THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Paper No. 1

The Economic and Institutional Impact of Mechanical Threshing in Iloilo and Laguna

by

Fleurdeliz Juarez and Bart Duff
AGRICULTURAL ENGINEERING DEPARTMENT
International Rice Research Institute
Los Baños, Laguna

October 1979

The Consequences of Small Rice Farm Mechanization Project is supported by the United States Agency for International Development under Contract tac-1466 and Grant No. 931-1026.01 and is being implemented by the International Rice Research Institute and the Agricultural Development Council, Inc.

The Consequences of Small Rice Farm Mechanization Project is a cross country study of the impact of engineering technologies on agricultural output, employment and income distribution. The project, a centrally funded activity of the United States Agency for International Development, has two major components. The first is a series of case studies addressing specific topics relating to the application of mechanization. The majority of the case studies are funded through awards from the Agricultural Development Council to graduate and post-graduate research personnel in the Asian region. A second component is a three country comparative study being administered by the International Rice Research Institute in cooperation with agencies in Thailand, Indonesia and the Philippines. This portion of the project consists of a series of stratified cross sectional surveys and daily recordkeeping activities at sites in the above countries. Details of the field design and research methodology are contained in the operations manuals noted on the last page of this report.

Reports contained in the Working Paper Series are released without formal review or editing to facilitate communication of preliminary results and to elicit constructive comment.

Additional copies of the reports listed may be obtained by writing to:

Mechanization Consequences Project
Agricultural Engineering Department
International Rice Research Institute
P. O. Box 933
Manila, Philippines

or

The Agricultural Development Council, Inc.
1290 Avenue of the Americas
New York, New York 10104
U.S.A.

THE ECONOMIC AND INSTITUTIONAL IMPACT OF MECHANICAL THRESHING IN ILOILO AND LAGUNA*

Fleurdeliz Juarez and Bart Duff**

Threshing is the terminal operation in the production sequence. In most small-scale rice production systems, it is also the time at which benefits are *shared* among farmers, laborers, landlords and creditors. Over long periods of time, sharing arrangements have been developed in most cultural systems which ensures an equitable partitioning of the crop among those whose resources (labor, land and capital) have produced it, including those within the community who have no access to land. The introduction of new technology tends to disrupt these arrangements and new systems of sharing emerge to replace older forms. As Hayami and his associates[1/] have pointed out, innovations may raise production levels, but the gains obtained often create pressures for a redivision of the crop shares. Seeking to

---

*A joint research project of the IRRI Agricultural Engineering and Cropping Systems Programs. We would like to acknowledge the assistance of the program staff in identifying field sites in Iloilo and for providing field support for the survey including assistance in gathering the field data.

**Research Assistant and Associate Agricultural Economist, respectively, IRRI Agricultural Engineering Department.

[1/] The details of these investigations are reported in Y. Hayami, et.al., "Changes in Community Institution and Income Distribution in a West Java Village," IRRI Agricultural Economics Department Project "Dynamics of Agrarian Change" Report No. 5, August 1979 and M. Kikuchi, et.al., "Changes in Rice Harvesting Systems in Central Luzon and Laguna," IRRI Research Paper Series Number 31, IRRI, Philippines, July 1979.

maximize shares initiates a process of adjustment between those who own productive resources such as land and water and those providing essential services such as labor. The final equilibrium may in large measure depend on the relative economic power or position which each faction holds in the village community, the existence of alternative employment opportunities, and the existence of established kinship relationship between groups.

Concern with both the distributive and output effects of adopting mechanical threshing forms the basis for the present study in Iloilo and Laguna provinces. In both areas there has been a very rapid change from traditional to mechanical threshing techniques over the past four years.

In both provinces there have also been varying levels of adoption and use of modern varieties and installation and expansion in irrigation facilities during the past decade. There is a strong tendency to conclude that increased yields and production caused by irrigation and HYVs has significantly increased the real wage of labor employed for threshing because the labor input does not increase in proportion to yield. As the productivity (cost) of threshing labor rises, it becomes economically attractive to farmers to mechanize the threshing operation. This hypothesis, however, cannot be accepted uncritically.

There are other unanswered questions which make the above conclusion unacceptable without empirical evidence. Do mechanical threshers affect the timeliness of the harvesting operation during

the critical intercrop period when harvesting of the first crop is underway and planting the second crop is beginning? Is mechanical threshing technically more efficient than manual threshing in reducing nonrecoverable losses? Do mechanical threshers allow the farmer to increase the productivity of other resources such as irrigation water through more timely planting and better quality land preparation? Conversely, we must also examine those factors effecting the existing supply of labor and their impact on the acceptance of machines. With the introduction of modern crop technology, is there sufficient labor available to carry out threshing on a timely basis? Have the opportunity costs of labor risen due to increases in the nonfarm wage? Are laborers willing to perform threshing operations using traditional techniques given the general rise in prosperity found in the two provinces?

The present report presents some preliminary evidence bearing on these and other issues relating to the adoption of small mechanical threshers. The study specifically presents information on: a) the pattern of thresher adoption and diffusion over time; b) the institutional framework within which machines have been adopted and the changes which have taken place to accommodate their use; and, c) the effects of thresher use on rural welfare.

Scope and methodology

Twelve villages were included in the study: 3 irrigated and 3 rainfed in Iloilo province and 6 irrigated in Laguna (Fig. 1).

These two provinces were chosen because of their high thresher population. The Iloilo survey was conducted from October to November, 1978 and the Laguna survey was conducted in July, 1979.

From a list developed by the IRRI Cropping Systems field office, Ministry of Agrarian Reform and Bureau of Agricultural Economics, farmers were classified according to thresher ownership and use and by farm size (below 1.0 hectare as small, 1.0 - 3.0 hectares as medium and above 3.0 hectares as large). Respondents were selected by simple random sampling and a single interview was held with each person selected. The number of respondents classified by thresher ownership and use are as follows:

Category	Iloilo irrigated	Iloilo rainfed	Laguna irrigated
Owner non-user	1	0	1
Owner-user	10	5	6
Non-owner user	14	16	12
Non-owner non-user	14	15	7
Total	39	36	26

The objective was to obtain 15 respondents per category but because of the limited number of thresher *owners*, a complete enumeration of this category was carried out. Unavailability of respondents and the limited time also reduced the sample size for other categories.

Supplementary data was obtained in each area from village captains, landless workers and thresher manufacturers.

Description of the villages

Laguna and Iloilo villages differ in the degree of urban influence and availability of non-farm employment opportunities. Laguna villages were situated near the main highway connecting towns to Manila. Farms in this province are also in close proximity to the many nearby factories and are relatively more urban than the Iloilo villages. In addition, early exposure to improved rice production methods and communication with machine dealers operating out of nearby Manila contributed to an early awareness of modern technology in the province. Early establishment of irrigation also contributed to earlier adoption of high yielding rice varieties and the accompanying package of modern practices. Villagers reported that the present irrigation system was established before 1950 and farmers started planting HYVs before 1970.

The Iloilo villages were located far from urban areas connected only by inferior roads. Most farmers became aware of modern production technology only in 1975 when IRRI introduced a cropping systems research program in the area. Threshers entered the area in 1976 when local manufacturers began fabrication and promotion of the machine. A new irrigation system was established in 1976 and was also partially responsible for rapid adoption of HYVs.

The cultivated rice area and number of farmers per village was larger in Iloilo but average farm size was smaller than in Laguna (Table 1). There were a preponderance of lessees planting only rice in both areas. IR-36 and IR-42 were the common varieties planted at the time of the survey. Average yields were reportedly higher in Laguna.

Despite differences in the timing and degree of modern technology adoption, both areas are presently characterized by a high degree of HYV and thresher adoption. Almost all farmers in both areas plant HYVs. Of all IRRI threshers sold in the Philippines in 1978 and 1979, 17% and 15% are sold in Iloilo province (Figs. 2 and 3). Laguna also has a large share of total sales.

Historical Perspective of Thresher Adoption and Diffusion

The first Iloilo firm produced an IRRI-designed portable thresher in 1976. By 1977-78, a number of medium-scale capacity manufacturers (IRRI cooperators) and small welding and machine shops began production resulting in popular use of the machines during these periods.[2/] Approximately 80% of the total threshers produced in the area are IRRI-designed. By late 1979, an estimated 1,200 units had been sold in the province.

[2/] A large thresher was reported to have operated in the area in 1967. Lack of mobility made its use infeasible for threshing the output from large numbers of small holdings.

The first mechanical threshers operated in Laguna in 1973-74 and were a portable-type, mainly from the Bicol region. Some early machines are still operating but mainly on owner's farms. Their use for custom work in recent years has been limited by the introduction of the IRRI axial flow units which produce a cleaner output. The IRRI threshers first became popular in 1976. The large IRRI axial flow threshers entered in the market in 1973 while the smaller portable types were introduced in 1975. The rapid spread of threshers was also enhanced in Laguna by the presence of the biggest thresher manufacturer in the country within 10 to 20 kilometers of the study area.

Manufacturers and dealers in both areas conducted farm demonstrations to introduce the threshers to potential buyers. The first thresher owners usually received initial information about the machines from these demonstrations and, later from salesmen. The first owners influenced subsequent farmer buyers or users. This chain of communication continues up to the latest adopter. Diffusion was not directly facilitated by government agencies or programs.

In Iloilo, the first machines were operated and employed by tenants. Owners usually live in a city or town but entrust the machines to their tenants. The owners seldom visited the village with the exception of the planting and harvesting-threshing periods. In Iloilo, the first owners who were village residents were owner-cultivators while in Laguna they were lessees. The first owners in Laguna were also the first users.

Most thresher owners have farms over 4.0 hectares. They also usually owned one to two power tillers and draft animals before acquiring the thresher. Most bought the threshers for cash or through short-term dealer installments. Many early owners belonged to the higher income class in the village. From custom work, owners were often able to acquire a second machine. Many non-owners in both areas expressed a strong desire to purchase a machine but were constrained by lack of capital and low incomes. There was no bank financing available for the purchase of threshers at the time of the survey.

Interviews with village heads and authorities indicated that in irrigated Iloilo sample villages, more than 50% of the farmers used threshers by 1977 (Fig. 4). This figure rose to about 75% in 1978. In rainfed Iloilo, 35% were adopters in 1977, increasing to about 50% the following year. In Laguna, adoption rates were also rapid. The rate of user adoption is presented in Fig. 5.

Manufacturers and dealers supplied threshers at a time when HYVs were becoming widespread and new and improved irrigation facilitaties were being established. These plus other institutional factors effecting the supply of labor heavily conditioned adoption of threshers. These institutional factors also produced changes in traditional harvesting-threshing arrangements.

Institutional Arrangements for Harvesting-Threshing

Harvesting and threshing labor in both study areas is usually hired and is composed of farmers and landless workers. Only the smallest farms utilize only family labor for these operations. Using traditional threshing methods, hired harvesters also carry out the threshing operation. Payment is commonly in kind as a percentage of the gross production.

Harvesting-threshing arrangements in Iloilo

The alternative harvesting systems and types of labor used are presented in Table 2. One traditional arrangement is called the *pakyaw* or contractual system. Under this system, a crew of about 6-8 persons harvests, threshes and cleans the output from a farm or parcel for a 1/6 share of the gross production. Once started, the group may finish the job at their own convenience. Of concern to farmers is the danger that during peak periods, the crew may leave the field on which they are currently employed to harvest in other fields. Cut grain can be left on the ground for extended periods of time. The farmer must wait for the crew's return to complete threshing and cleaning. Farmers consider *pakyaw* an inefficient arrangement. In addition to the *pakyaw* system, a second traditional system called *inadlaw* was also widely used. Harvesters in this system do not necessarily thresh the crop. Payment is separate. with harvesters getting a fixed

rate of 1/2 *panega*/day (7.2 kg.) or its cash equivalent and threshers receiving 1/11 or 9.1% of the threshed grain. A harvesting-threshing group is usually composed of 4-7 persons. For both systems, meals are usually provided, although under the *pakyaw* arrangement meals are sometimes given for operations following harvesting.[3/]

A new system called *pasapar* replaced the two older systems. Although there still remain traces of *pakyaw* in the irrigated villages and *inadlaw* in rainfed villages, farmers feel they will soon disappear. The *pasapar* is currently the most popular system in the survey areas. Under this system, harvesting, threshing and cleaning are carried out by a group of from 10 to 50 persons or more, working for a 1/6 share of gross production. All operations must be completed on one parcel before the group moves to another. Two types of labor use patterns are common under this system. With the first, harvesting is open without restriction to everybody from inside or outside the village, although most workers come from inside the village. The second arrangement imposes a limitation on the number of participants, restricting it to those specifically invited by the farmers. Invitees may include: a) a group of relatives from outside villages or nearby towns who customarily participate in the harvest, and b) a group of friends

---

[3/] Meals cost from ₱3.00 to ₱9,00 per person per day,

or neighbors from within the village. A farmer may approach a friend and ask him to contact other friends from within the village. He normally has to specify the number of harvesters required. Of the two variations under the *pasapar* system, the second is more common and considered more efficient because less grain is lost through minimized handling. Meals are not provided. *Sapar* in the local dialect means "to skip meals". Giving meals is, however, an option starting from the stacking operation for those who hire relatives.

A fourth system reportedly employed outside the survey area was the *sagod* arrangement.[4/] This system replaced the *pasapar* system in these areas. *Sagod* means "to care" and under this system, crop care in the form of weeding is carried out by the same group performing the threshing and cleaning. Harvesters receive a generous 1/6 share which is usually consists of overfilling the measuring container to compensate for the extra weeding labor. Weeding can become free for employers who are strict in sharing.

Traditional threshing employes a foot treading technique locally termed *linas*. Threshing takes place on an elevated bamboo platform about 2-3 meters above the ground. As grain falls to a mat below the platform the wind partially cleans the grains. Additional cleaning is done by manual winnowing. With a small harvest,

---

[4/] A.J. Ledesma, "The Sumagaysay Family: A Case Study of Landless Rural Workers," LTC Newsletter 55, January, 1977, University of Wisconsin.

threshing is often carried out on the ground.

Using the mechanical thresher, harvest is timed to coincide with the availability of the machine. Farmers may delay harvest if machines are not available since grain spoils more rapidly after the crop is cut. To avoid delays, farmers often contact thresher owners one day to one week before harvesting to set a threshing date. On the appointed day, two operators assisted by one or two harvesters bring the machine to the field. Several farmers may use the machine on a single day.

Cases were observed where farmers used the machines only for a part of the crop the first year but subsequently totally mechanized threshing the following year. No case, however, was found among the respondents where part of the crop was threshed traditionally and another part mechanically. This situation may, however, exist on farms with more than one parcel which cannot be scheduled conveniently for the machines because of extreme differences in harvesting dates. Farmers in the survey areas usually cultivate 2 to 3 parcels and it is their practice to plant parcels at one week intervals to avoid harvesting at the same time. Once respondents began using threshers, they used it continuously.

Harvesting-threshing arrangements in Laguna.

The *rumble* system dominated early harvesting-threshing arrangements. *Rumble* means to race with each other.[5/] In this

---

[5/] *Hunusan* is the word used by M. Kikuchi, et.al. in "Changes in Rice Harvesting Systems in Central Luzon and Laguna," op. cit.

system anyone could join, and when a farmer announced the day for harvesting, the result was a large group of harvesters from inside and outside the village.

The *rumble* system was replaced by the *gama* system which combines weeding, harvesting, threshing and cleaning operations. *Gama* is now the most popular arrangement. *Gama* is a counterpart of the *sagod* arrangement in Iloilo. One to three people offer to weed a plot in exchange for an exclusive right to harvest the same area. Weeding labor is considered a free service given in exchange for the right to harvest, but a can of palay (11 kgs) is usually added to the worker's share for a standard size plot. During the weeding period, the contract workers do the weeding but at harvest, two to three additional family members from the group join the operation. A single *gama* group may contract for more than one plot on one farm or conversely, several groups may work separate parcels on the same farm.

Using the traditional *hampas* threshing technique, bundles of unthreshed grain are beaten against a bamboo frame which has canvas suspended on three sides. Cleaning is usually carried out by manual winnowing. Workers receive a 1/8 share of the total production for harvesting, threshing and cleaning.

When a mechanical thresher is used, the farmer contracts the machine owner a few days before harvest to ensure it will be available. The machine owner provides the operator and crew, consisting of 3 to 4 persons for the small thresher and 6 to 7 persons for

larger units. During peak periods, it is common for the thresher owner to leave the machine in the field overnight for the next user, but to bring the engine home for safekeeping.

Institutional Factors Affecting Changes in Harvesting-Threshing Arrangements

One notable change in the harvesting system in Iloilo was movement away from a system from using limited number of harvesters toward the arrangement which permits everybody to participate. This transition is exemplified by changes from the *pakyaw* or *inadlaw* to the *pasapar* system. In contrast was the change in Laguna villages from an open to a closed arrangement with limited workers such as the movement from the *rumble* to *gama* system. A second pronounced change is in the threshing system wherein machines eliminated participation by harvesters in the threshing operation. These changes were influenced by technical and institutional factors such as high yielding varieties, irrigation, population, and industrialization.

Iloilo. In the past, the *pakyaw* and *inadlaw* harvesting systems were popular because farmers were still planting traditional varieties. These varieties were planted only once during the year, were generally harvested during the dry months, were low yielding and non-shattering. Thus, palay could be stacked in the

field for a month or more with little damage and loss. The variety's characteristics suited the slow *pakyaw* system. With a small harvest, harvesters were hired while family labor was often utilized for the threshing operation. This practice is also compatible with the *inadlaw* system.

Adoption of high yielding varieties induced changes in the harvesting system. With the new varieties, production increased. The HYVs mature earlier and two croppings were often possible, the first crop usually harvested during the rainy months. Under unfavorable conditions, the danger of grain spoilage calls for more timely harvesting and threshing. This means that stalks cannot remain in the field for an extended period as was common with the traditional varieties using the *pakyaw* system. About two years after HYVs were introduced, an expansion in irrigation facilities (the Sibalom River Irrigation System) occurred which further stimulated use of the HYVs. Water deliveries last, however, until January or February and are not fully predictable. This adds to the urgency to get the second crop planted after the first crop is harvested in October or November. A majority of the farmers now plant HYVs and harvest months often coincide. During these months, harvesting and threshing labor became a constraint. The limited tine available between crops for land preparation and planting further aggravated the labor problem. This situation induced farmerms to adopt the *pasapar* system which allowed unlimited number of laborers for faster harvesting and threshing.

Despite development of the new system, labor was still in short supply. In Iloilo, outside labor decreased and farmers within the village became busy on their own farms restraining them from helping their neighbor farmers.[6/] The problem of traditional threshing also remained. Foot treading is slow and laborious and the work was usually not finished before the rains resulting in a high incidence of spoilage. This was specially true during the wet season when both irrigated and rainfed areas were harvesting simultaneously and when threshing was more difficult because of the problems of wet grains.

Introduction of mechanical threshers meant more efficient and faster operations and less drudgery in threshing (Table 3). Decreased losses and lower costs were also major reasons cited for adoption. Farmers could also achieve more timely planting for the second crop.

One evaluation of data from the Cropping Systems project in the area gave similar findings. Use of traditional techniques (especially threshing) was identified as a major constraint to timely establishment and harvest of first and second crops and

---

6/ The new production technology causes labor shortages resulting from simultaneous harvesting and which lessens availability of outside labor in some Central Luzon villages. It is reported also that some farmers attribute the shortage of labor within the village to the increased production and income, which enable tenants and members of their families to increase the time allocated to leisure activities rather than seek off-farm work. (Grace Goodell, Memo No. 1 on Post production Labor and Income in Nueva Ecija, Philippines, May 6, 1979. IRRI).

did not provide sufficient power to achieve maximum cropping intensities or yields.[7/]

The machine population increased after high yielding varieties were widely used and after irrigation was well established. Utilization was highest in well-irrigated areas. The introduction of HYVs and irrigation must be considered as the major factors affecting changes in the harvesting-threshing system. The same factors contributed to the rapid acceptance and adoption of small mechanical threshers. These two factors preconditioned the adoption of threshers (Fig. 6).

Laguna. The conditions that existed in Laguna were different from Iloilo. Irrigation had been established long before HYVs were developed. The main reason for the shift from "open to all" harvesting (*rumble*) system to a more limited system (*gama*) was population pressure. Population continue to increase while farm area remained constant. As a result, an increasing number of harvesters were employed without a commensurate increase in production. When a large number of workers participate in the harvesting operation, inefficiencies such as handling losses increased. Farmers harvested as early as 0400 hours in the morning to avoid the pre-

---

7/ J.A. McMennamy and H.G. Zandstra, "Farm Machinery for Improved Rice-Based Cropping Systems," IRRI, Philippines, 1978.

sence of excessive number of harvesters. A fundamental reason for adopting the *gama* system was to control the number of harvesters and to confine sharing among the people within the village, particularly to the farmer's relatives and friends and to those willing to provide extra weeding. Threshers were also compatible with the *gama* system. Mechanical threshers permit *gama* workers to weed and harvest as many plots as possible because threshing is faster. In many instances, laborers agree to employment under the *gama* system only if the farmer provides a mechanical thresher. Using traditional methods limits the area harvested per season. Although the *gama* system was used before threshers were introduced, farmers reported it has become more popular since the threshers became available. Most farmers had previously adopted *gama* on only a small portion (one to two plots) of the farm but more recently, it is employed on the whole farm.

The new rice technology adopted in Laguna also accelerated adoption of the *gama* system. Increased fertilizer use and the *dapog* method of raising seedlings increased weed problems. When using *dapog* seedlings, the fields cannot be flooded immediately after transplanting because of the danger of drowning the young seedlings. Weeds therefore, cannot be controlled by flooding at early stages in the plant's growth. The high level of fertilizer application also increased the weed population. Manual weeding using hired labor was very expensive for the farmer. The *gama* system reduced weeding costs.

Laguna farmers adopted mechanical threshing for several reasons such as the need to harvest and thresh within a limited time (as demanded by the HYVs), the thresher's efficiency and its compatibility with the present practices. The compatibility of thresher use with the present practices is exemplified by the use of sickles which became more common following introduction of HYVs. Sickles facilitated harvesting the short statured varieties.[8/] Cutting the stalks at the desired length is relatively easy with a sickle. Generally, stalks are cut shorter for machine threshing than when using the traditional *hampas*. Thresher use also eliminated the extra job of bundling which accompanied use of the *hampas*.

During the past decade, many factories and cottage industries have been established in Laguna. Increasing industrialization has absorbed local rural labor, although farm labor does not appear to be much affected by the change as only those with secondary education are hired. Most harvest workers do not have this level of

---

[8/] Before this sickles were introduced, the two harvesting tools most widely used for traditional varieties were the scythe (*lingkaw*) and hand knives (*ani-ani*). Scythes were used in lowland areas and were compatible with the *hampas* method of threshing. The curved blade of the scythe is fastened at an angle to a long handle which facilitates cutting long-stemmed and lodged varieties. The cut grain is tied after six or more bundles are cut. A wooden frame (*piyuka*) is used to hold the bundle while beating it against the threshing frame. Hand knives were commonly used in upland areas. It facilitates cutting of crop near the base of the panicle which facilitated the popular foot treading threshing technique.

education. There is also a growing attitude among young workers (especially the farmers' children) of disinterest in farm work and a rising level of education consciousness.[9/] This situation may have influenced the adaptiveness of the *gama* system and use of mechanical threshers. With the *gama* system, farmers are assured that harvest labor is available. Even with sufficient labor, there is the risk that it may not be available at the time required. For the *gama* workers, an area to harvest is assured giving him a reliable source of income.

In summary, several factors have induced changes in harvesting-threshing systems. High yielding varieties, irrigation, population pressure and industrialization appear to be the most important. Adoption of mechanical threshers provided relative advantages over the traditional methods in hastening operations, minimizing losses and costs and increasing labor efficiency. The machines were compatible with local needs and practices and simple enough that use and operation were well within the knowhow of farmers. Behind these factors was the role of manufacturers and dealers in supplying the machines and enhancing adoption through demonstrations and provision of service, spare parts and special installment credit terms.

[9/] Wives and children of farmers have never contributed significantly to farm work, amounting to only 7 days/ha/crop. Eighty percent of the younger sons are students and help out only on weekends and vacations (J. Smith and F. Gascon, "The effect of the New Rice Technology on Family Labor Utilization in Laguna," IRRI Research Paper Series No. 42, November 1979.

Changes in Harvesting-Threshing and Rural Welfare

To carry out a complete analysis of the welfare impact of mechanical threshers would require the following information:

1) Changes in labor requirements and labor income per crop before and after thresher adoption.

2) Changes in cropping intensity, yield, cropping patterns and area under production before and after adoption.

3) The composition of the labor force (family, hired) used for harvesting threshing before and after adoption.

4) The demand for nonfarm labor before and after adoption (existence of alternative employment possibilities for those who may be displaced) and income from such employment.

5) The extent to which output changes are attributable to a) irrigation improvements, b) varietal technologies and c) mechanization.

In order to assess the village level effects of mechanical threshers on aggregate employment and income, the combined cropped area per season in each village is also required. From the above information we can determine if total annual employment and income has decreased or increased, whether machine threshing was instrumental in causing the change, which employment groups were affected and whether nonfarm employment opportunities added to or compensated for changes in total farm labor requirements. Unfortunately, the present cross-sectional study does not embody suffi-

cient data to carry out such an analysis. We therefore confine our attention to an assessment of labor use and income effects for the individual groups included in the survey.

Labor mobility. Even before thresher adoption, most labor requirements in Iloilo and Laguna were derived from within the village (Table 4). Some now report they hired people only from inside the village because of the machine's reduction in labor requirements. Even before thresher use, most labor came from inside. Outside labor decreased most significantly after widespread use of HYV rather than following thresher adoption. The increased manpower associated with use of the HYVs kept laborers fully occupied in their own villages, particularly during the harvesting and threshing periods which often coincide across a wide area. This change in production technology resulted in decreased labor availability within individual villages. Despite these developments, some farmers (especially those with relatively larger farms) reported continued use of outside labor (when available) in combination with workers from within the village. The primary reasons were: a) lack of harvest labor in the village, b) harvesters come looking for work, c) were regular workers, and d) proximity to outside villages (Table 5). Most workers from other towns and other provinces were landless relatives of the farmer and most HYVs were grown in their area.

The effects of thresher use on the movement of landless and small farmer harvesters were analyzed further. Landless families

in Iloilo constitute about 10% of the total families in the survey villages and about 30% in Laguna. Twenty percent of the harvest labor hired by farmers in Iloilo and 70% in Laguna are landless workers. In Iloilo, thresher use did not displace workers. (No data were obtained in Laguna). Landless workers remained in the village after thresher adoption for the following reasons: a) demand for labor remains high, b) most were regular workers of large landowners in the village, c) increased double cropping, d) most are natives, own lots and have relatives in the area, and e) their income was not adversely affected.

When asked for reactions to thresher adoption, most landless workers cited two positive reasons for machine use: a) less laborious and b) faster. These findings were confirmed by other farmer respondents (who hire these laborers) when asked to evaluate their workers' reactions. Thresher use permits individual workers to harvest a larger area. The size of the harvested area in proportion to the number of landless workers in each area should be examined more completely to assess the effects of thresher use. Where the landless population represents a high proportion of the total, thresher adoption may have a different effect.

Labor efficiency. The major reason given by farmers for using mechanical threshers was the provision of faster and less arduous services. With the machine, harvesting and threshing requires 18.4 mandays/ha in contrast to 42.6 mandays using traditional methods (Table 6). Machine threshing requires only 1.4 mandays/ha

compared to 26.0 mandays/ha using traditional methods. The lower labor input with the thresher is also shown in Fig. 7. Total labor input per hectare per year for harvesting and threshing is higher in irrigated areas because yields are higher and double cropping is widely practiced. Labor requirements are also higher with modern varieties compared to traditional because of higher yields.

Management of harvesting-threshing operations. When using the mechanical thresher, farmers have better control over the number and composition of the labor force. It enabled him to limit harvest labor to relatives and acquaintances within the village. Children were also allowed to participate. With the *pasapar* system in Iloilo, there also appeared to be a difference in the labor hiring practices between machine users and non-users. For the *pasapar* system encountered in well-irrigated villages where many threshers are operating, harvesters are limited only to the number needed. In contrast, in rainfed and poorly irrigated areas where the machine population is low and where non-users are more prevalent, the "open to all without limit" version of this system is still widely practiced. Farmers in irrigated villages usually employ the latter system only during peak harvest periods when they cannot secure sufficient labor or when the harvest is late. Thresher use, therefore, uses less labor, permits more timely operations with less labor, and requires less supervision because the duration of harvesting-threshing is less. It also eliminates night guard duty in fields while palay is in the process of being threshed.

Sharing arrangements. Using traditional threshing systems in Iloilo, 1/6th of total threshed grain goes to harvester-thresher. With a mechanical thresher, the harvester's share is reduced. One-third of 1/6th or 1/18th goes to the machine and only 2/3 is retained by the harvesters. From the 1/18th machine share, one part goes to the operator(s) and two parts to the owner, who must provide the fuel and oil (Fig. 8). While threshing, harvesters usually help haul and pile materials near the machine for easy feeding by the machine operator. Final cleaning remains a job of the harvester and sharing takes place only after cleaning is completed. Harvesters may also transport cleaned grain to the farmer's house if it is near but are sometimes paid from ₱0.50 to ₱1.00 per bag if the field is at a distance from the house.

The laborer's share in Laguna is slightly lower. With traditional methods, the harvester-thresher share is 1/8 or 12.5% of gross output. Using the machine, the harvester's share is reduced to 10% and the machine receives 7 to 8% in payment. In other instances, the harvester receives 12% and the machine, 7.4% (Fig. 9). Unlike Iloilo, the harvester's share in Laguna does not include cleaning. Harvesters are relieved of cleaning because the large axial flow threshers used in this area incorporate cleaners. Portable thresher owners in Laguna also provide winnowing fans at no extra cost to compete with the large thresher. If operated independently, rental for the blower is one percent of the gross cleaned grain.

Income. Thresher adoption affected the income of owners, users and harvest workers. Owners reported income from thresher use averaging $837/year in irrigated Iloilo and $383/year in rain-fed Iloilo and $666/year in Laguna (Table 7). Examination of annual utilization patterns revealed an average use level of 166 hours/year, 69% for custom threshing, 19% for threshing on own farms and 12% for other uses such as water pumping and grain cleaning with the thresher engine (Fig. 10). Users, which include owners and non-owners, also reported increased income resulting from higher yields or in th operator's share as a result of decreased losses. Income increases attributed to thresher use were reported by 29% of the users in Iloilo (71% reported no change in income) and 100% in Laguna (Table 8). Harvest workers, who worked in conjunction with the threshers, also benefited from machine adoption. An increase in harvesting income by 60% and 100% due to thresher use was cited by two of ten landless and small farmer worker respondents (Table 9). One small farmer became a thresher operator after thresher adoption. Fifty-four percent of the total income of landless and small farmer workers come from harvesting-threshing, 21% from land preparation, planting and other farm operations, and 25% from non-farm jobs which include carpentry, livestock production and others.

Analyzing income distribution at the village level. It is apparent from this analysis that the owner-user is the principal beneficiary of thresher adoption. Aside from slightly increased yields

custom work is the primary source of additional income derived by this group. Users receive an average daily wage for threshing six times that of non-users (Table 10). Despite the fact that thresher use decreased the harvesters' percentage share of the total crop threshed, daily wage rates are still higher with thresher use. Harvesters received $2.7 per manday for harvesting and threshing using traditional methods (irrigated Iloilo) while he receives $4.6 per manday for harvesting alone using mechanical thresher. Wage rates are higher in irrigated than in rainfed villages. They are also higher during the wet season for Iloilo workers because yields are higher. Conversely, dry season wages for Laguna farmers are higher because yields are higher during this season. Wages are low for the contractual *gama* labor arrangement in Laguna because of the free weeding labor by the harvester-threshers.

Yields. Thresher use increased yields for 17% of the users in irrigated Iloilo, 14% in rainfed Iloilo and 94% in irrigated Laguna (Table 8). The remainder indicated no change. Yield refers to total grain recovery after threshing. The operator's yield increased due to minimized handling losses, spoilage and less pilferage by disnonest laborers and elimination of the cleaning fee. Although we were not able to measure the loss separately, farmers reported a total loss of 7.3% using the *hampas* method,

1.7% using foot treading and .7 to 2.0% using the machine.[10/] Lower handling losses were incurred because infield threshing became possible. These losses are non-recoverable for both the farmer and the worker because no one benefits except the ducks that glean the fields. Losses due to pilferage occur when laborers purposely leave excessive grain on the stalk for subsequent hand gleaning.[11/] Paddy recovered by gleaners (usually relatives of harvesters) are losses to the farmer but not to the community because many gleaners are landless persons living within the village.

Leisure and prestige. Leisure time increased for thresher users. Owners reported they gained in status and were now able to send their children to school because of the added income from custom work (Table 9).

[10/] A grain loss of 1.56% using foot treading and beating of a flail or stick on cement pavement and 0.48% using the large axial flow thresher was reported in study conducted in the Bicol area. ("Technical and Economic Characteristics of Rice Postproduction Systems in the Bicol River Basin". A report submitted by the Process Engineering Department, INSAET/UPLB and the IRRI Agricultural Engineering Department with the Bicol River Basin Development Program, April 1978.)

[11/] One study reported it is normal for a gleaner to gather grain worth ₱25.00 per day and if diligent enough, she can gather as much as 25 kgs. per day or may end up with 10% of the harvest per season. The author, however, considers it not a reflection of the technical inefficiency of the traditional method, although it may indeed affect his adoption of the mechanical thresher (Grace Godell, op. cit.).

Cropping pattern and intensity. A majority of the thresher users in Iloilo and Laguna has adopted the rice-rice pattern before adopting the machine. Most reported thresher use had little effect on cropping patterns. Only 18 out of 63 users reported changes from rice-fallow, or rice-upland to rice-rice after thresher adoption. Of these, 8 reported the change was due to the machine because of more efficient use of available water and HYV.

Fourteen of the 63 thresher users reported changes in cropping intensity following use of the thresher. Of these, one-half attributed the change to thresher adoption and the remaining half to HYV and irrigation. Water availability, rather than thresher use, was the main constraint to increased cropping intensity.

Turnaround time. Thresher use increased turnaround time for Iloilo farmers and had no effect in Laguna. Thresher users have longer turnaround time in Iloilo because users harvest earlier than non-users but plant concurrently with others in the community. Harvesting was sometimes delayed if threshers were not available. A standing crop is less susceptible to rain damage than cut grain piled in small stacks. Farmers also plant simultaneously with others to coincide with water deliveries (irrigated farms) and sometimes in the case of Laguna to preclude major concentrations of pests on a parcel planted out of phase with others in the surrounding area. The time saved with mechanical threshing was used for better farm management, increased leisure

activities or some income generating activities. Farmers felt the time required for straw decomposition and availability of water were the main determinants of the turnaround period.

Summary

The results presented are largely descriptive and examine 1) the patterns of thresher adoption and 2) the institutional framework within which the machine was adopted, and 3) the changes which accompanied adoption and use of the machine. The major findings are:

Historical perspective

1. Sale and use of mechanical threshers is increasing rapidly in Laguna and Iloilo. The manufacturing and distribution industry for these machines is largely localized in each region.
2. Use of threshing machines in Laguna has become popular since 1976, the year following introduction of the large IRRI axial flow thresher. In Iloilo, portable threshers are widely used, first becoming popular in 1977-78. In Iloilo, the first users were tenants while in Laguna owner-cultivators were the initial adopters.
3. Most owners in both provinces were farmers with average farm sizes over 4 hectares. Most do extensive custom threshing and many owned one or two power tillers prior to thresher ownership.

Labor use arrangements

1. Harvesting and threshing labor composed of farmers and some landless workers is usually hired. Only the smallest farms utilized only family labor for these operations. With traditional threshing methods, hired harvesters also do the threshing. Payment for harvesting and threshing is commonly in kind as a percentage of the gross production, 17-19% in Laguna and 16% in Iloilo.
2. The labor use system most widely used in Iloilo is the *pasapar* consisting of hired workers. It replaced the previous contractual basis *pakyaw*. The system presently used in Laguna is *gama*, a contractual system which replaced the hired *rumble* system.

Technological factors

1. Thresher adoption proceeced most rapidly in areas where use of HYV and irrigation are widely accepted.
2. Adoption of HYVs was the main reason Iloilo farmers shifted from contractual to hired labor for harvesting and threshing. In contrast, population pressure and wide use of HYVs caused Laguna farmers to shift from hired to a contractual labor system. They adopted the *gama* system to reduce weeding expenses and improve weed control which are more abundant with HYVs.

3. Thresher use was complementary with a harvesting system involving a limited number of harvesters. Because of the capacity of the mechanical thresher, a *gama* crew could contract for several plots despite the conditions that they not leave one plot before completion of threshing. In a number of cases, laborers agreed to the *gama* system only after assurances from the farmer that a mechanical thresher would be used.
4. In Laguna, factories and cottage industries have absorbed growing numbers of workers from the rural labor force. This situation also appears to have influenced more extensive use of the *gama* system and of mechanical thresher.

Rural welfare

1. In Iloilo, where landless labor represents an estimated 10% of total farm households, thresher use reduced the share paid to harvesting and threshing labor. Most laborers, however, accepted this arrangement because it allowed them to harvest a greater area and reduced the burdensome nature of manual threshing.
2. Labor is controlled with thresher use, threshing and cleaning are better supervised, and handling losses were reportedly lower. For machine owners, there was considerable added income from custom work.

3. Thresher use has little apparent influence on cropping patterns and intensity. Conversely, increased cropping intensity appears to be a major inducement to rapid adoption of machines in both seasons.
4. The confounding effects of irrigation, HYV and small sample size make assessment of the turnaround issue difficult. It appears, however, that users harvest earlier and have longer turnaround period than non-users. However, the extra time saved by machine users is employed in productive activities.

References

Cordova, V.G. 1979. New Rice Technology Its Effect on Labor Use and Shares in Rice Production in Laguna, Philippines: 1966-1978. Paper presented at the First International Conference of the Canadian Council for Southeast Asian Studies at University of British Columbia, Vancouver, Canada. November. IRRI Agricultural Economics Department Paper No. 80-02.

Goodell, G. 1979. Memo No. 1 Ongoing Harvest: Post Production Labor and Income in Nueva Ecija. May 6. IRRI Agricultural Economics Department. Philippines.

Hayami, Y. et. al. 1979. Changes in Community Institution and Income Distribution in a West Java Village. IRRI Agricultural Economics Department Project "Dynamics of Agrarian Change" Report No. 5. August.

Hayami, Y. and A. Hafid. Some Observations on the Changes in Rice Harvesting Systems in Java. Agro-Economic Survey, Rural Dynamic Study. Bogor, Indonesia.

IRRI Agricultural Engineering Department, INSAET/UPLB Process Engineering Department and Bicol River Basin Development Program. 1978. Technical-Economic Characteristics of Rice Postproduction Systems in the Bicol River Basin.

Kikutchi, M. et. al. 1979. Changes in Rice Harvesting Systems in Central Luzon and Laguna. IRRI Research Paper Series Number 31. July. IRRI. Philippines.

Ledesma, A.J. 1977. The Sumagaysay Family: A Case Study of Landless Rural Workers. LTC Newsletter 55. January, University of Wisconsin.

McMennamy, J.A. and H.G. Zandstra. 1978. Farm Machinery for Improved Rice-Based Cropping Systems. IRRI, Philippines.

Smith, J. and F. Gascon. 1979. The Effect of the New Rice Technology on Family Labor Utilization in Laguna. IRRI Research Paper Series Number 42. November. IRRI. Philippines.

Table 1. General characteristics of irrigated and rainfed villages in thresher study, Iloilo and Laguna, 1978-79.[a]

Item	Iloilo		Laguna
	Irrigated	Rainfed	Irrigated
Cultivated rice area per barrio (ha)	500	430	140
Average farm size (ha)	2.08	1.74	2.45
Estimated number rice farmers per barrio	250	250	60
Tenure (%)			
owner	25	33	8
lessee	57	57	80
share tenant, etc.	18	10	12
Farmers cultivating (%)			
one rice crop per year	26	62	few
two rice crops per year	70	38	majority
three crops in two years	0	0	few
five crops in two years	4	0	few
Farmers planting (%)			
rice only	75	40	78
rice plus other crops	25	60	22
Average rice yield (t/ha)	3.9	3.6	4.4
Common variety planted	IR36	IR36	IR36, IR42

[a] Information obtained from village captains.

Table 2. Harvesting system and type of labor used, 99 farmers, Iloilo and Laguna, 1978-79.

Thresher use/type of labor		Iloilo				Laguna	
		Irrigated		Rainfed			
		No.	%	No.	%	No.	%
User:	Before thresher use						
	Hired (Pasapar/Inadlaw/Rumble)	19	79	19	90	9	50
	Contractual (Pakyaw/Gama)	5	21	1	5	4	22
	Family	-	-	1	5	-	-
	Combination	-	-	-	-	2	11
	Not specified	-	-	-	-	3	17
	After thresher use						
	Hired (Pasapar/Inadlaw/Rumble)	18	75	19	90	5	28
	Contractual (Pakyaw/Gama)	6	25	1	5	11	61
	Family	-	-	1	5	-	-
	Combination	-	-	-	-	2	11
Non-user:	Hired (Pasapar/Inadlaw/Rumble)	12	86	12	80		
	Contractual (Pakyaw/Gama)	-	-	1	7		
	Family	2	14	-	-		
	Combination	-	-	2	13		

Table 3. Reasons for utilizing mechanical threshers, 63 users, Iloilo and Laguna, 1978-79.

Reasons	Iloilo		Laguna
	Irrigated	Rainfed	
Number of users	24	21	18
		percent	
Faster threshing	64	80	52
Easier threshing	22	20	10
Lower losses			21
Lower threshing cost	14		3
Preferred by laborers			7
Trend			7
Total	100	100	100

Table 4. Sources of harvesting labor, 99 farmers, Iloilo and Laguna, 1978-79.

Sources	Iloilo		Laguna
	Irrigated	Rainfed	
Number of farmer users	24	21	18
		percent	
No change in source (before and after thresher use)			
Inside village	63	80	27
Outside village	8	5	16
Inside and outside village	8		45
Change in source (before to after thresher use)			
Inside to combined outside and inside village	12	5	6
Combined outside and inside to inside village only	9	10	6
Total	100	100	100
Number of farmer non-users	14	15	7
		percent	
Inside village	71	67	86
Outside village	7		
Inside and outside village	22	33	14
Total	100	100	100

Table 5. Reasons for obtaining labor from outside village, 99 farmers, Iloilo and Laguna, 1978-79

Reasons	Iloilo				Laguna	
	Irrigated		Rainfed			
	User	Non-user	User	Non-user	User	Non-user
Number of farmers	13	5	3	8	10	1
				percent		
Lack of labor in village	32	60	67	25		100
Outside labor soliciting work	54	20	33	38	30	
Regular workers	7			12	10	
Proximity to outside village	7			25	10	
No reason		20			50	
Total	100	100	100	100	100	100

Table 6. Labor requirements per hectare for harvesting and threshing modern rice varieties before and after thresher adoption and use, Iloilo and Laguna, wet and dry seasons, 1978-79.

Thresher use/labor arrangement	Irrigated Iloilo			Rainfed Iloilo			Irrigated Laguna			
	H	T	H+T*	H	T	H+T	W*	H	T	H+T+W
	manday/hectare									
User: Before thresher use	16.6	26.0	42.6	17.1	19.1	36.2				
Hired [a/]	15.3	24.4	39.7	17.1	19.1	36.2	-	14.1	19.8	33.9
Contractual [b/]	20.5	31.4	51.9	-	-	-	21.9	24.5	20.8	67.2
After thresher use	17.0	1.4	18.4	15.5	0.9	16.4				
Hired	14.7	1.2	15.9	15.5	0.9	16.4	-	14.5	4.4	18.9
Contractual	22.4	1.8	24.2	-	-	-	21.9	25.0	4.8	51.7
Non-user:	18.0	26.0	44.0	17.6	24.4	42.0				
Hired	18.0	27.7	45.7	17.6	24.4	42.0	-	-	-	-
Contractual	-	-	-	-	-	-	21.9	35.8	16.0	73.7
Family	18.0	16.0	34.0	-	-	-		12.0	22.0	34.0

* H - Harvesting; T - Threshing; W - Weeding

[a/] Hired refers to the "pasapar" system in Iloilo and the "rumble" system in Laguna.

[b/] Contractual refers to the "pakyaw" system in Iloilo and the *gama* system in Laguna.

Table 7. Thresher cost and use patterns in Iloilo and Laguna, 1978-79.

Area	Initial cost	Annual use	Output	Gross income	Cash expenses	Net income	Payback period
	$	hrs	t/yr	$/yr	$/yr	$/yr	yrs
Iloilo irrigated	738	214	120	965	127	837	0.9
Iloilo rainfed	775	116	72	510	127	383	2.0
Laguna irrigated	1243	153	98	827	103	666	1.9
All	914	173	103	818	119	686	1.3

1US$ = ₱7.35

Table 8. Effects of thresher use on yield, income, farm size, tenure, and prestige, 63 farmers using threshers in Iloilo and Laguna, 1978-79.

Item	Iloilo		Laguna
	Irrigated	Rainfed	
	percent		
Yield			
increase	17	14	94
no change	83	86	6
Income			
increase	55	29	100
no change	45	71	
Farm size			
no change	100	100	100
Tenure			
no change	100	100	100
Prestige			
increase	39	15	25
no change	61	85	75

Table 9. Annual off-farm and non-farm income of landless and small farmer workers before and after thresher adoption, 10 respondents, Iloilo, 1978.

Respondent	Off-Farm							
	Land preparation		Planting/broadcast		Other operations		Harvesting, threshing, cleaning	
	Before	After	Before	After	Before	After	Before	After
					US$/year			
1			11	32	18	43	114	183*
2			27	14	41	27	229	171*
3	102	102	7	7	17	17	160	114*
4			10	na	na	na	23	17
5	34	20	11	14	2	na	57	57
6			14	14	71	71	114	229*
7					6	6	57	57
8	14	41			2	5	57	103
9					5	5	57	103
Average[a/]	17	20	8	10	23	25	113	137

	Total off-farm		Total non-farm[b/]		Grand total	
	Before	After	Before	After	Before	After
			US$/year			
1	144	259	82	136	225	395
2	297	212	68	54	365	267
3	286	241	7	7	293	248
4	na	na	136	136	na	na
5	104	na	27	68	132	na
6	199	313	41	41	239	354
7	63	63	16	212*	80	275
8	73	149	14		86	149
9	62	108		7	62	115
Average[a/]	161	192	33	65	194	257

a/Does not include respondents with incomplete data (nos. 4 and 5).
b/Non-farm jobs engaged in are carpentry, driving, livestock raising, tailoring, thresher operator, selling firewood, cutting bamboo and rope making.
*Respondents whose income changes were attributed to thresher use
na - not applicable
1US$ = ₱7.35

Table 10. Daily wage rates for harvesting and threshing modern rice varieties before and after thresher adoption and use, Iloilo and Laguna, wet and dry seasons, 1978-79.

Thresher use/labor arrangement	Irrigated Iloilo			Rainfed Iloilo			Irrigated Laguna		
	H	T	H+T*	H	T	H+T	H	T	H+T
	US$/manday								
User: Before thresher use	4.7	1.5	2.7	3.1	1.4	2.2			
Hired	5.1	1.6	2.9	3.1	1.4	2.2			2.7
Contractual	3.8	1.2	2.2	-	-	-			1.4
After thresher use	4.6	9.2	5.0	3.4	9.8	3.8			
Hired	5.3	10.8	5.7	3.4	9.8	3.8	5.1	4.7	5.0
Contractual	3.5	7.2	3.7	-	-	-	2.9	4.3	1.8
Non-user:	3.3	1.1	2.0	3.0	1.1	1.9			
Hired	3.3	1.1	2.0	3.0	1.1	1.9	-	-	-
Contractual	-	-	-	-	-	-			0.9
Family	3.3	1.9	2.6	-	-	-			1.9

* H - Harvesting; T - Threshing

Formula: Wage rate = % rate of payment for labor (Figs. 8 and 9) x yield (US$) ÷ mandays/hectare (Table 6)

Yield: Irrigated Iloilo - 3.8 tons/ha ($698) for users and 2.9 tons/ha ($533) for non-users.
Rainfed Iloilo - 2.6 tons/ha ($478) for users and non-users.
Irrigated Laguna - 4.0 tons/ha ($735) for users and 2.8 tons/ha ($514) for non-users.

1US$ = ₱7.35; 1 kg. paddy = ₱1.35; 1 ton = 1000 kgs.

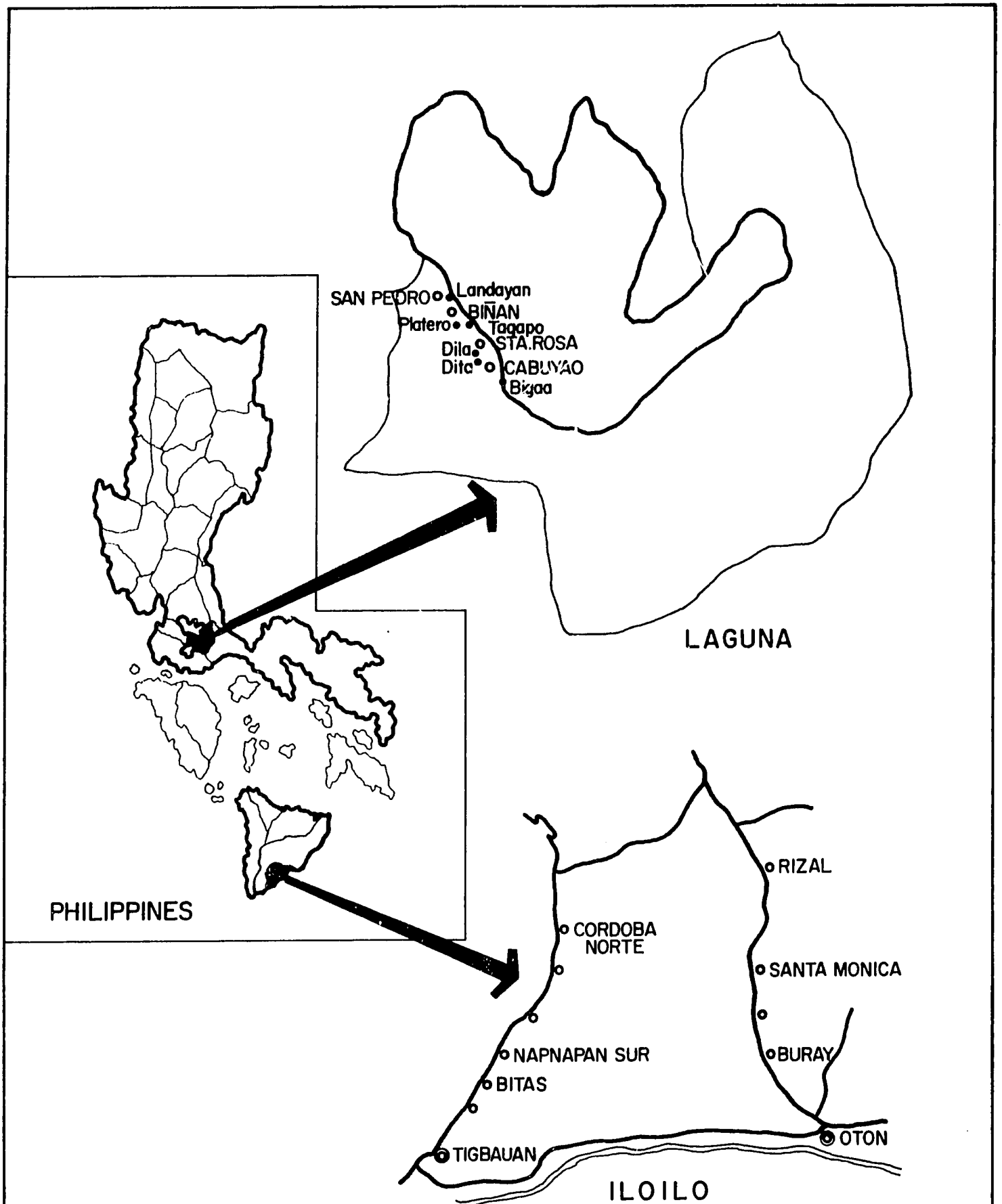


Fig. 1 Map of study areas in Laguna and Iloilo, Philippines, 1978-79.

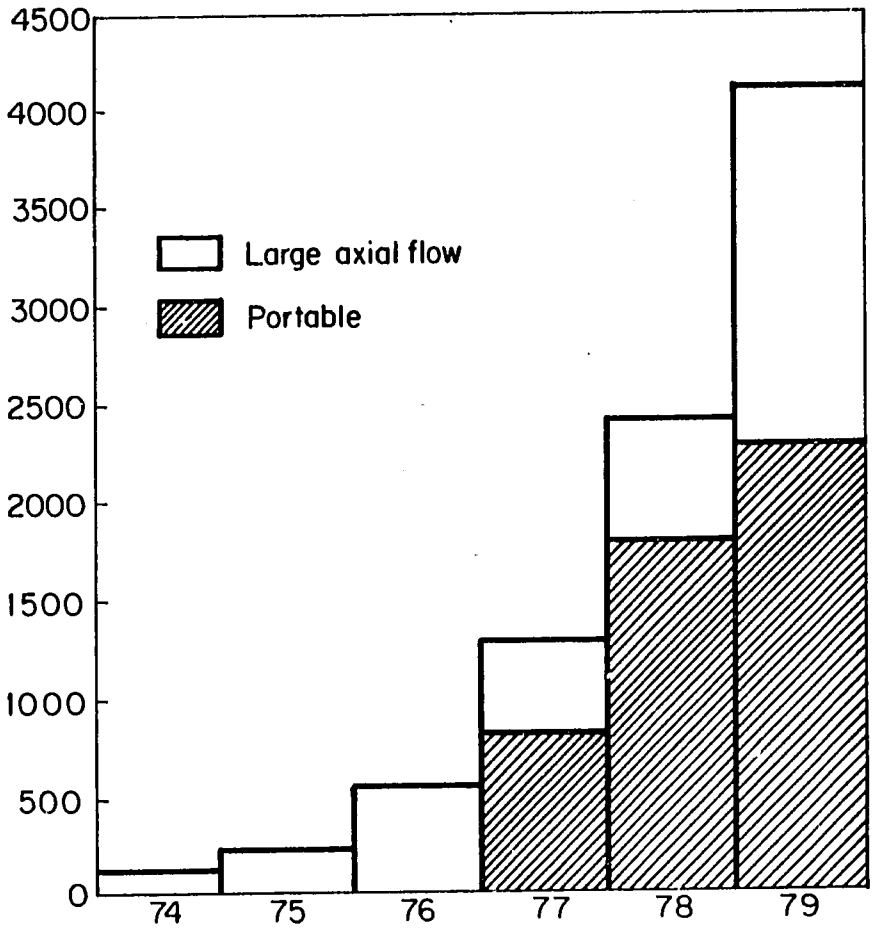


Fig. 2 Sale of IRRI designed mechanical threshers in the Philippines, 1974-79

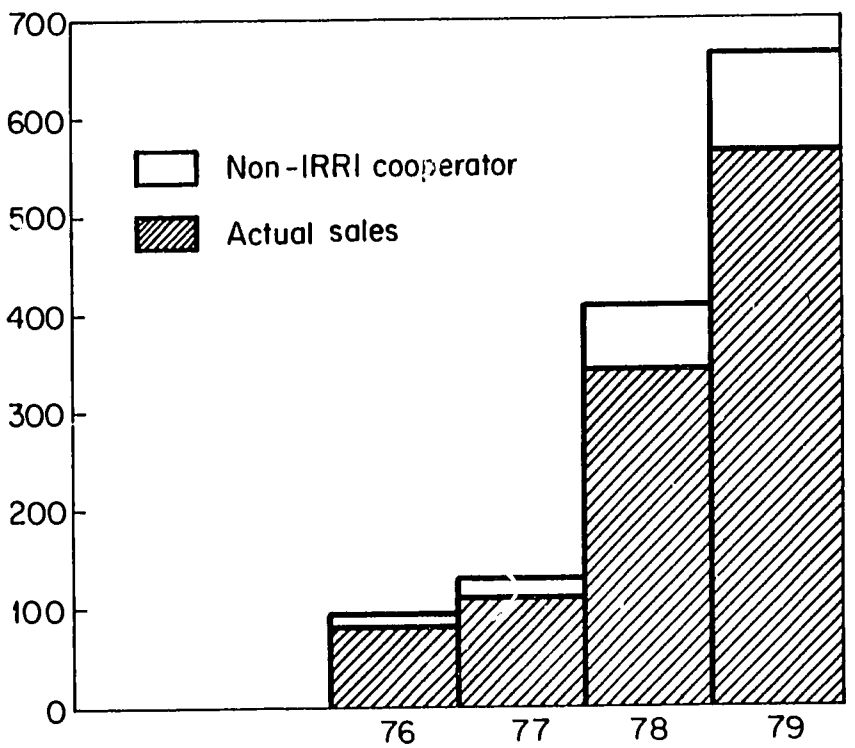


Fig. 3 Sale of IRRI portable axial flow threshers in Iloilo, Philippines, 1976-79

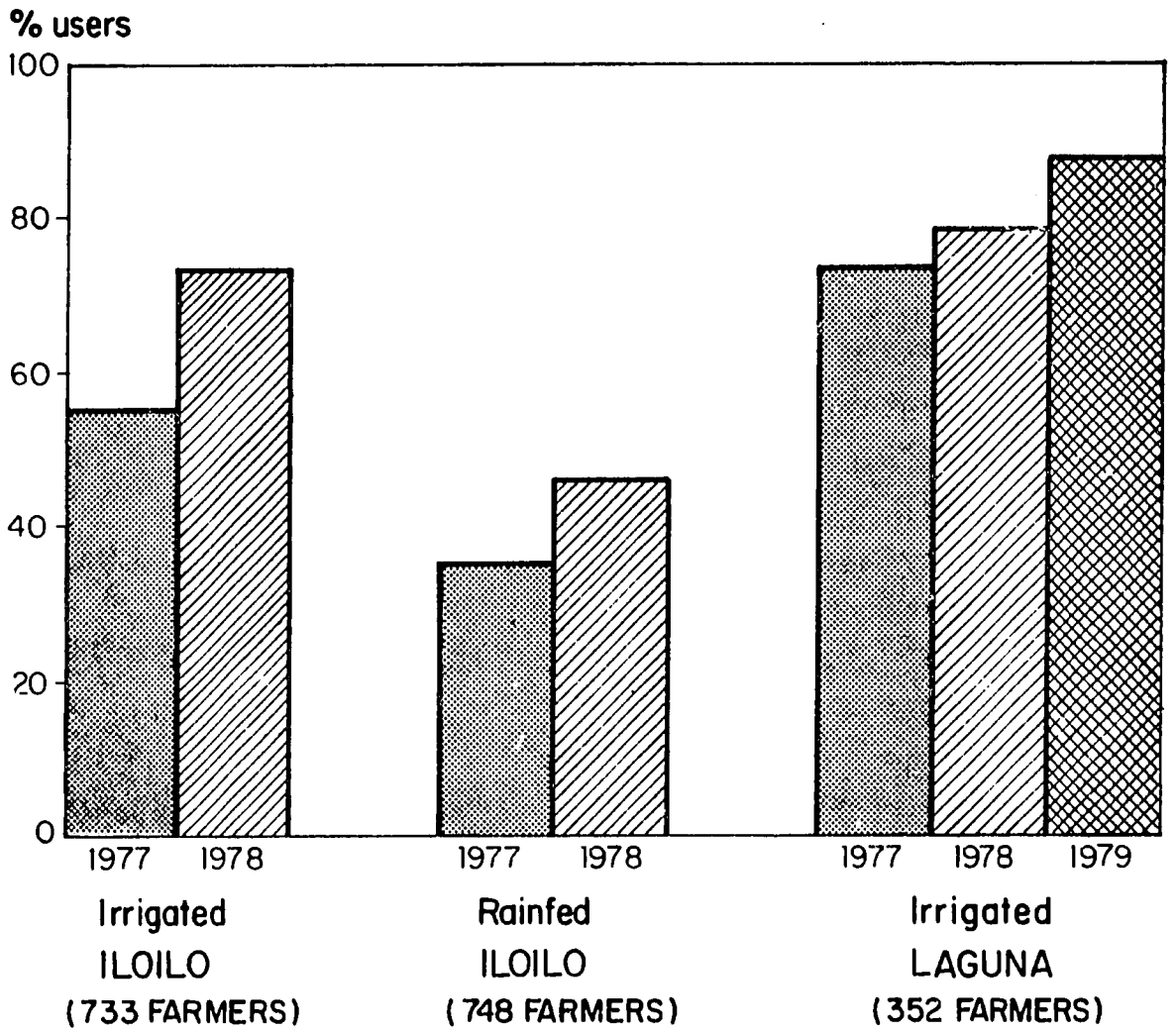


Fig. 4 Thresher adoption and utilization in three irrigated and three rainfed villages of Iloilo and six irrigated villages of Laguna, Philippines, 1978 - 1979.

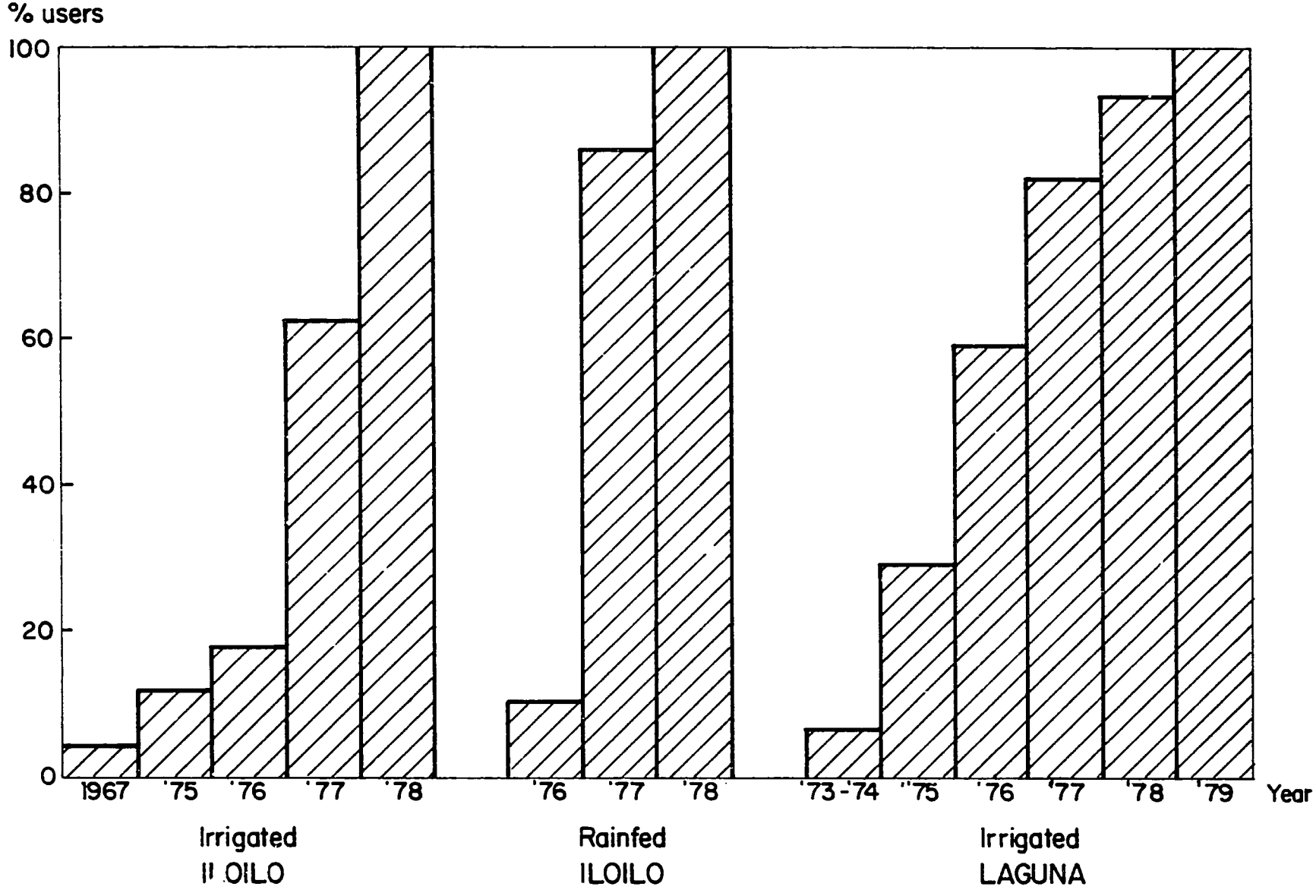


Fig 5 Thresher adoption patterns by farmer-users in Iloilo and Laguna, 1967–79.

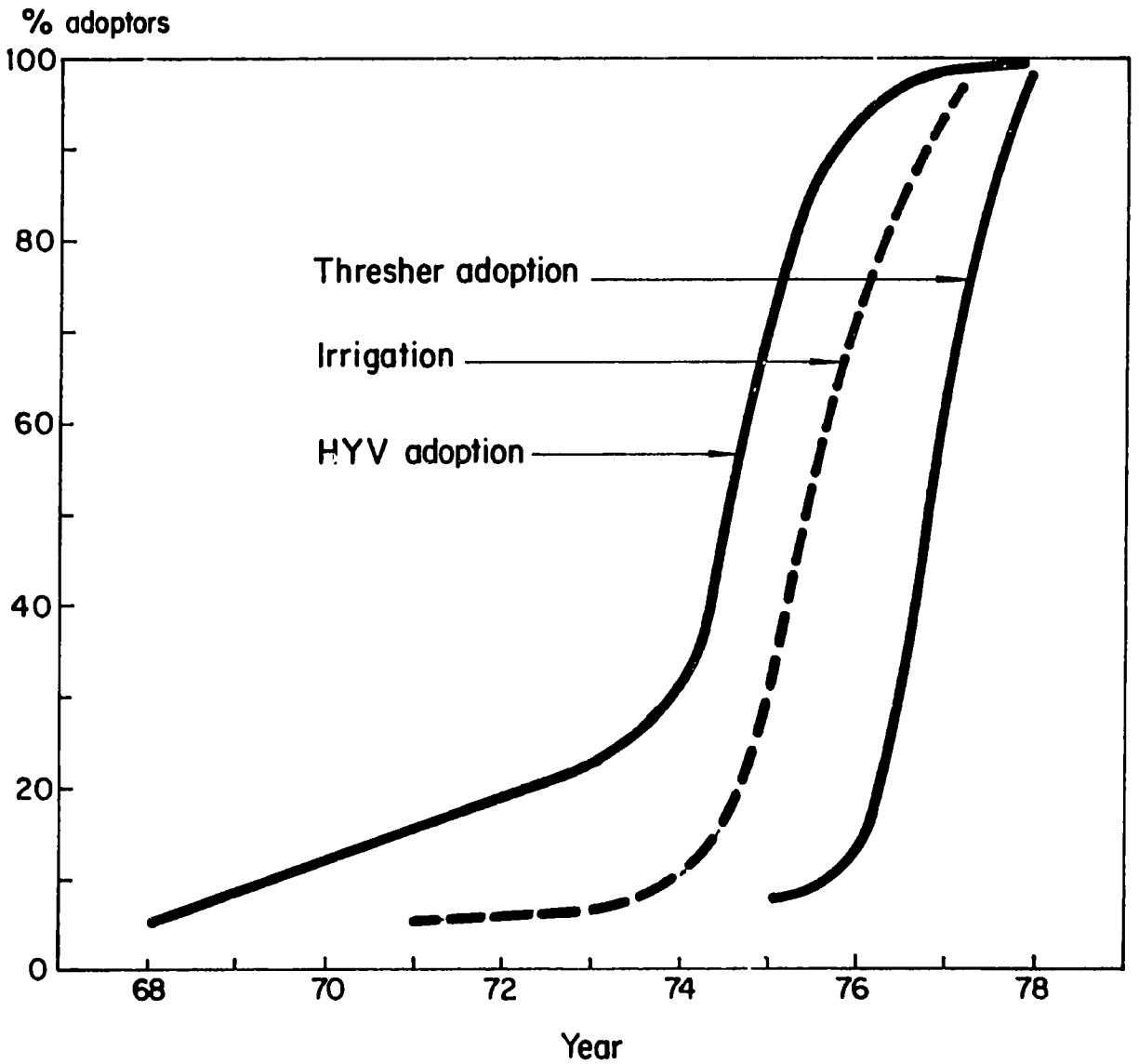


Fig. 6 Adoption of three rice production technologies in three sample irrigated villages, Iloilo, 1968-78.

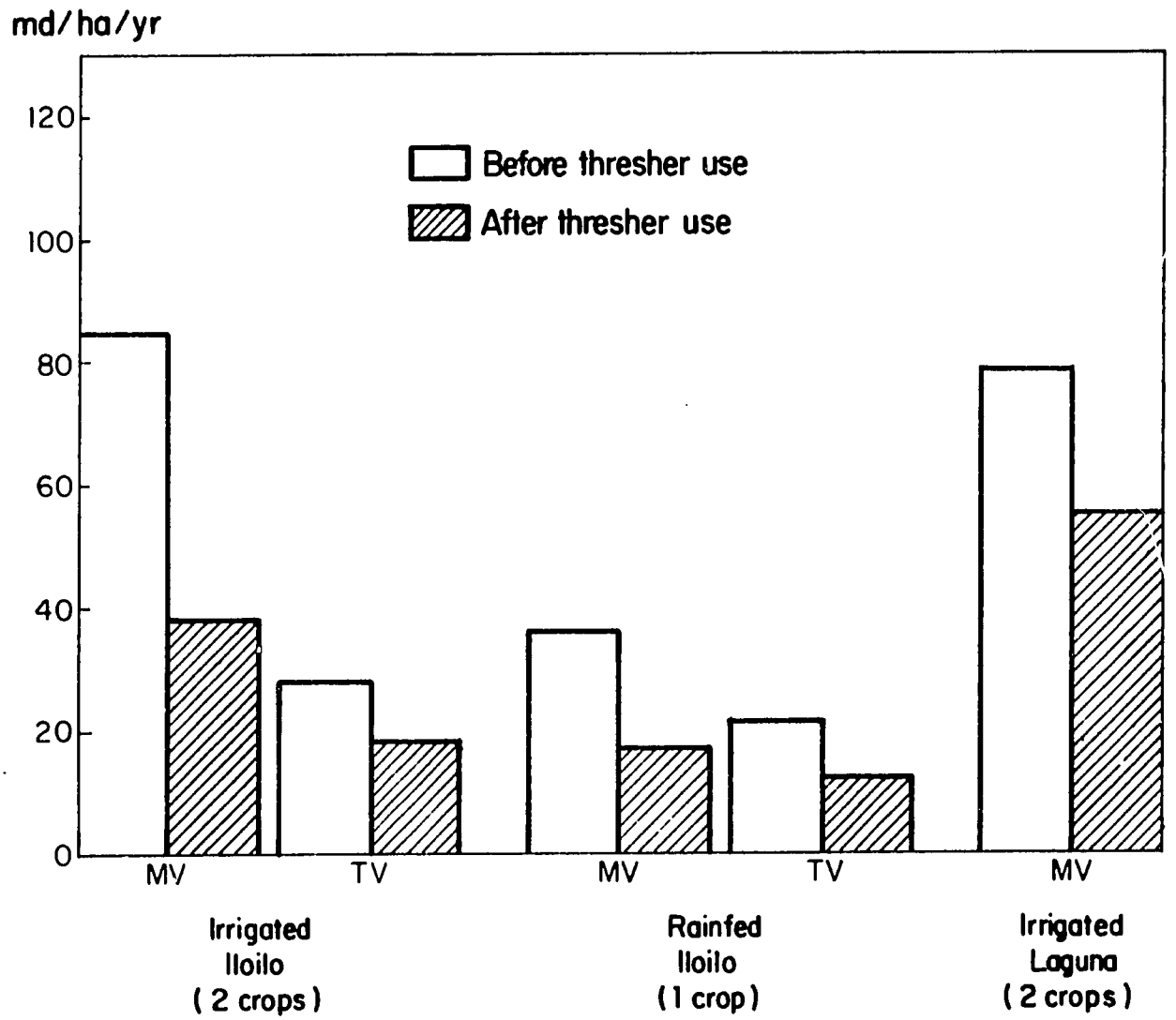
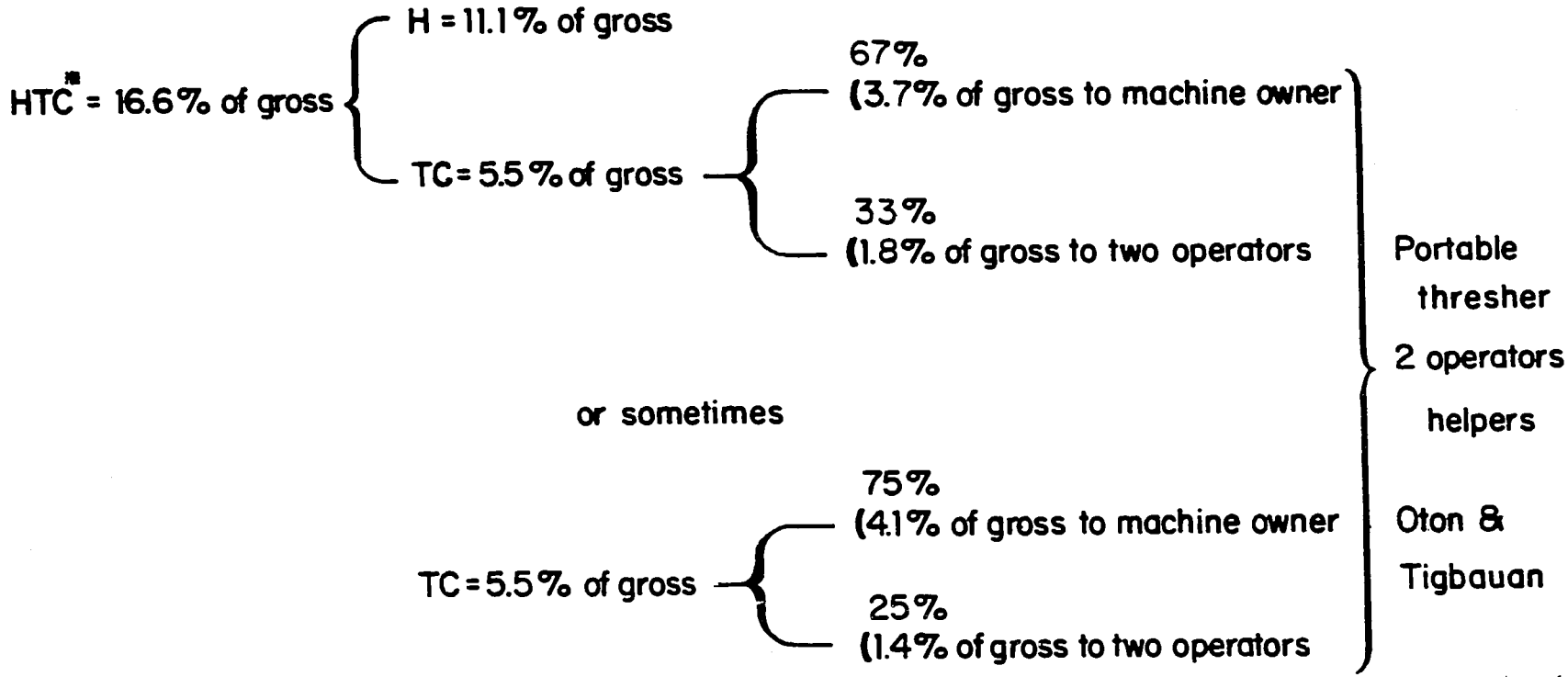
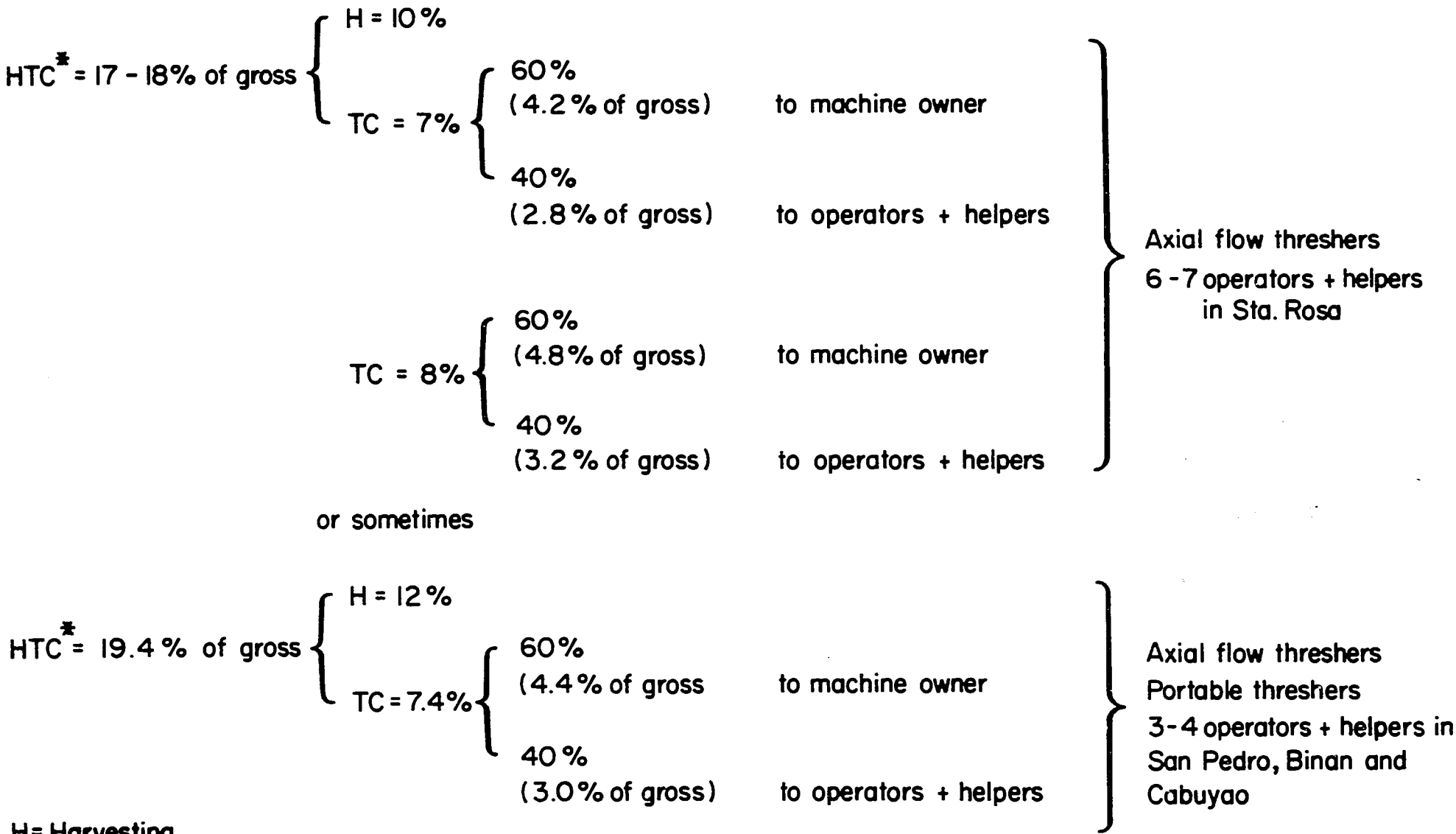


Fig 7 Mandays per hectare for harvesting and threshing rice, Iloilo and Laguna, wet and dry seasons 1978.



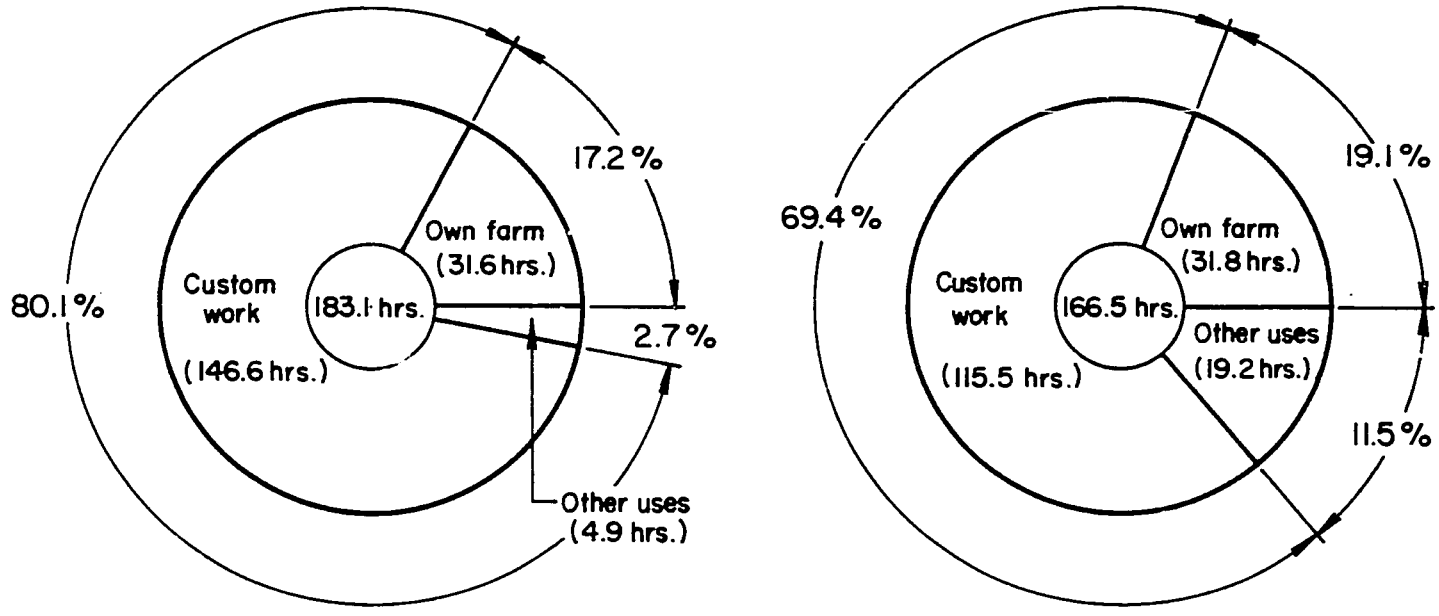
*H — Harvesting
T — Threshing
C — Cleaning

Fig. 8. Rates of payment for harvesting, threshing and cleaning in Iloilo.



* H= Harvesting
T= Threshing
C= Cleaning

Fig. 9 Rates of payment for harvesting, threshing and cleaning in Laguna.



Iloilo, 14 owners

Iloilo and Laguna, 19 owners

Fig. 10 Allocation of threshing time, 19 owners, Iloilo and Laguna, 1978-79

CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Operations Manual

1. Moran, P. and D. Unson. Farm Survey and Recordkeeping Procedures for Consequences of Small Rice Farm Mechanization Project. Revised May 1980.

2. Wicks, J.A. Procedures for Constructing Two-Way Tables for Consequences of Small Rice Farm Mechanization Project. January 1980.

3. Wicks, J.A. Specification of Variables to be Included in Data Files for Consequences of Small Rice Farm Mechanization Project. October 1980.

Working Papers

1. Juarez, F. and B. Duff. The Economic and Institutional Impact of Mechanical Threshing in Iloilo and Laguna. October 1979.

2. Pathnopas, R. The Economics of Rice Threshing Machines in Thailand: A Case Study of Chachoengsao and Supanburi Provinces. October 1979.

3. Gardezi, J.,A. Rauf, M. Munir, K. Altaf, Q. Mohd-ud-Din, and B. Lockwood. A Study of Mechanical and Traditional Wheat Threshing in Multan District, Punjab, Pakistan: Some Preliminary Results. October 1979.

4. Habito, C. and B. Duff. A Simulation Model to Evaluate Mechanization of Rice Postharvest Operations in the Philippines. October 1979.

5. Chapman, J. The Potential of Mechanization for Crop Intensification in a Rainfed Area - Iloilo, Philippines. October 1979.

6. Thapa, G. The Economics of Tractor Ownership and Use in the Nepal, Terai. October 1979.

7. Jongsuwat, N. Productivity Growth and Farm Machinery Adoption in Thai Agriculture. April 1980.

8. Bernsten, R.H. and R. Sinaga. A Methodology for Identifying Lowland Rice Farms that would Benefit from the Mechanization of Land Preparation. October 1979.

9. Bernsten, R.H. and A. Rochim. Labor Shortage as a Constraint to Increasing Cropping Intensity. Revised March 1980.

10. Ayob, A.M. The Economics and Adoption of the Combine Harvester in the Muda Region of Malaysia. October 1979.

11. Lubis, R. Impact of Cropping Pattern Technology on Income, Employment and Production: A Case Study on Expanded Crop Production in Lampung. October 1979.

12. Wicks, J. A. Modelling the Consequences of Future Mechanization: An Outline of Possible Procedures. October 1979.

13. Khoju, M. R. and J. A. Wicks. Economics of Pump-Irrigation in Eastern Nepal. August 1980.