For threshing/winnowing _____ Ha-hours

_____ Ton-hours

18. Capacity of thresher/winnower per hour _____

19. Approximate total number of hours used so far

a. Self

b. Custom work

20. Rental charge _____

21. How many helpers are needed to operate the threshers/ winnower? _____

22. Who were the laborers whom you used to hire for threshing/ winnowing ? (neighboring farmers, custom groups, landless or not, where from, etc.) _____

_____

23. Do you have any problems with laborers who used to do your threshing/winnowing ? _____

_____

24. What do you service most often ? _____

25. What parts have been repaired or replaced ? _____

26. Do you have problem in spare parts availability ? What part(s) ? _____

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27. Does your dealer provides warranty ? How many month(s) or year ? _____

28. Cost of operation of thresher/winnower :

*Yearly repairs and maintenance cost Rp. _____

- Fuels cost/day _____
- Yearly cost _____
- Labour cost/day _____
- Yearly cost _____
- Total yearly cost _____
- Total yearly revenue _____
- Total yearly profit/loss _____

29. Were you taught by your dealer, how to maintain or operate the equipment? Printed manual? Specify? _____

_____

30. What part of the equipment do you think needs to be improved?

Threshing cylinder _____

Cylinder pully _____

Engine pully _____

Axial fan _____

Grain container _____

Idle pully _____

Stripper bar _____

Concave _____

Any others _____

31. Do you want to buy some more units _____ threshers/winnower

32. What other farm equipment do you own ? _____

33. What other type of agricultural equipment would you like to have ?

_____

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IRRI-DITPROD
MENUJU SWADAYA DAN SWASEMBADA
PROYEK PENGEMBANGAN ALAT-ALAT PERTANIAN

SURVEY OF LANDLESS WORKERS AND SMALL FARMERS

Name _____ Enumerator _____

Address _____ Date _____

I. GENERAL INFORMATION

A. Number of years living in the area _____

B. Where did you live before you come to this place ?

1. adjacent Desa (specify) _____
2. other Desa within town (specify) _____
3. other towns within province (specify) _____
4. other province (specify) _____

C. Why did you come to this place ?

_____

_____

D. Household composition

Household members	Age	Education	Residence in the house (days/year)
Husband			
Wife			
Children :			
other :			

E. When was high yielding rice variety (HYV) adopted in the area? _____ What are these varieties?

_____

F. When was thresher/winnower first used in the area ?

_____

G. What was your reaction when a thresher was first used in the area ? _____

_____

_____

H. What advantage has thresher use in the area done to you at present ? _____

_____

II. FARM WORK

A. Do you work in other's farms ? _____

If yes, number of years working in other's farms

_____

B. What kind of cropland do you work most of the time ?*

	Before HYV adoption	After HYV but before thresher adoption	After thresher adoption
Wet season (1st-crop)	_____	_____	_____
Dry season (2nd-crop)	_____	_____	_____

* 1. rice

2. corn

3. Mungbeam

4. others (specify)

If not rice, do you work on riceland sometime ? _____

If there's any change in kind of cropland before and after thresher and HYV adoption, give reasons for change

_____

_____

_____

How much of your harvest was threshed using

mechanical threshing _____%

traditional threshing _____%

If there is any change in farm operation done before and HYV adoption, give reasons for change.

_____

_____

If there is any change in income received before and after thresher and HYV adoption, give reasons for change.

_____

_____

C. Do you as a labourer in :

Land preparation _____days/year

_____

Planting _____

_____

Broadcasting _____

_____

Weeding _____

_____

Fertilizing _____

_____

Spraying _____

_____

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Harvesting _____

_____

Threshing _____

_____

Cleaning _____

_____

Hauling _____

_____

D. How many farmers do you usually help do farm operations for one cropping season ?

	Before HYV adoption	After HYV but before thresher adoption	After thresher thresher adoption
Land preparation	_____	_____	_____
Planting	_____	_____	_____
Broadcasting	_____	_____	_____
Weeding	_____	_____	_____
Fertilizing	_____	_____	_____
Spraying	_____	_____	_____
Harvesting	_____	_____	_____
Threshing	_____	_____	_____
Cleaning	_____	_____	_____
Hauling	_____	_____	_____
Others (specify)	_____	_____	_____

E. Who are these farmers that your family help after thresher adoption ?

of t r	Status of hiring a/	Relation to landless worker/small farmer	Farm location b/	No. of parcels	If many parcels, distance fr. each (km)	Distance of parcels to LW's or farmer's house(km)	Farm oper-ations done c/	Payment receive

a/1 - permanent
2 - regular but not permanent
3- seldon

b/1- w/in desa
2- adjacent desa
3- ather desa w/in town
4- other town

c/1- Land prep.
2- planting
3- broadcasting
4- weeding
5- fertilzing
6- spraying
7- harvesting
8- threshing
9- cleaning
10- hauling

Was there any change in tenant farmers, farm location, farm operations, etc.

If yes, specify change and why?

_____

_____

_____

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F. How are you contracted to work on these farms?

_____

_____

III. NON-FARM WORK

A. What kind of non-farm work do you do and much income do you receive?

Before HYV adoption		After HYV but before thresher adotion		After thresher adotion	
Non-farm work*	Income per season	Non-farm work*	Income per season	Non-farm work*	Income per season

*1- Livestock and poultry
2- carpentry
6- tuba gathering
3- tricycle/jeepney driving
7- rope making
4- storekeeping
8- other business
5- tailoring/dressmaking
9- employment

If there is any change in kind of non-farm work done before and after thresher and HYV adoption, give reasons for change.

_____

_____

_____

IV. EMPLOYMENT OPPORTUNITIES

A. How much of your family's income come from-

	Total share	Landless woarker or small farmer's share	Family's share
Other people's farm	____%	_____%	____%
Non-farm	____%	_____%	____%
Own farm (if small-farmer)	____%	_____%	____%

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B. Do you have enough work on other people's farm or are you looking for more work ?

1-more than enough

2-enough work

3-looking for more work

4-don't know

C. Do you feel you are fully employed or not ?

	Before HYV adoption	After HYV but before thresher adoption	After thresher adoption
1-Yes fully employed	_____	_____	_____
2-Sometimes	_____	_____	_____
3-No, not fully employed	_____	_____	_____
4-Don't know	_____	_____	_____

D. If work is available, would you like to work more ?

1-Yes

2-Sometimes

3-No

4-Don't know

E. What kind of work do you prefer ?

1-tilling own farm

2-Work as hired laborer

3-factory work

4-Office work

5-Business

6-Others(specify)

F. Aside from work, what other income earning activities are you capable of doing ?

_____

_____

V. SOCIO-ECONOMIC PROFILE

A. What are your plans for your family in the future or what do you aspire to own in the future ? Or what do you need to develop your own livelihood ?

_____

_____

_____

_____

B. Whenever you are in need, whom do you go for help in this kampung ? _____

_____

C. Aside from threshing and land preparation, what other farm operations would you like to be mechanised and why ?

_____

_____

_____

VI. FOR SMALL FARMERS ONLY

A. Are you a thresher user ? _____

B. Number of years in farming _____

C. The farm :

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Parcel no.a/	Area(ha) Total	Cultivated	Rice	Land scope b/	Source of water c/	Tenure d/	Land rent

a/ parcel division based on distance or tenure of farms

b/
1-submit
2-plateau
3-plain
4-WW

c/
1-gravity
2-pump
3-rainfed

d/
1-owned
2-A.O.
3-leased
4-tenanted
5-sub-tenanted

D. How did you acquire your present farm ?

1-from own parents
2-from parents of spouse
3-arranged with landwner directly

4-arranged with another tenant
5-bought ownership of the land
6-bought cultivating right
7-others (specify) _____

E. Crops grown :

1st crop _____

2nd crop _____

3rd crop _____

F. If grow first and/or 2nd crops only, what are your constraints to increasing cropping intensity ? _____

_____

G. If thresher user, did the use of thresher helped increased cropping intensity on your farm ? _____

If yes, how _____

_____

_____

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IRRI-DITPROD INDUSTRIAL EXTENSION PROJECT
P.O. BOX 18/KBYPM. PASAR MINGGU, JAKARTA SELATAN INDONESIA TELEPHONE : 782557

May 18, 1983

To : Dr. J.R. Cowan
IRRI-Liaison Scientist

From : V.R. Reddy
Agricultural Engineering Consultant

Subject : Bali Tour Report

Left for Bali on May 6th evening flight. On May 7th morning, met Mr. Marcel Boegaerts, consultant to Bank Indonesia in Bali at the hotel. He took me to DIPERTA office and introduced me to Mr. Tenaya, inspector of DIPERTA.

Mr. Tenaya informed me that there are two districts, Tabanan and Singaraja where due to shortage of labour, the need for farm mechanisation is greater. The total area in Bali under Sawah is about 98.000 Ha and more than 60 % is cultivated two times/year and 90 % of area is using H.Y.V. of paddy. There are about 1.200 subaks, (farmer groups) which are unique in Bali only and are known for their effectiveness in not only controlling water distribution but also other agricultural inputs. According to DIPERTA records, as on '81 ending they have about *300 Hand Tractors, 20 Mini Tractors, 1000 Water-pumps, 400 pedal threshers, 1.550 Rice mills.

* Most of them are in Tabanan and Singaraja districts.

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Mr. Rakka Mulyan Adi, officer of DIPERTA looking - after mechanisation has taken me to Desa Kapal near Denpasar to visit their seed farm and repair shop for hand tractor nearby. The field survey for post-harvest losses conducted by this group has revealed that threshing losses alone are up to 3,5 %. Their major priority area now is to decrease these post-harvest losses through extention. Their seed farm had two imported hand tractors, two IRRI-type paddy threshers manufactured by Kobuta, Yogya, one pedal thresher and one winnower. Except for the hand tractors, the above equipment was not being used.

We then visited small repair shop Bakti Pertiwi and met the owner Mr. Nyoman. He had one lathe machine one drilling machine and one electric welder. He had 5 hand tractors which came for repairs from farmers of that area.

He seemed very confident young man and already made plans for expanding to manufacture and sell farm equipment. He showed great deal of interest to manufacture IRRI type hand tractors and threshers. Finding him a very potential candidate for our assistance, on the recommendation of DIPERTA, we have supplied him 'Memorandum of Agreement'. After he fills up the form, we shall be sending the technical drawings and other information he requires.

Since Mr. Lulu Yusuf, Managing Director of Bank - Pembangunan Daerah had come for a meeting to Bali from Mataram, I had to cancel my visit to Mataram. I and Mr. MArcel Boegaerts had a very good visit with him on May 9th at Pertamina Cottage. He shows great deal of interest in the entire range of IRRI type farm equipment. According to Mr. Yusuf, Lombok is very short of labour and that is why their daily wage for Agricultural labour is around Rp. 3.000,-/day.

Since most of the Agricultural operations like land preparation, transplantation and harvesting are carried out simulataneously during peak seasons there is a marked shortage of labour during such periods. One of the units, Bank Pembangunan Daerah promoted Wisaya YAsa is already manufacturing some agricultural tools and other engineering equipment. He recommends that this unit be provided the technical information and training to take up the manufacture of IRRI type equipment. However, after discussing various details, it has been decided that Mr. Yusuf will discuss with the Governor of N.T.B. and will coordinate with DIPERTA and Perindustrian to send a team to visit Jakarta and see our facilities and also discuss with DITPROD officials for including N.T.B. as one of the provinces to take up field extention work.

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of IRRI type small farm equipment technology.

We visited interior areas of Tabanan and Singaraja on May 11th to get some information from the farmers in the field and also met few potential manufacturers. We were able to collect the following information from the farmers in the field.

The hand tractors operating in the area are generally in great demand and they are renting out for Rp. 45.000,- to Rp. 50.000,-/HA. Some of the custom hirers are owning more than two hand tractors and find them quite profitable. However, after recent devaluation the cost of imported hand tractors has further increased, therefore showed greater interest for less expensive locally manufactured IRRI type hand tractors. Traditional bullock ploughing comparatively costs up to Rp. 80.000,-/Ha. The cost of pair of cows is around Rp. 300.000,- and can cultivate 15 are/day (4 to 5 hours only) and need to plough 4 times ready for transplanting. Threshing capacity of each person/day in traditional manner is around 50kg and the wage paid is Rp. 1.500,-/day.

To start with, it seems more appropriate for Bali is to introduce improved pedal threshers and pedal winnowers. We have given the sketches showing the dimensions of improved pedal threshers which are now being used in Central Java.

The DIPERTA official has indicated that they will build few proto-types and show demonstrations during the coming season.

We also visited a small workshop in Singaraja, 'Kelana' and met the owner Abdillah Hery. He has already manufactured threshers mainly used for local variety paddy and supplied to local rice milling units. The quality of these threshers were not found up to the mark and they were not under use in a rice mill unit, which we visited later. He, however, shows great interest to take up manufacturing of IRRI-type farm equipment provided the demand is created.

We recommend Bali will do well to take up the extention of pedal thresher and pedal winnowers as first priority.

The usage of hand weeders also needs to be popularised as at present mostly hand weeding is done taking more than 3 times the cost and the time to weed.

In the two areas where some imported hand tractors are finding increasing use can be encouraged to take up IRRI-type hand tractors.

It appears the need for IRRI-type farm equipment in N.T.B. is greater seeing the higher wages prevailing and the scarcity of agricultural labour there. However, for taking up this province also for extention work in addition to the existing 4 provinces, the project needs the consent of G.O.I. and also more staff and more budget.

THAI-IRRI Cooperative Machinery Project

(Semi-Annual Report for USAID, 1 Sept. '82 - 28 Feb. '83)

A. First half of Third Fiscal Year

The December, 1982 Semi-Annual Report remains an up-to-date status report for this project, with the following exceptions :

1. Anusarn Company, Chieng Mai, has built 600 rotovator attachments over the past six years, including 150 during the calendar year, 1982. The attachment consists of three assemblies of four spring steel blades mounted on each power tiller axle, in lieu of cage wheels. An adjustable depth gage is provided.

The design was furnished by personnel from the Thai-IRRI cooperative project. This has not been reported previously because the production was unknown until it was shown at a demonstration at Chieng Mai on January 19.

2. Work was started on a buffalo powered water pump in mid-January. The engineer and counterpart believe that a unit of this type may be beneficial to farmers, particularly in the northeast. The buffalo would be utilized in the off season, after the paddy fields are worked. The farmers with a suitable water source, such as a shallow well or a stream, would benefit from irrigation with virtually no cost for energy.

Pumps of this type are used in India, Pakistan, and other countries. Formerly they were used in Europe and the U.S. A double opposed piston pump for buffalo power from India looks attractive. It operates at 30 rpm and has a capacity of 7 lit/sec., which will provide 15 cm of water to 1/6 ha in approximately 10 hours of operation.

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3. The Khon Kaen plow firm built 20 improved buffalo plows in the last half of 1982 which increases the 1982 total to 55 units.

4. A Nakhon Sawan firm built 15 improved buffalo plow moldboard assemblies since 1 January, 1983. Ten of them are the narrow upland unit and 5 are the wider paddy plow. Three companies have now started production of this design.

5. It was recently learned that a small shop has started commercial production of the cyclone seeder. The number of units built is not yet known.

B. Review of progress, 1978-1982

It is appropriate to reflect on project progress at this time. The June and December semi-annual reports for the two calendar years compares the numbers of producers and total IRRI design machines built.

	Year			
	Producers		Machines	
	1978	1982	1978	1982
Axial Flow Thresher	10	28	1,919	9,490(a)
Portable Thresher	1	1	16	1
TH-8 Thresher	-	1	-	-
Power Tiller	3	-	122	-
Rotovator att. for Power tiller	1	-	60(est)	150
Improved Buffalo Plow	-	2	-	35
Batch Dryer (2 T & larger)	-	2	-	4
Extendable Lug Wheel	-	1	-	14
Reaper	-	1	-	1
Grain Cleaner	-	1	-	1
Total	14(b)	38		

a. The 1982 production estimate was 28% less than in 1981 because of low farm income and drouth or flood problems.

b. One firm built two items.

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C. Looking Ahead

1. Promotion of New Designs to Farmers and Manufacturers.

Eighteen different designs have been furnished to some manufacturers at their request. The axial flow thresher is very well established and the extendable lug wheel for power tillers is built by one producer. The buffalo plow has been introduced by three firms and it is expected to gain momentum in 1983. In addition to one prototype reaper reported, another firm has ordered material for a prototype and a third company plans to produce an initial lot of 5-10 units on a PT-5 power tiller. The 2 ton batch dryer design has been started at two firms and production is expected to expand. Production of the TH-7, TH-8, and portable grain cleaner were limited prototypes during the period. With only seven present development projects not yet completed, it appears appropriate to increase emphasis on promotional and extension activities among farmers and manufacturers.

Purchase of a limited number of nine items from manufacturers who have blueprints should increase the interest of producers in these items. They will be loaned to various organizations who would use them, and demonstrate or loan them for farmer use. The organizations would furnish feedback to the cooperative project. Assuming this activity proves of value, it can be expanded to other designs in the future. The initial program would be within the limit of the machinery component of the third fiscal year budget. Most of the costs are based on quotations received.

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Machine	Number	Est. Total
1. Reaper, 1.0 m & PT-5	2	฿ 20,000
4 HP B & S engine	2	5,000
2. Reaper, 1.6 m	1	8,000
3. PT-3	1	7,000
7 HP B & S engine	1	4,000
4. Upland Seeder, 3 row	3	10,000
5. Land Leveler, 2 m	3	6,000
6. Improved Paddy Plow	10	2,500
7. Upland Hand Weeder	20	6,000
8. Paddy Weeder	20	8,000
Total ($3,340)		฿ 76,500

Distribution is anticipated to :

1. Selected rice and upland crops experiment stations
2. Department of Extension
3. Thailand farmers association
4. Thai-Netherlands I.D.P., Mr. Winai Sri-Amporn, Agricultural Engineer
5. Interested volunteer organizations
6. Other.

2. Forecast for the Future. It is anticipated that most, but not all of the IRRI designs would be accepted in significant numbers by Thai farmers. Continuing the project and increasing the promotional activity, as indicated earlier, should result in several of the designs being commercialized. If the cooperative project was terminated now, it is predicted that only a few designs would find acceptance.

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A UNDP representative recently suggested that there should be a coordinator group, committee, or individual to monitor activities of the three bodies who are now in cooperative farm machinery developments with the Agricultural Engineering Division (AED). The IRRI engineer feels that there has not been a lot of duplicative effort. However, he agrees with the UNDP individual, because the Technical Committee appears to be dominated by one cooperator.

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THAI-IRRI AGRICULTURAL MACHINERY PROGRAM

Semi-Annual Report July 1 - December 31, 1982

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THAI-IRRI AGRICULTURAL MACHINERY PROGRAM

Semi-Annual Report July 1 - December 31, 1982

1. Staff

a. IRRI

The Cooperative Agricultural Machinery Program included four full time personnel from July 1 - December 31, 1982 as follows: Ray Fischer, Associate Agricultural Engineer; Kriengsak Sirichaimanus, Senior Research Assistant; Juthaporn Charoenpravat, Secretary; Vacharachai Pumarin, Junior Engineer; and Chalit Chuensombat, Technician. Suwit Bunyawanichkul resigned from his position as Senior Research Engineer on November 30 to accept an assignment at Chulalongkorn University.

b. Agricultural Engineer Division (AED)

Jaruwat Mongkoltanatas, Head of the Workshop and Service Section; and Chak Chakkaphal., Head of Research and Testing Section provided guidance that reflected Ministry policies and priorities, as well as valuable consultation. Prasarn Kradang-nga returned from leave on October 26 and rejoined the cooperative project. Supasit Sngiamphongse, a recent graduate of Kasetsart University was assigned to the project on a full time basis on July 27. Assistance was provided by other engineers. Jaruwat and his people fabricate the components and machines required for field test. Chak provides technicians as required for testing and research activities.

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2. Training

A. Thai Training Course

A six day training course in cooperative project designs was presented in Thai language on September 13 - 18, 1982. Manufacturers of IRRI designs who had not attended prior courses and young agricultural engineers who are in a position to promote farm mechanization were invited. The following were represented in the course this year:

Manufacturers of Axial Flow Thresher	8
Producers of Improved Buffalo Plow	2
BD-2 Dryer Fabricator	1
Manual Transplanter Firm	1
	12
Agricultural Engineering Division Engineers	3
Department of Extension Engineer	1
Asian Institute of Technology	1
	5

Manufacturer Trainee Data

No. Firms	Owner or Mgr.	Education, Years, %				No. Employees	
		6-	6-12	12+	NA	Range	Ave.
12	8	33	50	-	17	3-90	22

The 1980 trainees recommended a longer course so this year it was extended through Saturday. The extra day provided time for presenting the reapers and the new small power tiller. The course content was as follows:

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	%
Farm Machines	33.8
Demonstrations	16.7
Field Trip	16.7
Production Engineering	13.0
Business Subject	12.5
Opening and Closing	7.3
	100.0

A hand-out was prepared in Thai language for most of the presentations. Many of them were translations adapted from those used in the Agricultural Engineering training course at Los Banos. The entire staff devoted approximately three weeks to this activity, which is why it is held on alternate years.

All trainees were given a questionnaire to determine if the course filled their needs and was effective. The results, as well as verbal responses, were generally favorable. An examination was also given at the end of the course. This course should be given at least once every two years.

b. Los Banos Agricultural Engineering Training Course

Setsamut Tonskun, representing a thresher manufacturer in the Northeastern region, attended the course during December 6 - 17.

3. Project Activity

A. TH-8 Thresher

A perforated sheet has been installed in the straw discharge housing, with the objective of reducing the separation loss in soybeans and sorghum,

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which was mentioned in the previous report. This modification requires a declining sheet under the perforated housing, to transfer seeds that are separated at this point to the upper cleaning sieve. Space for accommodating a suitable transfer sheet is very limited, which resulted in trash plugging between the perforated and transfer sheets on initial tests in rice. New modifications are ready to try. The feasibility of this modification should be determined as soon as tests can be run in the relevant crops.

B. Cutterbar Reaper

1. Blueprints for the 1.6 m reaper have issued to a total of 8 manufacturers. None of them have started limited production. More firms have expressed an interest in the smaller 1.0 m reaper, to date. The principle reason given for this preference is that the Chinese reaper is established in this size. They are advised that the IRRI design belt drive unit does not require a power tiller with a P.T.O. outlet, and it could therefore be made available to farmers at a substantially lower price.

2. A set of 1.0 m reaper blueprints has been given to an aggregate of ten manufacturers. One firm has built a prototype from IRRI blueprints, except he has extended it to 1.2 m. It is ready for test.

C. Manual Transplanter

Other activities have delayed the resolution of the root washed seedling version of the five row transplanter.

Some additional manufacturers have recently expressed a desire for mat type seedling blueprints. They feel they can successfully launch the machine in their area. Blueprints have been furnished to additional

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firms in the past six months. Promotional emphasis has increased on the mat type machine. A successful demonstration was given at Pattani Station in the south on October 28 and at the Northern Agricultural Center, Chieng Mai, on December 24. Each of these demonstrations was preceeded by instructions to station personnel on starting mat type seedlings. The seedlings were subsequently started by the local people. The demonstrations of the IRRI design were the first successful ones in Thailand, when the mat seedlings were started by non-engineering personnel.

D. Upland Seeder

Drawings on the three row upland seeder are about ready for release to fabricate one unit in the AED shop, after which prints will be available to manufacturers. This smaller unit is a low cost buffalo powered seeder that is intended for use primarily in the northeast.

E. Paddy Seeder and Cyclone Seeder

An August controlled seedling test comparison at Klong Luang Rice Station, between the paddy seeder, cyclone seeder and hand broadcast was harvested in December. The paddy seeder produced a yield, adjusted to 14% MC, 11% higher than hand broadcast. Yields from hand broadcasting and cyclone seeding in this test and in a Huntra trial were virtually the same.

F. Paddy Leveler and Tine Harrow

Both mechanical transplanting, paddy seeding and cyclone seeding trials have indicated a need for a leveler. One unit of a paddy leveler and tine harrow has been built by modifying a Pakistan design. The frame is triangular

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in shape and constructed of wood. Steel tines on one side are for harrowing paddy or upland. When the unit is inverted it will function as a paddy leveler. The initial test as an upland harrow indicated additional weight is required. A weight box is suggested which can be removed for paddy use. Animal power was used in the first test.

G. Four Wheel Drive Tractor

A 1.6 m IRRI reaper has been mounted on this tractor, which was produced by coupling two power tillers. A reverse traction drive needs to be incorperated prior to testing. The front engine will drive the reaper and the rear engine will propel the machine. The steering clutches on the front tiller should be disengaged to avoid operating the reduction drive by rotation of the front wheels.

H. Power Tiller

The reverse propulsion drive for the PT-3 is being installed. A caster wheel and riding attachment for use with the 1.6 m reaper will soon be released for fabricating one unit in the AED shop.

4. Survey of Manufacturers

More than 70 farm machinery producers were contacted for this year end report. Total employment and production has declined from 6 and 12 months earlier. Some larger firms did not reduce production soon enough in the declining market of the first half year and accumulated excess inventory.

A number of managers report that the demand for their products is much less than a year ago. However, some of the small to medium size firms indicate their business is better than in 1981. A thresher manufacturer in

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Korat demonstrated his machine in several provinces during the irrigated crop harvest. This promotional activity significantly increased his thresher orders for the main rice crop and his sales were better than in 1981. Manufacturers generally are not inclined to pursue such extension programs.

A producer of a 1.2 m Chinese reaper reported that the demand for reapers has regressed. Some farmers complain that on a windy day the windrows are blown and scattered, resulting in difficulty in gathering and bundling. Also when the paddy is flooded, some of the heads may fall between the stubble and get wet. These objections may be minimized if a custom operator would not cut all of one farmer's paddy at one time. If he has work for a few farmers in a given area, he could cut a portion of each farmer's crop and rotate from one to another until all the rice is windrowed. This strategy would reduce the time from windrow to gathering. The reduced purchasing power of farmers in 1982 also reduced the demand for reapers.

Guidelines for manhours required to fabricate parts and assemble one machine are considered to be working out well for threshers, power tillers and Thai tractors. (Reference the December, 1981 report). It is believed that they provide a more accurate total of country production than the production data supplied by factory managers, which was used prior to 1981. Some first half year production figures were revised because some firms had reduced the hours worked per week.

5. Manufacturers of IRRI Designs

Designs available from the Thai-IRRI cooperative project were built by 33 firms in the last half of 1982. Five of them started limited production

of a new design and one built a prototype of two machines. One firm is building an initial lot of 10 two ton batch dryers; 3 of them were completed near the end of the year. He fabricates metal bins, which he considers comparable in cost to wood construction. Another company with IRRI BD-2 blueprints expanded the design to 8 tons capacity and sold it to a group of farmers. Performance is satisfactory. Some rice mills had expressed an interest in a larger dryer; a source now exists. A new producer of the improved buffalo plow completed 27 units. The firm that started production in the first half plans to build 750 improved plows for the 1983 season.

Region and Company	Produced					
	AFT	Plow	Dryer	Reaper	Cleaner	Ext.Lug
Metro Bangkok						
Farm Yuthana	x					
Pramual Kolakij	x				(a)	
Thai Seng Yont	x					
Yontrakumpanich	x					
Other Central Region						
Banpong Utsahakum						x
Jakkawan Tractor	x					
Jongpradit	x					
Panit Borikarn			(a)			
Pitakyont	x					
Somchai Karnchang	x					
Sahakarnyont	x					
Sompis Karnchang	x					
Vichaiyont	x					
Thunyawiswakum	x					
Yontpradit	x					
North						
Gor Rungruang				(a)		
Kaset Pattana	x					
Kunasin	x					
Nakhon Sawan Tractor	x					
Prateep	x					
Sri Sa-nga Yont	(a)					
Uppakorn Kaset	x					
U-Thavin Panich	(a)		(a)			

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	Produced					
Northeast	AFT	Plow	Dryer	Reaper	Cleaner	Ext. Lug
Chor Karnchang	x					
Mee Karnchang		(a)				
Settakit Karnchang	x					
East						
Chinnadit	x					
Chit Panich	x					
J. Chaidee Panich	x					
Kaset Pattana	x					
Pusri Panich	x					
Roongroj	x					
Talay Thong	x					
Number of producers	29	1	2	1	1	1

(a) indicates first production.

6. Estimated 1982 Production of IRRI and Other Machines

July 1 - December 31, 1982

	IRRI DESIGN						Other	
Region	AFT	Plow	Dryer	Reaper	Cleaner	Ext. Lug	P.T.	Tractor
Metro Bangkok	1,060				1		3,305	75
Other Central	965		3			7	3,595	1,775
Total Central	2,025		3		1	7	6,900	1,850
North	55		1	1			700	150
Northeast	90	27					400	
East	3,100						6,450	
South	5							
Total	5,275	27		1	1	7	14,450	2,000
January - June	4,215	8				7	25,045	4,530
1982 Total	9,490	35	4	1	1	14	39,495	6,530

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7. Estimated Total Production of IRRI Designs

	Reported Prior to '81	Estimated 1981	Estimated 1982	Total
Axial Flow Thresher	8,557	13,180	9,490	31,227
Portable Thresher	21	1	1	23
Power Tiller	2,184			2,184
Transplanter	16	2		18
Upland Seeder	1			1
Paddy Seeder	38			38
Dryer, 1 Ton	37			37
Dryer, 2 Ton			3	3
Dryer, 8 Ton			1	1
Diaphragm Pump	16			16
Ext. Lug Wheel		13	14	27
Improved Buffalo Plow			35	35
Portable Cleaner			1	1
Reaper			1	1

8. Machinery Exhibits

The cooperative project participated in six exhibits during this period. Field demonstrations were made during the Chieng Mai exhibit; and AIT and Klong Luang Station for the training course in September.

a. Haad Yai in south. July 19 - 23.

b. Chulalongkorn University, Bangkok, UNESCO meeting. August 16 - 18

c. Kasetsart University, Bangkhen. October 1 - 4.

d. Chulalongkorn University. October 28.

e. King Mongkut Institute of Technology. December 3 - 7.

f. Northern Agricultural Center, Chieng Mai. December 24 - 25.

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9. Status of Thai-IRRI Cooperative Project

Blueprints on eighteen designs are now available, and are in the hands of some manufacturers. In addition to the axial flow thresher which is well established, prototype or limited production on nine other designs has started since 1980. Blueprints have been distributed to one or more firms on the 1.6 m reaper, PT-5, paddy weeder, upland weeder, inclined plate planter, paddy seeder, cyclone seeder and axial flow pump. The depressed machinery market in 1982 was not encouraging for manufacturers to introduce new products.

Test and development activities are continuing on the riding attachment for the PT-3 reaper application, four wheel tractor, transplanter for root washed seedlings, combination paddy leveler-harrow, and TH-8 modifications for crops other than rice. With somewhat reduced development activity, increased emphasis on the promotion of some of the completed designs among farmers and manufacturers appears feasable.

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THAI-IRRI AGRICULTURAL MACHINERY PROGRAM
REPORT MARCH 1-AUGUST 31, 1983

1. Staff

a. IRRI

The IRRI expatriate engineer and two research assistants have departed. Juthaporn Charoenpravat, secretary was exchanged. The coorperative agricultural program included three full time personnels from March 1 to August 31, 1983 as follow: Kriengsak Sirichaimanus, Senior Research Assistants; Naruemon Chaikittiratana, Secretary; and Chalit Chbensombat, Technician.

b. Agricultural Engineering Division

Chak Chakkaphak Thai government counterpart provided guide lines for the project work plan. Jaruwat Mongkoltanatas, Head of the workshop and Service Section, provided people and facilities to fabricate the components and machines. Prasarn Kradang-nga and Supasit Sngiamphongse was assigned full time with the project from AED.

2. Training

Dr. Winit Chinsuwan, Head of Agricultural Engineering Department Faculty of Engineering, Khon Kaen University and Mr. Chalermsak Bomrungthai, Assistant manager of Lim Ching Seng, Agricultural Equipment Factory were selected for the Agricultural Engineering Training course held at Los Banos on July 25-August 12

3. Project Activity

The direction of project activities was according to the work plan discussed on March 7 by Mr. Chak Chakkaphak, Mr. Jaruwat Mongkoltanatus, Dr. Ben R. Jackson, The IRRI respresentative and other senior engineers

who concerned with the project.

The project emphasized some machines for small farmer mechanization in Northeast, Thailand. The following activities were performed.

3.1 Machine development and testing

a) One row animal seeder

The feature of the inclined plate planter was used to design a one row animal seeder. The hopper, seed plate, driving/ covering wheel were reduced the size and attach to the rear of conventional buffalo plow bean. The buffalo plow was replaced by a small opening furrow. From preliminary tests, it was found that uniform seed metering and good covering was obtained for unplowed lose soil but planting in a straight line and uniform spacing was not maintained.

b) A two row seeder.

An animal tool bar was designed to replace the inclined plate planter tool bar. General performance of the seeder is acceptable however a straight row and uniform spacing is difficult to maintain.

c) Buffalo plow

Demonstration and testing of the improved buffalo plow, both large and small radius moldboard were conducted in five district of the Northeast. The purpose of the demonstration was show better performance compared to the native plow. Some native plows similar in shape to the improved plow were found in the market. Five pair of improved plows were given to five stations for extension purposes and one pair of the improved plow was sent to the IRRI-Burma project for evaluation.

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Eighty plow were produced by two manufacture during this period.

d) Direct paddy seeder

Reports from a farmer indicated the planting with a seeder can increase yield 23% more than by the hand boardcast method. The farmer planted 38 rai with seeder and 10 rai by the hand boardcast method. Two men can plant 12 rai per day with the seeder compared to rai by hand. Fifteen paddy seeders were order for extension purposes.

e) Inclined plate planter.

The performance of the planter was found superior to other experimental planter develop by AED. Two planters was fabricated by AED for the Rice Division and CIMMYT, Asia Regional Maize Coordinator. A prototype was sent from a manufacture in the north to the project for testing and evaluation. Five planters will be ordered for extension purposes.

f) IITA punch planter

An automatic feed punch planter was developed from the early American design of hand-feed "Jab planter". Demonstration of the planter was carried out in 3 Northeast locations and 5 districts in the North. This simple inexpensive unit seems to have potential in this area. Blue prints will be completed and distributed to interested organizations in the future. Ten units are being fabricate by AED.

g) Cyclone seeder

Farmers show considerable interest in the inexpensive cyclone Seeder. The gear drive mechanism appear to be a main problem for a small shop to build. A modified belt drive unit is costly, not compact and difficult to operate.

h) Batch dryer

The two ton Batch dryer was used for drying 22 tons of paddy by a farmer in the Minburi area. Performance was reported as satisfactory. Rice mill is very plased with the paddy dried by this unit. The farmer can sell the dried paddy for 25% more than wet paddy.

3.2 Demonstrations

The cooperative project demonstrated selected machines at each of the following locations.

a. Khao Hin Sorn, King project, Prachinburi, June 25

b. Chum Pae Rice Station, Khon Kaen, July 5

c. Prae Rice Station, Prae, July 14

d. Northeast agricultural centre, Khon Kaen, July 20

e. Appropriate Technology Associate, Korat, August 19

3.3 Exhibitions

The cooperative project exhibited machines at each of the following locations:-

a. Chum Porn Rice Station, Chum Porn, March 11-14

b. King Mongkut Institute of Technology, Bangkok, June 17-20

c. Prae Rice Station, Prae, July 14

d. Northeast agricultural centre, Khon Kaen, July 20

e. Appropriate Technology Associate, Korat, August 19

4. Extension Machines

The following machines was ordered from manufacturers for extension purposes.

- 20 large curvature improved buffalo plows
- 20 small curvature improved buffalo plows
- 15 light weight paddy seeder
- 10 IITA-IRRI rolling injection planter
- 20 Upland weeder
- 5 Inclined plate planter will be ordered in the near future when modified blue prints are finished
- 20 Paddy weeder

Blue print distribution:

Twenty-seven sets of blue prints were distributed to manufacturer and Agriculture Organizations as follows:

a. Thresher TH8 1 set

b. Upland seeder 1 set

c. Cyclone seeder 5 sets

d. Paddy seeder 6 sets

e. Buffalo plow 3 sets

f. Two ton Batch Dryer 2 sets

g. Rice Hull Furnance 1 set

h. Rotary Injection pl ıter 1 set

i. Transplanter 1 set

j. Paddy weeder 2 sets

k. Extension lug wheel 1 set

l. 6 inch Axial flow pump 1 set

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ACTIVITIES IN BURMA IN 1982

MEETING OF INDUSTRIAL EXTENSION ENGINEERS

NOVEMBER 21-22 1983

BACKGROUND

The current or second phase of the Canadian funded IRRI-Burma Cooperative Project differs from the first phase as far as the Agricultural Engineering content is concerned, but the plant breeding and the farming systems programmes are a direct continuation of the first phase.

During the period of the first phase agricultural engineering was mainly concerned with the Agricultural Machinery Department in Rangoon, who were provided with equipment, materials and training, and the principle was to manufacture, without wasting too much time on testing and evaluation, so as to get the implements to the farmer as rapidly as possible. There was not the concern over convincing farmers that they should purchase, because the agricultural machinery department sends the machines out to the farmers fields and operates them. In the case of the rice transplanter 7000 have been constructed and operated by tractor drivers trained in their use. There is no charge to the farmer. If any farmer wished to purchase, it is, said that the cost of a transplanter would be Kyat 900 ($ 120).

Under the second phase, the project is directly related to ARI, the Agricultural Research Institute which is based at Yezin, 250 miles north of Rangoon. The emphasis is on hand or animal powered equipment, encompassing non rice crops within the rice based cropping system. There is a greater stress on evaluating suitable indigenous and imported machines. Where necessary modifications or improvements are made to indigenous or imported machines. For instance there are various improved types of ploughs and seeders for animal draft in isolated areas of the country that could be more widely adopted.

Here it should be explained that Burma has a shortage of manpower which is critical at the peak periods of planting harvesting and threshing. There is not sufficient fuel or cash available to the farmers to use fossil fueled machines. There are many buffalo and oxen which have increased the area ploughed and cultivated, and increased paddy production, through intensive mechanical and hand planting of improved varieties, and the use of fertilizer.

Paddy production has increased considerably due to improved varieties and fertilizer. A greater area is ploughed and cultivated but the problem comes with the inadequate manpower and fuel for the increased volume to be reaped, threshed and dried, especially with the earlier maturing HYVs. The consequence is that the crop stands in the field too long before being cut, and has to wait for manual, animal or perhaps motorized threshing. There is little possibility of drying or storage of the grain. With the alternate wetting and drying, both undue cracking and poor colour are only too apparent leading to a surplus of rice that could otherwise be exported. There is therefore the need to develope animal drawn reapers and animal powered threshing. Never the less Burma looks to the future when fuel and cash is more readily available, so improved fuel powered equipment is not forgotten.

Burma abounds with village craftsmen (the wood workers) producing implements and high quality furniture. Plywood is available but is expensive owing to the high cost of glue. There are many species of hard wood, not all are heavy. Wheel making is of high quality and generally of two types - the heavier larger farmers ox or buffalo cart and the lighter "gari" wheel for horse pulled passenger use. The latter are rubber tyred and allowed on the road but the ordinary metal rimmed wheels have to keep off the tarmac roads. Beams and yoke pins are turned on a lathe. The ox

or buffalo cart is the main means of transport for the farmers paddy, sugar cane, timber and other products and for road making materials etc. Normally they are drawn by two animals, except in some areas, notably higher areas with plentiful forage supply producing larger animals in better all year round condition, in which case single animals are used for hauling and field work.

Ox cart axles can be of wood but more popularly are made of forged railway line.

The animal drawn plough is one of the most important items. It is made of wood and has similarities with the middle eastern and Chinese triangular and quadrangular ards. Wooden ploughs are cheap and long lasting but it is increasingly difficult and deleterious to forest supplies to get the "all in one shapes". Many types of Burmese wooden ploughs have been collected at ARI with the object of finding out which has the most value in ploughing efficiently and requiring less exotique shapes of timber. Perhaps a greater contribution can be made in spreading the use of mouldboard plough shares with replaceable points, as this is where better ploughing and with less effort can be obtained.

This brings us to the competitive village foundry business producing a great variety of cast iron items, with considerable skill. Plough shares, pulley wheels, sewing machine castings, ox cart axles, engine blocks and cylinder heads, oil expellers and so on. Scrap iron is used together with raw iron ingots produced from the Government iron or mine. Carbon is added. Sand moulds are finished off with graphite. All equipment and tools are hand made, such as bellows or blower, crucible and hand tools. Techniques could be improved along with the iron/carbon mix.

A further small business is the blacksmith/metalworker who builds and repairs similar to say the Poying shop at Los Banos but smaller. Electric welding is available but gas is not.

In Rangoon there are larger shops well equipped but with ancient machines. Some may have been producing tin cans, and had their own machines for fabricating jigs and dies. Now there is only a very small demand from the canning industry. Such a shop turns over the support machinery for fabricating. The machine that produced oil cans handles now makes the treadle thresher rounded wire for the drum. Other machines are fabricating new machines. Scrap Road Rollers 4 ft in diameter are purchased and mounted in a lathe and turned down to be used in paper pulp making and polishing. Other heavy machinery is produced such as foundry stamping mills and dies, but the same workshop will produce the smallest item.

It is this kind of workshop that we find most useful and we can get equipment such as the fertilizer applicator, briquette making machine or axial flow pump fabricated. Anything that can be cast, is better made that way because of the availability of scrap, and Burmese produced iron is available in ingots. Sheet metal is more of a problem, but there is a vast stock of 44 gallon oil drums that are flattened out and made into thresher, childrens pedal cars, and numerous other items. A great deal of metal is purchased from brokers and is in the form of armour plating, gun barrels and other scrap from the last war. No vehicles are scrapped, they are reconditioned or rebuilt time after time. Vehicles cannot easily be imported and are liable to 300% duty.

There is some legal importation of raw materials that can occassionally be purchased from government by registered cottage industries. But normally most supplies are purchased on the black market that have been imported from India, China or Thailand. One or two people have turned to plastics, and because of its weight can be more cheaply and easily brought into the country overland. Some knapsack sprayers, seeders, plastic buckets etc. have been made by injection moulding.

CURRENT WORK PROGRAMME

Under the IRRI-Burma Cooperative Project Phase II (IBCP II) the Canadian International Development Agency (CIDA) have provided funds to increase multiple cropping through the

1. Use of modern, high yielding short duration rice varieties.
2. Development and use by farmers of machines to speed up rice planting and harvesting.
3. Development and adoption of multiple cropping systems.

As far as agricultural engineering is concerned, the conditions expected at the end of the project will be - "that the numbers of different types of project developed machines used by farmers increases." Specifically it is stated that there should be introduction, adaptation of machines to reduce turnaround time in the multiple cropping system. Furthermore it is intended that some hundreds of transplanters, reaper windrowers and threshers are in use by farmers.

The actual project plan as agreed by the Government of Burma interprets this as follows.

Number of field equipment to be designed and tested per year.

Item No.	Particulars	Years I	Years II	Years III	Total
1	Tillage implements	1	1	1	3
2	Animal-drawn implements	1	1	1	3
3	Hand farm tools	1	1	1	3
4	Sowing/seeding machine	1	1	1	3
5	Fertilizer applicator	1	1	1	3
6	Field crop threshers	1	1	1	3
7	Water pumps and irrigation equipment	0	1	1	2

The number of personnel needed to fully accomplish these objectives are summarized as follows.

Minimum number of counterpart personnel needed for small-scale farm mechanization and their assignments.

Number	Designation	Assignments
1	National Counterpart, (Ag. Engineer, at least DGM)	Counterpart of the Agri. Engineer. He has to attend to the overall planning and programming of research activities on small-scale farm mechanization in accordance to national economic program
1	Full-time Deputy Counterpart (AGM)	To help Ag. Engineer in the detailed programming of research activities on small-scale farm mechanization
1	Full-time Research associates (Bs. Ag. Engineers, DAGM)	To carry out the design and oversees the construction and testing of implement prototypes.
2	Junior Research Officer	To carry out field testing of the implement
10	Auxilliary Personnels (draftsmen, welder, machinists, carpenter blacksmith, tractor operators)	To carry out the physical aspects of the design, construction and test of implements prototypes

ORGANIZATION OF AGRICULTURAL ENGINEERING

Our small scale farm implement research working group was formed and approved by September and had its first meeting on 5th October. The group comprised:

U Arthur Mundt Dy. Asst. General Manager Yezin	President
U Thein Win Dy. Asst. General Manager Extension, Rangoon	Member
U Kyaw Shinn Asst. General Manager Yezin	Member
U Mya Thein Agricultural Mechanization Dept. Rangoon	Member
Mr. M. M. Hammond Agricultural Engineer ARI, Yezin	Member
Dr. R. K. Palis C. S. Agronomist ARI, Yezin	Member
U Than Shein Dy. Asst. General Manager ARI, Yezin	Member

Of these only myself U Mya Thein and U Than Shein are engineers. U Mya Thein completed his M.S. course at IRRI early this year and eventually he will be transferred to ARI Yezin. He will be a very useful member. U Than Shein unfortunately has other commitments on water and electricity supply and maintenance as well as tractor and motor vehicle maintenance and repair. However in spite of this progress has been made due largely to U Arthur Mundt and his drive. He is an agronomist but very mechanically minded. Through him, and a trainee AMD engineer attached to me to learn English, and the assistance of the rice.

division, we carried out an evaluation of the IRRI hand transplanter and the development of other equipment before the working group was formed.

Fortunately we had the benefit of a carry over from the first phase of a small workshop Dr. Palis started for cropping systems. This we have been able to use and fills the gap from the start of the project in June, and until such a time that we get other premises, equipment, materials and staff. The consequent comparatively low level of work has fitted in with the other duties as team leader and the time consuming work of specifications, quotations and ordering equipment for the project as a whole. None of this ordering so far has been for our agricultural engineering equipment. However contacts with other agencies have enabled us to use their surplus funds for buying some engineering equipment and tools. After April 1984 the Equipment Control Committee allows us to purchase machines, tools and materials.

SELECTED EQUIPMENT FOR DEVELOPMENT RESEARCH

In our working group our choice of equipment for development has been determined by the following parameters- shortage of fuel, materials, labour, the bottle necks, and the need to speed up turnaround time in the multiple cropping system. What is also important is that we contribute to the improvement of rice quality.

At the moment we do not have an agricultural engineering division within ARI. Legislation will eventually allow one to be created.

TILLAGE AND ANIMAL DRAWN IMPLEMENTS

Our project tasks have commenced under animal drawn and tillage implements by designing a single tine animal drawn slit seeder. At the moment a tine has been made and requires a pull of 120-140 kg at a depth of 8". The aim is minimum tillage or direct seeding and hopefully to penetrate the plough or puddle pan. We have very little information to go on, but it is hoped that more knowledge can be gained on this, with the help of Dr. Woodhead and the Yezin Chemist Division. A penetrometer is being purchased and some trials will be laid down. Basically the problem is this, especially in the dry zone, follow on crops after paddy have to be planted as quickly as possible to utilize residual moisture, and if possible to allow roots to penetrate through the pan.

Under tillage implements the IRRI power tiller is to be modified to carry a 6 hp Kubota diesel engine. This is the only engine manufactured in Burma. (by Government under licence)

Wooden ploughs and harrows from various parts of Burma are being examined. There are areas where implements that have already been improved and could be spread to other areas, with perhaps some of our own improvements incorporated. Under hand farm tools a simple draw Dutch hoe has been produced and is being copied by village blacksmiths. The weeder and star wheel soil aerator has been made at Yezin and copied by village blacksmiths.

SEEDER

There is a great need for animal drawn seeders that will speed up planting and ensure better germination and survival of the seedling, e.g. broadcasting, ploughing and harrowing in of groundnuts often means a poor plant population. Improvements have been made to the animal drawn multirow harrow with a seed box mounted above driven by a land wheel. Peanut, wheat, sessamum and other crops can be sown. Most of the construction is wood.

The feed roller is interchangeable according to the kind of seed. There is not much damage to the seed because seed is lifted over from a trough of seed rather than being carried out between the roller and the seed box edge.

FERTILIZER APPLICATOR

The IRRI type prilled 2 row applicator with auger feed appear to be satisfactory. It has been used by cropping systems. The main complaint is its rate of application which is too high at 85 lb/acre. They have overcome this by mixing the fertilizer with sand. We now have had an applicator copied by a shop in Rangoon with two different rates of application 26 lbs and 52 lbs per acre. The size of the drive wheels has been altered, and the pitch of the auger changed with a rod inserted in the centre. Advice on other methods of reducing flow but at the same time having a regular flow would be appreciated. This is a very satisfactory machine.

HAND RICE TRANSPLANTER

There was a need to evaluate the transplanter because there was a general feeling that it was not working so well as expected. In the first phase the aim was to take an implement and not waste time evaluating but to get it into mass production as soon as possible. By and large this has worked well enough.

At first, although there were 6-7000 transplanter in Burma, and new machines with AMD, we could not get a transplanter to test until midway through the planting season. An old machine was found and put into working order. When we eventually obtained two new machines on loan from AMD the immediate finding was the lack of quality control. Welding was poor, fit of working parts too sloppy and thickness of working and wearing parts too thin.

Some modifications had been made to the original IRRI

design e.g. a free-wheel was substituted for the ratchet system, but there is too great a delay in changing direction of the travel of the tray, which does cause misses. A longer stroke on the operating arm is required. It is noted that K.S. in hig report or 14th January/82 changed to the free-wheel. We may change to a pawl and pinion.

The seedling mat does not have a reliable downward travel and changes were made to the angle, paint surface, and watering of the matt. If the mat moves steadily downwards there are less missed hills.

Pickers were not very accurately made or mounted, misses and floating seedlings were frequent. Improvements have been made. One farmer in Mandalay has constructed his own transplanter with an extra action of the pickers. They plant move up 2" then travel backwards and finally upwards. This results in less floating seedlings.

The seedling mat is mainly grown using the wood double frame method. Using bamboo has not been satisfactory. The usual method of cutting through the roots between the two frames has been adopted. The full report on our testing and evaluation has yet to be written up. It was hoped that yields could be included. This is not going to be possible since the crop has not had a fair chance. The field work was started before the agricultural engineering working group was formed and before any permanent allocation of land, fertilizer or labour was possible. It should also be stated that the land preparation prior to planting was not up to farmers standard. In spite of this the report will show this transplanter to be very satisfactory particularly, when our recommended improvements in manufacture and modifications are carried out. This is a machine that will be more widely adopted and there is a great deal of expertise in Burma on its operation.

REAPER

The IRRI reaper is in use at C.S. sites, but otherwise no developments to report. It was suggested under the last phase that the mounting could be changed to use the Kubota Diesel engine. This is produced in Burma and used at other times of the year for boats and canoes and for driving pumps.

In order to be more economical it is has been requested that we consider a reaper that can be mounted on the front of the Burmese power tiller.

If drawings can be found an animal powered reaper (without binder) will be constructed because of the shortage of fuel. If no drawings can be obtained construction will carried out from our own design.

THRESHER

There was some development by AMD under the first phase. They produced a light engine driven thresher for mounting on, or transported on an ox cart. This thresher will be evaluated this season. The TH7 and TH8 models are being used on C. S. sites and will also be evaluated. It is probable that will get some TH7 models made. The lightness for hand carrying to fields is important.

Because of lack of fuel treadle threshers will be constructed. Various departments have requested quantities and arrangements have been made to construct 600 in private workshops.

WATER PUMPS & IRRIGATION EQUIPMENT

There is a real need for low lift pumps. Either for draining out water before harvesting or for irrigating. We anxiously await the low lift high volume axial flow pump that I requested last May. Operators or purchases of these pumps will drain or irrigate an area in exchange for the fish that will be

filtered out. This easily pays for the black market fuel at three times the government price. These pumps will be constructed privately at first before Government (AMD or Heavy Industries) can accept the manufacture.

Blue prints of the PU4 and the PU5 axial flow pumps have just arrived. It is hoped that these pumps can now be fabricated locally. We also anxiously await the low level high volume axial flow pump, with drawings. If we are any slower in producing this pump other government departments may beat us to it.

TRAINING PROGRAMME

Two AMD Trainees joined the first 1983 Agricultural Engineering Course.

We are behind hand with sending trainees overseas. Five scholars, one of whome is an engineer, were selected in 1981. It is hoped that he will be starting his M.S. course in January 1984. We are at this moment waiting for the written letter of acceptance. Four Nondegree trainees were supposed to be on this present agricultural engineer training course, but the selection may not be completed in time.

One of the greatest problems is to find engineers for training, within the Agricultural Research Institute, so that we are obliged to select from AMD which is not building up agricultural engineering expertise within ARI, U Mya Thein (AMD IRRI MS Graduate) is still not working with us although the promise is there.

The lack of English further reduces the availability of suitable candidates. There is seldom the breathing space in which to give English tuition. The availability of scholars is further reduced by the Governments 40 year age limit and the stipulation that most people are not allowed out of the country more than once a year. This has stopped me sending U Arthur Mundt on the short course because I want him to go on a longer postgraduate course, he is over 40 so excluded from a degree course. Since his degree is in agronomy and not engineering he needs a course tailored to this. I think Silsoe can provide this.

The recent parameter laid down by IRRI for nondegree training is questionable and does not fit in with the Burmese situation. IRRI should review the position. This new criteria would exclude our trainees.

CONCLUSION

In Burma we are contracted to the Agricultural Research Institute at Yezin which is primarily concerned with development, without the means at the moment of manufacturing, except in wood on a small scale. Therefore it is necessary to involve the small private shop. On the other hand the CIDA funds judge the success of the projects in hundreds of machines in use by the farmer. To enable the quantity of machines to be manufactured either we revert to AMD or Heavy Industries, or to private industry, which would mean making materials available to the private sector.

The private shop is often favoured by Government departments and the authorization is given for the supply of materials, or they might be registered as a cottage industry or cooperative. We find that there are several departments, Agricultural Extension, Applied Research, Trade & Cooperatives who have ideas on improved agricultural equipment, but their efforts need coordinating. Burma is full of inventivness but needs guidance. For instance they endeavour to copy machinery from photographs brought back from IRRI. This makes it important that we get prototypes and drawings as soon as possible even before they are normally ready for release.

Lastly, Cropping Systems, or Farming Systems Research is invaluable to us and our testing and evaluation program. They also important because of the future farming systems in Burma and the future higher level of mechanization, and the need to produce the implements for the non rice crops.

Malcolm M. Hammond
November 17, 1983

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AID-492-CA-1707
Statement of Expenditures and Commitments
For the three years ending August 31, 1983
(In US $)

	Actual Expenditures 09/01/80 08/31/82	Actual Expenditures 09/01/82 08/31/83	Total	Commitments up to 08/31/83	Total Expenditures & Commitments	Approved Budget*	Balance
1. Salaries and Wages	$403,473.63	$232,330.48	$ 635,804.11	$ 28,975.14	$ 664,779.25	$ 829,360.00	$164,580.75
2. Overhead	52,629.17	28,660.88	81,290.05	16,432.50	97,722.55	120,840.00	23,117.45
3. Fringe Benefits and Allowances	213,952.02	95,045.64	308,997.66	39,031.34	348,029.00	637,280.00	289,251.00
4. Travel and Transportation	113,196.42	73,187.15	186,383.57	13,028.58	199,412.15	291,730.00	92,317.85
5. Equipment, Materials and Supplies	107,891.17	53,048.19	160,939.36	12,727.42	173,666.78	237,000.00	63,333.22
6. Training	34,352.36	12,021.33	46,373.69	6,916.67	53,290.36	94,780.00	41,489.64
7. Studies	-	-	-	-	-	73,000.00	73,000.00
8. Workshop	-	-	-	-	-	40,000.00	40,000.00
Total	$925,494.77	$494,293.67	$1,419,788.44	$117,111.65	$1,536,900.09	$2,323,990.00	$787,089.91

*Total approved budget for the period September 1, 1980 to August 31, 1983.

AID-492-CA-1707 (Phil. Headquarters)
Statement of Expenditures & Commitments
For Three years Ending August 31, 1983
(In US $)

	Actual Expenditures						
	09/01/80 08/31/82	09/01/82 08/31/83	Total	Commitments up to 08/31/83	Total Expenditures & Commitments	Approved Budget*	Balance
1. Salaries and Wages	$295,369.32	$182,917.96	$478,287.28	$20,386.30	$498,673.58	$ 567,610.00	$ 68,936.42
2. Overhead	39,671.46	20,728.86	60,400.32	12,904.70	73,305.02	83,400.00	10,094.98
3. Fringe Benefits and Allowances	196,427.05	84,743.89	281,170.94	36,410.12	317,581.06	528,640.00	211,058.94
4. Travel and Transportation	16,161.25	15,496.96	31,658.21	876.70	32,534.91	71,050.00	38,515.09
5. Equipment, Materials and Supplies	951.65	2,566.98	3,518.63	3,144.48	6,663.11	52,000.00	45,336.89
6. Training	21,950.01	918.37	22,868.38	543.75	23,412.13	18,000.00	(5,412.13)
7. Studies	-	-	-	-	-	15,000.00	15,000.00
8. Workshop	-	-	-	-	-	40,000.00	40,000.00
T o t a l	$570,530.74	$307,373.02	$877,903.76	$74,266.05	$952,169.81	$1,375,700.00	$423,530.19

*Total approved budget for the period September 1, 1980 to August 31, 1983.

AID-492-CA-1707
Phil. Headquarters
Schedule of Expenditures
For the period September 1, 1982 - August 31, 1983

Schedule 1. Salaries and Wages	
a. Senior Staff	
June 1982 - July 1983	$164,834.41
b. Local Staff	
September 1982 - August 1983	18,083.55
	$182,917.96
Schedule 2. Overhead	
June 1982 - February 1983 (Senior Staff) July 1982 - March 1983 (Local staff)	$ 20,728.86
Schedule 3. Fringe Benefits and Allowances	
a. Senior Staff	
1. IIE Perquisite August 1982 - July 1983	$ 33,460.43
2. Educational Allowance School Year 1983 - 1984	4,631.72
3. Housing & Utilities Allowances August 1982 - August 1983	23,889.41
4. Post differential Allowances August 1982 - August 1983	7,183.35
5. Medical Allowances September 1982 - August 1983	214.00
6. Insurance and others September 1982 - August 1983	550.07
	$ 69,928.98
b. Local Staff	
1. Cost of Living Allowances September 1982 - August 1983 (Exc. July 1983)	$ 6,665.17

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2.	Social Security System (SSS) August 1982 - July 1983 (Exc. February 1983)	$ 669.60
3.	Retirement Savings Plan (RSP) September 1982 - August 1983	1,641.41
4.	Medical & Dental Allowances September 1982 - August 1983	119.80
5.	Insurance September 1982 - August 1983	68.98
6.	13th Mo. Pay, Leave Credits and others September 1982 - August 1983	5,649.95
		$ 14,814.91
		$ 84,743.89

Schedule 4. Travel and Transportation

a.	Local travel August 1982 - August 1983	$ 4,134.09
b.	International Travel	
	- US & India - June 27 - July 1, 1982	$ 3,949.21
	- India - March 2 - 11, 1983	2,123.50
	- US - June - July 1983	2,194.82
	- Indonesia - April 4 - 9, 1983	834.28
	- Thailand - Feb. 6-12, 1983, March 7-10 & May 3 - 6, 1983	2,261.06
		$ 11,362.87
		$ 15,496.96

Schedule 5. Equipment, Materials & Supplies

a.	OIS charges for printing & photography September 1982 - August 15, 1983		$ 344.90
b.	Supplies issued by IRRI Supply Room August 21, 1982 - August 20, 1983		276.17
c.	Subscriptions, Books & periodicals		
	P.O.#82-00540 - 1 Copy Psychometrics	$ 12.10	
	82-00541 - 1 copy Solar Application in Agr.	21.50	
	83-01313 - 1 copy Guide Book Rural Cottage	15.00	48.60

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d. Various P.O.s issued

P.O.#82-04936	- Various raw materials	$ 69.29	
82-05612	- reprint holder	103.64	
82-05916	- lumber	79.11	
82-05917	- Gray uniforms	33.37	
82-05198	- T-shirt uniforms	29.30	
82-06155	- IBM type element	20.93	
82-00538	- Trigger	57.87	
82-08379	- Ring Binder	114.13	
82-08379	- ID Jacket	4.79	
82-02353	- Spare parts	69.48	
83-10598	- Axial plow pump	412.37	
83-10310	- Uniform	24.74	
83-12344	- T-shirt uniform	40.91	
83-15150	- Blueprint diazo paper	475.16	
83-15046	- Ring binder	82.19	
83-13708	- Calling cards	7.31	$ 1,624.59

e. Shipping charges, Insurance and others September 1982 - August 1983 — 272.72

$ 2,566.98

Schedule 6. Training

a. Two-week training course (Dec. 6 - 17, 1982) - Ruben Perez

- Airticket - Davao/Mla/Davao	$ 163.40	
- Training charges	362.50	$ 525.90

b. Local travel of 18 Agricultural Engineering trainees — 392.47

$ 918.37

Total Expenditures — $307,373.02

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AID-492-CA-1707
Phil. Headquarters
Schedule of Commitments
As of August 31, 1983

Schedule 1.	Salaries and Benefits		
a.	Senior staff June - August 1983		$ 19,193.34
b.	Local staff July 1983		1,192.96
			$ 20,386.30
Schedule 2.	Overhead		
	March - August 1983 (Senior Staff) April - August 1983 (Local staff)		$ 12,904.70
Schedule 3.	Fringe Benefits and Allowances		
a.	Senior staff		
	1. IIE Perquisite June - August 1983	$6,593.23	
	2. Educational allowance 1983	5,600.00	
	3. Housing & Utilities Aug. 1982-Aug. 1983	23,948.06	$ 36,141.29
b.	Local staff		
	1. Cost of Living Allow. February 1983	$ 220.21	
	2. Social Security System August 1983	48.62	268.83
			$ 36,410.12
Schedule 4.	Travel and Transportation		
a.	Local Travel		$ 100.00
b.	ATO#83-0838 - MLa/Seoul/Mla		726.70
c.	Miscellaneous		50.00
			$ 876.70

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Schedule 5. Equipment, Materials & Supplies

a.	Local purchases	$ 500.00
b.	Supplies	100.00
c.	Various P.O.s	
	P.O.#83-15285 - Ring Binder	58.48
	83-03107 - Bruning Revolute paper	2,336.00
d.	Miscellaneous	150.00
		$ 3,144.48

Schedule 6. Training

a.	Three-Week Agricultural Eng'g. Course July 25 - August 12, 1983 (Noel Lazaro Oquis) - Training charges	$ 543.75
	Total Commitments	$ 74,266.05

AID-492-CA-1707 (Phil. Outreach)
Statement of Expenditures & Commitments
For Three years Ending August 31, 1983
(In US $)

	Actual Expenditures 09/01/80 08/31/82	Actual Expenditures 09/01/82 08/31/83	Actual Expenditures Total	Commitments up to 08/31/83	Total Expenditures & Commitments	Approved Budget*	Balance
1. Salaries and Wages	$ 33,714.38	$19,012.21	$ 57,726.59	$2,722.18	$ 60,448.77	$104,800.00	$ 44,351.23
2. Overhead	5,297.58	2,401.85	7,699.43	1,186.54	8,885.97	15,400.00	6,514.03
3. Fringe Benefits and Allowances	11,669.49	4,423.05	16,092.54	287.59	16,380.13	44,460.00	28,079.87
4. Travel and Transportation	43,846.50	22,067.72	65,914.22	516.68	66,430.90	86,840.00	20,409.10
5. Equipment Materials & Supplies	23,753.73	7,126.44	30,880.17	1,200.00	32,080.17	40,000.00	7,919.83
6. Training	-	1,481.03	1,481.03	-	1,481.03	22,000.00	20,518.97
7. Studies	-	-	-	-	-	13,000.00	13,000.00
8. Workshop	-	-	-	-	-	-	-
Total	$123,281.68	$56,512.30	$179,793.98	$5,912.99	$185,706.97	$326,500.00	$140,793.03

*Total approved budget for the period September 1, 1980 to August 31, 1983.

AID-492-CA-1707
Phil. Outreach
Schedule of Expenditures
For the period September 1, 1982 - August 31, 1983

Schedule 1. Salaries and Wages	
a. local staff Sept. 1982 - August 1983	$ 9,344.72
b. BPI personnel June 16, 1982 - May 1983	9,515.12
c. others PPC - temporary laborer on Sept. 8 - 20, 1983	152.37
	$ 19,012.21
Schedule 2. Overhead	
July 1982 - March 1983 (local staff) May 1982 - March 1983 (DITPROD staff)	$ 2,401.85
Schedule 3. Fringe Benefits and Allowances	
a. COLA - Cost of Living Allowance Sept. 1982 - August 1983	$ 1,551.03
b. SSS - Social Security System August 1982 - July 1983	125.16
c. RSP - Retirement Savings Plan Sept. 1982 - July 1983	636.03
d. Medical allowances Sept. 1982 - August 1983	20.94
e. Insurance Sept. 1982 - August 1983	22.04
f. 13th Mo. Pay, leave credits and others Sept. 1982 - August 1983	2,067.85
	$ 4,423.05

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Schedule 4. Travel and Transportation

a.	local travel Sept. 1982 - August 1983	$ 10,365.75
b.	Repairs and maintenance of project vehicle Sept. 1982 - August 1983	116.83
c.	Home Leave 1983	10,701.04
d.	Trip to Indonesia May 1 - 6, 1983	884.10
		$ 22,067.72

Schedule 5. Equipment, Materials & Supplies

a.	Office supplies (including supplies issued by IRRI supply room) July 1982 - August 1983		$ 1,237.31
b.	OIS charges for printing and photography July 1982 - August 1983		72.65
c.	Subscriptions, books and periodicals P.O.#82-00573 - 1 copy Repair & Tune Up Guide	$10.00	
	P.O.#82-01074 - The Design Construction & Performance	14.50	24.50
d.	Raw materials & shop supplies July 1982 - August 1983		5,630.95
e.	Others		
	P.o.#82-06324 - 1 Unit filing cabinet	$100.00	
	#82-10310 - uniform	8.25	
	Checkbook	4.51	
	Miscellaneous	48.54	161.30
			$ 7,126.44

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Schedule 6. Training

- Two-week training course (Dec.6-17, 1982)
  a. Pedro Malaluan
  b. H. Comia
  c. F. Daguro
  d. I. Ventura

- local travel	$ 31.03
- training charges	1,450.00
	$ 1,481.03
Total Expenditures	$ 56,512.30

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AID-492-CA-1707
Phil. Outreach
Schedule of Commitments
As of August 31, 1983

Schedule 1.	Salaries and Wages	
	- BPI staff June - August 1983	$ 2,722.18
Schedule 2.	Overhead	
	August 1983	$ 1,186.54
Schedule 3.	Fringe Benefits and allowances	
	RSP - April 1983	$ 180.53
	SSS - August 1983	7.06
	Miscellaneous	100.00
		$ 287.59
Schedule 4.	Travel and transportation	
	P.O.#83-15044 - Windshield Assy.	$ 157.93
	ATO#83-0883 - 8/22 - 8/26/83	208.75
	Local Travel	100.00
	Maintenance of vehicle	50.00
		$ 516.68
Schedule 5.	Equipment, Materials and Supplies	
	Local purchases	$ 600.00
	Local supplies	400.00
	Miscellaneous	200.00
		$ 1,200.00
	Total Commitments	$ 5,912.99

AID-492-CA-1707 (Thailand)
Statement of Expenditures & Commitments
For Three years Ending August 31, 1983
(In US $)

	Actual Expenditures 09/01/80 08/31/82	Actual Expenditures 09/01/82 08/31/83	Total	Commitments up to 08/31/83	Total Expenditures & Commitments	Approved Budget*	Balance
1. Salaries and Wages	$31,072.08	$17,451.97	$ 48,524.05	$ 2,356.66	$ 50,880.71	$ 56,920.00	$ 6,039.29
2. Overhead	3,390.99	2,832.57	6,223.56	1,255.90	7,479.46	7,800.00	320.54
3. Fringe Benefits and Allowances	1,418.53	2,982.31	4,400.84	754.13	5,154.97	24,320.00	19,165.03
4. Travel and Transportation	16,844.31	12,128.85	28,973.16	4,000.00	32,973.16	34,660.00	1,686.84
5. Equipment, Materials and Supplies	17,112.44	9,274.86	26,387.30	1,782.94	28,170.24	27,000.00	(1,170.24)
6. Training	2,700.08	2,427.94	5,128.02	1,994.89	7,122.91	13,940.00	6,817.09
7. Studies	-	-	-	-	-	13,000.00	13,000.00
8. Workshop	-	-	-	-	-	-	-
T o t a l	$72,538.43	$47,098.50	$119,636.93	$12,144.52	$131,781.45	$177,640.00	$45,858.55

*Total approved budget for the period September 1, 1980 to August 31, 1983.

AID-492-CA-1707
Thailand
Schedule of Expenditures
For the period September 1982 - August 31, 1983

Schedule 1.	Salaries and Wages	
	Local staff July 1982 - June 20, 1983	$ 17,451.97
Schedule 2.	Overhead	
	April 1982 - January 1983	$ 2,832.57
Schedule 3.	Fringe Benefits and Allowances	
	a. RSP - June 16, 1981 - August 1983	$ 1,419.86
	b. Medical - July 1, 1982 - June 30, 1983	493.01
	c. Insurance - July 1, 1982 - July 1, 1983	499.09
	d. Leave credits - July 1982 - July 1983	438.03
	e. Miscellaneous	132.32
		$ 2,982.31
Schedule 4.	Travel and Transportation	
	a. local travel July 1982 - July 1983	$ 3,387.97
	b. Maintenance of vehicle July 1982 - July 1983	2,573.56
	c. ASAE meeting June 25 - July 5, 1982	247.41
	d. Los Baños trip 1982	389.11
	e. R & R travel	11.75
	f. Terminal travel	5,519.05
		$ 12,128.85

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Schedule 5. Equipment, Materials and Supplies

a. Share in office expenses July 1982 - June 1983		$ 5,680.94
b. Office supplies July 1982 - June 1983		2,394.18
c. Raw materials and shop supplies repair of BS engine		145.48
d. Subscriptions, books and periodicals August 1982 - April 1983		474.01
e. Others		
- Service agreement for IBM typewriter Jan. 1, 1983 - Dec. 31, 1983	$ 52.18	
- Telephone charges	86.96	
- Resurfacing of IRRI office	326.09	
- Cleaning of 1 unit Tempmaster airconditioner	13.04	
- Miscellaneous	101.98	580.25
		$ 9,274.86

Schedule 6. Training

a. Two-week training course (Sept. 9-13, 1983)		
- meals and lodging	$960.30	
- local travel	351.52	
- supplies & misc. expenses	55.31	$ 1,367.13
b. Two-week training course (Dec. 6-17, 1983)		
-Sitsamut Tansakun		
- training charges	$362.50	
- Pre-departure allow.	50.00	
- Post departure allow.	50.00	
- Airticket	431.74	894.24
c. Two-week training course (July 25 - August 12, 1983) - Banrungthai & Chinsuwan - Post departure allow.		150.00
d. Local training charges		16.57
		$ 2,427.94
Total Expenditures		$ 47,098.50

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AID-492-CA-1707
Thailand
Schedule of Commitments
As of August 31, 1983

Schedule 1.	Salaries and Wages		
	July - August 1983		$ 2,356.66
Schedule 2.	Overhead		
	February 1983 - August 1983		$ 1,255.90
Schedule 3.	Fringe Benefits and allowances		
	July - August 1983		$ 754.13
Schedule 4.	Travel and Transportation		
	a. local travel June - August 1983		$ 800.00
	b. maintenance of motor vehicle June - August 1983		500.00
	c. initial travel		2,700.00
			$ 4,000.00
Schedule 5.	Equipment, Materials & Supplies		
	a. Local purchases July - August 1983		$ 500.00
	b. Share in Bangkok office expenses July - August 1983		1,082.94
	c. Miscellaneous		200.00
			$ 1,782.94
Schedule 6.	Training		
	- Three-week Training course (July 25 - August 12, 1983) a. Chalermsak Banrungthai		
	- training charges	$543.75	
	- Post departure allow.	75.00	
	- Airticket Bkk/Mla/Hkk/Bkk	431.74	$ 1,050.49

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b. Dr. Divit Chinsuwan

-training charges	$543.75	
-Pre-departure allow.	75.00	
-airticket - Bkk/Mla/Bkk	325.65	$ 944.40
		$ 1,994.89
Total Commitments		$ 12,144.52

AID-492-CA-1707 (India)
Statement of Expenditures and Commitments
For three years ending August 31, 1983
(In US $)

	Actual Expenditures 09/01/80 08/31/82	Actual Expenditures 09/01/82 08/31/83	Actual Expenditures Total	Commitments up to 08/31/83	Total Expenditures & Commitments	Approved Budget*	Balance
1. Salaries & Wages	$ -	$ -	$ -	$ -	$ -	$ 53,990.00	$53,990.00
2. Overhead	-	-	-	-	-	7,900.00	7,900.00
3. Fringe Benefits and Allowances	-	-	-	-	-	20,190.00	20,190.00
4. Travel and Transportation	-	-	-	-	-	55,520.00	55,520.00
5. Equipment, Materials & Supplies	1,259.33	2,054.55	3,313.88	100.00	3,413.88	79,000.00	75,586.12
6. Training	3,492.00	4,452.79	7,944.79	1,631.25	9,576.04	25,000.00	15,423.96
7. Studies	-	-	-	-	-	16,000.00	16,000.00
Total	$ 4,751.33	$ 6,507.34	$11,258.67	$ 1,731.25	$ 12,989.92	$257,600.00	$244,610.08

*Total approved budget for the period September 1, 1983 to August 31, 1983.

AID-492-CA-1707
India
Schedule of Expenditures
For the Period September 1982 - August 31, 1983

Schedule 1. Equipment, Materials and Supplies

P.O.#83-11951- Axial plow thresher and rice planter	$ 2,054.55

Schedule 2. Training

Three-week training course
(July 25 - August 12, 1983)
a. S.C. Patra
b. S.K. Makhija
c. Dr. Prabhakar

- Airtickets	$ 3,877.65
- Pre and Post departure allow.	570.00
- Travel expenses	5.14
	$ 4,452.79
Total Expenditures	$ 6,507.34

AID-492-CA-1707
India
Schedule of Commitments
As of August 31, 1983

Schedule 1. Equipment, Materials and Supplies

Miscellaneous	$ 100.00

Schedule 2. Training

Three-week training course (July 25 - August 12, 1983) a. Prabhakar Datt b. S.K. Makhija c. S.C. Patra	
- training charges	$ 1,631.25
Total Commitments	$ 1,731.25

AID-492-CA-1707 (Indonesia)
Statement of Expenditures and Commitments
For three years ending August 31, 1983
(In US $)

	Actual Expendites 09/01/80 08/31/82	Actual Expendites 09/01/82 08/31/83	Actual Expendites Total	Commitments up to 08/31/83	Total Expenditures & Commitments	Approved Budget*	Balance
1. Salaries and wages	$ 38,317.85	$12,948.34	$ 51,266.19	$ 3,510.00	$ 54,776.19	$ 46,040.00	($ 8,736.19)
2. Overhead	4,269.14	2,697.60	6,966.74	1,085.36	8,052.10	6,340.00	(1,712.10)
3. Fringe Benefits and Allowances	4,436.95	2,896.39	7,333.34	1,579.50	8,912.84	19,670.00	10,757.16
4. Travel and Transportation	36,344.36	23,493.62	59,837.98	7,635.20	67,473.18	43,660.00	(23,813.18)
5. Equipment, Materials and Supplies	64,814.02	32,025.36	96,839.38	6,500.00	103,339.38	39,000.00	(64,339.38)
6. Training	6,210.27	2,741.20	8,951.47	2,746.78	11,698.25	15,840.00	4,141.75
7. Studies	-	-	-	-	-	16,000.00	16,000.00
Total	$154,392.59	$76,802.51	$231,195.10	$ 23,056.84	$254,251.94	$186,550.00	($67,701.94)

*Total approved budget for the period September 1, 1980 to August 31, 1983.

AID-492-CA-1707
Indonesia
Schedule of Expenditures
For the period September 1, 1982 - August 31, 1983

Schedule 1. Salaries and Wages

a.	Local staff		
	July 1982 - December 1982	$3,496.60	
	January 1983 - June 1983	2,770.47	$ 6,267.07
b.	DITPROD staff		
	June 20 - December 1982	$3,723.48	
	Jan. 1983 - June 20, 1983	2,957.79	6,681.27
			$ 12,948.34

Schedule 2. Overhead

February 1982 - January 1983 (Local staff)	
January 1982 - February 1983 (DITPROD staff)	$ 2,697.60

Schedule 3. Fringe Benefits and Allowances

a.	Local staff		
	1. RSP		
	July 1982 - June 1983	$ 564.16	
	2. Medical		
	June 23, 1982 - June 1983	618.70	
	3. Insurance		
	Group Life, Accident death & dismemberment	297.95	
	4. Leaves		
	Unused annual leave	121.39	
	5. Educational allowances		
	Honorarium of English teacher Oct. 14-Dec.2,1983	448.12	$ 2,050.32

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b. DITPROD staff

- Lebaran bonus - July 1982	$584.73	
- June 1983	261.34	$ 846.07
		$ 2,896.39

Schedule 4. Travel & Transportation

a. Local travel		
June 23 - June 21, 1983		$ 13,342.45
b. Repairs and Maintenance of vehicle		
June 23 - June 21, 1983 including car registration		2,684.23
c. Trips to Los Baños		
- Airticket - Jkt/Sing/Mla/Jkt November 1982	$ 904.00	
- Driving services	16.39	
- FDS bills on food & lodging	111.00	1,031.39
d. US & India Trips		
June 24 - July 31, 1983		574.58
e. R&R Travel		
Airticket - Mrs. Uma Reddy		1,122.00
f. Home Leave & ASAE meeting		
VRR- Jkt/Sin/Maa/Hyd/Del/Lon/Was/Ord/Bzn/Sea/Tko/Jkt		
Mrs. Reddy - Jkt/Sin/Maa/Hyd/Mla/Sin/Jkt - June 1982		4,412.00
g. Others		
- Registration fee - ASAE meeting for June 27 - 30, 1982	$ 145.23	
- Visa extension	158.54	
- Passport	23.20	326.97
		$ 23,493.62

Schedule 5. Equipment, Materials & Supplies

a. Office rent, supplies & other expenses - August 1982 - June 21, 1983	$ 10,130.23
b. Raw materials & shop supplies - August 1982 - May 21,1983	16,654.29

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c. Subscriptions, books & periodicals August 1982 - June 1983		$ 374.92
d. Shipping & delivery charges for various machines August 1982 - June 1983		662.89
e. Others		
- 1 Unit Ricoh copier DT 5350	$4,000.00	
- Repair & Maintenance of IBM typewriter	132.02	
- Repair of office ceiling	33.89	
- Driver's uniform	33.71	
- Bank charges	3.41	4,203.03
		$ 32,025.36

Schedule 6. Training

1. Two-week training course (June 7 - 18, 1982) Zaider Said & Ahmad Deny Suan		
- Additional airticket		$ 431.82
2. Two-week training course (Dec. 6 -17, 1982) - Mappa Effendry Hemdani & Made Dasnaya		
- Post departure allowance	$ 199.26	
- Airtickets	1,235.12	
- Training charges	725.00	2,159.38
3. Two-week training course (July 25 - August 12, 1983) D. Junus & Sufardi		
- Post departure allowance		150.00
		$ 2,741.20
Total Expenditures		$ 76,802.51

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AID-492-CA-1707
Indonesia
Schedule of Commitments
As of August 31, 1983

Schedule 1. Salaries & Wages	
a. Local staff July 1983 - August 1983	$ 1,200.00
b. Ditprod Staff June 21 - August 31, 1983	2,310.00
	$ 3,510.00
Schedule 2. Overhead	
February - August 1983	$ 1,085.36
Schedule 3. Fringe Benefits & Allowances	
Local staff - June - August 1983	$ 1,579.50
Schedule 4. Travel & Transportation	
a. Local Travel June 22 - August 1983	$ 3,200.00
b. International travel	4,435.20
	$ 7,635.20
Schedule 5. Equipment, Materials & Supplies	
P.O.#83-01788 - Tester Kit	$ 2,500.00
Local purchases - June 22 - August 31, 1983	4,000.00
	$ 6,500.00
Schedule 6. Training	
- Two-week training course July 25 - August 12, 1983 D. Junus & Sufardi	

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- Tickets	$ 1,259.28
- Enroute Allowances	300.00
- Training charges	1,087.50
- Miscellaneous	100.00
	$ 2,746.78
Total Commitments	$ 23,056.84