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9. ABSTRACT

A study of mechanization on small rice farms in the Philippines. It included all phases of the mechanization process from research and development to manufacturing, distribution, adoption on farms, economic adjustments and adaptations and government policies. Objectives were: 1) to evaluate the extent to which the IRRI agricultural machinery development program is helping to bring about mechanization in the Philippines; 2) to identify political, social, economic, and cultural conditions which have encouraged or inhibited the adoption of small-scale mechanization in the Philippines; 3) to assess the positive and negative socio-economic impacts of emchanization on small farms; and 4) to determine the kinds of problems that may be encountered in both domestic and international transfer of technology. From the findings, recommendations were made to continue the IRRI program in mechanization for small rice farms with more emphasis on: 1) developing and introduction smaller and less expensive implements and machines, 2) integrated systems for producing more than one crop per year on existing lands, and 3) improving national capability for extension activities. The Philippine government also is encouraged to increase and improve extension/education programs, assistance and supportive policies; conduct manpower and employment analyses; and extend availability of credit to small farms and businesses.

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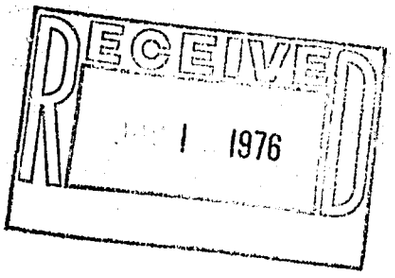

EVALUATION OF FACTORS AFFECTING THE RATE OF ADOPTION OF IRRI SMALL FARM EQUIPMENT

Contract No.: AID/ta-C-1242

Project No.: 931-11-999-937-73

by

A. L. Becker, W. R. Butcher,
C. F. Feise, and C. A. Ulinski
(In alphabetical order)

Agricultural Economics Department
Washington State University
Pullman, Washington 99163
U. S. A.

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Executive Summary

USAID Project No: 931-11-999-937-73

Title: EVALUATION OF FACTORS AFFECTING THE RATE OF ADOPTION OF IRRI SMALL FARM EQUIPMENT

Introduction

This project involved an 8-week field study of mechanization on small rice farms in the Philippines. The study focused on the agricultural machinery development program in the Agricultural Engineering Department of the International Rice Research Institute at Los Banos, Philippines, however, it also considered other machines and programs that are also a part of farm mechanization development in the Philippines. The scope of the study included all phases of the mechanization process from research and development to manufacturing, distribution, adoption on farms, economic adjustments and adaptations and government policies.

The objectives of the project were: (1) to evaluate the extent to which the IRRI agricultural machinery development program is helping to bring about mechanization on small farms in the Philippines, (2) to identify political, social, economic and cultural conditions which have encouraged or inhibited the adaption of small scale mechanization in the Philippines, (3) to assess the positive and negative socio-economic impacts of mechanization on small farms, and (4) to determine the kinds of problems that may be encountered in both domestic and international transfer of technology.

Findings

(1) The effect of IRRI program on mechanization:

Small power tillers and threshers are being sold at an accelerating rate in the Philippines. There appears to be a well established trend toward widespread adoption of these machines, but extending mechanization to most of rice farming in the Philippines would require a several-fold increase in rate of machine sales. Other machines, such as grain cleaners, batch driers, transplanting machines, irrigation pumps, and power cultivators are, at most, just beginning to be introduced.

Power tillers are mostly found on farms that are medium-sized by Philippine standards--4-10 hectares in size. More than a third of the tillers are being used at least partly for custom hire operation on other farms. The average usage is about 12 hectares per year per machine, which requires about 60 days operation for complete preparation for planting.

The power tillers seem to be gaining ground relative to large 4-wheel tractors which are usually owned and used by large rice farmers and custom operators and by sugar and pineapple plantations. Among power tillers, smaller simpler locally built models are gaining more of the market from the more expensive Japanese built import models.

The IRRI small farm mechanization program has made an important contribution to introduction of power tillers for small farms. Virtually all of the locally built machines are built either by approved manufacturers of the IRRI-designed tillers or by other manufacturers who have adopted IRRI's design, which is open patented, or at least followed the concept introduced by IRRI.

The IRRI-designed axial-flow thresher is not yet found in large numbers on Filipino farms. Other locally built models--the Tillyadora, Cotabato, and table top threshers--are more numerous at this time. However, initial reaction to the IRRI thresher seems favorable and it may catch on quickly.

The IRRI program has demonstrated that small local companies can successfully produce small agricultural machines. Total output of these shops in the Philippines is growing very rapidly. However, the experience of individual small machinery manufacturers is quite mixed with a fair number of "drop outs" or "failures" mixed in with some outstanding successes.

(2) Conditions that encourage or inhibit adoption:

Most of the power tillers in use to date are on irrigated farms that are raising two crops of rice per year. The advantage of mechanization for them are: (1) their potential for use of the machine is effectively doubled, (2) there is less slack time between crops and more need to rush land preparation, and (3) care and feeding of the carabao may be more difficult since there is little land available for grazing.

The cost of land preparation with carabao depends mostly on the appropriate value for labor, especially for the large number of hours spent in care and feeding of the animal. Cost with the power tiller depends mostly on the number of hectares over which fixed costs may be spread.

Cost comparisons indicate that power tillers are less costly than the carabao only if the tiller owners costs can be spread over at least 10 hectares of land preparation per year. Smaller farmers will find it economical to convert to power tillage only if: (1) they place unusually high value on the labor saved by the mechanical system and/or very low values for the capital invested in a power tiller, or (2) they are able and willing to do custom hire work with their power tiller, or (3) they rent or hire a tiller rather than buy their own, or (4) they expand their farm and increase double cropping to achieve the needed size.

The costs and capacity of the axial-flow thresher are such that it is only suited for operations of at least 15 hectares per year and preferably for use on 40 hectares or more per year. When used 50 or more days per year (about 50 hectares), the average cost with the mechanical thresher is less than one-half the conventional share payment to hand threshing crews.

Access to IRRI technicians and advisors is important for all manufacturers and especially for the smaller ones. They need advice, information, guidance, and encouragement. Most firms now producing IRRI designs are located in the Greater Manila Area where access to IRRI and other sources of help is relatively easy. In Mindanao, where contact with IRRI has been very slight, we found no firms now producing IRRI designs.

Market development is a major problem. Small firms lack marketing expertise, ties with sales outlets and adequate scale to justify advertising and promotion. Large firms are concerned about the "open patent" policy that makes it possible for a competitor to move in to supply a market that has been promoted at substantial cost.

Philippine government policy is now explicitly committed to the support and encouragement of indigenous industry and growth of employment opportunities. Programs that are helpful to small agricultural equipment manfuacturers are being initiated, but there still are many inconsistencies and actions that hinder or harm small local firms. Apparently, this is still a low priority goal for the governmnet or else conflicts with other goals which have not been completely resolved.

(3) Socio-economic impacts of mechanization:

It is hoped that mechanization will help to increase food production, but there is no evidence so far of measurable increases in rice production per hectare that are attributable to adoption of power tillage. There may eventually be more adoption of potential yield increasing improvements such as more timely planting, more double and triple cropping, etc.

The most significant displacement by the power tiller is the carabao. There will be some loss of by-products as carabao are replaced by machines, but many farmers seem inclined to keep at least one carabao even after mechanizing.

Labor savings by the power tiller are about 7 days of field labor per hectare per crop and about 6 days of animal care time. The labor that is saved is mostly that of the farmer, his family and neighbors. Possibilities for absorption within the farm operation are good and the labor displacement does not appear to be creating a problem. There is some incentive for power tiller owners to expand their farms in order to make more complete use of the machine once they have it.

The threshers are being purchased by larger farmers and by individuals who use them in custom operations. The capacity of the machine (and the cost) are too great to be suitable for the typical small farmer. A program designed to include small farmers through cooperative ownership is too new to evaluate at present.

There could be significant labor displacement problems with a large conversion to mechanical threshing. Mechanical threshing requires only about 4 worker days of field labor per hectare, whereas hand threshing requires 16 worker days. The labor that would be displaced is all hired labor. A large portion of these are farm workers who depend on shares of the crop earned during harvest for a substantial portion of their income.

Credit programs have been recently changed and expanded in ways that significantly aid small industries and small farmers, but both still are often not able to obtain credit that they need for modernization and expansion.

(4) Problems that may be encountered in technology transfer:

The cost of the machines will be a severe hindrance to their widespread adoption on typical small rice farms in Asia. Present early adopters in the Philippines are averaging more than 4 hectares in size, but the average rice farm in that

country has less than 2 hectares. Even the small IRRI-designed machines have much more capacity than these small farms require and the investment costs are prohibitive under present economic conditions unless spread over considerably more hectares of crop than the typical very small rice farms have. Development of a workable cooperative or "machine sharing" program will be essential to the spread of mechanization onto these small farms.

It is apparently going to be difficult to convince farmers to use the power and speed of the new machines as a means to switch to output-increasing cropping systems such as double cropping. There needs to be research and education programs that combine the mechanization with all other aspects of an intergrated program of increasing crop production.

Labor displacement by machines is a problem in several respects. When jobs are scarce because there is not enough expansion in farming areas and intensity or in industrial activity, mechanization programs may be forced to include employment expansion as a necessary companion to technology transfer.

Labor displacement in an uneven seasonal pattern is a problem when agricultural workers are dependent upon as much farm work as they can get during a year. Mechanization of an operation that creates peak demand pressure on labor supplies--such as rice transplanting--minimizes the problem and should be emphasized as much as possible. Mechanization of operations for which farmers report no difficulty in getting labor, such as harvest and threshing, will result in more displacement of disappointed and perhaps desperate workers.

Small local manufacturers of new technology equipment encounter several problems that should be recognized and, if possible, some assistance should be provided. As very small businesses grow, there is a tremendous increase in the need to develop capabilities for managing labor, finances, sales and customer services. Small entreprenuers may fail to recognize these needs or realize how to cope with the problems until too late. These small manufacturers also have serious capital availability problems that are accentuated by the fact that they are dealing with a new and apparently risky process. Small manufacturers also must contend with the threat of being over powered by large competitors.

In many locations it may be difficult to provide the early adopters with the expertise that is required to assist them through the early stages of the process. Much direct contact is required and there are heavy demands for skilled individuals who are thoroughly familiar with the technology, the transfer process and the socio-economic setting in which it is to take place.

National governments sometimes create problems by failing to give the technology program the support that is required to solve several of the problems listed above. Conflicts with objectives, such as growth of major or glamorous industries seems to be particularly troublesome to the establishment of small-scale agricultural technology.

Recommendations

Continue the IRRI program in mechanization for small rice farms with some change to:

Give more emphasis to developing and introducing implements and machines that are even smaller and less expensive than models that are receiving major emphasis at the present time, i.e. machines that a typical 2-5 hectare farmers will find feasible to own by himself without the necessity of custom work and partnership arrangements.

Give more emphasis to devices that are directly output-increasing (such as irrigation pumps, wells, water control systems, multiple-cropping techniques, etc.).

Give more emphasis to integrated systems (including tools and schedule of operations) for producing more than one crop per year on existing lands.

Give more emphasis to improving the national capability for extension type activities with farmers, small manufacturers, dealers, lenders, etc.

Encourage the government of the Philippines to:

Increase and improve their extension/education program with farmers, small manufactueres, dealers and lenders.

Increase assistance, supportive policies, etc. for development of industries in the rural areas to provide off-farm employment opportunities for labor that may be released through farm mechanization and for the rapidly growing labor force in these areas.

Conduct careful manpower and employment analyses to determine the present situation and outlook in rural areas and provincial towns. Particular attention should be given to the hired farm work force.

Further extend the availability of credit to small farms and small businesses, including credit for agricultural machinery.

In any extensions of the program to outlying areas and to other countries care should be taken to have adequate IRRI manpower and direct involvement of local nationals from the beginning. Too small a program may never get off the ground.

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INTRODUCTION

Mechanization is slowly being introduced into the agriculture of the less developed countries (LDCs) of the world. Hand labor and use of animal power with very simple tools still predominates, but change is coming. Tractors, similar to those found in the U.S., can now be found in a small part of the agriculture of almost all countries. Furthermore, there is a rapidly increasing number of small indigenous machines being adopted on these small farms. In most LDCs mechanization is still coming only at a trickle and now covers only a small percentage of the land, but the move is enough to raise considerable interest. Is mechanization good for these countries? What kinds of machines and patterns of mechanization are most appropriate for the typical small scale labor intensive agriculture of a less developed country? Can application of research, development and extension activities bring about a better pattern of development for mechanization in the agriculture of LDCs?

Rising interest in mechanization of agriculture in LDCs has led to a number of studies of mechanization and to a few research programs aimed at developing and fostering the adoption of machines. Probably the first and one of the most prominent of these programs is the agricultural machinery development program of the International Rice Research Institute, which is located in the Philippines. This report summarizes findings and conclusions of a recent study of agricultural mechanization in the Philippines, under the assistance and stimulation of the IRRI program.

The Washington State University/George Washington University Study

The idea for this study was conceived and the background review of available secondary materials prepared by Carol A. Ulinski and Ann Becker under the direction of Professor Henry Nau as a part of work performed under a National Science Foundation grant to the Graduate Program in Science, Technology and Public Policy at the George Washington University. This original work resulted in a report by Ulinski and Becker titled "The IRRI Small Agricultural Machinery Project." The report gives a history of the IRRI program with extensive references to the available literature. It also discusses several important aspects of the program, such as the manufacture of IRRI design and the extension of the IRRI technologies. However, the study was limited in breadth and in inclusiveness to information that could be obtained with access to available documents and individuals in Washington, D.C. In order to overcome this limitation and obtain primary information from the field for use in the analysis, it was proposed that USAID support a field investigation of agricultural mechanization in the Philippines with a particular emphasis upon small-scale machines in the IRRI program. USAID did have an interest in such a study, and eventually agreed to finance the work through a contract with Washington State University. Professor Walter R. Butcher was the leader and the team members included Ulinski, Becker, and Christopher Feise, a former Peace Corps volunteer in the Philippines and currently a Ph.D. candidate in Agricultural Economics at Washington State University.

The objectives of the study were: (1) to evaluate the extent to which the IRRI agricultural machinery development program is helping to bring about mechanization on small farms in the Philippines, (2) to identify political, social, economic and cultural conditions which have encouraged or inhibited the adoption of small scale mechanization in the Philippines, (3) to assess the positive and negative socio-economic impacts of mechanization on small

farms, and (4) to determine the kinds of problems that may be encountered in both domestic and international transfer of technology.

The scope of the study included all phases of the mechanization process reaching from the research and development through manufacturing, distribution, adoption on farms, economic adjustments, and adaptations to, finally, government and institutional policies. The study did focus on IRRI-designed machines, but not to the exclusion of other machines or other programs that are also a part of mechanization on farms in the Philippines.

There have been several studies of the IRRI small machines and of the machinery project. Reports of several of these studies were available to the team members and were of considerable value. The Agricultural Engineering Department at IRRI prepares a semi-annual progress report which provides an excellent chronicle of activities in the agricultural machinery program, and also summary information on the number of evaluative studies that have been conducted by IRRI researchers. Reports for AID have been made by Don Davis in 1972, Davis and Judson Harper in 1973, and Harper in 1974. More recently a large study of the CB/IBRD loan program, which has been quite instrumental in financing mechanization on farms, has developed some valuable data regarding adoption of mechanization and its effects. A substantial study by Gustav Ranis for the International Labour Organization (Sharing in Development: A Programme of Employment, Equity, and Growth) helps to place farm mechanization in the context of overall development, employment, and income distribution in the Philippines. The Ranis report does touch specifically on some aspects of farm mechanization, and it has stimulated some additional investigation, particularly into the question of labor displacement in relation to mechanization.

The field work for this investigation was carried out during a six week visit by the study team to the Philippines during July, August and September of 1975. IRRI provided much helpful background, guidance, and support for field work. Reviews were conducted with several manufacturers of IRRI designs

and also with farm machinery manufacturers who were not associated with the IRRI program. Farmers, local machinery dealers, and local governmental officials were interviewed in Central Luzon and on the southern island of Mindanao. Government agencies, national research institutes, and other individuals who have made a study of farm mechanization in the Philippines were contacted and interviewed during the visit.

Methodology

In order to obtain as broad a perspective as possible and to augment our own findings with relevant information and documentation, we read the available literature pertinent to the objectives of our study. This included studies undertaken by IRRI and private individuals along with current Philippine government studies and documents.

The intent of the field study is two-fold: (1) to obtain a general picture of the IRRI project and its impact on the industrial and agricultural sectors; (2) to identify forces beyond IRRI's control which encourage or inhibit the diffusion of the technology in question. Our study was not intended to be an evaluation of the IRRI Small-Scale Agricultural Machinery Project.

Our primary research consisted of interviewing the following parties: farmers, manufacturers, distributors, government officials, representatives of national research centers, and members of private organizations. Filipino research assistants from IRRI's Department of Agricultural Engineering aided us in the task of formulating questionnaires and conducting interviews at the farm level. The Department further assisted us in locating manufacturers of IRRI-designed equipment and in making initial contact with the appropriate government officials.

After consultation with IRRI personnel, three provinces in which to do field work were chosen -- Nueva Ecija, Cotabato and Davao. Nueva Ecija was

decided upon because it is one of the major rice producing areas in the Philippines. Additionally, it has also been the testing ground for many IRRI and Philippine government pilot projects.

In order to focus on a region very different from Nueva Ecija, and again after discussion with IRRI personnel, Mindanao was chosen to be the second region of concentration. The area's geographic, climatic, demographic and cultural conditions are dissimilar to those of Nueva Ecija. Beyond that, Mindanao is geographically far from IRRI and at present, outside the range of strong and frequent IRRI influence and contact. Because of its distance from IRRI it is felt that the identification of certain constraints to the transfer of IRRI designs to Mindanao may be indicative of similar obstacles which may arise in IRRI's official extension of the small agricultural machinery project to Thailand, Pakistan and other LDCs in the near future.

One other area given consideration for the second week of actual field research was Bicol. However, Bicol had already been the subject of much past IRRI research, and was therefore not the appropriate choice for alternative research.

In Nueva Ecija, the research was conducted in the vicinities of Cabanatuan City, Munoz, Gapan, and Talavera. The three barrios in which the majority of farmers were interviewed were Pulo, Baluarte (both irrigated) and Kapalangan (non-irrigated) of Gapan. These had been suggested by IRRI as a follow-up to a 1973 study of farmers employing specific methods of land preparation in these particular barrios.* We interviewed some farmers who had responded to the earlier survey and others whom we arbitrarily chose as we drove through the barrio. These included owners, non-owners, users and non-users of machines

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* "The Tractor and the Carabao: A socio-economic study of choice of power source for land preparation in Nueva Ecija" by Fe Bautista and Tom Wickham, IRRI Dept. of Agricultural Economics, presented July 27, 1974.

in both irrigated and non-irrigated areas. In the Cabanatuan City - Gapan area, manufacturers of locally-produced machines were interviewed, with special attention given to producing IRRI designed equipment. In addition, we interviewed a cross-section of distributors of large and small machines, both imported and local. In barrio Tabacao, Talavera discussions were held with the president of the Samahang Nayon (cooperative), barrio captain, and a group of about twenty farmers.

The decision to visit Davao and General Santos in Mindanao stemmed from two factors. First, it was known that some of the land there is devoted to rice production. Secondly, there is some degree of local manufacturing of agricultural implements both by manufacturers who have had extremely limited contact with IRRI and by those who have had none. After learning that some of the manufacturers with whom interviews were held had sold their machines to farmers outside of driving distance, we once again interviewed randomly.

The final portion of the research consisted of interviews with officials of government and non-government agencies. This included a focus on both the local (in the two areas in which field work was conducted) and national levels, with emphasis on the latter. Among the agencies interviewed were: Rural Bank (Cabanatuan City), Land Bank (Cabanatuan City), Bureau of Agricultural Extension (Cabanatuan City and General Santos), Philippine National Bank (Davao), Development Bank of the Philippines (Davao), Central Bank, Department of Agrarian Reform, Department of Industry, Department of Labor, Department of Local Government and Community Development, National Grains Authority, Asian Development Bank, Institute of Philippine Culture (Ateneo University), Institute for Small-Scale Industry (University of the Philippines - Diliman), Department of Agricultural Engineering (University of the Philippines - Los Banos), South-East Asian Regional Center for Graduate Study in Research in Agriculture (SEARCA), Agrarian Reform Institute (Los Banos), Agricultural Engineering Department (Central Luzon State University), Philippine Rural Reconstruction Movement (PRRM).

All team members were involved in all phases of the study. Primary responsibility for drafting the report was divided as follows:

Summary and Introduction -	Walter Butcher
Manufacturing -	Carol Ulinski
Farms -	Christopher Feise
Government -	Ann Becker

Development of Mechanization for Philippines Rice Production

Rice production in the Philippines takes place mostly on small farms averaging about 2.0 hectares in size. Most of the farms raise one crop of rice during the monsoon season. When adequate irrigation water is available, two crops of rice are produced. Some of the land is used in the off-season for vegetable production.

1960 census of the Philippines reported that only 3 percent of all farms in the Philippines used mechanical power. At that time the percentage of rice farmers using mechanical power was probably even smaller since tractors tended first to be introduced in the production of sugar cane and other plantation crops. The typical rice farmer prepares his land for planting using a carabao to pull a plow, and then a simple harrow to break up the soil into a fine puddled condition for transplanting of the rice crop. Planting, weeding, harvesting and threshing are done mostly by hand using simple hand tools.

Since the early 1960's rice farming in the Philippines has been undergoing a number of significant changes. High yielding varieties of rice were introduced in the latter part of the 1960's and have been widely adopted throughout the major rice growing areas of the Philippines. Use of commercial fertilizer has increased several fold, as has the use of chemical control for weeds, pests and diseases. Also, since 1960 there has been a significant and steady increase in the use of mechanical power for land preparation and for post-harvest operations.

A number of factors have been involved in the introduction and spread of mechanization in rice farming in the Philippines. Economic conditions have changed to perhaps favor mechanization somewhat more, special programs have been developed to provide financing for farmers to buy machines, and there has been a general activity of technology transfer on the part of manufacturers of machines, and also on the part of research institutes. While all of these aspects are of interest to this study, our major concern is with technology transfer and, in particular, with the activities of the International Rice Research Institute located at Los Banos, Philippines.

The IRRI Agricultural Machinery Development Program

In 1965 USAID entered into a contract with the Internation Rice Research Institute for the purpose of adapting, testing, and developing more suitable rice production equipment for the Far East and South Asia. At that time, there was still very little mechanization of rice production in the Philippines or other Far Eastern countries with the exception of Taiwan and Japan. The early effort in the program emphasized developing basic information about rice farming in the Philippines and the kinds of operations that were performed. The purpose was to determine what kinds of machines were needed.
At the same time, a testing program was inaugurated which applied particularly to machines from the United States, Japan, and Australia. The design work under the project emphasized developing modifications to these machines so that they would perform suitably under the conditions found for rice production in Asia.

As the program progressed, the leaders of the project came to the conclusion that the readily available machines from other areas were simply inappropriate for Philippine conditions (or for other similar Asian countries). What was actually needed was an emphasis on the development of small machines that would be suited to the small (2-10 hectares) farms found there, but furthermore the

machines should be simple in design so that they could be manufactured in the kinds of shops that exist within the country. Simple machines that could be locally manufactured would have the advantage of providing additional employment within the country and saving scarce foreign exchange needed to import the machines that are basically produced in the more developed economy. In addition, locally built machines should be more easily maintained and repaired when needed since the skills for manufacturing imply that the skills for repairs would also be developed. The IRRI program has been operated with this revised objective in mind since 1967.

The IRRI program has resulted in the development and introduction of a number of machine designs that fit the criteria of being suited to relatively small farms and to manufacture with few machine tools and basically unskilled labor. The power tiller has been the most notable success in the IRRI line of equipment. Several thousand units have been produced and there are, significantly, several similar machines being produced by independent Filipino manufacturers. The program has also led to the development of a multi-hopper seeder for planting pregerminated rice seed and a hand powered weeder. Three basic types of threshers have been developed, a small bed-type thresher, a drum thresher, and an axial-flow thresher. The latter is currently receiving a good deal of attention and seems to show much promise of being a widely successful machine. The IRRI list of machines also includes a power operated cleaner, a forced air batch-dryer, and a human powered bellows pump.

The program which has developed at IRRI has four major phases. The first phase is design of machine, which is carried out by engineers in the Department of Agricultural Engineering at IRRI. The designs are based on modifications of known designs which may be gathered from anywhere in the world, but most likely from countries either with a very small scale agriculture, such as Japan, or developing countries. Modifications are made to better adapt the machine to

the conditions in the Philippines and the objectives of this program. In some cases the machine may be developed from scratch on the basis of the knowledge about what is needed by the Filipino farmer. In either case, the design phase incorporates substantial input of knowledge and of feedback from farmer users. The second phase of the program is coordination with potential manufacturers. This includes surveys of manufacturers to determine which ones have the requisite skill, resources, and interest, then working with manufacturers to develop prototypes and a general policy of providing the plans and instructions to anyone who is interested in producing the IRRI designs. IRRI also provides advice to manufacturers and follow up with them to iron out any difficulties that they may be encountering and to help them to improve their operation. Particularly, they are interested in improving the quality of the final product. The third phase of the overall program involves field trials of equipment, which partly serves a demonstration purpose as well as finding out exactly how suitable the machines are in farm conditions. In some cases, the results of field trials may lead back to an additional modification from the original design. The fourth phase of the program includes working with government agencies and other institutes to be sure that they have an understanding of the program, and to enlist their support and help in the general introduction of mechanization under the rice farms of the Philippines.

The IRRI program has lately been giving increased emphasis to extension of these designs to other countries outside the Philippines. Because of their location the adoption has been much more extensive by manufacturers and by farmer users in the Philippines than it has been in the other countries. AID/W has recently funded an extension effort and there are direct contacts with government agencies and manufacturers in many Far Eastern and Asian countries.

Other Agricultural Machinery Development

In addition to the work by IRRI, there is other effort within the Philippines in design and introduction of machines for small rice farms. The University of the Philippines at Los Banos has an agricultural engineering program. Some of the other national institutes have small projects in this general area, and international agencies are involved. Mechanization is tied in with some other programs, such as land reform and the cooperatives effort.

In the private sector there are a number of local inventors and entrepreneurs who have developed their own designs for machines. In most cases these are copies with modifications from machines that are already available on the commercial market, but there are some instances of truly original inventions that have extended to a small scale commercial basis. Importation of machines from outside the Philippines has also been a major factor in mechanization to date. Several thousand large four-wheel tractors have been imported and a number of power tillers and other items of equipment have been imported from Japan.

A major effort has been launched in the financial areas to help speed the adoption of machines on rice farms. The International Bank for Reconstruction and Development has entered into a cooperative program with the Central Bank of the Philippines to make loans available to the farmers. Most of these went for the purchase of tractors and power tillers with by far the substantial amount of the money going for tractors. This program is now in its third phase. The government has also tried to speed up the adoption of tractors by making special import arrangements to bring in power tillers and by more recently launching an emergency loan program to help farmers buy power tillers in order to replace work animals that were incapacitated by an outbreak of foot and mouth disease.

MECHANIZATION ON SMALL RICE FARMS

The ultimate goal of a farm mechanization program is use of machines by the farmers. Some indication of progress toward that goal in the Philippines can be found in statistics and general information on machine sales and numbers in use. These are reported in this chapter along with some extrapolations and speculations about future trends in machine adoption. Also reported in the chapter are findings concerning the economic and social factors that encourage or discourage farmers from adopting the machines. Our own interviews with farmers and results of various previous studies provide the base for these observations. Finally, in the last section attention is turned to the changes that widespread use of machines may bring to agriculture and rural areas.

Adoption of Mechanization on Filipino Farms

Mechanization is coming at an accelerating pace to Filipino agriculture. Tractors and other engine-powered implements represent a distinct change from the Filipino farmer's traditional method of operating with carabao, simple implements, hand tools and hard work. The change to new methods is rapid on the very large farms, but much slower among the many small farmers who make up the bulk of rice farming in the Philippines. Nevertheless, an accelerating trend toward mechanization in the Philippines is evident in the case of tractors, threshers, and cultivators.

A. Tractors

There are two distinctly different types of tractors used on Filipino farms--large (35 horsepower or more) 4-wheel tractors and small (6-12 horsepower) 2-wheel hand tractors or power tillers. The IRRI Farm Mechanization Program is involved only with the small machines. Nevertheless,

the large tractors are of considerable relevance since they can be and are used on a custom hire basis to perform the same tillage operations as the small tractors.

1. Four-wheel tractors

Four-wheel tractors in the Philippines are all imported, mostly from Australia, Great Britain, and the United States. Sales during the 10 years from 1965 to 1974 were:

Year	Units Sold[1]
1965	648
1966	518
1967	1,837
1968	1,491
1969	1,001
1970	945
1971	1,063
1972	1,185
1973	1,457
1974	1,660

Sales of 4-wheel tractors have been greatly aided by the availability of credit under a loan program that is sponsored jointly by the Central Bank of the Philippines and the International Bank for Reconstruction and Development. The CB/IBRD loan programs made money available for various farm investments, including purchase of hand tractors, but most of the money was used to finance purchase of 4-wheel tractors.[2]

Sugar growers purchased a significant share of the tractors financed under the loan programs and most of the tractors purchased before or aside from the CB/IBRD loans. So mechanization with use of these tractors has progressed quite far on Filipino sugar plantations. But a large number of these tractors have also been put to use on rice farms. Some have been purchased by owners of large rice farms for use on their own acreage and others by individuals who invested in the tractors

as a base for a custom tractor renting operation. A 1967 study showed that 50 percent of the purchasers of tractors had farms of 50 hectares or more in size. The tractors were used mostly for land preparation, and 83 percent of the rice farmers who purchased tractors rent them out for custom work. More than 90 percent of tractor users in 1967 did not own their own machinery.(3) Thus, many small farmers are being introduced to mechanized land preparation as hirers of custom tractor services.

The practice of providing tractor services by rental is one way by which mechanization of land preparation could be extended to Filipino farmers that are too small to either justify or afford to purchase a 4-wheel tractor for use on their farm alone. If the practice does continue to spread, sales of 4-wheel tractors could continue to increase in traditional rice farming areas, as well as in the areas with new lands, sugar plantations, etc. If tractors serve an average of 100 hectares each, it would require about 50,000 tractors to completely mechanize rice production in the Philippines. But, whether 4-wheel tractor numbers ever swell to that level is highly dependent on what happens to the competing potential source of mechanization--the 2-wheel hand tillers.

2. Power tillers (2-wheel hand tractors)

Power tillers in the 5-12 horsepower size range have been sold in the Philippines for several years. Reported sales of all types of tillers are:

Year	Units Sold (4)
1960-65	1505
1966	1932
1967	3058
1968	1873
1969	910

Year	Units Sold
1970	475
1971	680
1972	1239
1973	2456
1974	4500 (projected)

The sharp drop in sales from 1968 to 1969 coincides with devaluation of the peso which greatly increased the cost of imported tractors. Economic conditions at that time were not good for the farmers, so potential purchasers lacked both the incentive and financial capability to mechanize. By 1971, purchases of hand tractors were again on the increase as economic conditions for farmers improved and the much less expensive Filipino built tractors entered the market. Sales have accelerated since then with 60 to 65 percent of sales made up of tractors manufactured in the Philippines. In 1975, it is estimated that over 6,000 hand tractors will be purchased. Various loan and financial assistance programs helped to boost sales in 1975.

Power tillers being used in the Philippines are supplied by a large number of different manufacturers. The major differences among them are between the imported machines and those that are built in the Philippines. The majority of the locally built machines are produced under contract agreement with IRRI and bear the label designating that they are designed by IRRI. However, many of the other machines are similar in size, style and operating features to the IRRI-designed machines. Each manufacturer tries to differentiate his product. Still, many farmers that we interviewed expressed the feeling that there was no real basis for choosing one over another from among this group. This similarity need not mean that all the locally built machines are ultimately attributable to IRRI. But, it is certainly

true that several of the other machines are derived legitimately from the open patented IRRI design. Moreover, in a broader sense, even the machines that may have been developed without reference to IRRI designs are benefiting from the concept of a locally built hand tractor that was advanced in the Philippines by IRRI.

The tillers are being put to use in all of the major rice producing areas. There are no firm statistics on exactly where some 16,000 units now in use may be located. It appears that they are concentrated in Nueva Ecija, Bulacan, Laguna and parts of the Bicol region. Early acceptance seems to occur in areas that are relatively progressive and prosperous and have good accessibility to the industry and technology of the Manila area. In far distant Mindanao, the areas around Davao City and Cotabato Province had few hand tractors.

The first farmers to get the new hand tractors had larger farms, were more progressive and more prosperous than the average Filipino farmer. According to the CB/IBRD evaluation, those purchasing hand tractors under the first and second loan programs averaged 12.5hectares in size compared to a 2.4 hectare average size for all rice farms. The farmer-purchasers that we interviewed were also above average in size, although not as large as the purchasers under the CB/IBRD program. Most of the farmers that we interviewed had paid cash for their tractors, which indicates that they were more prosperous than the average farmer. Most had irrigated land, making it possible for them to produce two crops per year. Their yields were also above average which probably is due to more complete adoption of high yield technology.

The potential for future sales of hand tractors appears to be great if one calculates the number of tractors that would be required to cultivate all 4 million hectares of rice land in the Philippines, or replace the 2.3 million cara g tractor horsepower per agricultural worker up to Taiwanese or Japanese levels. Between 300,000 and 700,000 units would be needed to meet those standards. An order of magnitude increase in rate of sales would be required to build the number of tractors on farms up to those levels and supply replacements for such a large stock of tractors.

Whether sales ever reach 50,000 to 100,000 units per year or not depends on a number of less-than-certain developments. For one thing, supplying tractors to farm more of the land requires that somehow they be made feasible to the smaller, poorer farmers who presently cannot afford to either purchase or operate them. Also, if hand tractors are ever to become universally used for rice production in the Philippines, they must rate higher than their competition--eg. 4-wheel tractors and carabaos--both in economic efficiency and in the preferences of the farmers. These economic and social factors in mechanization will be discussed in a later section.

B. Threshers

Rice threshing in the Philippines is, like land preparation, partially mechanized, but still predominantly carried out by old methods. In the case of threshing, the traditional method is to remove the grain from the head by flailing against a threshing frame and then separate grain from chaff by winnc ing in baskets. The threshing is performed by large crews working for a share of the crop. It is a relatively lucrative and popular employment for small farmers, landless rural people, etc.

There are no available data on the present extent of mechanical threshing throughout the Philippines. A study by Toquero that was limited to Luzon and Camarines Sur found 25 percent of the farmers utilized some type of mechanical threshing.[5] But other regions likely differ because mechanization of threshing seems to be a distinctly regional phenomenon.

The mechanical threshers now being used in the Philippines are mostly local improvisations or adaptations of designs built elsewhere. There are very few foreign-built machines in use. In fact, most of the machines are built locally for use in a particular area. In Central Luzon, the large, McCormick-type "tillyadora" has been in common usage for many years. They are built in the region where they are used. In Mindanao, the most commonly found thresher is the "Cotabato-type" which is a double-drum type thresher developed and built in the Cotabato area. In other areas, small flat-bed type threshers are used. These vary slightly in design from area to area depending on the innovations of the local builder

Although the use of locally manufactured threshing machines is well established in the Philippines, one gets the definite impression that it has not been spreading nearly as rapidly as has the tractorization of land preparation. In hopes of finding a more acceptable design and thereby speeding up the process, IRRI has developed and introduced three different thresher models. Their first two models were a small flat-bed thresher and a drum-type model. Neither of these has been produced in large numbers. Their most promising model is an axial-flow design thatwas released to manufacturers about two years ago.

Acceptance of the IRRI axial-flow thresher is encouraging. Two small manufacturers are delighted with their sales experience and enthusiastic

about future prospects. Two larger manufacturers of the same design reported some difficulties in selling the item and were more cautious about the future outlook. Manufacturers and IRRI staff both were looking forward to the harvest season as a time when sales would likely boom if a good harvest was in store.

There are, as yet, relatively few of the IRRI axial flow threshers in use so it is not surprising that we did not encounter many users in our visits to rice growing areas. The ones that we did find were on a large corporate farm (in Mindanao) and in the hands of custom operators (in Central Luzon). This is similar to the pattern of ownership and use for other threshers except for the very small flat-bed models. The capacity of the machine (1/2 - 2 hectares per day) and the cost (approximately $1,700) combine to make it more attractive to larger unit operators. The best hope for getting the machines to small farmers appears to be through cooperative arrangements. The government of the Philippines and U.S.A.I.D. are working on programs to facilitate this development.

Further adoption of the IRRI axial-flow or similar threshers depends upon the development of successful arrangements for making the machines available to the small farmers either through cooperative ownership or through lease or custom use arrangements. The ability of this model to compete with other designs is also still an unanswered question. Experimental results indicate favorable performance results. If further experience proves it to be very superior in performance and cost, tillyadoras and Cotabato-type threshers would likely be gradually replaced on the farms where they are now being used. Competition with the flat-bed threshers and other very small models is a somewhat different question because the easier adaptability to small farms could cause them to be preferred even though somewhat less efficient.

If the axial-flow thresher proves to be more desirable than the alternatives and comes to be the dominant method of rice threshing, and use rates average about 40 hectares per machine, then it would take 100,000 machines in use to thresh the entire rice crop. Numbers could even go above that level if the average use rate fell lower than 40 hectares per machine. But, competition from other designs and retention of hand harvesting methods would both cut eventual numbers, perhaps to only a fraction of the 100,000 figure.

C Other Machines

Several other small equipment items are used to some extent on rice farms in the Philippines. IRRI has contributed to the introduction of some of them.

1 Seeders

Rice is sometimes seeded directly in the field where it is to be grown, rather than following the transplanting approach that has become the standard method in the Philippines. IRRI has developed a multi-hopper seeder for use in direct planting. It is a relatively simple and inexpensive implement. Over 1,000 units have been manufactured and sold in the Philippines. The manufacturer that we visited reported that sales were slow. The only seeder that we saw in the field was in General Santos City. It was not functioning and the farmer did not intend to use it.

A completely different type of machine that transplants seedlings is manufactured and used in Japan. IRRI is working on an adaptation that would fit with manufacturing and farming conditions in the Philippines. It is not yet ready to release. It will of necessity be a more complex and expensive machine than the multi-hopper seeder, but it will be better suited to the transplant method of rice production

2. Hand cultivators

Hand cultivators are sometimes used to reduce the amount of labor required for weed control. Weeding requirements have become greater with the introduction of the short-strawed, high yielding varieties of rice and heavy fertilization rates. Hand cultivators are simple, inexpensive implements that remove a majority of the weeds with much less work than is required for the traditional hand-pulling approach The cultivators are widely used in Laguna where farmers follow the straight-row planting technique which is necessary for successful use of the cultivator. It is seldom used in Central Luzon or Mindanao where labor is generally less expensive and straight-row planting is not practiced.

A power-driven, back pack model is being developed by IRRI. An importer of similar devices from Japan reported that so far they are not selling to farmers.

3. Batch driers

Batch driers are in the early stages of introduction, but few are actually being used. The predominant technique for drying grain is by spreading on a paved surface or plastic sheet and allowing the solar heat to dry the grain. The batch drier uses fan-forced heated air to dry the grain. IRRI has recently introduced a model which has a capacity of one ton in about five hours. The University of Philippines at Los Baños has developed a similar drier. A major advantage of batch driers is that they yield higher quality grain than can be obtained by conventional drying methods.

4. Pumps

Pumps are used sparingly in the Philippines for lifting irrigation water to fields from wells or streams that are below field level. Most irrigated fields receive water from gravity flow systems. The pumps that are used are mostly fairly small gasoline or diesel powered units, some of which are partly fabricated in the Philippines. IRRI has developed a foot-powered bellows pump for low head lifting of water. It provides a highly labor-intensive alternative for increasing irrigated acreage. So far it has met with no apparent success in the Philippines where we saw no evidence of manufacture, promotion or use of the bellows pump.

FEASIBILITY OF MECHANIZATION

The adoption of mechanization can take place only if it is economically feasible for the farmers to purchase or hire the machines and use them on their farms. If costs and returns with the machine are not more favorable than with the alternatives there is no economic incentive for mechanization. Small farmers in particular are in no position to ignore relative costs and returns as they seek to make a living from their limited land resource. To them, an important dimension of the appropriateness of technology is whether or not the technology will contribute to higher incomes for the farm family. Thus, new technology needs to meet an economic efficiency test before it is recommended and promoted for these farmers. Furthermore, these farmers are themselves assessing the likely costs and returns of new technology. Machines are not apt to be widely adopted if they do not show favorable costs and returns compared to the alternatives.

A. Power Tiller Costs and Returns

The power tiller is primarily a substitute for the carabao, so we have focused our feasibility calculations for the power tiller on a comparison to costs and returns when land preparation is carried out by the traditional, carabao powered method. The 4-wheel tractor is also an alternative source of power for land preparation. For the small farmer, however, the 4-wheel tractor is only available on a custom hire basis since purchase of a machine costing around $10,000 or more is clearly beyond the farmer's reach.

Estimated costs for the tiller and carabao are shown in Table 1. The costs are based on results from our survey, the study of the CB/IBRD loan program and IRRI studies of mechanization. The carabao have a relatively long useful life and substantial salvage value if sold for slaughter after they are no longer useful for work. Thus fixed costs are relatively low except for the

Table 1.

Fixed and Variable Costs for Power Tillers and Carabao

Fixed Costs Per Year of Ownership	Carabao	Power Tiller
Initial valu	₱3,250	₱7,000
Salvage valu	₱1,750	0
Average valu	₱2,500	₱3,500
Useful life	15 years	5-8 years
Interest on investment @ 10%	₱250/yr	₱350/yr
Depreciation	₱100/yr	₱1,400/yr-875/yr
Maintenance	350-1,050 hrs/yr	₱100/yr
Total fixed costs	₱350/yr + 350-1,050 hrs/yr	
Variable Costs Per Day of Use		
Maintenance related to use	1-3 hrs/day	₱5/day
Fuel		₱11/day
Field labor	8 hrs/day	10 hrs/day
Total operating costs	9-11 hrs/day	₱16 + 10 hrs/day
Performance Characteristics(6		
Plowing	6.8 days/hectare	2.3 days/hectare
Harrowing	3.7 days/hectare	1.2 days/hectare
Total land preparation	10.5 days/hectare	3.5 days/hectare

labor required to feed and care for the carabao even when not being used. Power tillers of Philippine manufacture now cost around ₱7,000 which is more than twice the cost of a prime young carabao. Experience with hand tillers is so recent that it is hard to project useful life. General expectations, based mostly on experience elsewhere, are that the tillers will last from 5 to 8 years, or about one-half as long as a carabao. As a result, fixed costs for the tillers are estimated at ₱1325 to ₱1850 per year, which is 4-5 times as large as cash fixed costs for the carabao.

Maintenance and repair costs for the power tillers were estimated at ₱5 per day of use. With 50 days of use per year this would allow ₱250 for maintenance and repairs during a year's time which is approximately 3.5% of initial value. In addition, we included in fixed costs an allowance of ₱100 per year for maintenance that is generally required regardless of amount of use. Carabao, on the other hand, require almost no maintenance except the cost of caring for them. This is higher when they are being worked so we allowed 1 to 3 hours per day of additional labor whenever the carabao is used.

Costs per day of use and per year of ownership translate into costs per hectare on the basis of time required per hectare of land prepared and number of hectares prepared per year. Preparing a hectare of land using carabao was reported by farmers (7) to require approximately 10.5 working days. With power tillers the time is reduced to 3.5 working days' per hectare. These data result in estimated operating costs for the power tiller of ₱56 plus 3.5 days, or about 35 hours, of labor per hectare prepared for planting. For the carabao there are no cash operating costs but the labor required is 10.5 days per hectare or approximately 95 to 115 total hours of labor. Thus relative operating costs will depend on the rate per hour used in calculating the labor portion of costs. At a wage rate of

about ₱6 for an 8-hour day, the operating costs are about equal.

Fixed costs per hectare depend upon the number of hectares that are being tilled, using either the carabao or the power tiller. Table 2 compares these costs for different sizes of operation. For the carabao, labor costs are again important because of the large amount of time spent feeding and caring for the animal as long as the farmer has it. Traditionally much of this work has been performed by the farmer's children at no net cost to the farmer. But some of the care is necessarily done by the farmer and increased school attendance by the children may decrease their share. For tillage areas of 1-3 hectares, we chose a conservative 400 hours per year of the farmer's own labor taken up in this function and charged for that labor at alternative rates of ₱0, ₱3 and ₱6 per day. The estimated costs range from a high of ₱590 per hectare for a farmer who tills only one hectare with his carabao and places a value of ₱6 per day on time spent either caring for the carabao or working the land. At the other extreme, a farmer who puts no value on his time spent caring for his carabao, but uses it to till 3 hectares will have fixed costs estimated at ₱197 per hectare. We assumed that farmers tilling 4 hectares or more with one carabao would be mostly in intensively farmed, multiple cropping areas where caring for the carabao would be more time consuming. So, for those operations we doubled maintenance time to an average 800 hours per year of adult workers' time.

Total costs per hectare are shown in Table 3. Since fixed costs for the power tiller are much higher per unit, total costs are higher per hectare unless a large number of hectares are being tilled with one machine. At a labor cost of ₱6 per day, total costs per hectare for the power tiller are about twice costs for the carabao up to a size of 3 hectares. For larger

Table 2.

Fixed Costs Per Hectare of Land Tilled
For Carabao and Power Tiller
At Alternative Wage Rates

Area Tilled (ha.)	Carabao Total Fixed Cost Including Labor for Maintenance				Power Tiller Total Fixed Costs
	₱0/day	₱3/day	₱6/day	₱12/day	
1	350	470	590	830	1,325
2	175	235	295	415	662
3	117	157	197	277	442
4	88	148	208	328	331
5	70	118	166	262	265
6	58	98	138	218	221
8					166
10					185
14					132
20					92

Table3

Total Costs Per Hectare of Land Tilled
By Power Tiller or Carabao at Different Labor Values

Area Tilled (ha.)	Carabao	Power Tiller	Carabao	Power Tiller	Carabao	Power Tiller	Carabao	Power Tiller
	₱0/day		₱3/day		₱6/day		₱12/day	
1	350	1,382	502	1,392	653	1,403	956	1,424
2	175	719	266	729	358	740	541	761
3	117	499	188	509	260	520	403	541
4	88*	388	180*	398	271*	409	454*	430
5	70*	322	150*	332	229*	343	386*	364
6	58*	278	130*	288	171*	299	314*	320
8		223		233		244		265
10		242		252		263		284
14		189*		199*		210*		231*
20		149*		159*		170*		191*

*Assumes multiple cropping is practiced

sizes under a single, rainy season crop regime the carabao owner would have to either add an additional animal or hire some of his tillage so costs would not fall much, if any, below the 3-hectare level of ₱260 per hectare. But the machine can handle about 10 hectares during the same season so further expansion and spreading of fixed costs is possible. At 8-10 hectares, power tiller costs average about the same as do carabao costs at 3 hectares or more. Thus, farmers of that size tend to find it feasible to adopt the power tiller technology.

With double cropping, both power tiller and carabao owners can extend the total acreage tilled per animal or machine and further reduce average costs. With a ₱6 per day labor cost, power tiller use must be 2 to 3 times carabao use to produce comparable average costs. With labor costs of ₱3 per day, a power tiller must be used on about 20 hectares before costs of ownership and operation per hectare tilled fall below those for a carabao used for only 4 hectares of tillage (2 crops on 2 hectares).

Average costs of the carabao operation are very sensitive to labor costs since so much labor is involved. If the farmer considers his labor to have a value of only ₱3 per day, which is about 60% of the rural wage rate, carabao tillage costs fall by about one-fourth. Power tiller costs are only slightly reduced. As a result, carabao costs are appreciably lower for any feasible scale of operation at low values for the labor.

On balance, these cost comparisons indicate that the power tiller has lower costs than the carabao only if the tiller is used for considerably more than the 2 hectares which are average for rice farms or labor used for farming by carabao is valued at well above the going farm wage rate. It is possible to find farms that meet these conditions. In fact, tiller users that were

interviewed in our survey tended to be relatively large, with an average of 4.45 hectares of double-cropped land. They also tended to be more prosperous than average with a few holding down non-farm jobs, which suggests that they might place a high value on adopting power tillage.

Many Filipino farms will not fit these conditions for a cost saving by adopting power tillage. Several farms that are too small to afford a tiller may "expand" by doing custom work. Forty percent of the tiller owners in our survey were doing so. Extension of power tillers to the many small farms appears to be contingent upon further growth of this practice.

Joint ownership, which is another alternative for increasing tiller use, appears to be unacceptable to farmers. Both farmers who owned tillers and those who did not, said that they strongly preferred to own the machine themselves rather than in partnership. We found no cases of truly partnership owning of machines. Some of the custom work was on a "within the family" basis, but even so there appeared to be one owner of the machine who loans or rents it to others in the family.

B. Other Factors in Power Tiller Costs

Retaining Carabao

A surprisingly large percentage of farmers who adopt power tillage are keeping at least one carabao. In our survey, 40 percent of the tiller owners and all of those who rented tillers also owned a carabao. The carabao can be useful in plowing the edges and corners of the field where the machine cannot work as well, although many farmers do manage with only the machine. The carabao may also be kept as a form of insurance against the uncertain dependability of the new technology. Whatever the reason, the effect of retaining the carabao is to cause costs with

the power tiller and the carabao to be higher under any conceivable scale or labor cost than the costs of traditional carabao-powered tillage alone. Under those circumstances there is no possibility of achieving a cost savings by adopting power tillage.

2. Adjustments to Carabao Costs

Apparent costs of owning a carabao, as calculated above are subject to several potential adjustments. For one, carabaos kept for work can also yield valuable by products such as milk, meat and replacement stock. The value of these items can partly offset the cost of keeping the carabao and make its costs compare even more favorably with those of power tillage. Farmers also may greatly discount the costs of caring for and feeding the carabao if they consider that labor to have no alternative. If all of that labor is considered to be free, it is hard to imagine conditions that would make the power tiller a less expensive alternative.

On the other hand, some farmers mentioned the "nuisance" of caring for the carabao which indicates that time is costly as far as they are concerned. They also mentioned the danger of the carabao becoming lost, stolen or sick.

3. Benefits in Timeliness by Power Tiller

A farmer with power tiller can prepare a hectare of land for planting in about 3.5 days, whereas, with carabao, 10.5 days are required. In rainfed areas that must wait until the rains to begin plowing, the land can be readied for planting in much less time by using the power tiller. Thus, the planting can proceed more quickly and there is less chance of delaying transplanting until seedlings are too far advanced

for optimal results or until so late that rains will diminish before the crop matures. However, Bautista and Wickham[8] found in the rainfed area of barrio Kapalangan, Nueva Ecija that the land preparation duration from first plowing to final harrowing was shortened only 2.6 days from 29.5 days for carabao users to 26.9 days for tractor users.

Speed and timeliness of land preparation can assume greater significance with multiple cropping. It is theoretically possible, with new varieties of rice, to raise two crops within a single season on land with only a wet-season water supply. On land with a good year-round water supply, it is possible to crop continuously, raising perhaps three crops per year on each hectare of land. Under cropping regimes of this sort, the time spent in land preparation may detract significantly from the total production potential since it means that growing time is lost during what may be the ideal period. Under those circumstances, fast mechanized land preparation could be very valuable for the timeliness that it provides. But, in the Philippines, it appears that these more time-intensive regimes are not being used. Even among owners of power tillers and four-wheel tractors, we encountered nothing more intensive than double-cropping and that only on land with a good year-round supply of irrigation water. There is a definite tendency for mechanization to come to these irrigated areas rather than to the rainfed areas where only one crop per year is produced. There is some evidence that the tiller does serve to shorten the time between crops in those areas. Bautista and Wickham[9] reported that in Baluarte, farms that adopted tillers reduced the time of land preparation from 31.9 days to 20.7 days for the wet season crop. However, time for the dry season crop was not significantly changed.

4. Superiority of Power Tilled Land

Tractors work the land to a greater depth than is generally possible with the carabao. Some farmers in our survey mentioned that this made weeding easier because deep-rooted grasses were torn loose at plowing. However, there was no indication that farmers expected power tilling to increase their yields.

With respect to comparative quality of carabao and tiller land preparation Barker et al.[10] conclude "there is no clear evidence that land productivity increased as a result of this substitution" (of capital for labor) Most farmers in Baluarte reported no difference in yields after using two wheel tractors.[11]

5 Four-Wheel Tractor Alternativ

The hand tiller appears to have advantages over larger, four-wheel tractors when operating under conditions typical for small rice farms in the Philippines. A locally built hand tractor costs only about one-sixth to one-eighth as much as the smallest models in a line of imported four-wheel tractors that are being marketed in Nueva Ecija. However, as shown in the CB:IBRD report, the costs per hectare under assumptions of 14 and 160 hectares for the tiller and tractor respectively, indicate that the tiller has no cost advantage[12]. A higher wage favors the large tractor. Nevertheless, the four-wheel tractors hardly seem suited to small farms which are divided into many small and often irregularly shaped plots. Operation of a four-wheel tractor in fields that are often less than one-quarter hectare in size requires much turning and a significant fraction of time lost moving from field to field.

C. Thresher Costs and Returns

The IRRI Axial-flow thresher is a relatively new entrant to mechanization of agriculture in the Philippines. The thresher is designed to serve mostly as a traditional method of hand threshing although it may also prove to be a replacement for other mechanical threshers that are already in use.

The costs of owning and operating the thresher are shown in Table 4. There is limited data upon which to base these values, but they are believed to be representative. Costs per hectare of operation, shown in Table 5, are calculated using the average performance characteristics of 55 cavans threshed per day and an average yield of 55 cavans per hectare.

The thresher is more expensive than the power tiller and also has a much larger capacity. Thus, costs begin much higher, but decline to low levels if used nearer to capacity. At 2 hectares of use, thresher costs average ₱1154 per hectare, which is approximately 5 times as high as the payment to hand threshers. At 14 hectares, the average cost with the thresher drops below the cost for hand threshing. At 50 hectares of use, cost with the machine is less than one-half the cost with hand threshing.

The scale of operation needed to make the thresher more profitable than hand threshing would require a 7-hectare farm with double cropping. To realize most of the economies to scale with this machine would require a farm larger than all except corporate operations and large land owners. As a result, the machine is economically viable for small farmers only in a custom operation or cooperative venture. But, the operator who can achieve high usage per year in rental or custom operation can make a handsome profit if paid at going rates for hired threshing. We interviewed one custom operator who expected to cover all costs and pay for his machine in one year. According

Table 4

Estimated Fixed and Variable Costs

For Axial-Flow Thresher

Fixed costs per year of ownership		
	Initial valu	₱12,500
	Salvage valu	0
	Average valu	₱ 6,250
	Useful life	5-8 years
	Interest on investment @ 10%	₱625/yr
	Depreciation	₱2,500 to 1,563/yr
	Total fixed costs	₱2,188-3,125/yr
Variable costs per day of use		
	Maintenance[a/]	₱12.50/day
	Fuel	₱11.20/day
	Labor	4 workers/day
	Total variable costs	₱23.70/day + 4 days of labor
Performance characteristics		
	Field performance @ 30% of capacity[(6)]	55 cavans/day
	Time requirement	1 machine day/hectare

a/Computed at 5% of initial value with an average of 50 days per year of use.
b/Based on records of large farm that was using the thresher.

Table 5.

Costs per Hectare for Axial-Flow Thresher

Area Threshed (ha.)	Fixed Cost[a/]	Maintenance and Fuel	Labor (4 workers) ₱6/day	Total Costs per ha.
1	₱2188	₱23.70	24	2236
2	1094	23.70	24	1144
3	729	23.70	24	779
4	547	23.70	24	595
5	438	23.70	24	486
6	365	23.70	24	413
8	274	23.70	24	322
10	219	23.70	24	269
14	156	23.70	24	204
20	156	23.70	24	204
30	104	23.70	24	152
50	63	23.70	24	111

Hand Labor

Cost=1/12 of 55 cavan/ha. = 4.57 cavans X ₱50/cavan = ₱228/ha.

a/Assumes 8-year life for use of less than 20 days per year, 5-year life for 20 days use or more.

to our estimate that would require about 80 days operation at an average performance rate of 55 cavans per day.

Comparison of mechanical thresher costs to the customary thresher's share is in part misleading. Farm workers earn much more at threshing than at other tasks. Thus, in part threshing is subsidizing other tasks such as transplanting and weeding. A thresher's share of about one-half customary rates would yield an average farm wage. But at that rate, the mechanical thresher is more expensive than hand threshing unless the machine is used at least 50 days per year.

In addition to cost savings, the thresher has other potential benefits. It may make it possible to thresh grain at a high moisture content and thereby avoid the necessity of stacking it to dry before threshing. Grain loss may be less than with hand methods or other threshers. The grain may be cleaner and a smaller proportion of it damaged during threshing and other post harvest operations. Test results indicate that these will be achieved. Hopefully, field trials will confirm the tests.

Mechanization and Labor Displacement

The purpose of farm mechanization is to reduce costs by substituting efficiently working machines for less efficient machines and for human and animal labor. An additional purpose is to increase agricultural output by helping to increase productivity of crops and expand production through multiple cropping and extension of the cultivated area. Machine substitution for labor raises questions in the case of developing countries where labor is abundant, cheap and often unemployed or under employed. It is a question that needs to be faced with regard to the introduction of machines to small farms in the Philippin

Magnitude of Net Labor Savings

An estimate of the labor savings from the adoption of the power tiller is shown in Table 6. The reduction in the labor demand for land preparation is significant. Most of the saving occurs in plowing where the machine requires only about one-third as much labor as does the carabao pulling a single plow. Harrowing, the second phase of land preparation, is often done by carabao even when plowing is done by the power tiller. Harrowing by the machine is only slightly faster than with the carabao. Therefore, most of the saving in land preparation comes from plowing and not harrowing. In the farmer survey, labor reduction in plowing with the power tiller was 4.4 laborer days per hectare or a 70% decrease for the plowing operation. Labor saving in harrowing is equivalent to 2.5 worker days per hectare. Taking plowing and harrowing together, labor saving is 6.9 worker days per hectare per year or about 86 worker days for the average usage of 12.5 hectares per machine.

Table 6. Labor Savings with Power Tiller

Field time savings

Carabao	6.7 days	plowing	+ 3.7 days	harrowing	=	10.4 days/ha.
Power Tiller	2.3 "	"	+ 1.2 "	"	=	3.5 days/ha.
Net Savings	4.4 "	"	+ 2.5 "	"	=	6.9 days/ha.

Savings per year

Animal care savings

Minimum 1 worker days/day x 365 days/year x 2 animals = 73 worker days/year.

Maximum 4 worker days/day x 365 days/year x 3 animals = 440 worker days/year

Power tiller manufacture

Direct = 6 days/machine x 4 workers = 27 days/machine
Indirect = 0.5 x direct = 12 days/machine

Maintenance and repairs

Assume 1/2 of 350/year is for labor @ 10/day = 18 days/year

Overall net labor change

Field labor	-86 days
Animal care (min)	-73 days
Machine manuf.	+7 days
Machine maintenance	+18 days
Net	-140 days/year ÷ 12.5 ha./year = -11 days/ha.

In addition to the labor saved in field operations there may be a very significant reduction in labor required for carabao care if adoption of the tiller makes it possible to eliminate at least some carabao. At the rates of use by the survey farmers, the machines would be replacing at least 2 carabao per power tiller adopted. Labor saved from caring for these animals would be at least 2 hours per day or about 80 worker days per year and might be much more. Maintenance and repairs on the power tiller will also require labor. If 50% of estimated ₱350/year maintenance cost were for service and repair work on the machine, plus manufacture of and merchandising of supplies and replacement parts then total labor in this category would be about 18 worker days per year. The overall labor savings thus would be at least 140 days per machine per year or about 11 days per hectare converted to power tillage. Over a 5-year life of the machine, labor savings would amount to about 700 days per machine.

The thresher has much greater labor-saving potential. The estimates in Table 7 indicate a net saving of more than 500 days labor per yea for one machine or about 11 days of labor saving per day of machine operation.

Impact of Labor Savings

The concern about labor saving innovations arises from concern that the reduced labor demand will simply result in more unemployment and underemployment. Whether it does or not depe on which portions of the work force experience the reduction in den d for their labor and what opportunities may be for reemployment.

In the substitution of power tillers for carabao, the labor saved is mostly the farmer's own labor according to our interviewees.[13] They

Table 7. Labor Savings with Axial-Flow Thresher.

Field time

Hand threshers: 3.5 cavans/worker/day
16 worker days/hectare (55 cavans yield)

Machine thresher: 55 cavans/4 workers
4 worker days/hectare

Savings: 12 days/hectare
.22 days/cavan

Thresher manufacture

Direct employment:
Indirect employment:

Maintenance and repairs

1/2 of ₱625/year is for labor @ ₱10/day = 31 days/year

Overall net labor change (@ 50 days operation per year)

Field labor	-600 days
Machine manuf.	+18 days
Maintenance	+31 days
Net	-551 days/year

were rather vague about how the freed time was used.

In general, the labor saved by converting to power tillers seems to be moving into other productive employments. Indirect evidence indicates that the tiller owners are expanding slighlty the area farmed.[14] According to Barker, et al.[15] they are using some of the released time in a stepped up weeding program associated with adoption of high yielding varieties. Our interviewees mostly mentiond spending more time repairing dikes, working in the garden or just enjoying shorter working days. Those who were doing custom work with their power tiller undoubtedly used some of their released time in that way.

The evidence is encouraging that labor released by adopting power tillers is being reemployed or absorbed as desired reductions in work load. An important factor seems to be that the reduction is marginal, is spread over most of the year and falls on the farmers who are in a good position to make other marginal adjustments to put the freed labor to use. Extension of mechanization to smaller and smaller farms would lead to more cases where farmers are not in a position to productively use released labor. This will be another factor hindering the mechanizatio of farms in the 2 hectare size class. Even if the very small farmer can hire a machine at low average costs and avoid the high fixed costs of ownerships, he still must face the fact that his labor saved through mechanization may have only very little reemployment opportunities on his own limited land area.

Labor displacement by the power thresher is a different situation. Hand crews displaced are virtually all hired workers. Some are farmers who work in the crews to augment their cash income. Others are landless

laborers who depend upon farm work for their livelihood. For this latter group in particular mechanization of threshing could have a serious impact. They appear to be in a much more vulnerable position in that they do not have the opportuntity that farmers do to make marginal adjustments to reemploy the labor. The loss of threshing work would be especially serious to them since it is by custom the most lucrative of all hired farm work. If threshing is mechanized, rates of pay for different tasks will need to be somewhat restructured. In addition, some new employment opportunites will have to be found.

Prospects for Reemployment

The judgment, positive or negative, on the labor displacement effects of mechanization rests ultimately on the prospects for reemployment of the released labor. If the labor is simply left standing idly by the capital invested in machines will have contributed nothing to net national economic efficiency. Instead, it will have used scarce capital in a way that redistributes income away from the disemployed but adds nothing to aggregate income. But there is danger in assuming too readily that this is the case and stiflying all progress. Every innovation requires adjustments and changes. And it is only by adopting innovations that reduce labor requirements for performing various tasks that an overall increase in output and income per person can be achieved.

Ideally the Philippine economy would grow through increased output and employment in the production of consumer goods, including food, basic materials and equipment and exportable items. These sectors would grow using labor released from a mechanized agriculture and the new

sectors' outputs would provide for a higher level of income for the people of the nation. But growth has not been as rapid as desired in these industries. Added labor coming from population growth and some small amount from agriculture is tending to back up rather than be used to power the new industries.

In a recent report for the International Labor Organization, Ranis[16] estimated that unemployment is running around 10%. Underemployment of workers in the form of partial employment or very low productivity employment probably accounts for another 20% of the labor force that is in effect unused at the present time. The retail trades and personal services sectors, in particular, are characterized by lavish use of labor at what must be very low marginal productivity. Further labor displacement from agriculture is apt to follow the easy entry route into low-capital trades and services pursuits. But once there, it is likely to be underemployed at low average earning rates.

What is needed is a balance between release of agricultural labor from time-consuming tasks that can be readily mechanized, such as threshing and expansion of production in agriculture and in non-agricultural industries that can use the released labor. The key determinant of movement on both sides is capital, for investment in farm machines or in industrial plants. The supply of capital is limited. If too much goes into machines too fast, investment in industrial plants and agricultural expansion will be starved. Workers no longer needed on farms will lack alternative employment.

It was not possible for us to judge whether or not this balance was being achieved. It should be an early item on the agenda for investigation to supply facts urgently needed for government policy decisions.

FOOTNOTES

1. Luis Bernas, Marsteel Corp., Manila, Aug. 11, 1975.

2. Sharing in development: A programme of employment, equity and growth for the Philippines, International Labour Office, Geneva, 1974.

3. E.A. Uichanco, "Farm Equipment Marketing in the Philippines," Paper presented at the Philippine Society of Agricultural Engineers Convention, Los Banos, Philippines, Dec. 11-12, 1970.

4. Agricultural Machinery Dealers' Association, Manila.

5. Bart Duff and Zenaida Toquero, "Technical and Economic Factors Affecting the Efficiency of Mechanization in Rice Post-Production Systems in the Philippines," Paper presented to the Center for Policy and Development Studies, U.P.L.B., Laguna, Philippines, July 1975. Table 2.

6. Farmer Survey, July/Aug. 1975.

7. Farmer Survey, July/Aug. 1975.

8. Fe Bautista and T. Wickham, "The Tractor and the Carabao: A Socio-Economic Study of Choice of Power Source for Land Preparation in Nueva Ecija," Paper presented to IRRI, July 27, 1974.

9. Ibid., Table 7.

10. R. Barker, W.H. Meyers, C.M. Crisostomo and B. Duff, "Employment and Technological Change in Philippine Agriculture," Paper for ILO, Geneva Switzerland, Oct. 1971. Page 14.

11. Farm Survey, July/Aug 1975.

12. Fred King, "Evaluation of the CB-IBRD Agricultural Credit Program in the Philippines," Nov. 11, 1974, Table 27.

13. Farm Survey, July/Aug. 1975.

14. Fred King, "Evaluation of the CB-IBRD Agricultural Credit Program in the Philippines," Nov. 11, 1974, Table 27.

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16. Sharing in development: A programme of employment, equity and growth for the Philippines, International Labour Office, Geneva, 1974.

MANUFACTURING

I. Profile of the Metalworking Industry

A profile of the metalworking industry in the Philippines, followed by a description of the farm machinery and equipment industry will provide the necessary backdrop for the presentation of our particular research findings in the manufacturing sector

A. Metalworking Industry

The metalworking industry consists of fourteen major groups, one of which is the farm machinery and equipment industry.(1) As of 1974, the metalworking industry was comprised of 1,907 firms which employed a total of 49,520 people. The majority of the firms are small business: 90 percent hire fewer than 50 employees and 71 percent of all firms are capitalized at less than P 50,000.(2) In terms of geographic distribution, 59 percent are situated in the Greater Manila Area, with an additional 20 percent in Central Luzon and Southern Tagalog.(3) (see Table 1).

This concentration of metalworking firms is largely determined by the location of final markets as it is "the tendency of firms to choose locations that are near the market centers."(4) Almost eighty-three percent of all employees hired by the industry are employed by firms in the Greater Manila Area. (See Table 2).

Market strategy varies, depending largely on the size of the firm. The majority of firms (76 percent) are jobbers or small-scale operators who utilize the direct selling technique.(5) They rely heavily on personal contact and advertisement via word of mouth. The larger firms, on the

TABLE 1

REGIONAL DISTRIBUTION OF METALWORKING FIRMS

Region	No. of Metalworking firms	% Distribution
Greater Manila Area	1,124	59
Ilocos	101	5
Cagayan Valley	38	2
Central Luzon	218	11
Southern Tagalog	164	9
Bicol	39	2
Western Visayas	65	3
Central Visayas	49	3
Eastern Visayas	2	-
Western Mindanao	12	1
Northeastern Mindanao	44	2
Southeastern Mindanao	51	3
TOTAL	1,907	100%

Source: National Science Development Board, Metalworking Industry of the Philippines (Philippines: Metals Industry Research and Development Center, 1974), Vol. II, p. 53.

TABLE 2

REGIONAL DISTRIBUTION OF EMPLOYEES

Region	Employment	% of Total
Greater Manila Area	41,047	82.89
Ilocos	727	1.47
Cagayan Valley	114	0.23
Central Luzon	1,266	2.56
Southern Tagalog	1,112	2.25
Bicol	494	1.00
Western Visayas	1,707	3.45
Central Visayas	1,743	3.52
Eastern Visayas	8	0.02
Western Mindanao	193	0.39
Northeastern Mindanao	256	0.52
Southeastern Mindanao	828	1.70
TOTAL	49,520	100.00

Source: National Science Development Board, Metalworking Industry of the Philippines (Philippines: Metals Industry Research and Development Center, 1974), Vol. II, p. 117.

other hand, have established distribution centers which include marketing departments, salesmen and dealers.

Research and development capabilities are extremely limited. A survey conducted by the Metals Industry Research and Development Center (MIRDC) revealed that only 18 percent of the respondents have R & D facilities.(6) Half of these firms employ over 100 workers. (See Table 3).

TABLE 3

DISTRIBUTION OF FIRMS WITH RESEARCH & DEVELOPMENT

	Number of Employees					
	Less than 50 (70 firms)		50 - 99 (22 firms)		Over 100 (28 firms)	
	No. of firms	Percent	No. of firms	Percent	No. of firms	Percent
With R&D facilities	6	9	1	4	14	50

Source: National Science Development Board, Metalworking Industry of the Philippines (Philippines: Metals Industry Research and Development Center, 1974), Vol. II, p. 129.

The industry is plagued by a number of problems which must be given greater attention if this particular sector is to realize its growth potential. The major problem is one of financing. Strict collateral requirements and limited credit availability effectively disqualify or discourage small firms from applying for financing--be it for working capital, for maintaining efficient levels of production, or for expansion.(7) The problem of obtaining sufficient working capital has been aggravated by rising input prices--such as imports, raw materials and energy.

Other bottlenecks faced by the industry include shortages of qualified skilled labor, absolute shortages of raw materials, underutilization of existing plant capacity, and inability to meet export demand.(8)

B. Farm Machinery and Equipment Sector

In the years 1969-1973 the annual rate of growth of the metalworking industry averaged 28 percent. The value of local production was P 490 million in 1969; this climbed to P 1,305 million by 1973.(9) The farm machinery and equipment sector contributed to this favorable growth rate.

The increased demand for agricultural equipment during the past seven years can be attributed to the government's irrigation program, the widespread adoption of high yielding varieties and more intensive cultivation.(10) Other factors which may have impacted on demand for and increased local production of inexpensive, small-scale machinery are:

1) Presidential Decree No. 27, which limits the size of rice and corn holdings to a maximum of seven hectares;
2) Declaration of Martial Law in September 1972 and the resultant decline in criminal and other violent acts against citizens and their private property;
3) Devaluation of the peso, and consequent increase in the price of imports;
4) The increase in rice prices which ensure the farmer a fair return on his investment;
5) Artificially low interest rates which serve as a subsidy for borrowers of capital.

To date, the country has relied heavily on imports to satisfy its requirements for farm machinery. However, local production's contribution to satisfying

these needs has more than doubled in the period 1969-1973, increasing from 16 percent to 33 percent of total sales.[11] (See Table 4).

TABLE 4

APPARENT CONSUMPTION OF FARM MACHINERY EQUIPMENT
(IN THOUSAND PESOS)

Year	Production Value	Production % Share	Importation Value	Importation % Share	Consumption Value	Consumption Growth Rate
1969	22,820	16	115,500	84	138,320	--
1970	39,350	23	131,730	77	171,080	24
1971	66,920	26	186,610	74	253,530	48
1972	58,450	22	206,160	78	264,610	4
1973	70,810	33	144,740	67	215,550	(19)

Source: National Science Development Board, Metalworking Industry of the Philippines (Philippines: Metals Industry Research and Development Center, 1974), Vol. II, p. 14.

A look at the structure of production costs for the past six years indicates that raw material expenses figure heavily relative to labor in total costs. In 1968, for example, 53.6 percent of manufacturing costs could be attributed to purchases of raw materials. This increased to 71 percent in 1973. Proportionally speaking, direct labor costs have declined over the same period from 23 percent in 1968 down to 12.4 percent in 1973. Manufacturing overhead has also declined proportionally, from 23.8 percent in 1968 to 16.6 percent in 1973.[12] (See Table 5).

Ancillary industries within the Philippines remain relatively underdeveloped. Only the larger, more capital intensive firms have facilities for castings and forgings. Supply of local machine tools are also limited.[13] A creative owner/operator may produce his own lathe, but the majority of the more sophisticated equipment is imported. In terms of raw materials, the Philippines does have a capacity for steel production.[14] The quality of local steel, however, is questionable.

TABLE 5

BREAKDOWN OF MANUFACTURING COSTS FOR THE FARM MACHINERY AND EQUIPMENT INDUSTRY

	1968 Amount (in pesos)	1973 Amount (in pesos)
Raw materials	1,302,184	1,988,416
Direct labor	642,203	349,714
Manufacturing overhead	478,023	466,760
Total manufacturing cost	2,422,410	2,804,890

Source: National Science Development Board, Metalworking Industry the Philippines (Philippines: Metals Industry Research and Development Center, 1974), Vol. II, p. 149.

Four Wheel Tractors. In 1973 the tractor population in the Philippines was estimated to be 14,000. The country does not have the capability tc produce the equipment locally and is therefore completely dependent on foreign sources. The most popular brand--Ford--has cornered half the market: in 1973 Ford tractors accounted for 50 percent of total sales.(15) Local content of the Ford tractor is minimal, averaging only about 1-2 percent. Tractor implements such as ploughs and harrows have a local content of 20 percent.(16)

At the present time the majority of tractors--90 percent--are used in the production of rice and sugar cane. (See Table 6). These statistics are useful when predicting future demand for tractors in the Philippines. D.N. Porter, who completed a series of studies on the farm machinery and equipment industry in the Philippines, predicts

TABLE 6

MARKET FOR TRACTORS BY CROP

Palay	47%
Sugar	41%
Corn	5%
Fruit	4%
other	3%

Source: D.N. Porter, Market for Farm Machinery (Philippines: UN DP/ IBRD Technical Assistance Project, 1974), p. 10.

slow growth in the industry in the near future, estimating that total annual sales will reach 1,500 - 2,000. According to Porter, this phenomenon can be explained by three factors. First, the needs of the sugar cane industry for tractors have been almost completely satisfied, and future demand, excepting replacements, will probably be limited.(17) Second, the number of large rice farms--over 15 ha.--will decline as a result of Land Reform, and more farmers will opt for the less expensive power tiller. However, Presidential Decree No. 47 is forcing large corporations to enter rice production and may lead to an increase in the demand for large tractors. Third, demand for tractors by corn producers will probably be limited, due to the small size of most corn farms which makes tractor ownership uneconomical.(18)

Power Tillers. In contrast to tractors, the potential growth in demand for power tillers is considered to be high. In 1973 the tiller population was estimated 8,000. The current market is for 5,000 units annually, conservatively projected to reach 10,000 units by 1980.

Until recently, the Philippines relied primarily on imports to satisfy its requirements for tillers. In 1972, for example, imports accounted for 85 percent of total power tiller sales. During

1973, both consumption and local production almost doubled. Sales of tillers by AMDA (Agricultural Machinery Dealers Association) members totalled 1,239 in 1972, jumping to 2,456 in the following year. In 1973, sixty-five percent of sales, or 1,609 units, were locally produced.(19) Porter attributes this radical jump in total sales and local production to greater rural incomes and availability of IRRI-type tillers.(20)

II. Presentation of Research Findings

A primary objective of the Small Agricultural Machinery Project is the design and development of simple farm equipment for rice production which can be fabricated by the small metalworking shops scattered throughout the Philippines. This section focuses primarily on IRRI's efforts to encourage production of the designs by Filipino firms, and is based upon interviews with manufacturers in two regions. The section is divided into four parts. The first subsection provides a brief historical overview. This is followed by a description of those firms canvassed by the team during the summer of 1975. In the third part, a number of potential problem areas are identified and analyzed. The final subsection discusses the actual and potential contributions of the Small Agricultural Machinery Project to the overall development of the country.

A. Historical Overview

The introduction of the IRRI designs coincided with the growth of local industry, but it is not possible to establish a cause and effect relationship. Prior to 1972, the local agricultural equipment industry was underdeveloped; some entrepreneurs had designed threshers and power tillers of their own, but the market remained small. The country was almost wholly dependent upon foreign sources for supplies of agricultural equipment.(21) In 1971 IRRI released its design of the power tiller and

actively undertook a campaign to attract the interest of local firms. During the next few years the local agricultural equipment industry experienced rapid growth. This is reflected in part by the declining ratio of imports of power tillers to total sales. In 1972, imports accounted for 85 percent of total power tiller sales in the Philippines. In the following year the percentage of imports to total sales of power tillers dropped to 35 percent.(22)

The increased demand for small gasoline engines in the early 1970's is another indication of the growth of the local farm machinery industry. The IRRI-designed tiller does require an imported gasoline engine in the 5-8 hp range since the Philippines does not manufacture that essential component. Consequently, the demand for Briggs and Stratton engines--the most popular foreign brand in the Philippines--is related to growth in local machinery production. Noel Reyes--President of Muller and Phipps, the sole distributor of Briggs and Statton engines in the Philippines-reported a dramatic increase in sales (Table 7) which he attributed mostly to the introduction of the IRRI designs,(23) although the engines are also used for other purposes such as powering fishing boats.

TABLE 7

SALES OF B. & S. 7-8 HP. ENGINES, 1970-1973

Year	Total Sales 7-8 hp.
1970	.,100
1971	2,000
1972	5,300
1973	9,500

Source: Noel Reyes, Muller and Phipps, Philippines.

The responsibility of the AED, as stipulated by the contract with AID, is to design and develop farm equipment which can be locally fabricated,

utilizing indigenous resources to the greatest extent possible. That is, their job is to produce blueprints for hardware. By 1972 IRRI had a sufficient number of designs to warrant involvement of local firms in production of the new technologies. At this point IRRI shifted some of its energies from product design to transfer of the fruits of its research from the Institute to the industrial sector.

IRRI experienced some initial difficulty in attracting the interest of local manufacturers. Although the designs were available to interested parties at no cost, small firms were reluctant or unable to take the risks involved in producing and marketing a new product. IRRI then contracted with several firms to build prototypes of the machines, thereby assuming some of the initial financial risk.

Interestingly enough, it was a large local company which served as a vehicle for transferring the research product from the institute to the industrial sector. In 1972 the Marsteel Corporation, an importer of the Japanese Kubota power tillers and tractors, became concerned about what impact the revaluation of the yen would have on its sales. In February 1972, Luis Bernas, Marsteel's Marketing Manager, went to IRRI to examine the drawings for the tiller; by June 1972, Marsteel had constructed six prototypes.(24) They had no trouble selling the tillers, as demand exceeded supply.

Marsteel's contribution to stimulating the agricultural machinery industry in the Philippines was two-fold:

1) The first is that it demonstrated the marketability and profitability of the IRRI designed equipment. The old cliche--"nothing succeeds like success"--is particularly relevant when introducing a new product. The fact that a large company was successfully manufacturing and marketing the tiller may have

been sufficient inducement for small firms to follow suit.

2) Marsteel's widespread marketing structure facilitated the distribution of IRRI tillers throughout the Philippines. Farmers and small metalworking shops in outlying areas were exposed to the IRRI designs for the first time. This was, in effect, the beginning of the process of developing consumer and producer awareness, an essential step in introducing a new product into a market.

Since 1975 a healthy number of small and medium firms have commenced production of IRRI type equipment. The majority of these firms are located in the Greater Manila Area--IRRI's sphere of influence. One should also note, however, that 59 percent of all Filipino metalworking shops are located in the Greater Manila Area. Explanations for the concentration of firms producing IRRI-designed equipment are several:

1) proximity to IRRI, thereby permitting maximum contact between IRRI and the firms;
2) proximity of Manila to the market: Central Luzon is the Philippine's "rice bowl;"
3) concentration of suppliers in the Manila area;
4) availability of a large labor pool.

B. Description of Canvassed Firms

Regional Distribution. In the survey of local agricultural equipment manufacturers, producers of both IRRI designed and independently designed equipment were interviewed. A total of thirteen firms were canvassed. All eight firms falling within IRRI's sphere of influence--Laguna, the Greater Manila Area and Nueva Ecija--are currently producing or have produced IRRI-designed equipment. Seven firms are fabricating the axial flow thresher;

thresher, which involves a more labor intensive process and is therefore too costly for the company's existing production facilities at the current level of demand.

Technical Assistance. Seven of the eight firms which fall within IRRI's sphere of influence have been beneficiaries of assistance provided by IRRI engineers and technicians. One firm in Nueva Ecija has never been visited by IRRI personnel, but expressed an interest in making contact. In contrast, the firms in Mindanao have had only limited contact with visiting IRRI personnel, and one small company we visited never heard of IRRI or IRRI designs.

Marketing. Of the firms surveyed, some distribute their products through dealerships whereas others depend solely upon direct sales. Marsteel, for example, has an extensive marketing network throughout the country. In marked contrast, Durasteel has had great difficulty in developing a sales network for its agricultural equipment. It has recently begun selling a limited number of its threshers to Marsteel with the latter giving the product its final painting, attaching the Fieldmaster sticker and distributing it to dealers.

Some of the smaller firms, such as Kalayaan, have been operating through a number of dealers. Others, however, have no marketing structure and depend wholly upon direct sales. These same owner/operators expressed reluctance to work through distributors, who, they calim, want to absorb all the profit. Rather, they prefer to leave out the middleman, thereby keeping prices lower and enhancing the competitiveness of their product.

C. Analysis of Findings

During the course of the research, three issue areas were identified as being worthy of greater attention, given their potential influence on the Project's success. The first of these deals with IRRI's current patent policy and its impact on a firm's decision to fabricate and modify IRRI-

designed equipment. The second area concerns the compatibility of large companies--for example, Marsteel Corporation--and small firms. This is particularly relevant, given that the small metalworking shop is the target of the project. Insights into the third problem area--extension of IRRI designs to regions beyond IRRI's sphere of influence--were obtained during the course of field work in Mindanao, an area geographically distant from Los Banos. Interviews with firms in Mindanao helped us identify problems which may arise in the technology transfer process.

Patents. Larger firms employing more than 100 employees--for example Durasteel and Marsteel--can afford to support R&D facilities.(27) As was noted earlier, however, the overwhelming majority of metalworking firms in the Philippines are small-scale, few of which have their own R&D capability. The inability of small firms to support product development activities, coupled with a lack of a pool of appropriate, simple designs of agricultural equipment may be inhibiting the growth of the local agro-equipment industry.

The Agricultural Engineering Department has identified the need for new technologies which can be locally produced, and has assumed the task of designing equipment suitable to local production capabilities. Recognizing that few firms can afford to pay for the designs, IRRI has opted to disseminate its blueprints to interested manufacturers at no cost, subject to a few provisions. Two conditions are particularly relevant to a discussion on patent issues. The first states that no firm can "obtain patents or other encumbrances on any component or part originating from IRRI designs." The second condition stipulates that any improvements engineered by the manufacturer are to be submitted to IRRI, who retains the right "to distribute such information to manufacturers located outside the country in which the improvement originated."

The first condition--universal availability of the IRRI designs to interested manufacturers--may be the optimum strategy if the objective is

to stimulate an underdeveloped industry. This policy has undoubtedly been a factor in encouraging the smaller firms to commence production of the designs. These firms operate with extremely tight budgets and are unable to buy blueprints or production rights. The impossibility of obtaining exclusive rights to production, however, may discourage some firms from producing the technology.

Two larger firms, G.A. Machineries Inc. (GAMI) and Durasteel, expressed dissatisfaction with the policy: they noted that market development is a costly and unprofitable venture for unprotected products. GAMI, for example, has high overhead costs and is interested only in products with exclusive features which cannot be easily copied by small shops.(28) Marsteel, on the contrary, is unconcerned about the free availability of the design. Luis Bernas, Marketing Manager of Marsteel, informed us that his company is actually encouraging small firms to enter the market. According to Bernas, proliferation of small firms manufacturing agricultural equipment is a low-cost, effective method for developing the market for said products. Once the market has been developed the battle will be to caputure the largest possible share of total sales. Bernas hinted that when the time is ripe, Marsteel can temporarily lower product prices, driving smaller competitors who are unable to respond in like fashion out of the market.

The second condition, pertaining to IRRI's prerogative to disseminate information on design changes, raises a number of interesting issues. The Memorandum of Agreement states that no firm is to "obtain patents or other encumbrances on any component or part originating from IRRI designs." It further specifies that IRRI reserves the right to pass on information on design improvements to firms outside the country in which the change originated. It is unclear if local entrepreneurs are prohibited from obtaining patents on design changes they may make on IRRI equipment. The first company to

market an IRRI technology--Ohtake in Japan--did not sign a written agreement with IRRI; it has since obtained a number of patents on changes it has made on the weeder. However, Filipino firms have also made a number of changes on the original design and to our knowledge none has obtained patents on these changes.

Almost all local manufacturers of IRRI equipment have modified the original design to some extent. Each firm has adopted the design to its particular production facilities and at times these changes have been extensive, as in the case of Marsteel. In addition, where specific components have been unavailable locally, the designs have been modified in order to utilize local parts.

A number of firms have made design improvements in response to complaints and feedback from customers. For example, Arsenio Dungo of Kaunlaran outfitted the thresher with an oscillating tray, a modification which has resulted in cleaner grain. To his chagrin, Durasteel--a larger competitor--has copied his innovation. Dungo told us that he has spent many sleepless nights, knowing that his design improvements are unprotected and can be copied by others. He is reluctant to make further innovations.[29]

Bonifacio Isidro, of C & B Crafts, has also made a number of improvements on the thresher, one of which has reduced threshing losses. He is proud of his accomplishment, and is pleased that IRRI has taken note of, and in some cases has used, his design changes. Isidro's generous attitude may be attributable to his relative isolation from other manufacturers of the axial flow thresher. He may become more protective of his innovations if a competitor moves into his sphere of operation.

Assuming that an innovator cannot obtain patent protection on changes he has made, this policy in effect prevents him from obtaining

exclusive rights to changes which may enhance the competitiveness of his product vis-a-vis those of his competitors. The result could be to stifle innovativeness within the industry. An innovator such as Dungo may find that it is not worth the time and energy to modify the thresher if Durasteel can copy these changes without much ado.

As of this writing, the number of firms producing IRRI-designed agricultural equipment is limited. As the market grows and more firms initiate production of the designs in response to growing demand, marketing spheres will begin to overlap. This is already beginning to occur in Cabanatuan City, where there may be as many as 52 local dealers of agricultural equipment. To attract customers and corner a larger portion of the market, firms will wish to differentiate their product from those of competitors. One current method of achieving product differentiation is by color of the paint job, but this will be insufficient when competition becomes keen.

The current patent policy may discriminate against the small firm. A company such as Marsteel--with ready access to credit, considerable R&D resources and a national network of dealerships--can exploit a small firm's innovations and simultaneously make modifications which cannot be copied with the limited production facilities of small, labor intensive firms. According to Luis Bernas, Marsteel will respond to the growing sophistication of farmers by offering a number of options and accessories to its machines. He noted that these changes would be difficult, if not impossible, for the smaller firms to imitate and would enlarge Marsteel's share of the market. Smaller companies would be at a distinct disadvantage and could ultimately be forced out of business.

IRRI's policy regarding dissemination of information on design changes to manufacturers outside the country of origin has some potential implicati-ns for export opportunities. At the time of this writing the export market for IRRI equipment is small and therefore this policy does not currently affect Filipino firms. It is conceivable that as the export market grows, this policy could inhibit firms from improving their product as they would not be assured of recouping R&D expenses--the "raison d'etre" of patents. While this issue is not of immediate concern in regards tc local industry, it may merit consideration in the future as an export industry develops.

Compatibility of Large and Small Industry. An important issue which should receive more attention is the compatibility of large firms ā la Marsteel and small metalworking shops. Marsteel, as noted above, has played an important role in encouraging small firms to commence production of IRRI equipment. However, it should be recognized that Marsteel could also conceivably snuff out local competition when it is to its advantage to do so. Luis Bernas has already mentioned that Marsteel would like to see the currently small market grow into a huge market with small firms shouldering much of the promotion costs. Then he sees the battle worth fighting--a large share of a huge market can be greater than all of a small market.(30)

Marsteel's advantages over the smaller firms are many. It is a large, well-established company, which could absorb temporary losses to gain a monopoly. It has ties with the Marcos family, and therfore has political influence. It has benefited from the IRRI designs, but, unlike the majority of firms in the Philippines, has the necessary resources to support an R&D function. It can purchase raw materials and imported components (such as the

Briggs & Stratton engine) in bulk, thereby cutting its production costs and ultimate selling price. It can modify its product in a manner which cannot be easily copied by the small firm, thereby achieving a degree of product differentiation.

It was not the intent of the IRRI Project to benefit large powerful companies and they do not favor the large company. Nevertheless, a program which makes its designs freely available to interested parties can hardly prevent the large companies from gaining the benefits to be derived from production of the designs. However, their prominence raises serious questions:

1) Is the project missing the target of promotion of small decentralized firms?
2) Will large firms control the market and put the small companies in jeopardy?
3) Is the capital generated by the program flowing out of the rural areas and into hands of big industries in Manila?

The larger manufacturers and dealers of agricultural equipment have formed the Agricultural Machinery Dealers Association (AMDA). According to Edilberto Uichanco, 1974 President of the AMDA, the function of this organization is to represent the industry and its interests. This entails interaction with government officials on policy issues relevant to the health and well-being of the industry. In addition, lending institutions such as the Central Bank or the Development Bank of the Philippines are more favorably inclined to grant loans to AMDA members for the reason that AMDA "polices" its members. This is a particularly valuable benefit in view of the difficulties involved in obtaining financing.

To become a member, a firm must submit an application to the membership committee, which assesses the company's capability to maintain specified

standards. Membership dues amount to P 600 a year,[31] a fee most small firms cannot afford to pay. Of the companies surveyed in this study, only two firms--Marsteel and Durasteel--are certified members.

One way to combat the power of Marsteel is by mobilizing the small firms. Several functions which could be performed by an organization representing small-scale industry are immediately identifiable:

(1) Establish a system for purchase of raw materials and imported components in bulk. Cost of raw materials has risen substantially in the past few years and comprises a large portion of total production costs. Companies with large scales of operation, such as Marsteel, can obtain raw materials and imported components at a discount because of the size of their purchase orders. Small firms, on the other hand, are small customers and are forced to pay more for the same production inputs. Purchase of raw materials and imported components on a cooperative basis would serve to reduce the cost of these items to member firms, thereby reducing the final selling price.

(2) Assist small firms who wish to expand and service a larger area. A major problem faced by the small firm is one of marketing, and sales are usually limited to local customers. Expansion of a firm's operations is dependent upon demand for a given product, which can be increased by enlarging the service area either through distributors or dealerships. The small firm may require technical

assistance in making the transition from a system of direct sales to marketing his product through third parties. The small firm desiring to expand annual production and output faces the danger of increasing production costs, which would lessen its competitiveness in the local market. This suggests a need for technical assistance to effectively handle the technical, managerial, and financial implications of such a change.

(3) Operate a clearinghouse of information on potential government contracts, export opportunities and availability of new technologies. The majority of small firms have relatively little or no contact with government agencies, and are rarely exposed to information on potential sales outside their particular area of operation. Marsteel, on the other hand, can support staff whose responsibility is to identify potential customers and promote sales. For example, the National Grains Authority (NGA) recently signed an agreement with the Department of Education and Culture to establish nine demonstration and training farms throughout the country. The NGA will require agricultural equipment for the farms and Luis Bernas, cognizant of the pending government order, has already visited the appropritate officials to familiarize them with Marsteel's products.(32) Small local firms are probably unaware

of the pending order and are therefore unintentionally excluded from the bidding process, which represents, in essence, a foregone opportunity for a sale. Another problem entails dissemination of information regarding the availability of new technologies which can be produced by small-scale operators. IRRI, for example, has a number of designs which may be of interest to small metalworking shops; the problem lies with getting the information out to the potential users. One way to eliminate this information bottleneck would be to collect and diffuse information of particular interest to metalworking firms throughout the country.

(4) Establish an organization to represent the interests of small-scale industry in appropriate goverment forums and to protect its members from encroachments by the large firms. The larger, wealthier, established firms are members of the Agricultural Machinery Dealers Association. The smaller firms do not have an analagous association and currently have no input or voice in the policymaking process. In 1973, for example, President Marcos contracted with Marsteel Corporation for the purchase of 5,000 Kubota power tillers. This occurred when the local agricultural equipment industry was gaining momentum. Marcos' justification for buying Japanese tillers was that local

production could not meet local demand; Board of Investment (BOI) figures indicate that for FY 1974 local production exceeded sales by 1,079 units,[33] a figure representing approximately one-third of the government order. The government could have supported local industry during its critical growth stage by purchasing local as opposed to foreign tillers. If local farm equipment producers had been sufficiently mobilized at the time, they may have been able to put pressure on the government to buy the local product.

Mobilization of small firms would provide this sector with a political voice which it currently lacks. And the benefits to be derived by the small firm could be numerous. Such an organization could represent its interests in matters of particular interest to the small firm: tax breaks, liberalized financing, tariff protection to name a few. Mobilization of small firms would also make it more difficult for Marsteel to use its wealth and power to snuff out small competitors.

Arsenio Dungo of Kaunlaran has requested the assistance of The Institute of Small Scale Industries (ISSI) in establishing an association of small firms producing IRRI equipment. He was motivated into taking this step by his experience with Durasteel, which copied his oscillating thresher tray. The function of this organization would be two-fold: (1) to protect its members from big industry and (2) to represent the interests of small firms before the government. The ISSI has written to

a number of firms about this proposal, but has to date received only a few responses from companies indicating an interest.

If small firms can organize themselves into such an association, they will be less susceptible to exploitation or manipulation by their larger counterparts. It must be recognized, however, that there are great difficulties involved in attempting to organize firms which are producing the same product and are essentially competitors themselves.

The preceding discussion has focused primarily on the benefits to be derived from the mobilization of small firms producing agricultural equipment. It has assumed that each firm produces the entire unit on its own, and suggests cooperation among small firms in areas other than production. The idea of joint production of farm machinery has been promoted by Dr. Bart Duff and this particular approach has been initiated in Mindanao. At Dr. Duff's suggestion, the Davao Metal Industrial Association has been organized to manufacture and market agricultural equipment. The Association consists of 33 firms, each of which would contribute a component or service in which it has a comparative advantage. More specifically, some firms would build parts, one firm would assemble the machine and another would be responsible for sales and marketing. This approach, if it becomes operational, could result in the production of better quality, lower priced machines. As of this writing, the Association has not gotten off its feet, and one member expressed the opinion that the Association could not function without some government assistance. The nature or scope of the required aid was not specified.

The Marsteel Corporation provides us with an example of the private subcontract system approach vis-a-vis production in that it relies on nearby metalworking shops to provide it with components which cannot be economically

produced at the Marsteel factory. The company has subcontracted with as many as 62 firms to perform specific jobs. Marsteel has also begun to purchase completed threshers from Durasteel and Kalayaan. Luis Bernas explained to us that the current market for threshers is small and does not justify mass production with capital-intensive production methods. The thresher, as designed by IRRI, requires labor-intensive production processes which are too costly for Marsteel's mode of operation. Bernas pointed out to us that smaller firms can economically fabricate the thresher but do not have adequate marketing and distribution systems.(34) The current arrangement benefits both parties involved: the small firms sell the completed product to Marsteel, which in turn performs the marketing function after attaching the Marsteel label to all units.

Extension of IRRI designs to remote areas. We visited manufacturers of local agricultural equipment in Davao and General Santos and as of this writing, none are fabricating IRRI designs. One firm built a prototype of an IRRI power tiller in 1973, which was tested and approved by IRRI engineers. The firm, however, decided not to commence production. Other companies have designed their own equipment or are producing the local variety of the thresher, and are not interested in the IRRI designs. We asked the various companies why they had chosen not to produce the IRRI equipment. The responses are as follows:

(1) One local inventor and entrepreneur, who has designed and is currently manufacturing his own tiller, told us that it is too difficult to "imitate" someone else's work. He prefers to design his own equipment, for only in this way will he be familiar with all the working parts of the machine.

(2) Some farmers have expressed dissatisfaction with the IRRI product. The opinion of some end-users is that the tiller is too heavy and the belts break easily. The most frequently expressed complaints regarding the thresher are that (i) grain recovery is low and (ii) the seeds are cracked and cannot be used for transplanting.

Demand for power tillers is weak. One reason for this is the unavailability of credit to the farmer. Requirements for obtaining a loan from the PNB (Philippine National Bank) or the DBP (Development Bank of the Philippines) are extremely difficult (and in some cases impossible) for the small farmer to meet. The farmer must put up collateral; if the bank does not permit refinancing, it will foreclose should the farmer fail to meet his payments.[35] The farmer's lack of training on how to operate a machine was a second explanation for weak demand. According to several manufacturers, a farmer is reluctant to invest in a technology which he doesn't understand.

Some manufacturers feel that the IRRI equipment is inappropriate to the particular needs of farmers in Mindanao. The average farm size is relatively large and the tractor can prepare the land much more quickly than the power tiller. Continuous cropping is practiced in the area and timeliness is therefore an important element. As for the thresher, the Cotabato-type reportedly has a greater threshing capacity than the IRRI model (35-40 sacks/hour as opposed to 20 sacks/hour).

One manufacturer in General Santos, Cotabato did express an intent to commence production of three IRRI designs in the near future. He has recently been granted a loan by the Development Bank of The Philippines (DBP) and is in the process of expanding his production capabilities. After his shop is completed, he will manufacture the IRRI tiller, thresher and seeder. In striking contrast to other manufacturers we talked with, he feels there is a potential market for IRRI equipment. The reasons are as follows:

(1) The average farm holding is 8-12 hectares, which is sufficient collateral for obtaining a loan. He therefore feels that credit is not a constraint.

(2) The opportunities for doing custom work are many, thereby increasing the profitability of investment in agricultural equipment.

(3) Farmers in Cotabato are already employing modern farm technologies and are receptive to the idea of using machines.

(4) There is a seasonal scarcity of farm labor in the area, due to the presence of banana and pineapple plantations (Stanfilco and Dole).(36)

To date, extension of the designs to remote areas of the Philippines and other Asian countries has met with little success. The majority of firms fabricating IRRI designs are in close proximity to the Instiute--i.e., the Greater Manila Area and Laguna--whereas few firms in the outlying regions of the Philippines have commenced production of the IRRI equipment. In the same vein, efforts to transfer the agricultural technology to other Asian countries through the subcontract program have not been fruitful. One conclusion to be drawn from these experiences is that successful transfer and diffusion of new designs requires the entire spectrum

of services research, development, publicizing the availability of designs, providing designs at no cost, contracting with manufacturers to build a prototype, testing and evaluation of industry prototypes, provision of technical assistance.

The importance of these functions is supported by the experience of the University of the Philippines at Los Banos (UPLB), which designed a flatbed dryer but appears to have not achieved much actual adoption. Promotion and diffusion of the technology have been hampered by lack of the necessary financial resources. The Agricultural Engineering Department at the University provided us with a list of six manufacturers who are allegedly producing the dryer, but when we interviewed one firm who was on the list they were not producing the dryer.(37) The number of firms actually producing the design is limited.

The experience at UPLB emphasized the importance of going beyond the R&D phase. In IRRI's case, it cannot be realistically expected that IRRI can provide all the necessary transfer and diffusion services to all areas within the Philippines and Asia as a whole. It would appear that local and national institutes, such as universities and government-sponsored research facilities, would be the appropriate vehicle for facilitating the transfer of technology from the institute to the commercial sector. By assuming responsibility for some of the services, national institutes would relieve IRRI's burden and facilitate the technology transfer process. This approach has the additional benefit of developing the capabilities of national institutes to take over the activities currently performed by the IRRI--i.e., indigenization of the R&D and domestic technology transfer process. This could serve to enhance the country's problem-solving capabilities and reduce its reliance on foreign aid.

As of this writing, relatively little attention has been given to encouraging institutional involvement within the Philippines. It is interesting to note that there has been little or no interaction between IRRI and UPLB in spite of the fact that they are located within a half mile of one another.

Current IRRI policy is to distribute semi-annual reports and blueprints to manufacturers expressing an interest in IRRI designs. Our findings indicate however, that availability of designs at no cost to the manufacturer and dissemination of blueprints upon request may not be sufficient to stimulate production of agricultural equipment. We talked with one manufacturer in General Santos who had obtained copies of all IRRI reports and blueprints, which were neatly stacked in a corner and covered with dust.(38)

Not only are the majority of manufacturers currently producing IRRI designs physically situated near the IRRI complex, but most of them have maintained close contact with the Institute for several years. Relatively few additional firms located within and without the Greater Manila Area have commenced production of the technologies. One possible explanation for the failure of firms to exploit the technology may be the lack of information regarding the existence of the designs. At a recent seminar given by the authors of this report prior to their departure from the Philippines, IRRI staff discussed the prospect of publishing a short newsletter for national and international circulation. The newsletter would serve as an informational source to manufacturers on new technological developments at IRRI. This approach would serve the purpose of publicizing the work being conducted at IRRI and inform manufacturers of opportunities in agricultural equipment production. It must be recognized, however, that what can be accomplished through wide circulation of a newsletter is limited

and should not be a substitute for personal contact. It should also be noted that the initial mailing list for the newsletter will necessarily be limited to firms which IRRI is already aware of. If contact is to be made with firms which are currently unaware of the existence of IRRI, someone has to take the time and trouble to identify and contact these firms.

Personal contact between IRRI technicians and local manufacturers and farmers appears to be an important element in the technology transfer process. Acceptance of IRRI designs has been the greatest in those areas where this contact has been at a maximum. We feel that increased contact may accelerate the rate of adoption in more remote areas. Although this would initially be an additional burden on IRRI--and it is recognized that IRRI manpower is a scarce resource--this role could be eventually transferred to local institutes involved in the design and diffusion of appropriate agricultural equipment.

Increased personal contact would facilitate the acceptance and transfer of technology from the research institute to the commercial sector. It would also function as a feedback mechanism: traveling technicians would become a conduit for complaints and problems on currently existing equipment and would simultaneously be exposed to the needs of the manufacturer/farmer. This would place IRRI in a better position to identify potential areas for further R&D.

D. Contributions to Development

Development of the metalworking industry, and the agricultural equipment sector in particular, can contribute significantly to the overall development process in the Philippines. Currently over half of all metalworking firms employing more than three-fourths of total labor hired by

the industry are concentrated in the Greater Manila Area. However, the potential of the remaining 41% scattered throughout the country must not be overlooked. A more intensive campaign advertising the availability of simple, labor-intensive technologies, followed by acceptance and production of the designs by the small firm could have the desirable effect of partially fulfilling several development objectives. These include, in no particular order: the development of outlying areas, creation of job opportunities, more equitable distribution of income, reduction of reliance on imports, and development of human resources.

The introduction of intermediate, labor-intensive technologies which can be produced by small firms irrespective of geographical location would permit greater industrial activity in rural areas. In some cases, production of IRRI equipment has enabled the owner/operator to more fully exploit existing plant capacity which was previously idle or under-utilized.(39) In other cases, production of farm machines has generated employment in the industrial sector. As has already occurred in the case of several firms producing IRRI designs, labor requirements increase, thereby result-in employment creation for those firms. This in turn should somewhat stem the flow of people from towns to cities, a phenomenon plaguing many developing countries and in part caused by the lack of job opportunities in rural areas. The net demographic effect, however, will depend on the level of overall job creation in the non-agricultural sector relative to the labor displacing effect of the machines.

A valuable spin-off of the intermediate technology approach may be the promotion of a more equitable distribution of income among metalworking firms. The majority of metalworking firms in the Philippines are small-scale, and the IRRI technology has been designed with the capabilities of the small firms in mind. Small companies currently producing the tiller

and thresher are realizing considerable profits and are therefore enjoying some of the benefits of industrialization. However, as indicated earlier the share of the total tiller and thresher markets held by these firms is small and currently the distribution of income is probably worsening in favor of the large AMDA firms.

The availability of local models has enabled a saving of scarce foreign exchange in cases where the local tillers have substituted for imports. Engineers at IRRI have designed farm machinery which will maximize utilization of local resources. In the case of the power tiller, for example, the import content averages about 35% of the sale price, or 60% of the cost of inputs. The major imported component is the engine which costs approximately ₱ 1200 for the standard 8 hp model. If we assume that the foreign content of a local tiller is 35% of the selling price, the foreign exchange cost is about ₱ 2520. In comparison, the foreign exchange cost of a Kubota tiller is approximately ₱ 14,000. (See Table 8.) Even after taking account of the larger capacity of the Kubota, it is clearly a heavier user of foreign exchange.

On a per hectare basis, the comparison of the local tiller to its closest substitute, the 6 hp hand tractor model, indicates a foreign exchange savings of 4.4 pesos per hectare per annum in the case of substitution (see Table 9). The savings would be even greater when compared to the four-wheel tractor. However, no research has yielded any clear evidence to suggest that substitution is occurring at a significant level at this time.

Local tillers create less of a foreign exchange burden than do imports, but much more than continuation of carabao farming. Most of the current purchases of power tillers are by newcomers to mechanization who are switching from the traditional use of carabao. The foreign

exchange requirements will thus increase by 6.4 pesos per hectare per annum by adopting local tillers. Both the capital costs to the Filipino farmer and the foreign exchange requirements of the Philippines will increase.

The growth of the local farm machinery sector has contributed to the upgrading of the country's labor force. One major problem faced by developing countries--and the Philippines is no exception--is the shortage of skilled and semi-skilled laborers. Fifty percent of the owner/managers prefer to hire unskilled labor and perform the training function themselves. In this way they can maintain maximum control and authority over their employees and insure that their particular method of production will be followed. As one insightful owner commented, "It's too difficult to teach an old dog new tricks." Several company bosses did state a preference for hiring skilled labor, citing the expense involved in training a novice. However, chronic shortages of skilled labor have forced them to take in apprentices.

TABLE 8

A. LOCAL TILLER

Costs to Manufacturer:	
Foreign exchange (35% of 7200 or 60% of total costs):	₱ 2520
(includes engine ₱ 1200, roller chains sprockets, bearings, seals)	
Labor:	288
Local Materials and Overhead:	1452
Total Costs:	4260
Manufacturer's Profit (30%):	1278
Dealer's Mark-up (30%):	1663
Final Selling Price:	₱ 7200

B. KUBOTA TILLER

Foreign Exchange cost of import:	₱ 14,000
30% Tariff:	4,200
Approximately 55% Dealer Mark-up:	9,800
Selling Price:	₱ 28,000

TABLE 9

Capital and Labor Requirements for Different Land Preparation Techniques

	Power Source	Pesos per Hectare per Annum: Capital cost	Foreign Exchange
1	Carabao	37	2.5
2	Hand tractor (6 hp) and carabao	50	13.3
3	IRRI hand tractor (7 hp) and carabao	41	8.9
4	Hand tractor (12 hp) and carabao	51	19.0
5	Four-wheel tractor and carabao	60	18.9
6	Hand tractor (12 hp)	78	33.0
7	Four-wheel tractor	96	32.3

Source: Sharing in Development, a Programme of Employment, Equity, and Growth for the Philippines, International Labour Organization, Geneva: Table 126, p. 529.

FOOTNOTES

(1) The 14 sub-groups of the metalworking industry are the following: (a) manufacture of metal products; (b) machine-tool industry; (c) power engine and general industrial machinery; (d) transportation equipment industry (e) farm machinery and equipment industry; (f) heavy-machine building industry; (g) construction and mining machinery; (h) electrical machinery and electronic equipment industry; (i) chemical processing machinery and equipment industry; (j) food product machinery and equipment industry; (k) textile and shoemaking machinery industry; (l) office machine industry; (m) appliance industry; and (n) service industry.

(2) National Science Development Board, Metalworking Industry of the Philippines, 2 Volumes (Philippines: Metal Industry Research and Development Council, 1974), II, p. 2.

(3) Ibid., p. 5

(4) Ibid.

(5) Ibid., p. 5

(6) Ibid., p. 129

(7) Ibid., p. 216

(8) Ibid.

(9) Ibid., p. 2

(10) Ibid., p. 10

(11) Ibid., p. 14

(12) Ibid., p. 149

(13) Ibid., p. 193

(14) Ibid

(15) Products of International Harvester, Massey Ferguson and John Deere are also popular. Combined sales of tractors by these companies and Ford represent 85% of total tractor sales in the Philippines.

(16) D.N. Porter, The Market For Farm Machinery, Working Paper for Agricultural Machinery Sector Survey, Manila, Philippines, March 1974 (Manila, Philippines: Board of Investment, 1974), p. 12.

(17) Ibid., p. 13

(18) Ibid., p. 27

(19) Ibid., p. 23

(20) Ibid., p. 19

(21) In 1966 the Philippines obtained 61% of total imports of agricultural equipment and parts from the U.S., and 15% from Japan. In 1972 this percentage dropped to 37% and 9%, respectively. Other foreign sources of agricultural equipment are West Germany, Australia, Italy, Okinawa, and Singapore. See Agricultural Machinery and Implements Sector Program: Progress Report No. 2.: (Sydney, Australia: W.D. Scott & Co., November 30, 1973), Attachment 3 (p).

(22) Porter, Market for Farm Machinery, p. 19.

(23) Noel Reyes, President of Muller and Phipps, private interview held in the Philippines, August 4, 1975.

(24) Luis Bernas, Marketing Manager of Marsteel Corporation, private interview held in Manila, Philippines, August 11, 1975.

(25) The four firms which have developed and marketed their own designs are the following: Marsteel Corporation--rice mill; E. M. Marinas and Sons Manufacturing--multi-purpose dryer; C&B Crafts--thresher; A. P. Rodriguez--midget thresher.

(26) Gabaldon, a native of Cotabato, designed a thresher in the 1950's. A number of local manufacturers have copied his design and it has gained popularity among farmers.

(27) A survey of metalworking firms revealed that 18% of the respondents conducted R&D activities. Of those, the majority were larger firms employing more than 100 people. Further information can be obtained from the publication entitled, "Profile of the Metalworking Industry," published in 1974 by the Metals Industry Research and Development Center.

(28) Edilberto Uichanco, Vice President and Manager of Corporate Farm Systems Division, G. A. Machineries, Inc., private interview in Quezon City, Philippines, August 5, 1975.

(29) Arsenio Dungo, Kaunlaran Industrial Shop, private interview in Laguna, Philippines, July 29, 1975.

(30) Luis Bernas, private interview, August 11, 1975.

(31) Edilberto Uichanco, telephone conversation in Manila, Philippines, August 30, 1975.

(32) Ernesto Tubon, private interview at the National Grains Authority in Quezon City, Philippines, August 28, 1975.

(33) These figures were obtained from Joseph Pernia, Executive Director of the Commission on Small and Medium Industry, Board of Investments in the Department of Industry. The figures given are the IRRI machines manufactured and sold by nine firms.

(34) Luis Bernas, private interview, August 11, 1975.

(35) We talked with officials of PNB, DBP, and a Commercial Bank in Davao, and were informed that they were reluctant to grant loans to small farmers because of the risk involved. None of the banks has approve a loan to a small farmer for purchase of agricultural equipment, although the PNB and DBP have received applications for such loans.

(36) Romualdo Limsiasco, Manager of Steelpride Industries, private interview held in General Santos City, August 21, 1975.

(37) Bonifacio Isidro, proprietor of C&B Crafts, is currently manufacturing the IRRI thresher, a thresher he himself designed, a cultivator to be used in conjunction with a carabao, a dough roller and pumps for home use. He made no mention of fabricating the dryer designed by UPLB. Mr. Del Rosario of UPLB provided us with a list of firms, which included C&B Crafts, fabricating units of the dryer.

(38) His stated reason for not producing IRRI-designed equipment is its apparent unsuitability to the needs of the local farmer. In essence he does not perceive a market for the equipment. His competitor, however, is planning to commence production of IRRI tillers, threshers, and weeders.

(39) National Science Development Board, Metalworking Industry, II, p. 217.

Farm Machinery Dealers

In the same locations where the farmer and manufacturer interviews were conducted over twenty dealers in farm machinery were surveyed. Most were sellers of several products manufactured, either in Manila or imported while a few were small manufacturers engaged in selling their own single manufactured product. New dealerships were being established monthly in Cabanatuan City which had over 53 machinery dealers, several of which had regional offices around the province.

Sales:

The purpose in talking to dealers was to ascertain what type of enterprise was carrying out the selling function, what their linkages were to manufacturers and technology dissemination programs, and what range of services and other marketing factors might be important for technology adoption considerations. We therefore did not conduct a precise marketing study comparing sales of 4-wheel to 2-wheel tractors and imports to local brands. Our sample was biased in favor of dealers handling the locally made type. Nevertheless, the dealers indicated that sales of four wheel tractors, all imported, were continuing at about the same rate as in previous years. In Mindanao they were more prevalent than the hand tractor which had not become popular as in parts of Nueva Ecija. Some reasons given were lack of irrigation, different soil types, the prevalence of corn, bananas and other vegetables for at least one crop of the year, different farm sizes and relatively fewer farm laborers.

In Nueva Ecija hand tractor sales were well ahead of four wheel sales and accelerating. The farmer interviews confirmed the abundance of hand tillers in the irrigated barrio of Baluarte but not in the rainfed area of Kapalangan. A comparison of current sales of local to imported hand tillers is difficult to make because of the nature of the data reported; however, it appears that local brands sell two to four times as many units.

The power thresher market seems to be reversed from the tiller market geographically. There are very few units in Nueva Ecija where the large McCormick type has predominated for many years. In Mindanao the locally developed Cotabato type is widely used while the IRRI design did not appear to be a significant element in the market. Many dealers in Nueva Ecija had IRRI designs on display and felt that the farmers were preoccupied with tillers during land preparation but that when harvest arrived by December there would be strong interest in the portable thresher.

The prices quoted for tillers ranged from ₱5,250 to ₱7,323 for the local types. The dealers claimed that these went to farmers with an average of 2 to 3 hectares in Nueva Ecija and somewhat larger holdings in Mindanao. The imported types ranged in price from ₱8,550 to ₱32,000 and were bought by farmers with over 5 hectares. Four wheel tractors cost between ₱62,945 and ₱200,000 and were purchased by owners of at least 10 to 15 hectares minimum and were used extensively for custom plowing.

Apparently, inflation in the price of imported tillers over the last two years has been greater than for the domestic ones resulting in a price ratio of domestic to import of 1/3 or 1/4. Some dealers believe this price differential will aid the local types in capturing a larger share of the market. Other dealers feel that the imports are superior and will maintain status quo vis-a-vis the local models presently being manufactured.

A number of four wheel tractor dealers expressed concern that they might lose some of their market to hand tractors. One dealer recalled that a customer who previously had owned a four wheel tractor and was considering replacing it with another changed his mind and bought one of the two wheel types on display.

The threshers ranged from ₱7,800 for the double drum Cotabato type to ₱13,000 for the IRRI axial flow type. The McCormick sold for ₱52,000. Data on these sales is scant but common opinion was that threshers in all classes

were being sold to wealthy and "privileged" farmers for larger commercial rather than family farming, particularly in Mindanao. The Mindanao market had to shoulder an extra ₱800 to over ₱1,000 shipping costs on all machines from Manila.

Financial:

Dealers enter into numerous relationships with the manufacturers with respect to financing depending upon whether they are independently operated or branch offices and upon other special circumstances. Some pay in cash; others are given 60 to 90 days of credit by the manufacturer with a percentage down. However, the manufacturers may be forced into high interest short term borrowing to finance working capital and hence, are reluctant to extend credit to dealers. Similarly, the dealer may receive from 30% down payment from the customer and extend 30 to 90 days at 14% with chattle mortgage for tillers and land mortgage for four wheel tractors. Financing is available under the CB:IBRD program, Masagana 99, and the emergency 45 day foot and mouth disease program. Participating banks are the Rural Bank, Development Bank of the Philippines, Philippines National Bank, and Land Bank.

When asked what profit rate was being realized, some dealers did not give a response while others said between 15% and 35%. Since many manufacturers were reaching 30% to over 50% profit, it is reasonable to believe that producer/marketers were earning well over 50% profit and approaching 100%. The marketing profits were similar for both imported and locally made tillers and the thresher.

As far as availability of machines and parts is concerned, Nueva Ecija with its proximity to Manila had essentially no delays in delivery of orders with the exception of four wheel tractors. Mindanao had delays of from one to three weeks for initial orders and occasionally four month delays for parts on the four wheel tractor. Down-time of this magnitude could cause a farmer to become delinquent on his loan payment and the risk may serve as a deterrant to buying the machine.

All dealers extend guarantees on all working parts. They claim to offer a complete range of service and repairs as well as spare parts. We were not able to verify this claim. However, some farmer interviews indicate that spare parts were not always readily available.

While some dealers only gave instructions in the office, other dealers said they gave domonstations, the majority of which were conducted in the field, not in the showroom. Insofar as many farmers have had no prior experience with machinery of any sort, it would seem that competent instruction in the field with follow-up supervision would lead to both better maintenance and more efficient operations as well as avoidance of accidents.

In Nueva Ecija advertising is still being carried out by a very few, while in Mindanao several dealers go on the radio and utilize newspapers and magazines.

Generally, the dealers also carry pumps, some hardware supplies and even competing brands of tractors. While we frequently saw both imported and local tillers in the same store, only seldom did we find two local brands together.

The dealers were close to the farmers and heard reports from actual field operations which they passed on to the manufacturers. One or two were instructed by the manufacturer not to touch anything on a machine that broke, but to return it to the factory at once. There appears to be a consciousness at all levels to make note of performance and seek improvements, particularly when the manufacturer is a small locally based one as opposed to the intermediate and large Manila based firms.

As mentioned earlier, some producers do their own selling. In a few of the larger of the small firms, the owners carried the customer order list in their shirt pockets. They seem to be able to market and produce their products with little difficulty. Faced with the question of expansion, some see the sky as the limit, while others are content with their existing size. For the manufacturer who does expand, he must consider alternative managerial structures

and approaches to marketing. For the reluctant enterpreneur one must find out if he holds this attitude because he is content to remain as is or because he knows he is ill prepared to assume a more sophisticated management role. In any event, as some of these small firms grow, they will require technical assistance and advice of which they should be made aware.

GOVERNMENT POLICIES

Introduction

No matter what the approach or the type of technology, sensitivity to the political context in which a project such as IRRI's is operating is essential, for government policies often impact more strongly than anything else on the potential for success or failure of such a program. This section of the report describes governmental activities which may encourage or inhibit the growth of the number of small entrepreneurs and small consumers who can benefit from a program such as IRRI's and can participate in the overall process of socio-economic development in the Philippines. Special attention is given to incentives for small and medium-scale industries,(2) credit policies, education, and problems in communication.

Incentives to Local Industry

The first development objective of the Philippine Four Year Development Plan FY 1974-77 calls for "maximum utilization of the labor force, or more specifically, promotion of employment and minimization of underemployment."(3) In contrast to virtual neglect of this objective in the past,(4) government policies now encourage small and medium-scale industries using labor-intensive production processes. Such industries, which are more suitable to the relative factor endowments of the LDCs, cannot only help in lessening employment problems but can also aid regional development and the decentralization of industrial activity by helping to stem the exodus from rural to urban areas

Whereas the University of the Philippines Institute of Small-Scale Industries (UP-ISSI) was until recently the major institutional promoter of small and medium-scale industries, the government is now supporting these industries through a variety of institutional channels and through various

policies geared toward economic reform. One such channel is the Department of Industry's Commission on Small and Medium Industries (CSMI), a 12 member agency created on June 21, 1974, to aid the development of small and medium-scale industries through providing technical and managerial assistance.(5) One project of CSMI is the Medium and Small-Scale Industries Coordinated Action Program (MASICAP) begun by the Development Academy of the Philippines in September 1973 and subsequently absorbed by the Department of Industry on July 1, 1974.

> In the context of a development program for small and medium-scale industries, MASICAP performs a specific function. It assists the rural entrepreneur avail of bank credit by preparing with him the project feasibility study and assisting him comply with all the loan papers required by financial institutions(6)

While MASICAP compiles an extensive loan application and the only costs incurred by the small entrepreneur are for materials and secretarial services, the final decision on whether or not the loan is to be granted rests with the particular lending institution. During the fiscal year 1974-75, MASICAP's eleven regional assistance teams prepared a total of 756 small and medium-sized projects.(7) At the time of the writing of the MASICAP Annual Report FY 74-75, the loan proposals of 217 projects had already been decided upon by the particular lending source; of the 217, 215 projects had been approved for loans.(8)

For example, the proprietor of Steelpride Industries in General Santos City, South Cotabato, recently received a 450,000 peso loan from the DBP after having submitted a proposal compiled by MASICAP's Southern Mindanao assistance team. Having obtained the loan, Limsiaco has already begun to expand his existing production facilities. The expansion will enable him to produce a larger number of agricultural implements and employ a mechanical

engineer and an additional 25 workers.

The proposal submitted was extremely comprehensive; it included not only a complete economic feasibility study but also a discussion of the significance of Steelpride in helping the expansion of rural activity in South Cotabato.

> Realization of the Steelpride expansion program will benefit rural areas of South Cotabato. Agro-industrial machineries could be sold at cheaper price due to the expected cut down on transportation costs. Most farmers will be able to avail of these opportunities. Our country's food production program will therefore be boosted, thus accelerating our economic growth and progress.(9)

The final section of the MASICAP study was devoted to contributions that Steelpride could make to the Philippine economy as a whole. These included generation of more jobs, aid in reducing the reliance of the Philippines on imported farm equipment, and more tax revenue for the local and national government.

In addition to MASICAP, four Small Business Advisory Centers have been established by the CSMI in Zamboanga, Tacloban, San Fernando La Union and Legaspi City. The function of these centers is to provide management consultancy and analysis of small business problems. These four centers were started in 1974; it has been projected that an additional seven will be dispersed throughout the country within the next three years.

For several years the Philippine government has encouraged investment in industry through a variety of incentives, including such measures as profit remittance, tax exemptions, and deductions from taxable income.(10) The Board of Investments (BOI) administers such incentives and also prepares a list of preferential areas for investment known as the Investment Priorities Plan (IPP). The plan is a list of industries in which investment should be

encouraged because there is a gap between potential demand and present capacity. Industries that have excess capacity are not included in the IPP and are therefore not eligible for the government incentives mentioned above. Industries now on the BOI's priority list include animal feed and animal husbandry, poultry farming, and agricultural implements and machinery.

Early Investment Priorities Plans were criticized for overly general objectives and no clear cut rationale for many of the industries listed as "priority."(11) Many of the IPP's objectives now reach beyond simple encouragement of investments to develop local industrial production capacity for certain products. Newer and more specific policy considerations include promotion of small and medium-scale industries and the encouragement of regional development. According to the International Labor Organization's Sharing in Development - Programme of Employment, Equity, and Growth for the Philippines, the BOI shift to more specific policy and strategy considerations has, in reality, meant little.

> Actual BOI registrations in 1972 show a continuation of large-scale and capital-intensive concentration of the past, in spite of efforts to the contrary. What is of particular concern is the fact that, even with the best intentions, it is administratively difficult for the BOI to reach the smaller and more regionally dispersed firms. And yet these represent a very important untapped potential for output generation and employment growth. It is virtually necessary for a firm to have a Manila office to obtain a BOI registration.(12)

Available data regarding the power tiller industry appears to support this statement. As of April 1974, the BOI had two companies, Marsteel and Seacom, registered for the production of power tillers. Even though both companies manufacture IRRI-designed machines, Marsteel and Seacom are two of the largest Filipino firms devoted to agricultural machinery and both are located within the confines of Manila.

In early 1973 the government revised the Tariff and Customs Code in order to encourage the manufacture of locally-made products with a maximum amount of indigenous resources, thereby discouraging an excessive reliance on imports. However, while the tariff rate on power tillers is 30%, threshers are only subject to a 10% duty. With the Cotabato-type thresher having been available since the 1950's and the recent commercialization of the IRRI axial-flow thresher, should not the tariff rate for threshers be comparable to that for power tillers if imports are actually to be discouraged?

The 10% duty on four wheel tractors is a more debatable issue. On the one hand, there is no local industry which presently manufactures four wheel tractors and could be stifled by the imported ones. Four wheelers may in fact be the most suitable types of tractors for larger land holdings, especially in areas where sugar cane is grown. On the other hand, if locally produced power tillers replace the four wheelers, indicating that the former may actually be more appropriate than the latter in some cases, then locally produced equipment is in competition with imports. If the government is encouraging local production through its revised tariff structure, perhaps the duty rates on four wheel tractors should be increased.

While the government has supported the growth of local industry with many new policy changes, Presidential Decree No. 287, signed by President Marcos on September 6, 1973, appears to be in direct contradiction to this trend. According to the decree, local industry was unable to meet the immediate machinery needs of Filipino farmers; therefore, 140 million pesos were allocated to the Department of Agrarian Reform (DAR) to finance the acquisition of 5,000 hand tractors. In 1973, the DAR purchased 5,000 Kubota tillers from Japan which were provided on suppliers' credit. Repayment was to be made in U.S. dollars over a period of seven years at

9% rate of interest. Marsteel imported the tillers and sold them to the DAR.

The approximate cost per unit was 28,000 pesos; the cost to the farmer was substantially less, 17,894 pesos for the 10 horsepower tiller,[13] the difference being absorbed by the government. According to DAR officials, all power tillers obtained under this particular program have been distributed.

The government consummated the contract with Kubota during a period when the local agricultural equipment industry was gaining momentum. Available production figures suggest that local industry, if given the opportunity, could have provided the government with a portion of the total. BOI statistics show that nine firms manufactured 4,014 units and sold 2,935 in FY 1974. There was, therefore, a minimum of 1,079 units available locally which could have been purchased by the government. This could have supported local industry, represented a foreign exchange savings and a savings to the farmer.

Credit Policies and Programs

Several studies indicate that the allocation of credit has historically discriminated against the development of small and medium-scale industries; lending institutions have leaned heavily towards short-term loans and required collateral instead of recognizing projected revenue and growth potential of small and medium-scale industries as the crucial elements in considering loan repayment possibilities.[14]

A quick look at some past government efforts to provide credit for small and medium-scale industries indicates that several programs have been largely unsuccessful in fulfilling their objectives. One such program was undertaken in 1970 by the University of the Philippines - Institute for Small-Scale Industries (UP-ISSI) which was to assist the small entrepreneur with his loan project preparation. Loans were allocated from Social Security System (SSS) funds. Despite seemingly liberal terms, many loan applications were either not acted upon or refused.[15] By the end of 1972, only two million pesos had

been allocated out of a total of 10 million that had been made available. One source indicates that often the loan processing took as long as 80 days, a lengthy time period which could have discouraged many applicants, especially if their applications were for working capital loans.(16)

Also begun in 1970 was lending by the National Cottage Industries Development Authority (NACIDA); it was initially suspended because of collection problems, but resumed in 1972. As of late 1973 only a few cottage industries had taken advantage of this potential loan source.

The Industrial Guarantee & Loan Fund (IGLF) was established in 1965 with USAID/IBRD assistance. Operating under the Central Bank, the IGLF guarantees loans which banks have made from their own resources and also actually loans money to banks to be reloaned for IGLF-approved projects. In spite of the fact that the IGLF was created with the promotion of small and medium-scale industry as its major objective, large firms have received most of the benefits. Loans have averaged about 670,000 pesos, and two or more loans have been channeled to over one-third of the borrowers.(17)

> The IGLF has gone badly astray in the past, favouring large instead of small firms. Even after recent recommendations for change, which indicate some improvement, the final decision on loans is still highly centralized.(18)

The Philippine Four Year Development Plan recognizes the importance of adequate credit facilities as an influential tool to stimulate the development of SMSI; an increase in the supply of institutional credit is one of eight activities enumerated in the Plan for encouraging small and medium-scale growth. Financial institutions with special small-scale financing programs now include FNCB-finance, Inc., General Bank and Trust Company, Private Development Corporation of the Philippines, Rizal Commercial Banking Corporation, and the Development Bank of the Philippines.(19)

In brief, it is apparent that there has been no lack of recognition on the part of the government or lending institutions during the past several years of small and medium-scale industry's need for financial assistance. Whether or not these firms have actually fared better since that recognition is not at all clear. In the course of our interviews, it appeared that announcements of available financing have not necessarily been coupled with adequate liberalization of loan terms to allow the small manufacturer to actually benefit. Stringent collateral requirements and the amount of time necessary for loan processing were the two factors most frequently cited by small manufacturers we interviewed as the major bottlenecks in obtaining institutional credit.

Government promotion of the use of credit as a vehicle to stimulate production has taken on increasing importance during the past few years and is in direct accord with a second important objective of the Four Year Development Plan, namely more equitable distribution of wealth and income.

Between 1967 and 1974, the percentage of new loans to agriculture in relation to the total number of new loans decreased from 18% to 8%.[20] Presidential Decree 717, announced by Marcos on May 29, 1975, represents a governmental effort to combat this situation; it calls for both government and private banking institutions to allocate at least 25% of their loanable funds for agricultural credit purposes -- an attempt to triple present agricultural lendings.[21] However, the directives in the decree are inexplicit and it is unclear as to where such funds are actually being channeled.

Credit policies of the past have greatly neglected the needs of the small farmer and have been largely channeled to export activities and to the wealthier farmer. Statistics available prior to the land transfer decree of 1972 (P.D. 27) indicate that inequities in the distribution of credit were

especially blatant. It was estimated that small farmers (defined here as those with less than 10 hectares of land) were only receiving one-fifth of the total farmer population and operated 70% of total cultivated land area. However, the inequities become even greater when one considers those farmers with less than three hectares and no collateral. Although they constituted 73% of all farmers and were responsible for 39% of the cultivated lands, it was estimated that they received only 1.6% of all available production credit.(22)

In order to help meet the goal of self-sufficiency in rice production, Masagana 99, an integrated rice program, was launched in May 1973. The program was designed to supply farmers in need of support for increasing production with such elements as technical expertise and short-term production loans through a revised credit scheme.

While it appears that Masagana 99 production loans are reaching the small farmer (the majority of farmers we surveyed had such loans), loans for the purchase of agricultural machinery do not seem to be as easily accessible. Interviews which we conducted with bankers in Manila and the provinces indicate that one of the main reasons for not providing the farmer with a loan was fear of repayment difficulties. Many bankers continue to perceive loans to the small farmer as risky ventures.

Difficulties in obtaining adequate funds appear to be a significant constraint to the adoption of farm equipment. In a survey undertaken by Dale Porter for the Board of Investments in February 1974, lack of funds was overwhelmingly cited (61%) as the major reason why farmers have not bought or hired the machinery they want.(23)

> Larger and higher income farmers, mostly in the better-off regions, have been the major beneficiaries of the expansion of the institutional credit system, obtaining low-priced credit in a country where its scarcity price is very high.(24)

Several specific policies and practices of formal lending institutions appear to be major bottlenecks which have prevented the small farmer from gaining access to available credit. Firstly, institutional lenders have traditionally placed heavy reliance on collateral rather than potential capital to be generated by a loan project.(25) Our research findings support this statement. For instance, according to Mr. Rimorin, Chief of Loans & Discounts at the Davao Branch of the Philippine National Bank, two loans have been made to farmers for the purchase of four wheel tractors in Davao during the first half of 1975, while 12 farmers had applied for loans for the purchase of power tiller, all those loans were denied because the farmers' collateral and paying capacity were low.(26) Another example of stringent loan requirements exists at the General Santos Branch of the DBP; in order to receive a loan to buy a rice thresher, a farmer must own at least eight hectares of land. Romualdo Limsiaco, presently the proprietor of Steelpride Industries, Inc. and formerly a loan officer of the DBP - General Santos Branch, explained that the bank does not feel it is feasible for a farmer with fewer than eight hectares to purchase a thresher. The fact that a farmer often does custom work which supplements his income and could help with his loan repayment is not given consideration by the bank.(27)

One other likely factor influencing the accessibility of agricultural credit to the small farmer which should be noted is the length of time necessary in order to obtain a loan. Time involved in processing a loan can be as much as six to eight months; each provincial bank with which we had contact noted that it was subject to a loan ceiling which could not be exceeded without approval of the main branch in Manila, usually requiring an estimated additional two months of loan processing work.

One interesting point which deserves mention here is that in spite of farmers citing lack of credit as the major constraint to purchase of a

machine, very few had actually applied for a loan and been denied. Most expressed reluctance to even submit a loan application because they felt they could not meet all the necessary loan requirements.

Initial overly severe loan requirements were widely publicized as a major bottleneck in the implementation of a government sponsored emergency program which evolved in response to the foot and mouth epidemic affecting many of the carabao in Central Luzon in the summer of 1975. Central Luzon, the predominant rice growing region of the Philippines, is composed largely of small farm holdings. Under the emergency program, liberalized loan requirements for hand tractors were made available by the Land Bank of the Philippines for farmers whose animals had been stricken by the disease. Prerequisites for obtaining a loan included farm size of at least three hectares and membership in a Samahang Nayon, a farmer cooperative. Shortly after the program commenced, it became clear that the loan requirements could not be met by many of the small farmers whose carabao were diseased. According to an article in the Manila Bulletin dated August 28, 1975,

> ...Most of those farmers whose carabaos were afflicted with the foot and mouth disease are poor and cannot afford to rent power tillers and/or are disqualified from the Land Bank for the purchase of hand tractors.(28)

After this, Land Bank requirements were liberalized even more. A farmer could now apply for the hand tractor if his farm size was a minimum of 2.5 hectares; however, if his holding was smaller, he could apply for a joint loan with other farmers if their total land area met the necessary hectarage requirement. Samahang Nayon membership was no longer a prerequisite, and delinquencies in amortization payments for Phase III of Masagana 99 would not disqualify a loan application. As of September 4, 1975, 702 hand tractor

loans had been approved. Lack of existing information precluded the determination of the beneficiaries of the emergency program's loans at that time.

Government intervention as an effort to cope with the emergency situation in Central Luzon is significant in that it signals acknowledgement of the small farmer's need for liberal terms of credit if he is to purchase a machine. However, it must be realized that the absence of data does n enable one to conclude whether or not credit terms were actually liber to such a degree so as to allow the small farmer to benefit. Secondly because of the fact that this program evolved in response to an emerge situation, an effort such as this cannot necessarily be viewed as repr of a trend on behalf of the Philippine government and lending institut consistently respond to credit needs of the small farmer.

The impact of another special credit program on the promotion of farm mechanization also deserves special mention here; it is the Central Bank-International Bank for Reconstruction and Development (CB:IBRD) Farm Mechanization Loan Program. The first of three loan programs was begun in 1966 and was designed specifically to promote small farm mechanization.(29) Despite the fact that tiller sales increased greatly during the first and second programs, the value of the loans made for four wheel tractors far exceeded the amount allocated for power tiller purchases.(30)

> While the CB:IBRD loan program may have been a strong single factor in the promotion of small farm mechanization, loans have been granted selectively, resulting in limited participation by small farmers. Since all loans have been made on the basis of collateral available rather than on productivity of investment, more than half of all loan applications have been denied each year. The extension of medium and long-term credit has benefited mostly farm owners.(31)

The third loan program was begun in May 1974. Although farm size requirements have been adjusted to allow eligibility to any farmer not

owning more than 50 hectares of land, the following figures indicate that the majority of available funds has still gone overwhelmingly towards the purchase of four wheel tractors. These figures were obtained from the Department of Rural Banks and Savings and Loan Association of the Central Bank and include CB:IBRD credit financing from May 15, 1974, to June 30, 1975.

Education

> On the aspect of developing locally-adapted technology that would make use of a country's abundant resources, there is need for radical change in the educational system, which has been producing potential scientists with Western orientation and training.(32)

The above quotation from the Philippine Four Year Development Plan indicates that extensive involvement of and support from the educational system is necessary in order to achieve development goals as smoothly and as rapidly as possible. While there are obviously places for professionals trained in modern approaches and technologies, university students should also become familiar with the problems of those people in the rural regions of the country. Beyond adapting more of their R&D facilities to locally-oriented technologies, contact between the rural villages and the university students of today also holds significant implications for the future of the country as a whole. Developing sensitivities to the problems of the rural masses now may impact directly on policies and development strategies when the university students of today assume leadership positions throughout the country in the future.

The Philippine government provides free elementary education to all. In view of the fact that about 45% of those with primary education do not go on to secondary education(33) and that university degrees belong to only a fraction of the overall Philippine population, socio-economic development could be encouraged through the stimulation of the innovative ideas of those

LOAN TEAM	POWER TILLER		4-WHEEL TRACTOR	
	No.		No.	Amount
Southern Mindanao	283	₱ 7,638,475	26	₱ 3,116,513
Nueva Ecija	57	927,292	163	18,361,644
Panay	16	393,959	53	6,680,586.88
Panagasinan	9	303,959.50	163	19,739,068
Manila	282*	2,736,991	242*	26,970,248
Bicol	8	148,441	14	1,808,976
Cebu	39	996,303	56	7,358,016
Cagayan Valley	108	2,868,440.70	174	21,264,022.70
Bacolod	19	419,743.50	147	17,592,289.86
Total	770	₱ 16,433,604.70	1029	₱ 122,891,364.44

*more recent figures (7/3/75)

(Source: Central Bank - Department of Rural Banks and Savings and Loan Association)

with only primary school education. Such potential entrepreneurs should not be neglected because of lack of a high school or university diploma but should be encouraged to invent and innovate as their understanding of local customs and traditions may be invaluable in the development of locally-suitable technologies. While a university graduate may be the best person to design and construct a shopping complex for Manila, it is the small local innovator who may, in spite of lacking the university degree, have a much better understanding for simple technologies that he could develop which would reduce many inefficiencies and eliminate many bottlenecks inhibiting some manifestation of development in his village or community.

Communications

Gaps in communication emerged continuously during the course of the field research as bottlenecks which may often inhibit the small producer and small farmer from availing of all the ingredients necessary to establish a small business or to purchase a locally manufactured piece of agricultural equipment. For example, the MASICAP program to aid small manufacturers in writing workable loan proposals is young but has a good track record. However, very few manufacturers indicated awareness of its existence. Secondly, credit options are frequently changing and expanding; it is difficult to keep abreast of all the sources one could potentially tap. Lack of knowledge about the wide range of machine brands, operational and repair know-how may also be factors which discourage machine adoption.

One must look at such constraints to communication within the larger context of overall development efforts in the Philippines and the impact they may have on slowing down the achievement of such objectives as creating more employment opportunities, lessening the income gap between rich and poor, and promoting regional development. What may possibly be inferred from this is that the technological hardware, in this case the locally

manufactured agricultural machinery, may be far surpassed in importance by problems dealing with the "software," i.e. technical and managerial assistance, financial assistance, information, and education, if such technologies are to play an influential role in the development process.

GOVERNMENT POLICIES - CONCLUSIONS AND RECOMMENDATIONS

Inconsistencies

While the Philippine government has included maximum utilization of the labor force, more equitable income distribution, and the promotion of regional development among the development objectives in its current Four Year Plan, there are some existing inconsistencies between stated governmental goals and policies which have actually been implemented. One such inconsistency was the importation of the 5,000 Japanese Kubota power tillers authorized under Presidential Decree 287 at a time when local sales could have met some of the demands of the land reform farmers. Had the government thoroughly surveyed the capabilities of the local industry to meet this demand before the issuance of the decree, this could have provided another avenue for use of the domestic labor force and simultaneously fostered more growth of indigenous industrial capabilities. Another inconsistency is the channeling of the majority of loanable funds available under the CB:IBRD credit program to the purchasers of four wheel tractors rather than the purchasers of power tillers. Owners of four wheel tractors are usually those with large land holdings, i.e. the wealthier farmers. If the majority of loanable funds continue to find their way to the farmer who is from the wealthier segment of society to begin with, this will widen, not narrow, the income distribution gap.

Inconsistencies such as those cloud or even negate the meaning of stated government objectives. In order to encourage development in the Philippines

as rapidly and as smoothly as possible, it would appear to be in the best interests of the Philippine government to clear up such inconsistencies. Institutional obstacles which may thwart the pursuit of overall objectives could perhaps be replaced by measures which would help create an even more favorable environment for development of the country

Can Small and Large Firms Co-exist?

The promotion of small and medium-scale industry by the government is relatively young. It is by no means meant to stamp out big industry. It is simply recognition on the part of the government of past neglect of small and medium enterprises and simultaneously the need for assistance if large, medium, and small industries are to play an integrated role in development and the migration from village to big city is to be stemmed. As large firms continue to grow and move into new and technologically sophisticated products and export industries, they may subcontract with small firms for a few highly specialized products which they themselves do not manufacture. In turn, small firms may often purchase capital equipment from large. Often small and medium-scale industries may be more appropriate for dealing in local rural markets. This includes the ability to operate with a less sophisticated infrastructure and to maintain close personal contact with customers. The importance of the latter cannot be stressed enough for close links between manufacturer and consumer are crucial in determining what types of technologies a rural town or village needs. An understanding of farmers' needs stems from an understanding of local culture and traditional value systems; obviously, the local entrepreneur who may come from the same village as the farmers or a nearby town will have a more accurate perception of local needs than a large firm based in Manila.

Governmental assistance to stimulate industrial activity in rural areas may also tap technological innovation in areas where it was previously dormant due to any number of reasons, including lack of credit, technical

assistance, etc. Encouragement of technological innovation through the avenues of small and medium-scale businesses also widens the range of technological choices available to the consumer, the entrepreneur, and the government planner. To be able to choose from among a wide variety of technologies enables one to discover those technologies which are most suitable for local conditions. In the Philippines it is evident that the four wheel tractor is still appropriate for certain regions which still have large farms while power tillers may be more appropriate where farms are small.

How to Close the Communications Gap

If social and economic development is to become a reality, the communications gap must be closed. Creating and strengthening communication linkages is one area where government must play a crucial role. Provincial technical assistance centers could be developed to deal with several different functions. Simultaneously, trained technicians should be linked through an extension service to reach the individual manufacturers and the organizations of consumers, i.e. the cooperatives. Cooperative programs such as the Samahang Nayon in the Philippines then can reach the individual farmers of each barrio.(34)

The provincial centers could diminish communication problems in a variety of ways. For example, credit options and how to apply for loans could be advertised from there. Credit technicians could assist with loan applications and could perhaps take some of the loan processing burdens off the banks, thereby shortening the time necessary for processing loan applications. Close links between the banks and these centers may assure the main branches of the bank in Manila that loans are being properly handled and may provide stimulus to enable an increase in the allowable loan ceilings set in the provinces and perhaps decrease excessive reliance on collateral.

Such centers would also have close contact with local institutions and training centers that could provide much of the manpower for training about machine operation and maintenance. Manufacturers could benefit from marketing assistance, assistance in product design and adopting technologies to suit local conditions.

An integrated communications scheme such as the one suggested can do more than provide knowledge and assistance. Through frequent perception of traditional customs and values, trained technicians may come to assess the needs and innovation processes at work in the villages and local organizations. Awareness of new and changing technologies coupled with an understanding of the local innovation mechanisms at work may enable the extension agent to identify local capacity to absorb new information and build on it to foster change appropriate to local conditions. Simultaneously, recognition of the real needs of local communities may not only stimulate local inventiveness but may also signal new and appropriate areas for R&D activities on the part of local and regional institutes that may have greater financial and manpower resources.

Future Appropriate Technologies Projects

If one is concerned with the international extension of a project such as IRRI's, it must be reiterated that the socio-economic and political environments of the receiving nations play a vital role in whether or not a technology will be successfully diffused and is instrumental in furthering the development process. It has already been stated that the "software" elements may be of far greater importance than the actual design of the technologies; in the advent of funding future programs with objectives similar to those of the IRRI project, it would be beneficial for AID to look more closely at how the software operates in those countries being considered for AID-funded "appropriate technologies" projects. I

particular technology is to be recommended, it is assumed that it is suitable for application and readily adaptable to the needs of the people for whom such a technology is officially designed.

Pre-project "feasibility studies" should therefore involve more than cursory surveys conducted solely by engineers and economists; other professionals such as anthropologists, sociologists and educationalists can also provide valuable insight. Assessment of the potential demand for a new technology is only half of a survey; the other half is an assessment of the needs of the people for whom the new technology is being developed. Those best equipped to perform this task are obviously nationals themselves. Consequently, pre-project surveys should definitely make provisions for extensive input from nationals.

To overcome bottlenecks impeding the successful diffusion of an appropriate technology, those bottlenecks must first be identified. This can be accomplished through largely talking with those who have managed to overcome them and with those who are still inhibited by them. Identification of obstacles in the technological diffusion process was one of the main objectives of this field research. More work along this line should be encouraged, especially to aid in the determination of bottlenecks which may be common to more than one country and to a wide range of activities.

FOOTNOTES

1. In an effort to provide as broad an overview as possible of the many intricacies of the political environment, this section relies considerably on government documents and secondary sources along with information gathered through interviews.

2. Although commonly referred to as small and medium-scale industries, it should be noted that this also includes cottage industries, those which are usually family-operated and carried on, in, or near the home. Distinction among cottage, small, and medium vary according to each particular institution's definition; however, the industries are frequently categorized according to the total amount of assets: less than 100,000 pesos for cottage; 100,000-1 million for small; 1 million - 4 million for medium.

3. National Economic and Development Authority, Four Year Development Plan FY 1974-77, Manila, 1973, p. 18.

4. International Labour Organization, Sharing in Development: A Programme of Employment, Equity, and Growth for the Philippines (Manila, Philippines: National Economic and Development Authority, 1974), p. 541.

5. Members of the Commission include:
   - Department of Industry
   - University of the Philippines Institute for Small-Scale Industries (UP-ISSI)
   - Development Academy of the Philippines
   - Bureau of Domestic Trade
   - National Manpower and Youth Council
   - Food Terminal, Inc.
   - Development Bank of the Philippines (DBP)
   - Philippine International Trading Company
   - Design Center Philippines
   - National Economic and Development Authority-Center Bank Industrial Guarantee and Loan Fund (IGLF)
   - National Cottage Industries Development Authority (NACIDA)
   - Department of Local Government and Community Development (DLGCD)

6. Department of Industry, MASICAP Annual Report FY 74-75, Manila, P. 1.

7. Each MASICAP team is assigned to a particular region of the country in order that local needs may be more effectively met within each area. Regions are as follows:

   I - Ilocos Region
   II - Cagayan Valley
   III - Central Luzon
   IV - Southern Tagalog
   V - Bicol
   VI - Western Visayas
   VII - Central Visayas
   VIII - Eastern Visayas
   IX - Western Mindanao
   X - Northern Mindanao
   XI - Southern Mindanao

8. MASICAP undertook 32 agri-implement projects between November 1973 and August 1975. While eight of those projects have already been approved, lending institutions have not yet made decisions on the remaining 24.

9. MASICAP, Project Feasibility Study of Steelpride Industries - Expansion of Agri-Industrial Manufacturing (General Santos City, 1974), p. 2.

10. For further details, see International Bank for Reconstruction and Development, "Industrial Development Problems and Prospects in the Philippines," (Industrial Projects Department Report # 280 PH: Nov. 13, 1973), Vol. 1 - General Issues.

11. Ibid., p. 17.

12. Sharing in Development: A Programme of Employment, Equity and Growth, p. 167.

13. D. N. Porter, Policy Issues, Working Paper for Agricultural Machinery Sector Survey, UNDP/IBRD Technical Assistance Project, April 1974, p. 15.

14. Sharing in Development: A Programme of Employment, Equity and Growth, p. 235.

15. Firms could acquire loans for as much as 100,000 pesos for up to 10 years if they had paid up capital of 15,000 to 2000,000 pesos. Other requirements included a 2% service charge to ISSI and a 10% interest rate. Security requirements were also softer than those normally available. "Industrial Development Problems and Prospects," p. 43.

16. Ibid., p. 43.

17. Ibid., p. 48.

18. Sharing in Development: A Programme of Employment, Equity and Growth, p. 162.

19. The DBP began the Countryside Development Program in 1971; 500 million pesos were to be channeled through the DBP to reach small and medium-scale industries and the small farmer on the basis of liberalized loan requirements. The DBP has also recently created Industrial Projects Department II, a new department designed exclusively to facilitate financing of small and medium-scale industries in rural as opposed to urban locations. Although 357.7 pesos had been loaned by the end of 1973, the beneficiaries are not readily identifiable.

20. Dale W. Adams,"Agricultural Credit Research Needs in the Philippines," unpublished report prepared for USAID/Philippines, June 20, 1975, p. 4.

21. At least 10% is to be made available for the beneficiaries of agrarian reform such as tillers, tenant-farmers, farmers' coops. etc. The other 15% is to be channeled into agriculture/agribusiness loans.

22. Orlando J. Sacay, "Small Farmer Credit in the Philippines," paper for AID Spring Review of Small Farmer Credit, Vol. XIII, February 1973, p. 8.

23. D. N. Porter, Survey of Farmers, Working paper for Agricultural Machinery Sector Survey, UNDP/IBRD Technical Assistance Project, February 1974, p. 28.

24. Sharing in Development: A Programme of Employment, Equity and Growth for the Philippines, p. 96.

25. Ibid., p. 235.

26. Mr. Rimorin, private interview held at the Philippine National Bank, Davao, Philippines, August 19, 1975.

27. Mr. Romualdo Limsiaco, private interview held at Steelpride Industries General Santos City, Philippines, August 21, 1975.

28. Pedro M. Garcia, "Ecija Farmers Now Use Muscle Power," Manila Bulletin, August 8, 1975.

29. Small farms were then defined for purposes of the program as not less than five or greater than 50 hectares in spite of the fact that only 18.7% of all Philippine farms fell within that category and over 81.8% were less than 5 hectares. See Ida Estioko, "Farm Mechanization in the Philippines and the International Bank for Reconstruction and Development Loan Progam," (Paper presented for the seminar on Farm Mechanization in Southeast Asia, Penang and Alor Star, Malaysia, November 27 - December 2, 1972), p. 3.

30. For more detailed information on the first and second loan program, see Estioko.

31. Ibid., p. 7.

32. Four Year Development Plan FY 1974-77, p. 328.

33. Ibid., p. 327.

34. One of the advantages of working closely with cooperatives is that they are local organizations where all the members are closely involved in the activities. Since the declaration of martial law in the Philippines, farmers must be members of these village-level organizations in order to avail of land reform benefits. For more information regarding cooperatives, see Orlando J. Sacay, Samahang Nayon - A New Concept in Cooperative Development (Republic of the Philippines, National Publishing Cooperative, Inc., 1974).

SUMMARY, CONCLUSIONS AND RECMMENDATIONS

This is a report of findings from a brief field study of mechanization on small rice farms in the Philippines. A study team consisting of two agricultural economists from Washington State University and two social scientists from George Washington University gathered data in the Philippines during an 8-week field visit in the summer of 1975. The field study was entirely funded by USAID/Washington, but earlier background work at George Washington University had been financed by the National Science Foundation.

The study focused on the agricultural machinery development program in the Agricultural Engineering Department of the International Rice Research Institute at Los Banos, Philippines. The field work included visits with the IRRI staff, interviews with farmers, machinery manufacturers, dealers, government agents, banks, etc.

Conclusions

Small power tillers and threshers are being sold at an accelerating rate in the Philippines. There appears to be a well established trend toward widespread adoption of these machines, but extending mechanization to most of rice farming in the Philippines would require a several-fold increase in rate of machine sales. Other machines, such as grain cleaners, batch driers, transplanting machines, irrigation pumps, and power cultivators are, at most, just beginning to be introduced.

Power Tillers

Power tillers are mostly found on farms that are medium-sized by Philippine standards--4-10 hectares in size. More than a third of the tillers are being used at least partly for custom hire operation on other farms. The average usage is about 12 hectares per year per machine, which requires about 60 days operation for complete preparation for planting.

The power tillers seem to be gaining ground relative to large 4-wheel tractors which are usually owned and used by large rice farmers and custom operators and by sugar and pineapple plantations. Among power tillers, smaller simpler locally built models are gaining more of the market from the more expensive Japanese built import models.

The IRRI small farm mechanization program has made an important contribution to introduction of power tillers for small farms. Virtually all of the locally built machines are built either by approved manufacturers of the IRRI-designed tillers or by other manufacturers who have adopted IRRI's design, which is open patented, or at least followed the concept introduced by IRRI.

Most of the power tillers in use to date are on irrigated farms that are raising two crops of rice per year. The advantage of mechanization for them are: (1) their potential for use of the machine is effectively doubled, (2) there is less slack time between crops and more need to rush land preparation, and (3) care and feeding of the carabao may be more difficult since there is little land available for grazing.

The cost of land preparation with carabao depends mostly on the appropriate value for labor, especially for the large number of hours spent in care and feeding of the animal. Cost with the power tiller depends mostly on the number of hectares over which fixed costs may be spread.

Cost comparisons indicate that power tillers are less costly than the carabao only if the tiller owners costs can be spread over at least 10 hectares of land preparation per year. Smaller farmers will find it economical to convert to power tillage only if: (1) they place unusually high value on the labor saved by the mechanical system and/or very low values for the capital invested in a power tiller, or (2) they are able and willing to do custom hire work with their power tiller, or (3) they rent or hire a tiller rather than buy their own, or (4) they expand their farm and increase double cropping to achieve the needed size.

There is no evidence so far of measurable increases in rice production per hectare that are attributable to adoption of power tillage; however, there may eventually be more adoption of potential increasing improvements such as more timely planting, more double and triple cropping, etc.

The most significant displacement by the power tiller is the carabao. There will be some loss of by-products as carabao are replaced by machines, but many farmers seem inclined to keep at least a few carabao after mechanizing.

Labor savings by the power tiller are about days of field labor per hectare per crop and about 6 days of animal care time. The labor that is saved is mostly the farmer, his family and neighbors. Possibilities for absorption within the farm operation are good and the labor displacement does not appear to be creating a problem.

Thresher

The IRRI-designed axial-flow thresher is not yet found in large numbers on Filipino farms. Other locally built models--the Tillyadora, Cotabato, and table top threshers--are more numerous at this time. However, initial reaction to the IRRI thresher seems favorable and it may catch on quickly.

The costs and capacity of the axial-flow thresher are such that it is only suited for operations of at least 15 hectares per year and preferably for use on 40 hectares or more per year. When used 50 or more days per year (about 50 hectares), the average cost with the mechanical thresher is less than one-half the conventional share payment to hand threshing crews.

The threshers are being purchased by larger farmers and by individuals who use them in custom operations. A program to develop cooperative ownership is too new to evaluate at present.

There could be significant labor displacement problems with a large conversion to mechanical threshing. Mechanical threshing requires only about

four worker days of field labor per hectare, whereas hand threshing requires 16. The labor that would be displaced is all hired labor. A large portion of these are farm workers who depend on shares of the crop earned during harvest for a substantial portion of their income.

Manufacturing

The IRRI program has demonstrated that small local companies can successfully produce small agricultural machines. Total output of these shops in the Philippines is growing very rapidly.

The experience is quite mixed among firms with a fair number of "drop outs" or "failures" mixed in with some outstanding successes.

Access to IRRI technicians and advisors is important for all manufacturers and especially for the smaller ones. They need advice, information, guidance, and encouragement. Most firms now producing IRRI designs are located in the Greater Manila Area where access to IRRI and other sources of help is relativel easy. In Mindanao, where contact with IRRI has been very slight, we found no firms now producing IRRI designs.

Market development is a major problem. Small firms lack marketing expertise, ties with sales outlets and adequate scale to justify advertising and promotion. Large firms are concerned about the "open patent" policy that makes it possible for a competitor to move in to supply a market that has been promoted at substantial cost.

Large, well established firms such as Marsteel have advantages in the areas of access to capital, ability to mechanize the manufacturing process, and produce more of their own components, marketing skills and company owned distribution networks, and ability to absorb short-term or unexpected losses. These advantages make it difficult to implement the laudible IRRI policy of encouraging small local manufacturers.

Government Policies

Philippine government policy is now explicitly committed to the support and encouragement of indigenous industry and growth of employment opportunities. Programs that are helpful to small agricultural equipment manufacturers are being initiated, but there still are many inconsistencies and actions that hinder or harm small local firms. Apparently, this is still a low priority goal for the government or else conflicts with other goals which have not been completely resolved.

The government needs to give direction and policy guidance to the working out of a cooperative balance between large and small industries. If left uncontrolled, small industries may be overwhelmed by the large or may suffer from absence of needed linkages with the larger firms.

Credit programs have been recently changed and expanded in ways that significantly aid small industries and small farmers, but both still are often not able to obtain credit that they need for modernization and expansion.

Recommendations

Continue the IRRI program in mechanization for small rice farms with some changes to:

Give more emphasis to developing and introducing implements and machines that are even smaller and less expensive than models that are receiving major emphasis at the present time, i.e. machines that a typical 2-5 hectare farmer will find feasible to own by himself without the necessity of custom work and partnership arrangements.

Give more emphasis to devices that are directly output-increasing (such as irrigation pumps, wells, water control systems, multiple-cropping techniques, etc.).

Give more emphasis to integrated systems (including tools and schedule of operations) for producing more than one crop per year on existing lands.

Give more emphasis to improving the national capability for extension type activities with farmers, small manufacturers, dealers, lenders, etc.

Work more closely in cooperative programs with the University of the Philippines program in farm mechanization.

Encourage the government of the Philippines to:

Increase and improve their extension/education program with farmers, small manufacturers, dealers and lenders.

Increase assistance, supportive policies, etc. for development of industries in the rural areas to provide off-farm employment opportunities for labor that may be released through farm mechanization and for the rapidly growing labor force in these areas.

Conduct careful manpower and employment analyses to determine the present situation and outlook in rural areas and provincial towns. Particular attention should be given to the hired farm work force.

Further extend the availability of credit to small farms and small businesses, including credit for agricultural machinery.

In any extensions of the program to outlying areas and to other countries care should be taken to have adequate IRRI manpower and direct involvement of local nationals from the beginning. Too small a program may never get off the ground.