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THE SEMINAR-WORKSHOP ON THE ECONOMICS OF RICE PRODUCTION

Papers Presented at a Conference at
The International Rice Research Institute
December 8-9, 1967

Jointly Sponsored by
The Department of Agricultural Economics,
College of Agriculture,
University of the Philippines
and
The Department of Agricultural Economics,
The International Rice Research Institute

FOREWORD

This seminar-workshop on the economics of rice production was sponsored jointly by the Departments of Agricultural Economics at the University of the Philippines, College of Agriculture and at The International Rice Research Institute. During the two-day conference held at The International Rice Research Institute on December 8-9, 1967, nine papers were presented and discussed.

This limited mimeographed edition includes all of the papers prepared for the conference. Only minor revisions have been made so that they could be made available to those interested without delay.

The seminar held this year represents the third in a series of jointly sponsored conferences in economics held in Los Baños over the past few years. The first, entitled "Savings and Capital Accumulation in Philippine Agriculture," was held on April 24-25, 1964, and the papers published as a special edition of the Philippine Economic Journal. The second, "Growth of Output in the Philippines," was held on December 9-10, 1966. The papers were also reproduced in mimeographed form in a single volume.

These three seminar-workshops have served as an excellent forum for discussing and making available current research findings in economics. It is our hope that such conferences can be continued on an annual basis in the future.

Emilio U. Quintana
For the U.P. College of Agriculture

Randolph Barker
For The International Rice Research Institute

INTRODUCTION

This seminar on the economics of rice production has been held at a time of rapid development in Philippine rice farming. The introduction of new rice varieties has triggered a number of changes in the use of inputs and in management practices.

The initial conference paper by R. Barker and E. U. Quintana presents several budgets based on farm survey data which compare costs and returns using traditional and improved varieties and practices. One striking conclusion is that farmers who have adopted IR8 have adopted not a variety, but a whole package of new practices including a tripling or quadrupling of cash inputs.

The next four papers in the conference deals with the various physical inputs, fertilizer and chemicals, mechanization, irrigation, and seeds. The economic analysis of experimental results reported by S. K. De Datta and R. Barker shows that the input levels associated with maximum yields obtained for IR8 are uneconomical. The paper reports on research to determine optimum economic input levels not only for fertilizer but for other factors as well.

Studies in rice farm mechanization are being conducted by the U.P. College of Agriculture and The International Rice Research Institute. The Institute research is part of broad program covering both the economics and design engineering phases of mechanization. The paper by S. S. Johnson, E. U. Quintana, and L. Johnson reports on the surveys undertaken to obtain basic information and identify problems in this area.

Leon Mears compares the profitability of low-lift vs tube wells using three measures: (1) benefit-cost ratio, (2) internal rate of return, and (3) present values per unit of original investment. The analysis shows that the new fertilizer-responsive varieties of rice combined with the "package" of inputs will greatly increase the profitability of irrigation.

The speed with which IR8 has spread at the farm level was possible only because of the rapid seed multiplication program of the Philippine government's Rice and Corn Production Coordinating Council. T. V. Mina and F. A. Tiongson describe seed multiplication and distribution under the old and the new government programs.

The next three studies are concerned with rice farming from a business and management viewpoint. R. Z. Sorenson and E. L. Felton, Jr. use the case study approach to bring to light the key economic problems faced by a firm that is selling IR8 palay seed and discovers: (a) that it is not marketing merely seeds but a whole new process of farming and (b) that its major competition is the government.

C. Dimaano and A. M. de Guzman report on their experience of bringing about change in the barrio. They served in the program of the Farm and Home Development Office (FHDO) at the U.P. College of Agriculture. As such, they themselves provided a source of management input which allowed local farmers to increase production and income.

Another source of management services are the newly formed consulting firms. The operation of these firms is described in detail by J. D. Drilon, Jr.

The concluding conference paper deals with the role of institutions in increasing rice production. A. M. Weisblat and P. R. Sandoval point initially to the positive role that government can have in creating the proper environment for increased agricultural production. However, they also point out that the new technology may lead to an even wider disparity in incomes between progressive farmers with good resources and the majority of near subsistence farmers.

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FARM MANAGEMENT STUDIES OF COSTS AND RETURNS IN RICE PRODUCTION

Randolph Barker and E. U. Quintana

FARM MANAGEMENT STUDIES OF COSTS AND RETURNS IN RICE PRODUCTION

Randolph Barker and E. U. Quintana[1]

1.0. INTRODUCTION

The profitability of rice production is a subject of interest to a wide range of people. Costs and returns influence the decisions of: (1) farmers who grow the rice, (2) businessmen who manufacture and distribute fertilizer and other inputs, (3) bankers who loan money to rice farmers, (4) government officials who administer the rice production programs, (5) politicians who solicit the vote of both producers and consumers. Unfortunately, however, there is no one measure of profitability that will serve all interest groups on all purposes. The appropriate measure of profit will depend on the particular interest and objectives of the individual. The farmer may be most concerned about cash or "out of pocket" costs. However, a tenant and leaseholder will not view costs in the same manner since they will share difficulty in the profits.

1/ Agricultural Economist, International Rice Research Institute, and Chairman, Department of Agricultural Economics, U.P. College of Agriculture. The authors would like to acknowledge the assistance of Mrs. Nelly Fortuna and Mr. Eusebio Mariano, Research Assistants, Department of Agricultural Economics, UPCA, who worked with the farm management record keeping project; Miss Violeta Cordova, Research Assistant. Mr. Sheng-hui Liao, Research Scholar, Mr. Arkom Soothiphan, Former Research Scholar, Mr. Ernesto Venegas, Former Research Assistant, Department of Agricultural Economics, IRRI, who collected and analyzed much of the data for IRRI, and finally the Agricultural Development Council of Rizal who kindly supplied the data from their surveys.

While farmers are concerned principally with returns above cash costs, administrators and politicians are more apt to consider the full cost of production (including a charge for fixed cost of production such as land and family labor). Thus full cost of production usually will include a "normal rate of profit" for fixed resources (e.g. labor may be charged at minimum wage rate - ₱3.50 and capital an institutional low rate - 12% per annum). The economist has yet another way of viewing costs and returns. He may compute the "marginal value productivity" of a resource of the "opportunity cost" associated with the addition (or subtraction) of one more unit of a resource such as fertilizer. From this type of analysis it can be determined whether or not resources are being optimally allocated.

The discussion in this paper will focus on those measures of profitability which are of most concern to the producer. The empirical results are presented in three sections. In the first of these three sections, results are based upon the farm record keeping system of the U.P. College of Agriculture. This is followed by an analysis of budgeted farm costs and returns based on data from a survey in Central Luzon. The final section reports the results of three recent cost of production studies in rice. Comparisons are made between costs and returns in producing traditional and improved rice varieties. Before proceeding to the empirical data, it is necessary to describe in more detail procedures used in estimating costs and returns. These procedures are discussed in the section which follows.

2.0. PROCEDURES USED IN ESTIMATING COSTS AND RETURNS

There are two basic procedures used to obtain estimates of profitability: (1) collect and average individual farm records, or (2) based on farm records or surveys and other data sources, prepare budgets. In both the farm record keeping and the budgeting techniques (which will be described in more detail subsequently), it is useful to follow a system for classification of costs. This system makes it easier to understand the basic cost structure and to make adjustments in the data if measures of profit other than those provided are desired.

2.1. Classification of costs

Costs may be classified into four major categories: fixed, variable, cash, and non-cash, as shown in Table 1. The table also indicates how costs are normally shared between tenant and landlord in a 50:50 share rent.

Fixed costs are those costs incurred whether or not production takes place. On an annual basis, the fixed costs in rice production would include; land tax, government irrigation fee, and depreciation and interest charges on such equipment as tractor or irrigation pump, and the maintenance cost for a carabao.

Variable cost are those which vary with the quantity of production. Land rent is a variable cost if, as in a share management, more production means a larger payment in kind to the landlord. Seed, fertilizer, and insecticides are all variable costs. Two hectares of land will require twice as much

TABLE 1. Rice production costs - variable and fixed, cash and non-cash.[a/]

Cost Item	50/50 share b/ Landlord	Tenant
Variable Costs		
Cash or kind		
Seed	50	50
Fertilizer	50	50
Insecticide and herbicide	100	0
Hired labor and equipment c/		
Land preparation	0	100
Transplanting	100	0
Care of crop-weeding	0	100
Harvesting and threshing	50	50
Hauling	50	50
Sacks	50	50
Non-cash costs		
Family labor		
Land preparation	0	100
Transplanting	100	0
Care of crop-weeding	0	100
Harvesting and threshing	50	50
Hauling	50	50
Fixed Costs		
Cash		
Irrigation fee	50	50
Land tax	100	0
Non-cash		
Care of carabao	0	100

a/ The itemization of costs does not include interest and depreciation charges which are borne by the persons partly owning the capital or borrowing money.

b/ Breakdown of sharing costs most commonly found in 50/50 share rental based on survey of 91 50/50 share lease farms in Central Luzon, 1965. E.A. Bernal, Unpublished Master's thesis, Department of Agricultural Economics, U.P. College of Agriculture, 1967.

c/ Include custom contracts and "in kind" sharing arrangements.

of these inputs as one hectare. Hired labor, also, is a variable cost. The total supply of family labor available on a given farm, however, is fixed. Other variable costs would include harvesting and threshing (normally contracted on a share basis), operating costs for equipment such as tractor, pump, and pest control (rats and birds).

Table 1 indicates the breakdown between fixed and variable costs. This division is convenient because it separates those costs that are likely to change from those that will remain constant regardless of the cultivation practices followed.

The division between cash and non-cash costs is particularly important for the individual producer. Cash is the item that most farmers lack, particularly before planting. It is often necessary to borrow money to obtain the cash needed for crop production. On the other hand, costs paid in kind are normally paid at the time of harvest. Interest on operating capital is a non-cash cost if the capital does not have to be borrowed. However, interest paid to a bank, money lender or landlord is a payment in cash or in kind as the case may be. Likewise, the operator's labor and family labor are non-cash costs, but hired labor is paid either in cash or in kind.

To remain in business in the short-run, a farmer must be able to earn enough from the sale of rice to cover his costs in cash and in kind. A farmer considering the adoption of an improved variety, such as IR8, will be most concerned about the additional cash expenses needed to obtain the higher yield. The higher the cash expenses, the greater the potential profit, and the greater the potential loss in the event of a crop failure. Small farmers will hesitate to take this risk, since the consequences of a loss are severe. It is therefore natural to expect that the larger farms will be the first to adopt the improved varieties and improved cultural practices.

Another important factor is the degree to which care of the improved cultural practices requires more physical labor. For the small farm relying on family labor, this means more work. For the large farm a higher labor requirement means higner cash costs.

2.2. Farm record keeping vs budgeting

Two procedures are commonly used in computing farm costs and returns. What we refer to as _farm record keeping_ involves three steps: (1) collection of records, (2) averaging of expenses item by item, and (3) adding the results to obtain the desired measure of profit.

One of the most comprehensive studies of the farm cost of producing palay was completed by Quintana, _et al._ in 1954-55.[2/] A survey was conducted to obtain farm records from 1,513 lowland tenant farmers in 15 provinces of the Philippines. While the cost estimate are long since out of date, the study still provides some interesting insights with respect to the variability in cost of rice production by region. The differences in costs from region to region were due more to differences in land and labor values than any other single factors.

2/ E. U. Quintana, J. C. Sta. Iglesia and H. von Oppenfeld, "The Farmers Cost of Producing Palay," _The Philippine Agriculturist_, Vol. XL, No. 8, January 1957.

<u>Budgeting</u> is frequently used when the primary objective of the analysis is to make comparisons between specified cultural practices or systems of farming. Budgets are also used in the absence of reliable farm survey data. For example, budgets were prepared at IRRI showing the estimated costs and returns from growing IR8 before farm survey data were available. Information for these budgets were based upon: (1) previous knowledge of typical practices and cost requirements (e.g. land preparation where recommendations are the same for traditional and improved varieties), (2) estimated costs for new practices and additional input requirements (e.g. seed, fertilizer, and insecticide), and (3) estimates of associated yield response and returns. Since farm results were not available, experimental results and judgment of individuals formed the basis for the original budget estimates.

When budgets are used to make comparisons between farming methods or systems, the budgeting procedure can be likened in some respects to the experimental procedure of the physical and biological scientists. The majority of costs and prices are standardized between systems. Only the factors which differ due to the differences in systems are permitted to vary.

An illustration is needed to clarify this point. Assume that the objective is to compare costs and returns for irrigated vs non-irrigated farms. The comparison could be made by averaging farm records from two separate barrios, one irrigated, the other non-irrigated. However, the barrios may differ not only with respect to irrigation, but farm size, soil type and many other factors. Thus, the factors explaining differences in returns between the two situations become confounded. It is not clear how much of the difference in income is due to difference in irrigation, and how much to difference in other factors. Using the budgeting procedure typical farms are synthesized one for each situation, eliminating differences due to other factors. The differences in income are attributed only to differences in availability of irrigation.

In summary, the budgeting procedure involves three steps: (1) collection of data from various sources including farm surveys and experimental results, (2) construction of farm budgets, and (3) the adding of expenses to obtain the desired measure of profit.

3.0. FARM RECORD KEEPING ANALYSIS: CASE STUDIES IN COSTS AND RETURNS OF SELECTED RICE FARMERS IN LAGUNA, 1964-1967

From an economist's point of view, the most important objective of farm record-keeping is to appraise the financial position of the farm business in order to determine its strong and weak points during a given period. Thus, providing a basis of farm reorganization and planning for higher efficiency and maximum profit.

Specifically, records kept on the farm provide basic information which aid the farmer in (1) adjusting farm practices such as kinds, rate and method of fertilizer application, whether or not to spray or attempt other methods of controlling diseases, decide whether it is more profitable to purchase more expensive improved seeds or to continue using the traditional variety which is less expensive and decide whether it is more profitable to sell his crop immediately after harvest or hold it for a higher price,

(2) selecting farm enterprise, a decision which must be made every year. Selection may either be done (a) haphazardly (guesswork) or (b) intelligently, using his data and experiences as indicated by his records and accounts, (3) determining the best use and allocation of resources, and (4) obtaining loans from lending institutions for productive purposes.

While farm record-keeping schemes have been able to attain the above objectives in many developed countries, it has not yet gained acceptance and popularity in the Philippines.

To assess the desirability and applicability of this scheme, a record-keeping project was initiated in 1962 by researchers in the Department of Agricultural Economics, College of Agriculture in the provinces of Laguna and Batangas among lowland and upland rice farmers. The initial operation was greatly facilitated when the Pilot Study in Farm and Home Development of the Department was elevated the Farm and Home Development Office. Some of the original cooperators were willing to continue the working arrangement and expand the program to a more complete recording of operations. Additional farmers, however, were taken as cooperators in order to obtain more comparable data.

Farmers were selected from the pilot barrios and other areas on the basis of their (a) willingness to cooperate and ability to keep records (b) stability of their farm businesses, and (c) representativeness of enterprise in the area. More emphasis was placed on the first criterion because this project involves recording of all farm operations, hence, requires understanding and patience on the part of the farmer and his family. Without the competence and willingness of the farmer to cooperate, data gathered would not be useful and meaningful.

All selected cooperators are given simplified farm record books developed in the Department. Verbal instructions on how to enter farm operations, in addition to sample entries, are also given in order to show the mechanics of recording. Weekly visits are made to verify the accuracy of records, measured areas planted to particular crops, and discussed with the farmer and his family problems encountered in recording and operating their farms. When the researcher and the farmer can not arrive at satisfactory solutions, problems are referred to College Specialists for a more thorough study. Recommendations evolved by specialists and researchers are given to the farmer during the succeeding visits.

In addition to the assistance in record-keeping scheme, technical information such as prices, best source of farm supplies, and new technology are made available to the farmer.

At the end of each harvest season, data collected from cooperators are analyzed in the Department. Costs and returns in rice production and the different measures of profits appropriate to the different types of farms studied are determined for the production period. Results of the analyses are taken back to the farmer for on-the-spot discussions. Strong and weak points are pointed out and used as benchmark for determining adjustments to be made during the next planting season.

As data on several types of lowland rice farms have already been gathered for the past five crop years, 1962-63 to 1966-67, an attempt will be made to assess the impact and tangible effects of new technology on earning capacity of the different resources used on these farms and the changes that have taken place, particularly costs, returns, profits and other measures or criteria relevant to the economics of rice production.

3.1. Case Study I. - Before and After Masagana (Straight-Row) Method of Planting in Seven Rainfed Lowland Rice Farms, Laguna, 1964-1966.

During the 1965-66 crop year, seven cooperating farmers who were formerly employing the traditional or ordinary way of transplanting rice, shifted to the Masagana method. The Masagana method is a one-way-straight-row planting about 25 centimeters between rows and 18 to 25 centimeters between hills. While the ordinary method transplanting the seedlings about 15 to 25 cm both ways, without any pattern does not allow the effective use of the rotary weeder, the straight-row method will.

Data were collected from both methods to be able to compare costs and returns and basic input-output relationships resulting from the adjustments. An analysis of the second year of operation under the new method may further bring out and/or confirm the changes in relationships.

Results from this case study revealed the following significant changes: Yield increased about 30 percent, from 55 cavans in 1964-65 to 77 cavans in 1965-66 (Table 2). The increase in yield may not be entirely due to the efficiency of the new method but probably the combined effects of improved

TABLE 2. Costs and returns of producing rice per hectare, Masagana vs Ordinary method of transplanting, Laguna, 1964-66.

Item	Method of transplanting	
	Ordinary	Masagana
Crop year	1964-65	1965-66
Number of farms	7	7
Area per farm (ha)	0.82	0.82
Production per hectare	55	77
Total man-days per hectare	75	86
Man-days for transplanting alone	16	9
	(pesos per ha)	
Cash Cost		
Custom work a/	64.85	48.46
Food	25.63	19.83
Total cash cost	90.48	68.29
Non-cash cost		
Landlord's share b/	316.58	413.11
Harvester's share	155.63	219.48
Seed	33.83	24.44
Unpaid labor c/	107.28	105.99
Hired labor in kind	23.55	67.98
Interest	40.79	43.13
Depreciation	7.22	9.22
Total non-cash cost	684.88	883.35
Total Cost	775.36	951.64
Total Returns	931.52	1321.64
Net Return (TR-TC)	156.16	370.00

a/ Includes pulling, hauling and transplanting seedlings.

b/ Landlord's share is the net share for land alone. All cash expenses shouldered by the landlord are deducted from the gross share of the landlord.

c/ Unpaid labor includes family, exchange and operator's labor and is valued on actual days of labor input at the wage rate of ₱3.00.

Other features of the farms studied:

1. No fertilization.
2. No application of plant protection chemicals.
3. Rainfed (no artificial irrigation) one crop a year.
4. The same variety planted (Wagwag)
5. Price per cavan of palay almost the same in both periods.

farm practices.

Although the farmers had difficulty in introducing the method due to the lack of skilled rice planters in the area, the researchers facilitated the hiring of skilled laborers from nearby towns where the method had already been introduced earlier and accepted by organized planters.

The new method of planting reduced man labor days per hectare by about 50%. This reduction, however, was offset by the increase in labor employed in operations that accompanied the new method of planting, like weeding and harvesting. Total labor inputs increased 11 man-days (from 75 man-days per hectare in the traditional to 86 man-days in the new method).

Although fertilizer has been one of the most important yield-increasing inputs in rice production it is significant to note that the increase in yield was achieved under improved farm practices other than the use of fertilizer, plant protection chemicals, improved variety and gravity irrigation system. The prices received by farmers for Wagwag variety in the area also remained the same during the two crop years. Under a condition where farmers cannot afford to pay for all the costs of a package of improved technology in rice production, yields can still be maximized if the right kind of yield-increasing practices are employed. This, coupled with a reduction in costs as a result of more efficient combination and utilization of labor and other inputs can bring about substantial increases in profits. For example, cash cost per hectare declined by about 25 percent due to the reduction in the number of planters employed in the new method. The amount of seeds used also decreased by about the same percentage because in Masagana, the rate of seeding is only 1.5 cavans to a hectare while that of the traditional, 2 cavans. Non-cash costs, however, increased from ₱685 to ₱883 per hectare due to the increased use of labor in new yield-increasing practices. With a substantial increase in yield, landlord's and harvester-thresher's shares also increased proportionally.

While total cost increased by 18 percent, total return also increased by 30 percent. Net return per hectare increased from ₱156 to ₱370.

3.2. Case II. - Costs and Returns of Producing Traditional and Improved Varieties of Rice, Laguna, 1965-67

To assess the desirability of introducing improved varieties in rice areas where farmers have been planting the traditional varieties, records kept by farmers before and after shifting to improved varieties in Lumban, Laguna from 1965 to 1967 crop years are being compared. Table 3 shows that when the two farmers shifted from Peta (a high-yielding traditional variety) to IR8, yield increased by 37 percent. All improved practices except higher application of N fertilizer, insecticides and labor for more weeding remained the same during the period. Although yield increased by 37 percent, total returns increased by 55 percent because there was a 15 percent increase in the price of palay. While total costs increased by 50 percent due to substantial increases in costs of fertilizer, insecticides, seeds, labor, landlord's share and harvester's share, the combined effects of yield increase and rice in price of the product was reflected in a large increase in net return per hectare

TABLE 3. Costs and returns of producing traditional and improved varieties of rice, Laguna, 1965-67.

Item	Variety: Traditional	Variety: Improved
Variety	Peta	IR8
Crop year	1965-66	1966-67
Season	Dry	Dry
Number of farms	2	2
Area per farm (ha)	1.96	1.96
Total man-days per hectare	62.00	89.00
Rate of seeding (cav/ha)	1.78	1.78
Kg N per ha [a]	13.21	74.92
Production per hectare	82.40	112.55
Price per cavan (output	15.85	18.25
	(pesos per ha)	
Cash cost		
Custom work	23.47	37.50
Hired labor: Man	29.34	47.19
Tractor	-	19.13
Food	13.90	32.56
Fertilizer	20.46	99.23
Insecticides and weedicides	1.12	45.66
Fuel and oil	6.12	9.57
Seeds bought	9.69	44.64
Hauling and transport	16.43	37.04
Irrigation fee	6.00	6.00
Total Cash Cost	126.53	378.52
Non-Cash Cost		
Landlord's share [b]	413.20	539.67
Harvesters-threshers' share	215.49	340.28
Seeds (other than bought)	16.53	-
Unpaid labor [c]	48.60	56.34
Hired labor in kind: Man	40.43	23.21
Tractor	19.77	-
Interest and depreciation	9.12	23.42
Total Non-Cash Cost	763.14	982.92

Table 3 (cont'd)

Item	Variety	
	Traditional	Improved
Total Cost	889.67	1361.44
Total Returns	1312.74	2051.12
Net Returns (TR-TC)	423.07	689.68

a/ Primarily from ammonium sulfate, urea and complete (12-24-12) fertilizer.

b/ Landlord's share is the net share for land alone. All cash expenses shouldered by the landlord were deducted from the gross share of the landlord.

c/ Unpaid labor includes family, exchange, and operator labor and is valued on actual days of labor input at the wage rate of ₱3.00.

(63 percent). Table 4 also demonstrates the advantage of shifting from traditional to improved variety. When a farmer in Pila, Laguna shifted from Peta to C-18 (using similar practices) yield also increased by 20 percent. While increase in yield is only 20 percent, total returns increased by 63 percent because of an increase in the price of palay. This, coupled with a relatively lower increase in total costs brought about a 76 percent in net return.

The substantial yield difference between the traditional and the improved variety may have been obtained not only by the change in variety but also by the introduction of other improved farm practices. It must be recognized, however, that yield increase is forthcoming only if the farm practices required of the improved variety is also employed.

3.3. Case III. - Comparison of costs, returns and profits, before and after irrigation, 1965-66

"Improved water management including irrigation and drainage practices can probably do more towards increasing food supplies and agricultural income in the irrigated areas of the world than any other agricultural practice."[3] It serves as a limiting factor to the other factor inputs such as fertilizers, pesticides, farm machinery and equipment and other cultural practices. Although it is true that water can be provided by rain, it is to a great extent extremely unpredictable as to its occurrence and the volume of water it will bring. To be of productive use, water must be supplied to the plants at the

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3/ C. E. Houston, Recommendations for Improved Water Management Programs, FAO, Rome, unnumbered mimeo (1962).

TABLE 4. Costs and returns of producing traditional and improved varieties of rice, Laguna, 1965-67.

Item	Variety: Traditional	Variety: Improved
Variety	Peta	C-18
Crop year	1965-66	1966-67
Season	Dry	Dry
Number of farms	1	1
Area per farm (ha)	1.21	1.21
Total man-days per ha	48.00	79.00
Rate of seeding (cav/ha)	0.83	0.83
Kg N per ha [a]	15.62	15.62
Production per hectare	74.38	90.24
Price per cavan (output)	15.50	21.00
	(pesos per ha)	
Cash Cost		
Custom work	17.36	20.25
Hired labor	37.60	80.16
Food	14.05	36.36
Fertilizer	24.79	26.45
Insecticides and weedicides	-	3.47
Fuel and oil	17.36	19.83
Seeds bought	15.70	20.66
Hauling and transport	37.19	59.50
Irrigation fee	6.00	6.00
Total Cash Cost	170.05	272.68
Non-Cash Cost		
Landlords' share [b]	256.20	347.11
Harvesters-threshers' share	192.15	315.87
Seeds (other than bought)	12.81	-
Unpaid labor [c]	34.09	70.04
Hired labor in kind	-	17.36
Interest and depreciation	12.88	33.05
Total Non-Cash Cost	508.13	783.43

Item	Variety	
	Traditional	Improved
Total Cost	678.18	1056.11
Total Returns	1152.89	1895.21
Net return (TR-TC)	474.71	839.10

a/ Primarily from ammonium sulfate, urea and complete (12-24-12) fertilizer.

b/ Landlords' share is the net share for land alone. All cash expenses shouldered by the landlord were deducted from the gross share of the landlord.

c/ Unpaid labor includes family, exchange, and operator labor and is valued on actual days of labor input at the wage rate of ₱3.00.

right time in the right quantity in relation to the agronomic requirements of a given rice variety.

There are some irrigation schemes in the Philippines that failed to increase yields of farms served not only because of technical problems created by lack of water supply and inefficient distribution systems, but also due to inefficient use of irrigation water and cultural practices. Yield response to quantity and quality of irrigation vary widely because irrigation needs, and practices also vary from area to area and even from farm to farm.

While the potential contribution of irrigation on yield of rice in the Philippines has long been recognized by farmers, technicians, policy-makers and even by politicians, the magnitudes of their contributions have not been quantified yet. Because data recorded on this aspect of rice production were taken from only one farm before and after the establishment of the irrigation system, quantification of returns to each factor input employed is not considered in this analysis. However, an attempt is made here to determine productivity differentials between rainfed and gravity irrigated farms.

Table 5 demonstrates the function of irrigation in the introduction of improved cultural practices. In this particular farm, the farmer introduced the new and improved method of growing seedlings (dapog), shifted from Masagana to Margate method of planting for more effective control of weeds with the use of rotary weeder, advanced month of planting from September to July, increased levels of purchaseable inputs (fertilizers, pesticides and improved seeds) and more hired labor.

TABLE 5. Comparison of costs and returns before and after irrigation, 1965-67, Laguna.

Item	Before irrigation (rain)	After irrigation (gravity)
Variety	Wagwag	IR8
Crop year	1965-66	1966-67
Number of farms	1	1
Area (ha)	0.71	0.71
Method of growing seedlings	Wet bed	Dapog
Method of planting	Masagana	Margate
Planting months	September	July
Rate of seeding	1.50	1.50
Total man-days per ha	92.96	104.22
Production per hectare (cav)	47.32	90.85
Price per cavan	20	14
	(pesos per ha)	
Cash Cost		
Custom work	56.48	44.51
Hired man labor	-	76.06
Hired tractor	-	64.79
Fertilizer	-	21.13
Farm chemicals	-	3.52
Seeds	-	32.39
Food	14.08	7.04
Irrigation fee [a]	-	25.00
Total Cash Cost	70.56	274.44
Non-Cash Cost		
Leasor's share [b]	281.69	98.59
Harvesters' share	157.75	246.48
Seeds	28.17	-
Hired labor in kind	-	39.44
Unpaid labor (OFE) [c]	240.84	76.06
Interest and depreciation	38.83	19.30
Total Non-Cash Cost	747.28	479.87

Item	Before irrigation (rain)	After irrigation (gravity)
Total Cost	817.84	754.31
Total Returns	946.40	1271.90
Net return (TR-TC)	128.56	517.59

a/ ₱25.00 is paid during the wet season and ₱35.00 during the dry season.

b/ Tenant shoulders all expenses under the leasehold system. Half of the lease was paid from first season crop and the other half from the second crop.

c/ Unpaid labor includes family, exchange and operator's labor and was valued on actual days of labor input at the wage rate of ₱3.00.

While cash costs per hectare increased by ₱204, non-cash costs however, decreased by ₱267.41. The reluctance of many farmers to adopt improved practices have been due largely to increased financial requirements. This is borne out by the experience of this farmer. This farmer, however, managed to reduce his total cost.

The decline in the price from ₱20 to ₱14 per cavan was more than offset by the increase in yield from 47 to 91 cavans per hectare. The combined effects of a yield increase and a reduction in cost resulted in a large increase in net return (from ₱128 to ₱518 per hectare). With irrigation water available during the dry season, the farmer was able to plant a second rice crop. With high yield potentials, as shown by results of studies of farms in Laguna with similar types of irrigation systems, will further maximize returns to land, labor and other resources which would otherwise be idle during the period.

The dramatic increases in both yield and net gain were obtained under conditions of efficient utilization of improved farm practices. The experiences gained on this farm may be used as rational basis for evaluating the potentials of irrigation, fertilization and other improved cultural practices when adjusted carefully to local conditions. More data should be collected on this farm, adjoining farms and farms in other areas with similar conditions to assess further the potential contributions of each factor input in rice production.

4.0. BUDGETED RESULTS OF COSTS AND RETURNS UNDER VARYING RESOURCE PATTERNS

Budgeting is frequently used when the purpose is to make comparisons between different systems of farming. The objective of the analysis presented in this section is to show the differences in returns for rice farming under several different resource situations. This study of income potential for lowland rice farms under different technologies and resource situations was conducted in 1966.[4/]

4.1. Procedure

The first step was to decide on the specific farm budget situations to include in the analysis. Three major factors affecting farm income are: (1) farm size, (2) irrigation facilities, and (3) level of technology. The 1960 Census of the Philippines indicates that the average size rice farm is about 3 hectares. Approximately 92.5 percent of the rice farms fall in the size range 1 to 5 hectares. Thus, 2 and 4 hectares farms were chosen as being typical sizes. The 1965/66 figures of the Bureau of Agricultural Economics, DANR, show that approximately 1/3 of the lowland first crop rice is irrigated. Of this irrigated portion 40 percent is double cropped. The farm resource

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4/ A. Soothiphan, "Income Ceilings Under Alternative Rice Production Technologies: Southeast Asia," M.S. thesis, Department of Agricultural Economics, U.P. College of Agriculture, Sept. 1966 (unpubl.).

situations chosen for budgeting were as follows: (1) 2-hectare rainfed, (2) 4-hectare rainfed, (3) 2-hectare irrigated, and (4) 4-hectare irrigated.

Using this resource structure as a guide, a farm survey was conducted in Central Luzon. Sixty-one farms were surveyed in total to obtain basic information regarding costs, resource use, and production for each of the four categories.[5] Budgets were then constructed for each of the four categories based on current levels of performance. Budgets were also prepared for double cropped irrigation.

Most rice farm operators are endowed with certain fixed resources over which they have little or no control such as land, water resources, and family labor supply. These fixed resources impose a potential limit on profits. There appears to be relatively little potential for increased profits through the reallocation of existing resources on the farm.[6] However, potential does exist for increasing income through multiple cropping and through improved

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5/ Of course, it was not possible to choose farms exactly 2 or 4 hectares in size. The range was maintained at one-fifth of a hectare above and below the estimated 2 and 4 hectare farm size. Thus, a surveyed 2-hectare farm would have an actual cultivated area of anywhere from 1.8 to 2.0 hectares.

6/ See R. Barker and A. Soothiphan, "Economic Efficiency in Agriculture," paper presented at First Regional Farm Management Seminar, Eastern Visayas, March 13-15, 1967.

technology.

Budgets were prepared to show income potential under improved technology. The improved technology considered included the improved rice varieties. Since data was not available regarding the performance of these varieties in the field, it was necessary to rely on results obtained from experiments at the International Rice Research Institute as a major source of data. Experimental farm performance was discounted to more nearly approximate farm level performance.[8/]

4.2. Results

The results of the budgeting are shown in Table 6. The income measurement used is return to land, operator, and family labor. These are the resources considered to be fixed on the majority of farms.

7/ Multiple cropping is not analyzed here. For a discussion of this subject see E. A. Bernal, *et al.*, "Unit Requirements, Costs, and Returns for Producing Palay and Secondary Crops in Central Luzon, 1962-63," *Philippine Agriculturist*, Vol. XLVIII, No. 45, Sept.-Oct., 1964, pp. 203-232. See also R. Barker, A. Soothiphan and V. Cordova, "Farm Returns Under Varying Resources and Cropping Patterns in Rice," paper presented at First Regional Farm Management Seminar, Cebu City, March 13-15, 1967 (unpubl.).

8/ Discounting procedures were very crude but have proved on the basis of subsequent information to be reasonably realistic. The Bureau of Soils conducted on farmers fields was taken as the farm standard for BPI-761. This yield was found to be 16 percent below IRRI at 30 kg on nitrogen. At the time of the study information was not yet available on IR8. Taichung Native 1 and IR9-60 were giving approximately the same response. Yields of Taichung (N) 1 were discounted by 16 percent assuming 60 kg on fertilizer during the wet season and 90 kg of fertilizer during the dry season.

TABLE 6. Return to land, operator, and family labor by type and size of rice producing farms using current and improved levels of technology, Central Luzon, 1964/66. a/

Type and size	Current level: Single-cropped (pesos)	Current level: Double-cropped (pesos)	Improved level b/: Single-cropped (pesos)	Improved level b/: Double-cropped (pesos)
Irrigated				
2 ha	1,053 (2.3) c/	1,665 (1.8)	2,317 (5.5)	5,394 (6.4)
4 ha	1,513 (1.9)	2,398 (1.4)	3,405 (4.5)	8,447 (5.4)
Rainfed				
2 ha	827 (1.9)		1,685 (3.4)	
4 ha	1,061 (1.5)		2,414 (2.6)	

a/ Based on rice price of ₱16.56/cav of 44 kg.

b/ Assumes: (1) adequately irrigated, (2) increased levels of fertilizer, weed and insect control, (3) short-stemmed varieties such as IR8 in irrigated areas, and improved local varieties such as BPI-76 in rainfed areas.

c/ Yield in mt/ha of rough rice.

Table 6 is arranged as follows. Current level returns are shown at the left. Returns for improved varieties and practices are shown at the right. Differences in returns are due principally to differences in yield (shown in parentheses below each return). In the case of double cropped paddy the return is for both crops but yield is for the dry season crop only.

The figures in Table 6 provide a rough guide regarding income potential under the specified conditions. It is apparent that all farms are in a position to substantially improve income levels by adopting improved varieties and practices. Double crop farms if properly irrigated in the dry season are in position to make the largest gains.

These same results can be modified to compare labor productivity. Farm incomes in Table 7 are expressed in terms of return per worker. To compute this value, first a 50 percent share rent was subtracted from the returns in Table 6 as payment for the use of land. Then the remainder was divided by the number of workers employed. The survey indicated 3.3 laborers on the 2 hectare farm and 3.9 on the 4 hectare farm. To provide a measure of comparison, the minimum agricultural wage in the Philippines is ₱3.50 or U.S. $.90 per day which is equivalent to ₱1,050 (U.S. $270) per year (300 days). Only returns on the 4 hectare irrigated farm approach this minimum wage. The labor productivity of most rice farmers is well below the minimum wage. Adoption of new technology will reduce but not eliminate the gap.

TABLE 7. Return per farm worker on tenant-operated farms in Central Luzon using current and improved levels of technology, 1964/66. a/

Type and size	Current level		Improved level b/	
	Single-cropped (pesos)	Double-cropped (pesos)	Single-cropped (pesos)	Double-cropped (pesos)
Irrigated				
2 ha	160	252	351	817
4 ha	194	307	437	1083
Rainfed				
2 ha	106		255	
4 ha	136		309	

a/ Assumed a 50/50 share in returns and variable costs. One-half of return to land and labor in Table 6 divided by 3.3 farm laborers on 2-ha farms and 3.9 farm laborers on 4-ha farms.

b/ See footnotes of Table 6.

The budgets presented in this study provide some insights regarding income potential for Philippine rice farms. As with most budgets, the coefficients used in many cases represent the best judgment of the research worker. Even the definition of "irrigated" and "rainfed" is extremely subjective. There are, for example, some rainfed areas with an adequate rainfall pattern which consistently outyield other poorly irrigated areas.

5.0. PROFITABILITY OF TRADITIONAL AND IMPROVED RICE VARIETIES

This section reports the results of four different studies designed to compare the profitability of rice production using traditional and improved varieties and cultural practices. The studies are:

(1) Budgets based on yields of seed production farms in Baliuag, Bulacan, 1965-66 and 1966-67 wet season,

(2) A survey of farms in Pampanga and Bataan, 1966 wet and 1967 dry season,

(3) Surveys of farms in Rizal province, 1966 and 1967 dry seasons, 1966 wet season,

(4) A survey of farms in Laguna, 1966 and 1967 wet seasons.

Taken together, these studies provide a core of basic information regarding the changes that have been taking place in rice production with the introduction of improved varieties.

5.1. Budgeted costs and returns based upon yields of seed production farms at Baliuag, Bulacan

The Sino-Philippine Rice Production and Extension Project, covering the entire municipality of Baliuag, Bulacan, was initiated in September 1966. Fig. 1 is a chart reproduced from the published report of this project.[9] The figure shows a comparison of yields for the seasons October to February 1965-66 and 1966-67. Classification of yield performance has been made by category of farm and by variety both before and after the start of the project. Unfortunately, IR8 and BPI-76 seeds were not available for all categories of farms in the seasons reported. In the project report, budgets of costs and returns were prepared for the "variety demonstration farms." However, these demonstration plots consist of only 1,500 sq meters (less than 1/6 hectare). For this reason, we prepared separate budget estimates using the yield comparisons of the seed production farms and the cost information available from Baliuag and other sources.

The budgets are shown in Table 8. From the point of view of the producer, the most useful measure of profit is the net return after payment of cash crop and harvest costs. (The only cash cost missing is for labor.) This return is ₱630 for Intan, using traditional practices, ₱785 for BPI-76, with improved practices, and ₱1,130 for IR8, with improved practices.

9/ See Baliuag Rice Production and Extension Project, "The Development of a Pilot Rice Production Demonstration Center in Baliuag, Bulacan," Baliuag Press, Baliuag, Bulacan, 1967.

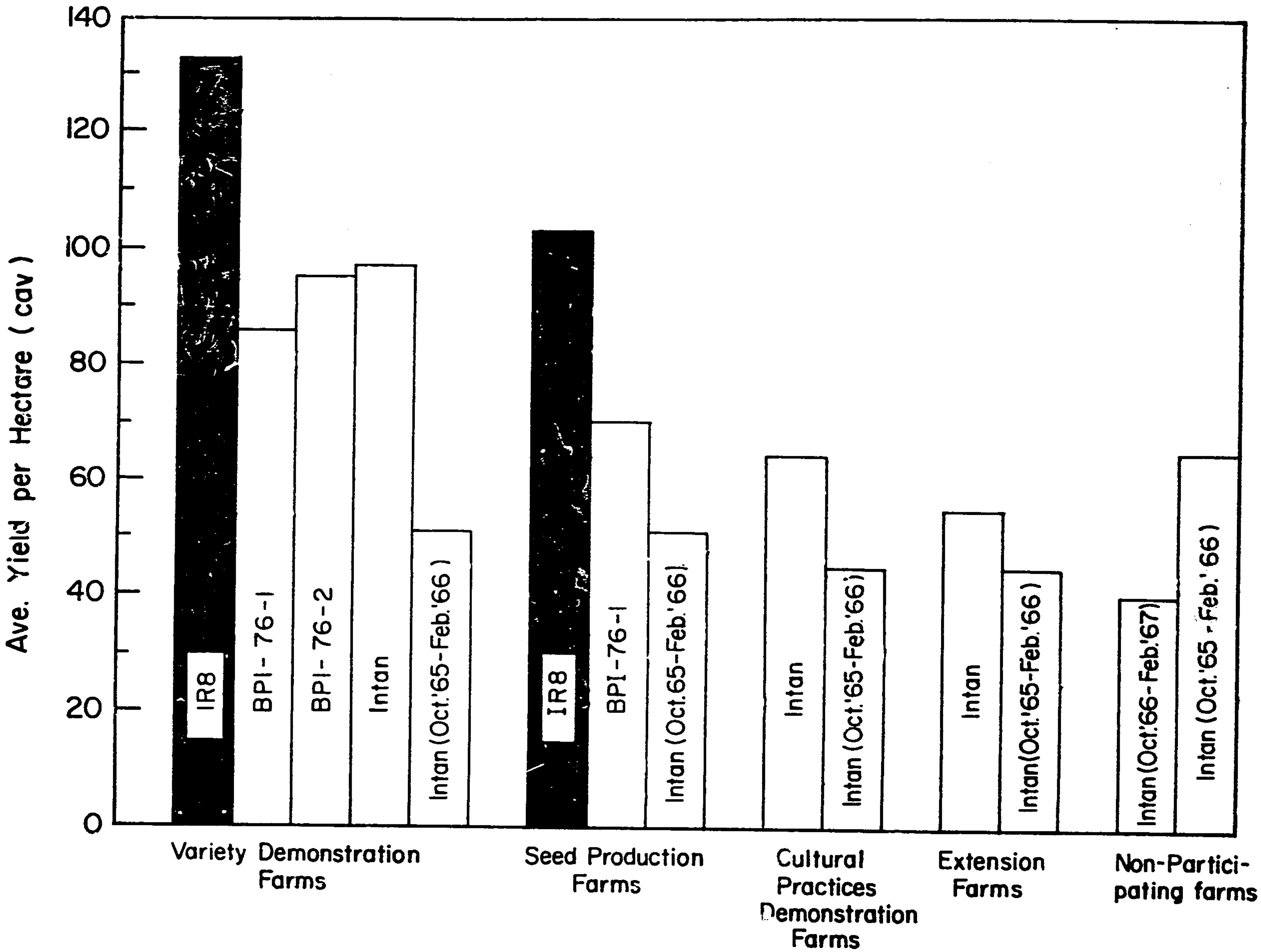

Fig. I. Chart showing the average yields of varieties in the different farm categories during crop season Oct. '66 - Feb. '67 in comparison with the average yields during the previous crop (Oct. '65 - Feb. '66)

TABLE 8. Returns and costs per hectare for producing three varieties of rice under traditional and improved practices. [a]

	Intan (Traditional practices) (1)	BPI-76 (Improved practices) (2)	IR8 (Improved practices) (3)
Variable costs			
1. Fertilizer	₱ 20	₱ 75	₱125
2. Chemicals	0	55	55
3. Seed	20	20	25
4. Labor	180	265	280
5. Harvest and thresh	130	185	265
6. Interest and others	10	35	65
	₱ 360	₱ 635	₱ 815
Fixed			
1. Irrigation fee	₱ 25	₱ 25	₱ 25
2. Land	200	200	200
3. Interest and depreciation	20	30	30
	₱ 245	₱ 255	₱255
Cost for cash crop and harvest (Variable 1, 2, 3, 5)	₱170	₱335	₱525
Total cost	₱605	₱890	₱1070
Yield (kg/ha)	2200	3080	4400
(cavan/ha)	50	70	100
Cost/cavan	₱12.10	₱12.70	₱10.70
Gross return [b]	₱800	₱1120	₱1600
Net return			
Cash crop and harvest	₱630	₱ 785	₱1130
All costs	₱195	₱ 230	₱ 530

a/ Based upon yield differences for seed production farms in Baliuag, Bulacan.

b/ ₱16/cavan or ₱0.36/kilogram rough rice. $1.00 = ₱3.90

5.2. A survey of farms in Pampanga and Bataan

A survey was made in the summer of 1967 to determine differences in yields, costs and returns on those farms using improved, seedboard, and local varieties.[10/] Yield differences by season are shown in Table 9 for those farms switching to improved varieties. Prior to the change there was little difference in yield between local and seedboard varieties with the average yield being around 60 cavans of rough rice per hectare for both wet and dry seasons. Following the change, farms switching to IR8 appear to have increased yields by 30 to 40 cavans, on the average while those changing to BPI-76 made a much less dramatic increase.

There were unfortunately too few farms in the survey growing improved varieties in the wet season of 1966 to make comparisons between the performance of improved and other varieties. Yields do not appear to differ sharply between wet and dry season in this region. Thus, Table 10 shows a comparison of costs and returns for improved varieties, 1967 dry season with seedboard and local varieties, 1966 wet season. In order not to bias the comparison between improved and other varieties, standard price of ₱16/cavan (₱0.36/kilogram) was used for both seasons. The price will normally be higher for the dry season. The yields are higher for improved varieties, and

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10/ As defined here, improved includes IR8 and BPI-76. However, as Table 9 indicates the majority of improved seed grown was IR8. Seedboard includes for this area Peta, Milfor, Seraup Ketchil, BE-3, and Tjeremas. Local includes all other varieties.

TABLE 9. Yields of rough rice on farms in cavans per hectare before and after change to improved varieties from seedboard and local varieties, 1966 dry season and 1966-67 wet and dry seasons, Pampanga and Bataan. a/

	Before change		After change			
	Local or seedboard		IR8		BPI-76	
	Farms	Yield	Farms	Yield	Farms	Yield
A.	1966 wet season	vs		1967 dry season		
Seedboard	29	62.3	23	97.3	6	73.5
Local	17	61.4	15	102.8	2	57.5
B.	1966 dry season	vs		1967 dry season		
Seedboard	13	60.3	8	91.8	5	67.7
Local	16	56.5	14	89.9	2	87.5

a/ From survey of farms by E. C. Venegas. Seedboard approved varieties grown in this area include Peta, Milfor, Seraup Ketchil, BE-3, and Tjeremas. One cavan rough rice = 44 kilograms.

TABLE 10. Returns and costs per hectare for rough rice on farms using improved, seedboard approved, and local varieties, Pampanga and Bataan, 1966-67. a/

	1967 dry season		1966 wet season			
	Improved		Other seedboard		Local	
	Owner/ operator	50/50 share	Owner/ operator	50/50 share	Owner/ operator	50/50 share
No. of farms	20	35	8	22	9	6
Fertilizer (₱)	190	123	53	49	46	22
Chemicals (₱)	47	39	12	8	14	31
Other cash costs b/ (₱)	299	195	189	105	167	135
Cost in kind c/ (₱)	132	173	131	119	111	141
Total cash costs and in kind (₱)	668	530	385	281	338	329
Total costs (₱)	999	853	765	650	728	667
Yield in:						
Kg/ha	4400	3828	3036	2464	2948	2200
Cavans/ha	100	87	69	56	67	50
Area of variety (ha)	2.04	1.79	1.87	3.59	2.71	2.18
Gross return d/ (₱)	1600	1392	1104	896	1072	800
Net return:						
Total cash costs and in kind (₱)	932	862	719	615	734	471
Total costs e/ (₱)	601	539	339	246	344	133

a/ Improved varieties include IR8 and BPI-76. Of the 55 farms planting improved variety, 11 planted BPI-76, the rest were planted to IR8.

b/ Include cash costs for land preparation, pulling of seedlings, transplanting and transportation.

c/ Costs in kind includes costs of harvesting, threshing and seeds.

d/ ₱16/cavan or ₱0.36/kilogram of rough rice. $1.00 = ₱3.90

e/ Includes charge for land, and family and operator labor.

higher on owner-operator than on tenant farms. In general order of magnitude, however, the yields and net returns compare rather closely with the budgets shown in Table 8 based on the yield data from Baliuag, Bulacan. Returns above cash costs and costs paid in land are approximately ₱200 per hectare greater for improved varieties than for local and seedboard varieties. Labor costs are somewhat higher for improved varieties, while cash crop costs are 3 to 4 times greater.

5.3. Surveys of farms in Rizal province, 1966 and 1967 dry seasons, and 1966 wet season.

The Agricultural Development Council of Rizal (ADCR) was formed in 1966 to further the agricultural development of that province. One of the first steps of the ADCR was to promote the production of IR8 rice variety (named by the ADCR, Rizal No. 1). The first extensive planting of IR8 in Rizal took place in the 1966 wet season. The recorded results of 45 farmers under the ADCR program with respect to yield and fertilizer and chemical use are shown in the two right hand column of Table 11. Both irrigated and rainfed farms obtained yields in excess of 100 cavans per hectare.

More complete information was obtained for the dry seasons through a sample survey conducted in 1967 in Rizal province. A 10 percent sample of lowland rice farms was drawn (with a minimum of 2 farms per municipality). The farmers were asked to recall their yields and expenses for the 1966 as well as the 1967 dry season. The results are shown in the first four columns of Table 11 for IR8 and Binato, the two most widely used varieties.

TABLE 11. Net returns over cash costs per hectare of rough rice, two rice varieties, 3 seasons, Rizal. a/

	1966 dry		1967 dry		1966 wet	
	IR8	Binato	IR8	Binato	Irrigated	Rainfed
No. of farms	4	143	200	127	37	8
Fertilizer (₱)	270	50	146	39	159	91
Chemicals (₱)	45	10	61	4	114	132
Other cash costs c/ (₱)	287	210	193	83	-	-
Costs in kind (₱)	539	176	379	249	-	-
Total cash costs and in kind d/ (₱)	1141	446	779	375	-	-
Yield in:						
Kg/ha	7267	3276	5852	3165	5332	4721
Cavans/ha	165	75	133	72	121	107
Area of variety (ha)	0.81	0.71	0.63	0.64	0.82	0.98
Gross return e/ (₱)	2640	1200	2128	1152	1936	1712
Net return:						
Over cash costs and in kind (₱)	1499	754	1349	777	-	-

a/ These data are summarized from the records provided by the Agricultural Development Council of Rizal. Results of the 1966 and 1967 dry season are based upon a sample taken throughout the province in 1967. The data for 1966 wet season are from all those farms participating in the ADCR program.

b/ This variety is also known as Thailand.

c/ Include cash costs for land preparation, weeding, transplanting and pulling of seedlings.

d/ Costs in kind includes costs of harvesting, threshing and seeds.

e/ ₱16/cavan or ₱0.36/kilogram of rough rice. $1.00 = ₱3.90

The yield of rice is higher in Rizal than in Central Luzon for both improved and local varieties. The prices used were not the prices obtained from farmers (many of whom initially sold rice for seed at a high return), but the approximate current commercial price of ₱16/cav for wet season (₱0.36/kg).

5.4. A survey of farms in Laguna, 1966 and 1967 wet seasons

A study was undertaken in three municipalities of Laguna (Calamba, Cabuyao, and Biñan) in the fall of 1967 to inquire into the physical, economic, and social factors influencing the spread of new rice varieties. The group of 155 farms surveyed were the same farms visited in an earlier study.[11] This provided a basis for comparing current and earlier records of performance.

The results of this study are still being tabulated. Some of the preliminary findings are reported here. Table 12 shows the yields of three groups of farmers. The first group of 61 farmers (40%) made the complete switch to IR8. The second group of 44 farms (29%) did not change varieties. The third group (31%) changed approximately half of the hectarage to IR8. The yield gains from the shift in variety paralleled those obtained in Pampanga and Bataan (see Table 5). As in all previous cases the shift in variety was

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11/ The earlier study still in process is on inquiry into the factors affecting technological change and is a part of the Master's thesis research of S.H. Liao. Several of these farms were also part of a still earlier farm management survey and study. (See H. von Oppenfeld, *et al.*, Farm Management, Land Use and Tenancy in the Philippines. *Central Experiment Station Bulletin No. 1*, U.P. College of Agriculture, College, Laguna, 1964). The survey for this earlier study was conducted in 1954/55.

TABLE 12. Input and output information for lowland rice farms of three selected areas, Laguna, 1966 and 1967 wet seasons. [a]

	Varieties						
	Local to improved		Local		Local to improved and local		
	1966	1967	1966	1967	1966	1967	1967
No. of farmers	61	61[b]	44	44[b]	47	47[c]	47[c]
Nitrogen (kg/ha)	16	73	15	20	18	76	24
Fertilizer expense (₱/ha)	28	97	24	30	31	105	37
Weedicides expenses (₱/ha)	5.0	8.0	4.0	8.7	4.4	7.2	2.2
Insecticides expenses (₱/ha)	2.8	18.0	1.9	4.7	3.0	17.6	5.0
Yield:							
Kg/ha	2420	4224	2288	2112	2596	4752	2420
Cavans/ha	55	96	52	48	59	108	55
Area (ha)	2.5	2.4	2.4	2.4	2.5	1.1	1.3

a/ For all but three farms the improved variety planted was IR8. Three farms reported growing BPI-76. No farms were growing C-18. The term local includes all other seedboard approved and native varieties.

b/ Typhoon damage was reported on 16 farms growing improved varieties and 11 farms growing local varieties in 1967. The estimated loss per ha was 31 cavans for the new and 9.6 for the local.

c/ Typhoon damage was reported on farms growing improved and local varieties as follows - 12 farms estimated damage of 28.5 cavans per hectare on new varieties and 6 farms estimated damage of 7.5 cavans per hectare.

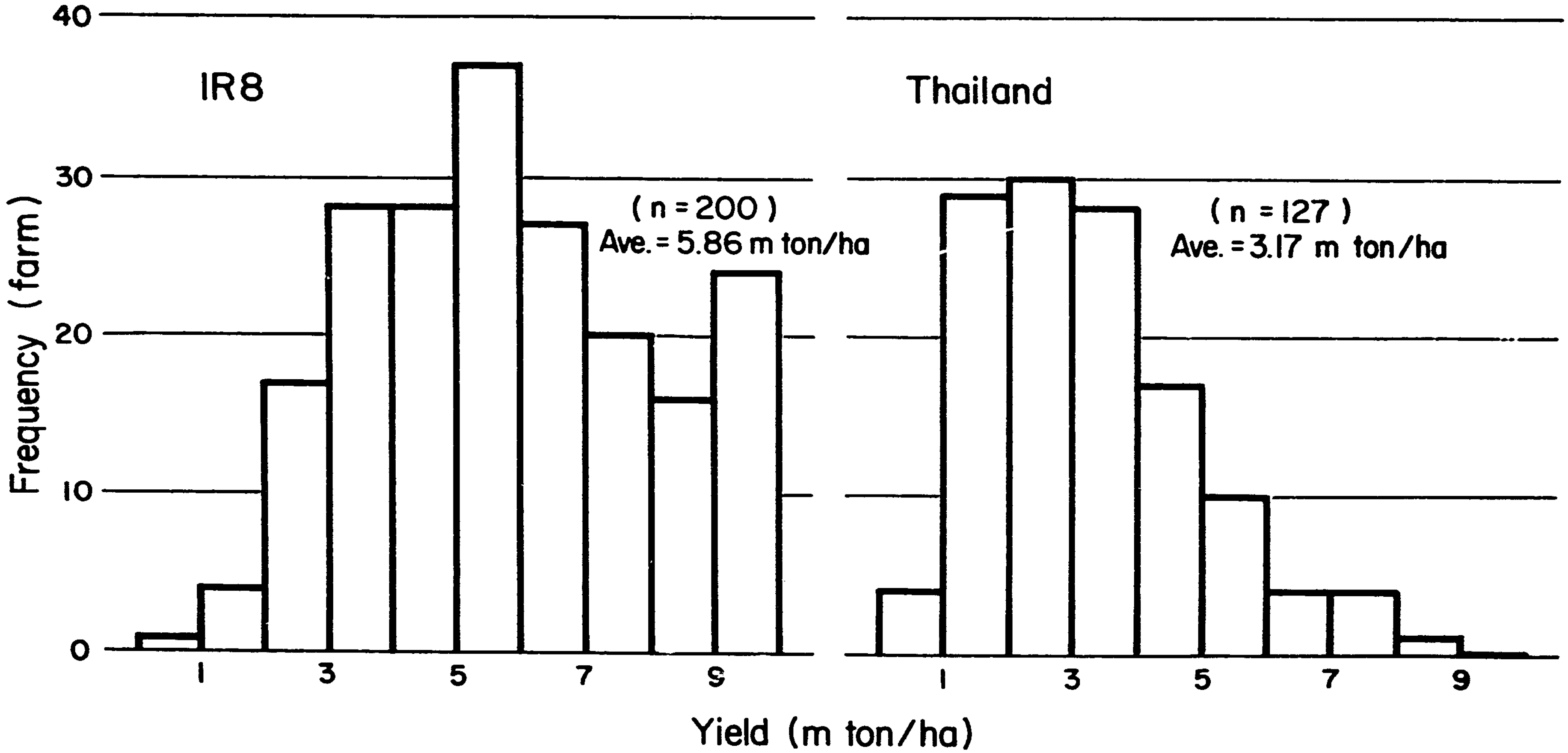

Figure 2. Yield Distribution of IR-8 and Thailand Rice Varieties, Rizal, Dry Season, 1966-67.

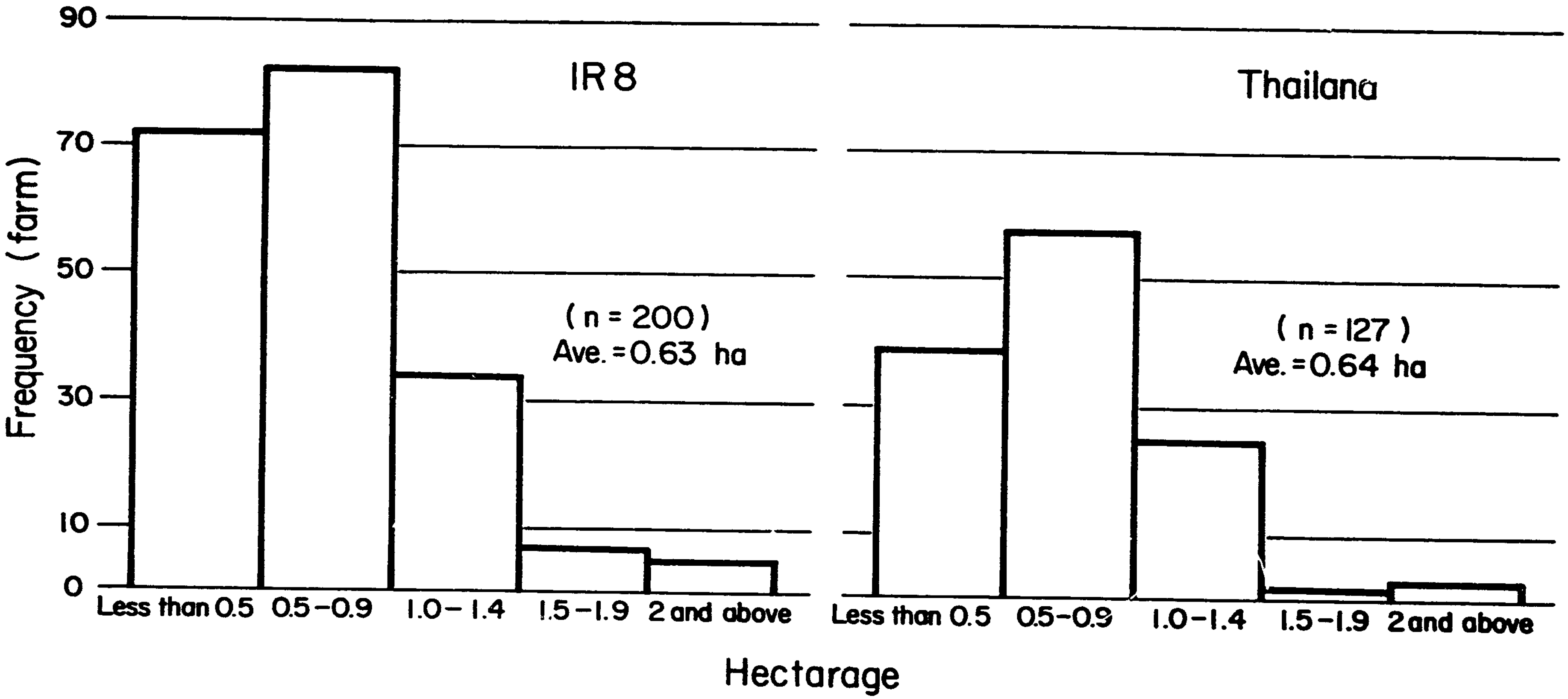

Figure 3. Hectarage Distribution of IR-8 and Thailand Rice Varieties, Rizal, Dry Season, 1966-67.

accompanied by a major increase in fertilizer and chemical inputs. This same marked difference in input use was observed even on those farms where both varieties were grown. For example, the shift in fertilizer input is nearly four fold from approximately 20 kg nitrogen per hectare to 75 kg nitrogen per hectare.

Another important piece of information reported in this survey is typhoon damage. Typhoon Welming, one of the most severe typhoon recorded in this area, struck at almost the peak of the harvest period. Twenty-eight farmers growing new varieties (26%) and 11 farmers growing local varieties (19%) reported typhoon damage. The estimated yield decline due to the typhoon was 31 cavans for IR8 and 10 cavans local varieties. The fact that IR8 did not lodge caused shattering as part of the panicle was "blown away." In the aggregate the loss represents 12% of the total IR8 crop on these farms, 4.5% of the local crop, and 10% of the total crop.

The farmers in this survey were questioned further as to why they adopted or chose not to adopt new varieties. The results of this questioning are shown in Tables 13 and 14. Expected high yield is the number one reason given for shifting varieties and cultural practices. Those that did not shift reported landlords decision and high cost of input as primary reasons.

During the course of the survey, it became apparent that farmers were considerably disturbed by the low price obtained for IR8. Millers were discounting the price of IR8 due to reported low milling quality and inferior eating quality. Further price discounting was due to the fact that much of the

TABLE 13. Reasons for the adoption of improved varieties of rice.

1. Total number of adoptors - 110

2. Total number of responding - 110

	No. of farmers giving the reasons a/	No. of farmers indicating the most important factors
a. Expected high yield	105	98
b. Landlord's decision	55	6
c. Follow advice of extension worker	68	0
d. Expected high price	41	1
e. Follow advice of neighbors	11	0
f. Others	21	6

a/ More than one reason have been given by same respondents.

TABLE 14. Reasons for non-adoption of improved varieties of rice.

1. Total number of non-adoptors - 45

2. Total number of responding - 41

	No. of farmers giving the reasons [a]	No. of farmers indicating the most important factors
a. Landlord's decision	16	14
b. Expensive	13	12
c. Lack of irrigation	7	3
d. Seed not available	4	3
e. Others [b]	21	9

a/ More than one reason have been given by same respondents.

b/ Others indicate too many planted IR8, low price, unsuitable to farm, no knowledge of variety, local variety for home use, etc.

rice was sold wet in the field. The IR8 matured earlier than most local varieties before the end of the wet season. The sensitiveness of farmers to the price and to the costs of growing IR8 is shown in Table 15. Forty-eight farmers (44% of those now growing IR8) said they would not plant this again. Another seventeen farmers (16%) said they would reduce planting of IR8. The major reasons given are expense and low price.

TABLE 15. Reasons given for not planting improved varieties again in dry season, 1967-68.

Total number of farmers responding - 39

Reasons:	No. of farmers giving the reasons a/
a. Expensive	18
b. Low price	17
c. Laborious	10
d. Landlord's decision	8
e. Farms not suited to improved variety	4
f. Common practice of planting one variety after another	3
g. Others b/	6

a/ Some farmers gave one or more.

b/ Reasons: Others include risky, waiting for better varieties, local variety planted for home use, insufficiency irrigation water and farmer left farming and susceptibility to disease.

6.0. SUMMARY AND CONCLUSIONS

A number of studies of the profitability of rice production have been reported in this paper. The procedures for estimating cost and returns were described in section 2.

Results of three case studies based upon farm management records are reported in section 3. These studies demonstrate the profitability of: (1) straight row planting, (2) irrigation, and (3) the shift to improved varieties.

Section 4 shows the budgeted results of costs and returns using traditional and improved varieties and practices for 2 and 4 hectare irrigated and rainfed farms. These results indicate the current income potentials for lowland rice farming in the Philippines.

The results of four studies of cost and returns using traditional and improved varieties and practices are presented in section 5. These studies show remarkable consistency and provide considerable insight regarding the changes currently taking place. The shift to IR8 has in all cases been accompanied by marked increase in inputs of fertilizer and chemicals. By contrast, on farms growing both IR8 and local varieties side by side, no change has occurred in cultural practices and yield on the local variety.

MANAGEMENT PRACTICES AND ECONOMIC ANALYSIS OF EXPERIMENTAL RESULTS IN RICE PRODUCTION

S. K. De Datta and Randolph Barker

MANAGEMENT PRACTICES AND ECONOMIC ANALYSIS OF EXPERIMENTAL RESULTS IN RICE PRODUCTION

S. K. De Datta and Randolph Barker[1/]

1.0. INTRODUCTION

The most profitable combination of resources can be determined: (1) through analysis of farm data, and (2) through controlled field experiments. Many extension recommendations to farmers are based upon experimental results. There are a number of reasons for this. The variability of farm data makes it difficult to ascertain the response of yield to individual factor inputs. The statistical procedures used to take into account the wide range of variables explaining yield do not provide satisfactory results. Failure to identify all of the significant factors relating to grain yield results in large unexplained variability. Through the controlled experiment, on the other hand, a few key factors can be varied while other factors are held constant. Techniques can be used to randomize unexplained variability and thus minimize bias in the estimation of coefficients.

1/ Associate Agronomist and Agricultural Economist, International Rice Research Institute. The authors would like to acknowledge the contribution of Abdullah Prawirosamudro, former Research Scholar, Akin Williams and V.P. Sharma, Research Scholars, Agronomy, IRRI; agronomists of the Maligaya Rice Research and Training Center who conducted much of the Agronomy field experiments; and Narciso R. Deomampo, Research Scholar, Department of Agricultural Economics, IRRI, who was in charge of the Agricultural Economics field experiments.

There are also many problems with the experimental approach. The most frequently heard criticism is that experiments are conducted under conditions which are in no way typical of the farm. The level of inputs and management is often higher than what is found even on the more progressive farms.2/

Another problem, which forms the focal point of this paper, is the translating of the results of biological experiments into terms of economic significance. Many experiments are never analyzed to determine their economic and extension implications. In some cases experiments are analyzed and recommendations are based on such criteria as "nutritional requirements." For example, a recommendation may call for a complete fertilizer application or a heavy application of certain fertilizer elements or insecticides. The person formulating the recommendation may regard this complete fertilization or heavy application as an "insurance" against low yields. From the point of view of the farmer, this same additional input may represent an added cost that seldom pays off or that pays off with relatively low returns and is hence a "risky investment."

2/ Those concerned with making farm recommendations frequently face this problem. One way of handling the difficulty is described in B.R. Davidson and B.R. Martin, "The Relationship Between Yields on Farms and in Experiments," Australian Journal of Agricultural Economics, Vol. 9, No. 2, Dec. 1965, pp. 129-140.

However, the application of economic analysis does not necessarily guarantee "better" farm recommendations. Ideally, recommendations should take into account:

(1) differences in physical response due to location, season, variety, etc.

(2) differences in the financial and resource situation of farmers.

(3) differences in the risk preferences of farmers.

Due in large part to lack of data, one commonly finds a single or blanket recommendation for a whole region or sometimes a whole country. For example, in lieu of information on existing wage and loan rates, economic analysis is based upon institutional rates (minimum wage or bank interest) which may have little relevance for many groups of farmers.

At a time when many Philippine rice farmers are making major changes in cultural practices, the need for sound management recommendations is obvious. We are now beginning to develop in the Philippines a body of experimental results in rice production upon which to base such recommendations. The purpose of this paper is to show how some of these results can be analyzed economically.

Experiments can deal with either single or multiple factors and with either quantitative or qualitative differences in treatment levels. The first of the two sections which follow discuss the results of fertilizer experiments. The purpose is to show how the results do vary (and the recommendations should vary) by soil type, by variety, and by season. The second section describes the results of two multiple factor experiments. These experiments can serve two purposes. First, they can provide a guide to other research workers who wish to conduct similar experiments in other areas using simple designs. Second, they can serve as a guide to the formulation of input packages to be recommended under specified physical and financial situations at the farm level.

2.0. ECONOMIC LEVEL OF NITROGEN APPLICATION

During the past two years fertilizer experiments have been conducted at IRRI farm (Maahas clay: pH 6.0; O.M. 2.0%; total N, 0.14%; CEC., 45 m.e/100 g. soil; predominant clay mineral; montmorillonite) and Maligaya Rice Research and Training Center (pH 6.9; O.M. 1.5%; total N, 0.08%; CEC., 36 m.e/100 g. soil; predominant clay mineral; montmorillonite) under the supervision of the Department of Agronomy, IRRI. The experiments at Maligaya were conducted in cooperation with the Bureau of Plant Industry of the Philippines. The objective of these experiments was to show the yield response of selected varieties to the application of nitrogen. The experiments were conducted in similar manner, with inputs other than fertilizer being controlled at approximately the same level. Most of the experiments had 5 fertilizer treatments running from 0 to 120 kg/ha N in 30 kg increments.

2.1. Response functions

The first step in conducting the economic analysis was to estimate the response function using regression analysis. Four varieties were chosen - IR8, BPI-76, Peta and C-18. Functions were fit separately according to season (wet vs dry), variety, and location. The data for two years, 1966 and 1967, were combined with the exception of Maligaya wet season. In this case, the wet season results for 1967 were not used because a severe attack of bacterial leaf blight greatly reduced yields.

An example of the regression analysis is illustrated by the following equation:

$$(1)\quad \hat{Y} = 3060.7 + \underset{(4.725)}{56.823\,N} - \underset{(.030)}{0.248\,N^2}$$

where

$\hat{Y}$ = yield of rice in kilograms - IR8

N = application of elemental nitrogen in kg

The equation was fit using data from the Maligaya wet season 1966. This same function is shown graphically in Fig. 1 as one of a set of four functions for the wet season. This figure shows a sharp contrast in response by variety and by location. For a given variety yields at IRRI are initially higher, but response to fertilizer is substantially less. This is explained by lower fertility status of Maligaya soil compared to soils at IRRI farm.

Fig. 2 is identical to Fig. 1 for the dry instead of the wet season. Peta has been substituted for BPI-76. This comparison shows rather less difference in response due to differences in location during the dry season.

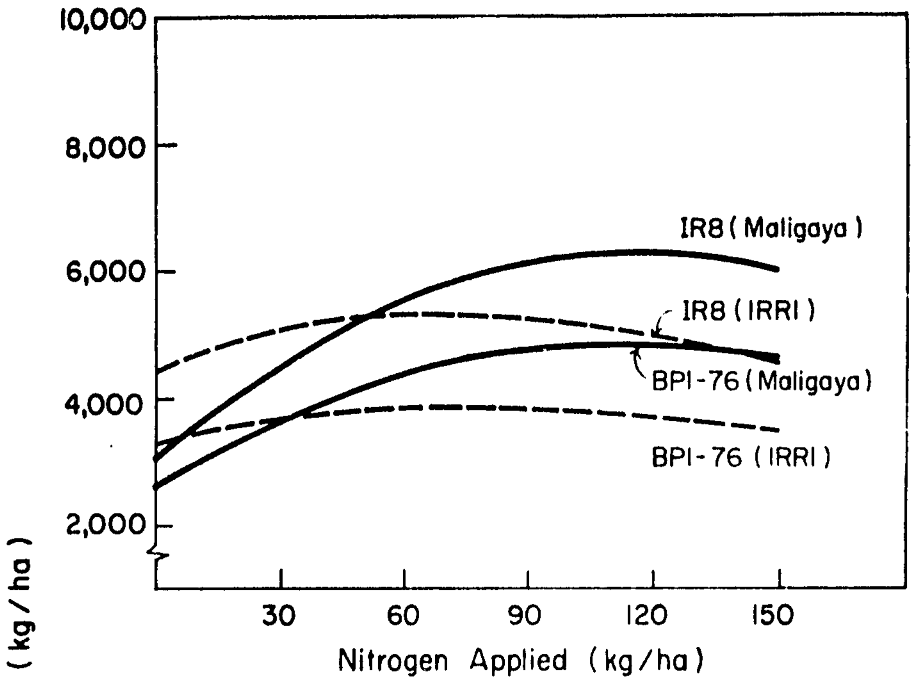

Fig. 1. Variation in yield response to nitrogen due to location and variety. - Wet season, 1966 and 1967.

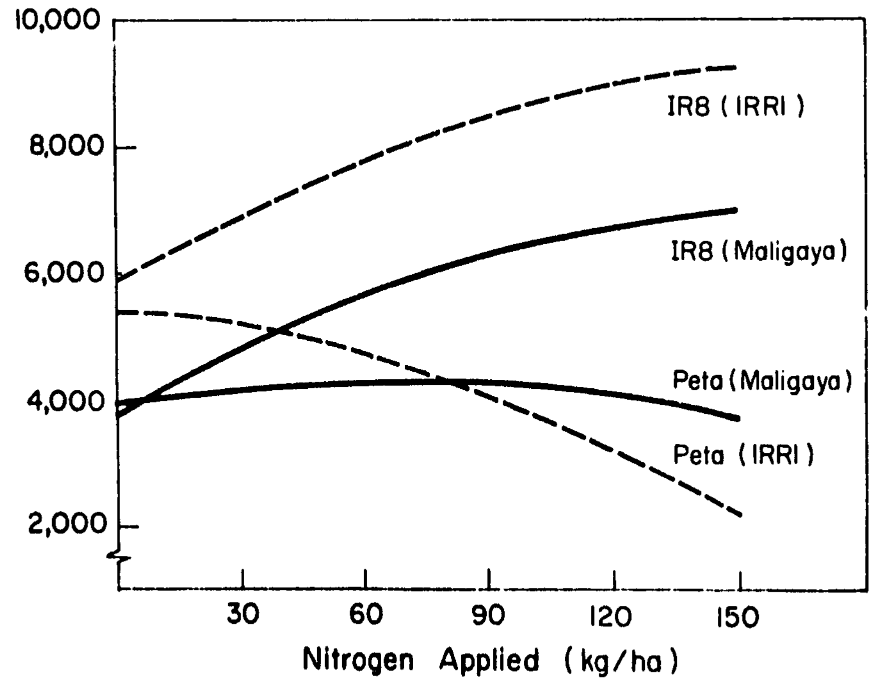

Fig. 2. Variation in yield response to nitrogen due to location and variety. - Dry season, 1966 and 1967.

Fig. 3 combines the results of four varieties for both wet and dry season at a single location. The response of C-18 provides an interesting contrast to the other varieties. Yield increases are at first very rapid exceeding the response of Peta and BPI-76. However, the increase drops off sharply beyond 30 kg N in the wet season and 60 kg of N in the dry season.

Fig. 4 shows the performance of one variety IR8 for two separate locations and seasons. Lowest response is found in the fertile soils of the IRRI farm during the wet season due in large part to the heavy cloud cover, and hence low solar energy. There is much less contrast between the wet and dry season performance in Maligaya.

2.2. Benefit-cost ratios

Using the production functions partial budgets were developed to compute the benefit-cost ratios for the use of fertilizer. An example is shown in Table 1 and is based on equation 1. Yields are established for 30 kg intervals of application of N running from 0 to 120 kg/ha (col. 2). The return due to fertilizer is computed by establishing the increase above the yield at zero fertilizer. This increase is reduced by 1/6 to allow for harvesters share and multiplied by ₱0.36, the price per kilogram of rice. The cost of fertilizer is subtracted from the return to obtain the net return to fertilizer (col. 5).

Added return (col. 6) is the return per additional 30 kg of nitrogen applied. Added cost (col. 7) is the cost for 30 kg of fertilizer. Added return divided by added cost (col. 8) is the benefit-cost ratio. Notice that this ratio declines with each additional input of 30 kg nitrogen.

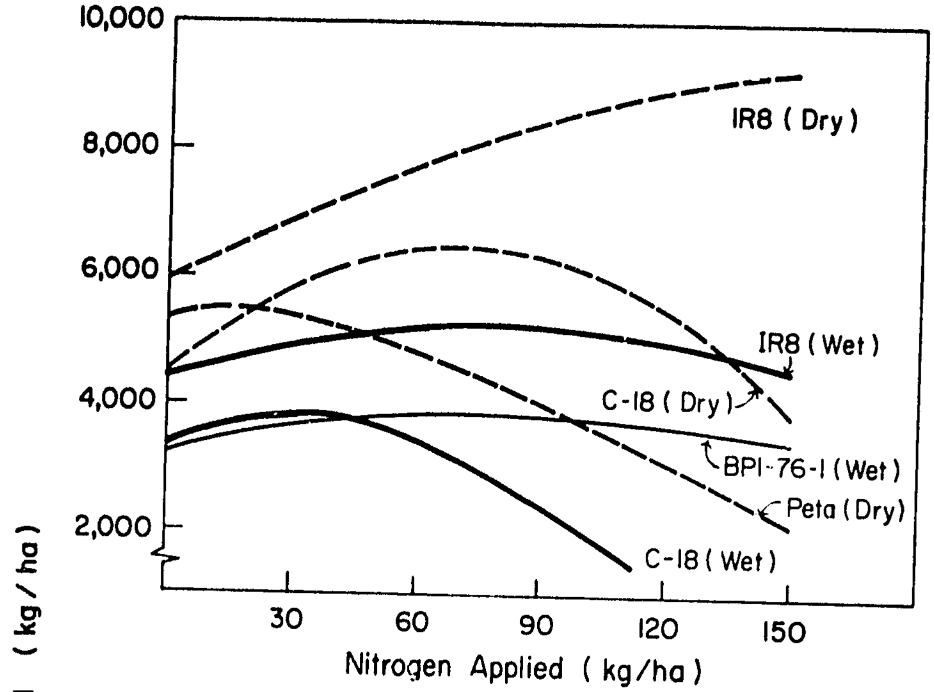

Fig. 3. Variation in yield response to nitrogen by varieties and season. IRRI, wet and dry, 1966 and 1967.

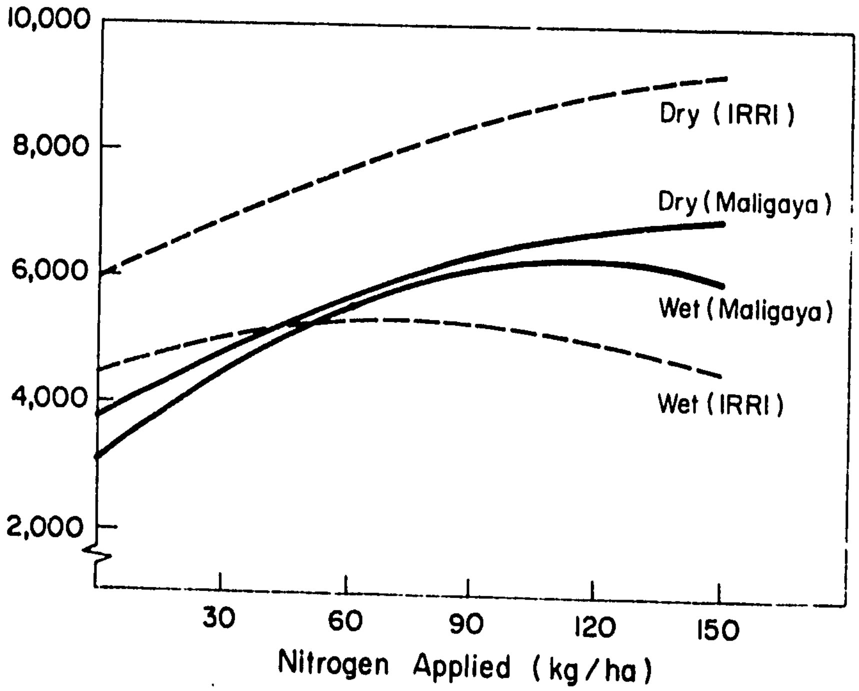

Fig. 4. Variation in yield response to nitrogen due to location and season. IR8 variety, 1966 and 1967.

TABLE 1. The change in cost and return associated with a 30 kg increase in fertilizer level, IR8, Maligaya Rice Research and Training Center, 1966 wet season. [a/]

N-applied (1) (kg/ha)	Grain yield (2) (kg/ha)	Return from fertilizer [b/] (3) (₱)	Cost of fertilizer (4) (₱)	Net return from fertilizer (5) (₱)	Added return (6) (₱)	Added cost (7) (₱)	Marginal benefit-cost (col. 6 ÷ col. 7) (8)
0	3060.7	0	0	0	0	0	0
30	4542.2	444.45	35.40	409.50	444.45	35.40	12.6
60	5577.3	754.99	70.80	684.19	310.54	35.40	8.8
90	6166.0	931.61	114.70	816.91	176.62	35.40	5.0
120	6308.3	974.27	141.60	832.67	42.66	35.40	1.2

a/ Based on: $Y = 3060.7 + 56.823\,N - .248\,N^2$.

Rough rice = ₱0.36/kg, N = ₱1.18/kg N from urea.

b/ Include deduction for cost for harvesting increased production due to N application.

In a strict theoretical sense profit maximization occurs at a point where added return equals added cost. Beyond this point an additional amount of fertilizer applied will not provide sufficient yield of rice to cover the fertilizer cost. In the example in Table 1, this occurs at approximately 120 kg/ha of nitrogen.

However, a more realistic economic interpretation should take into consideration other factors such as shortage of capital, high interest rates, and risk and uncertainty. Evidence suggests that benefit cost ratios in the neighborhood of 2 or 3 to 1 are needed to stimulate the use of cash inputs.[3/] This level is reached somewhere between 90 and 120 kg/ha of nitrogen for this example.

Using the same procedure illustrated in Table 1, benefit-cost ratios were calculated at varying fertilizer levels for all of the functions shown in Fig. 1 through 4. These ratios are presented in Table 2. A line has been drawn to indicate the approximate location of the marginal 2.5/1 benefit-cost ratio for each function.

3/ See for example, R. Barker and A. Soothiphan, "Economic Efficiency in Agriculture," paper prepared for the First Regional Farm Management Seminar, Eastern Visayas, March 13-15, 1967. Estimates of marginal value productivity of capital were 1.9 and 2.1 for 2 and 4 hectare irrigated farms, respectively.

TABLE 2. Benefit-cost ratios for each additional 30 kg of nitrogen applied to selected varieties. IRRI and Maligaya, wet and dry seasons, 1966 and 1967 observations combined. a/

Nitrogen applied (kg/ha)	Dry Season, 1966 and 1967							Wet season, 1966 and 1967						
	IRRI				Maligaya			IRRI				Maligaya		
	IR8	C-18	BPI-76-1 b/	Peta	IR8	C-18 b/	Peta	IR8	C-18	BPI-76-1	Peta	IR8 c/	BPI-76-1 c/	Peta c/
30	9.3	9.7	9.0	0	9.8	4.3	1.8	4.1	1.01	2.7	0	12.8	8.5	5.9
60	7.6	2.3	6.2	0	7.6	3.3	0.3	1.5	0	1.1	0	8.3	5.4	1.9
90	5.9	0	3.5	0	5.4	2.3	0	0	0	0	0	3.7	2.3	0
120	4.2	0	0.7	0	3.2	1.4	0	0	0	0	0	0	0	0

a/ Procedures for computation differ slightly from Table 8 since calculus was used to obtain point instead of interval estimates. Rice was valued at ₱.36/kg with 1/6 of the added profit deducted as harvesters share.

b/ Only data for 1967 available.

c/ Only data for 1966 used since 1967 crop was badly damaged by bacterial leaf blight.

2.3. Fertilizer requirements for marginal 2.5 to 1 benefit-cost ratio

In Table 3, the benefit-cost ratio for the marginal increment was held constant at 2.5 to 1. The optimum level of fertilizer input were computed on the basis of this ratio. The optimum level computed was rounded off to the nearest 30 kg. Thus, fertilizer level shown in Table 3 vary by 30 kg intervals from 0 to 150 kg.

For the cloudy wet season, nitrogen levels for high grain yield are similar between varieties with the exception of Peta which is consistently lower than the other three varieties. However, optimum levels of fertilizer application are higher on the less fertile soil at Maligaya than at the Institute farm.

For the sunny dry season, optimum nitrogen levels differ primarily by varietal type, but are not consistently different for different locations. The absolute grain yields are higher at the Institute farm than at Maligaya. This is believed to be due to the severe insect problem at Maligaya.

3.0. ECONOMIC ANALYSIS OF MULTIPLE FACTOR EXPERIMENTS

In the previous section, we were concerned with finding the optimum level of input for a single factor, nitrogen and different rice varieties. However, farmers are faced with the problem of allocating their limited resources in such a way as to find the optimum combination of inputs. For example, should available cash be spent for fertilizer, insecticide, or some combination of these inputs? The two experiments described in this section are designed to provide information on this problem of resource combination.

TABLE 3. Estimated nitrogen requirement in kilogram per hectare based on marginal benefit-cost ratio of 2.5 to 1. [a/]

	IR8	C-18	BPI-76-1	Peta
Wet				
IRRI	60	30	30	0
Maligaya	90	-	90	60
Dry				
IRRI	120	60	90	0
Maligaya	120	90	-	30

a/ Results are rounded to the nearest 30 kg.

3.1. Nitrogen response in relation to varietal types and management level

The nitrogen response and the profitability of fertilizer use vary with varieties, the soil-climatic complex, and the perfection attained in other management practices such as insect, disease, and weed control, and water supply. The profitability of fertilizer application with a specific variety or varietal type is closely associated with fertilizer prices, grain yield, and price of rice. Finally, to decide the quantity of fertilizer to use, the cost of other management practices, particularly those needing cash inputs, must also be taken into consideration.

Experiments were conducted at the Institute farm during the 1966 crop seasons to: (1) determine the nitrogen response and yield potential of 2 or 3 varietal types under three management practices, (2) evaluate the profitability of nitrogen fertilizer application under three management practices, and (3) determine the cost of production under experimental conditions. Three levels of management were employed but the degree of insect control and fertilizer application differed between the wet and dry seasons.

3.11. Dry season.[4/] The varieties used were Chianung 242, a high-yielding japonica variety from Taiwan, Sigadis, a tall, leafy, weak-strawed variety from Indonesia, and IR8 developed by the Institute. Nitrogen as ammonium sulfate was harrowed into Maahas clay at rates of 30, 60, 90, and 120 kg/ha.

4/ For a more complete discussion of the dry season experiment, see S. K. De Datta, "Nitrogen Response of Rice Varieties Under Three Management Practices," paper presented at the IRRI Seminar, July 21, 1966.

Except for a no-nitrogen check, all varieties received an additional 20 kg/ha N at panicle initiation. The yields obtained are shown in Fig. 5 and details of the management practices and their cost are presented in Table 4.

Chianung 242, which lodged 3 to 4 weeks before harvest in one replicate of each of the 110 and 140 kg/ha N treatments, matured 117 days after seeding. The variety IR8 did not lodge at any stage of growth even at 140 kg/ha N and matured 135 days after seeding. The variety Sigadis exhibited leaf lodging at all levels of added nitrogen about 2 months before harvest. No leaf lodging was observed on non-fertilized plots. However, 39 days before harvest, Sigadis lodged completely at all levels of added nitrogen or management levels and matured 145 days after seeding.

The grain yield differences between the three varieties were 1,269 kg/ha between Chianung 242 and Sigadis, 1,744 kg/ha between IR8 and Chianung 242, and 3,013 between IR8 and Sigadis. It is notable that the highest yield of Sigadis, obtained with 80 kg/ha N, was lower than those obtained from IR8 and Chianung 242 with no applied nitrogen (Fig. 5).

Under management practice III, Chianung 242 and Sigadis produced similar grain yields in the no-nitrogen treatment. IR8 produced 7.5 m ton/ha without added fertilizer nitrogen and a maximum yield, with fertilizer, of 9,989 kg/ha (Fig. 5).

Costs and returns under three management practices. The cost of production is shown for the dry season in Table 4. The least expensive item was protection against insect pests in the seedbed, followed by weeding and

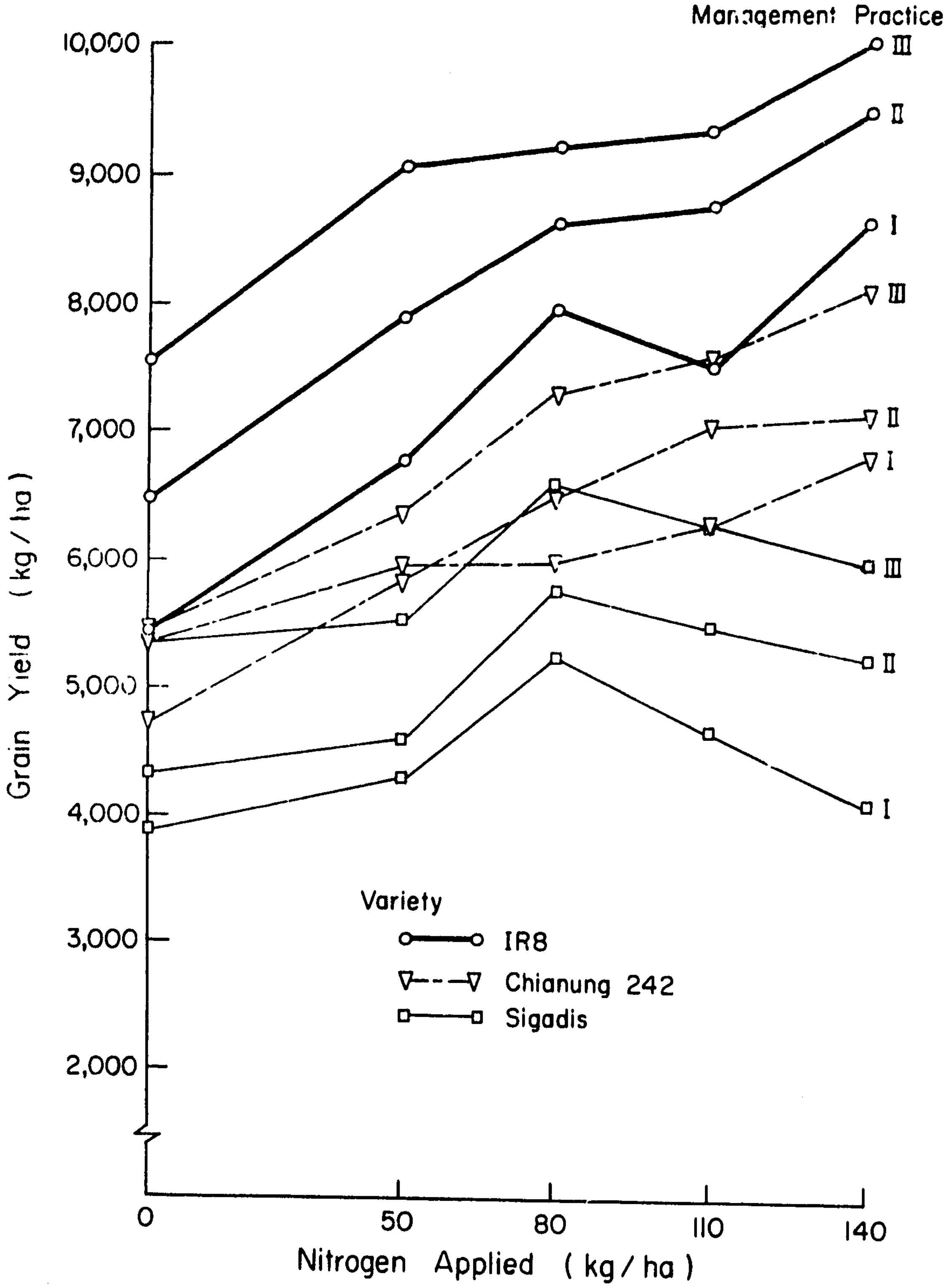

Fig. 5. Effect of levels of nitrogen on the grain yield of IR8, Chianung 242 and Sigadis under three management practices, IRRI, 1966 dry season.

TABLE 4. Details and costs (Philippine pesos)[a/] of three system of management and five levels of nitrogen fertilizer.[b/] IRRI, 1966 dry season.

Operation	Management practices I	II	III
1. Seedbed spray (0.2% endrin)			
No. of treatments	1	2	3
Cost of material	0.7	1.4	2.1
2. Carbaryl field spray			
No. of treatments	2	4	8
Total a.i. used (kg/ha)	6	12	24
Cost of spray and application	230.9	461.8	923.5
3. Gamma-BHC			
No. of treatments	2	3	5
Total a.i.[c/] used (kg/ha)	5	8	14
Cost of material	117.5	188.0	329.0
4. Handweeding	1	1	1.5[d/]
No. of treatments	80	80	120.0
5. Weedicide (MCPA)			
No. of treatments	-	1	1
Cost of material and application	-	22.0	22.0
Total cost	429	753	1,397

a/ Philippine peso = about US $0.26

b/

Nitrogen applied (kg/ha)	Cost of nitrogen (as urea) (₱/ha)
0	0
50	59.0
80	94.4
110	129.8
140	165.2

c/ Active ingredient.

d/ 1 complete and 1 light.

fertilizer application in the field. The most expensive item was the cost of insecticides for application in the field, particularly carbaryl.

The return above cash costs for fertilizer and other management practices is shown in Table 5. The cash input necessary for the three management levels varied from ₱594/ha (Table 4) to ₱1,561/ha at 140 kg/ha N. For Chianung 242 the highest return over the cash inputs (gross income - cash input) was obtained at 140 kg/ha N under management level I. IR8 also gave the highest return at these nitrogen and management levels, but the return over the cash input was higher than for Chianung 242. For Sigadis the highest return was obtained from management level I at 80 kg/ha N.

From these results it seems that beyond management level I, the additional cash input necessary to obtain higher grain yield does not raise the net return. When the values of production and farm expenses, including operator's labor, are calculated for the grain yield data (8,618 kg/ha), and the cash inputs necessary to obtain such grain yields with 140 kg/ha N under management practice I (Table 4), it can be shown that a net return of about ₱1,000/ha (US $260) can be obtained if a high-yielding variety such as IR8 is grown under appropriate management.

3.12. Wet season. The experiment was repeated with varieties IR8 and Sigadis and nitrogen levels from 0 to 100 kg/ha with 25-kg increments. The degree of insect control used was less intense in the wet than in the dry season; fewer applications of insecticide were made. Weed control was similar to that of the dry season. The total cash costs for the three management level inputs were as follows:

TABLE 5. Gross income less cash inputs for three management practices and 5 nitrogen levels, IR8, Chianung 242, Sigadis, IRRI, 1966 dry season. [a]

Nitrogen applied (kg/ha)	Management level	Varieties: IR8	Varieties: Chianung 242	Varieties: Sigadis	Averages: Management	Averages: Nitrogen
		(₱/ha)			(₱/ha)	
0	I	1529	1517	989	1345	
	II	1611	962	818	1130	1100
	III	1355	580	542	826	
50	I	1980	1668	1052	1567	
	II	2033	1305	854	1397	1352
	III	1837	842	599	1093	
80	I	2364	1653	1379	1799	
	II	2270	1518	1239	1676	1592
	III	1854	1161	892	1302	
110	I	2154	1717	1134	1668	
	II	2256	1667	1100	1674	1536
	III	1840	1210	744	1265	
140	I	2543	1872	884	1766	
	II	2503	1660	974	1712	1608
	III	2075	1352	612	1346	
Average	I	2114	1685	1088		
	II	2135	1422	997		
	III	1792	1029	678		

[a] Rice - ₱0.36/kg.

Nitrogen - ₱1.18/kg N in urea.

Sevin - ₱34.48/kg (active ingredient).

Gamma-BHC - ₱23.50/kg (active ingredient).

I - ₱255, II - ₱417, and III - ₱644.

Yield response is shown in Fig. 6. There were significant increases in grain yield with IR8 up to 100 kg/ha added N, with a maximum yield of 6,029 kg/ha at management practice III. If the average of the three management levels are taken, the highest yield for Sigadis was without added nitrogen. But the highest yield for an individual treatment was with 25 kg/ha N at management level III. The differences in grain yield between management levels were highly significant. IR8 yielded 4,383 in management practice I and 5,353 with management practice III, an increase of 1 m ton/ha (Fig. 6). The differences in grain yield between the two varieties were also significant; IR8 produced almost twice as much grain as Sigadis (Table 6). On an annual basis IR8 produced 16 m ton/ha/2 crops compared with 10.5 m ton/ha/2 crops for Sigadis. The results demonstrate that whether the management level is high or low, a stiff-strawed variety will outyield a tall, weak-strawed variety by a substantial margin.

3.13. Summary of results of these experiments. To summarize the results of these experiments:

(1) IR8 has consistently outyielded a highly productive Taiwanese japonica in the dry season and, by a greater margin, a tall, weak-strawed indica variety from Indonesia in both seasons.

(2) The grain yields of rice varieties presently grown in the tropics can be improved substantially if appropriate management practices are followed. However, the increase in grain yield from improved practices is higher with a short, stiff-strawed variety than with existing tall, weak-strawed, indica varieties.

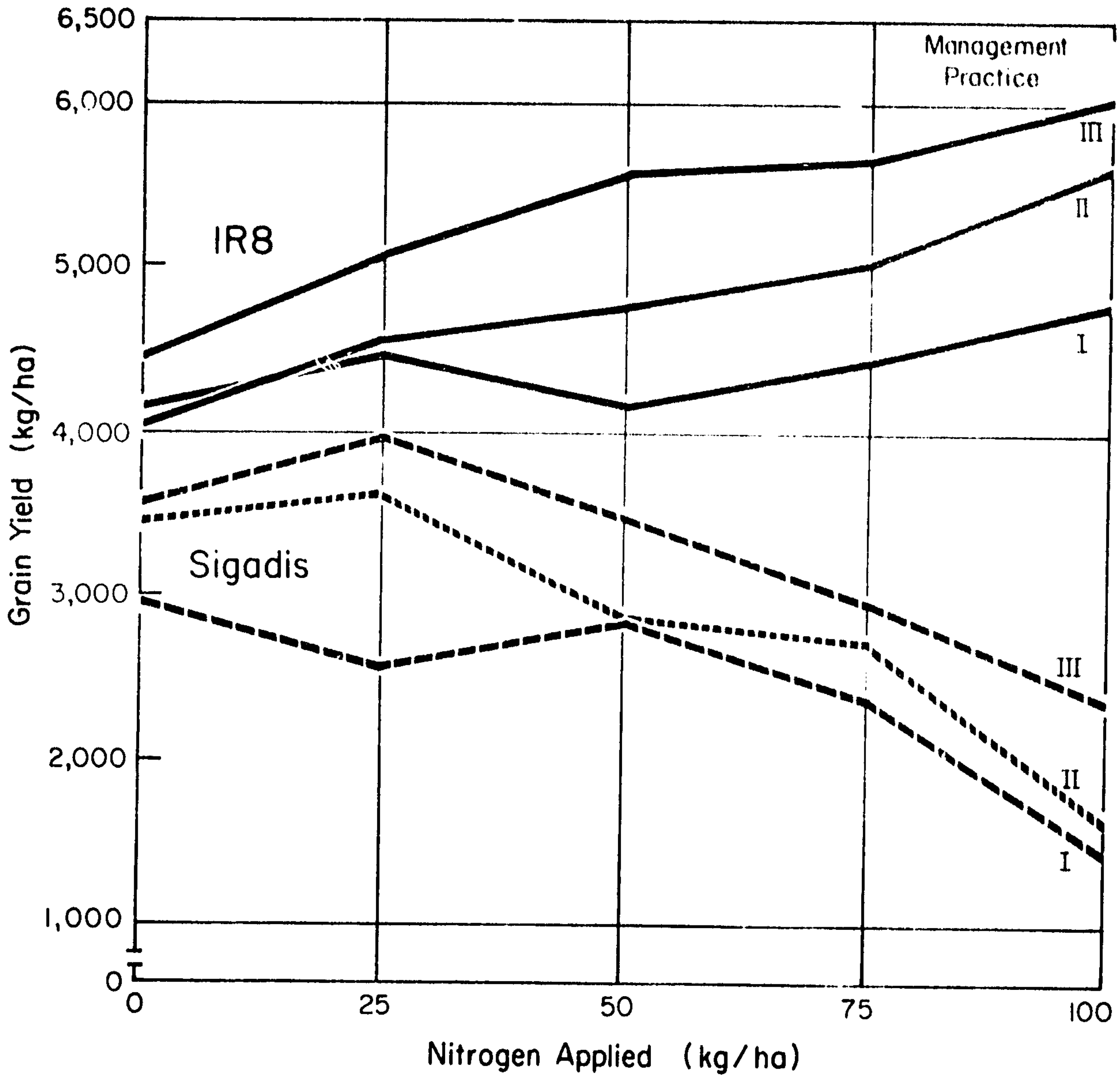

Fig. 6. Effect of varietal types, levels of nitrogen, and management practices on the grain yield of rice. IRRI, 1966 wet season

TABLE 6. Gross income less cash inputs for three management practices and 5 nitrogen levels, IR8, Sigadis, IRRI, 1966 wet season.[a]

Nitrogen applied (kg/ha)	Management level	Varieties IR8	Varieties Sigadis	Averages Management	Averages Nitrogen
		(₱/ha)			(₱/ha)
0	I	1180	819	1000	
	II	1061	840	950	933
	III	1012	689	850	
25	I	1222	643	932	
	II	1211	867	1039	992
	III	1210	798	1004	
50	I	1164	703	933	
	II	1244	558	902	934
	III	1350	585	967	
75	I	1229	496	862	
	II	1301	460	880	864
	III	1337	365	851	
100	I	1331	100	715	
	II	1481	26	753	733
	III	1398	65	732	
Average	I	1225	552		
	II	1260	550		
	III	1261	500		

a/ Rice - ₱0.36/kg.

Nitrogen - ₱1.18/kg N in urea.

Sevin - ₱34.48/kg (active ingredient).

Gamma-BHC - ₱23.50/kg (active ingredient).

(3) With IR8 the grain yield was increased substantially as the level of management was raised in both seasons.

(4) In this experiment the net return for any variety in the dry season was greatest with management practice I. Further increase in input increased the cost twofold to threefold and net return was correspondingly reduced. There were, however, some extremely high yields obtained with the management practice III.

3.14. Revision of model. The results obtained indicate that the inability to increase returns at the higher management levels was due to the high cost of insecticide for application in the field. The introduction of diazinon, a systemic chemical which can be used in place of carbaryl and gamma-BHC has changed this cost picture.

The model was revised in 1967 to take into account a wider range in level of management inputs and to test out this new chemical. A split split split plot design was used with four factors (fertilizer, variety, insecticide, and weed control). There were two varieties, IR8 and H-4 (a tall indica from Ceylon). For the other three factors there were 5 treatments each. Fertilizer application ranged from 0 to 140 kg/ha, diazinon treatments from 0 to 12 kg/ha, active ingredients, and weed control from 0 to 2 handweeding and 1 spraying with MCPA herbicide. The yield response to weeding was not significant. At mean yields for weeding, the yield response for fertilizer and diazinon is shown in Table 7 for the 1967 dry season. (The experiment was repeated for the 1967 wet season, but results have not yet been analyzed.)

TABLE 7. Yields of rice at 5 levels of nitrogen and diazinon, IR8 and H-4, IRRI, 1967 dry season, grain yield/ha (mean of 4 treatments and 2 reps).

Diazinon level (kg/ha, a.i.)	IR8 NO (kg/ha)	IR8 N50 (kg/ha)	IR8 N80 (kg/ha)	IR8 N110 (kg/ha)	IR8 N140 (kg/ha)	IR8 Mean (kg/ha)	H-4 NO (kg/ha)	H-4 N50 (kg/ha)	H-4 N80 (kg/ha)	H-4 N110 (kg/ha)	H-4 N140 (kg/ha)	H-4 Mean (kg/ha)
0	5953	6767	6609	6388	7638	6671	5219	6413	5974	4887	5447	5588
3	5729	6986	6652	6976	7432	6755	5439	6272	6170	4392	4155	5268
6	6066	6715	7254	7104	7696	6967	5258	5200	6292	4200	3772	4948
9	6305	6809	7443	7321	8796	7335	5449	6094	6662	4442	5189	5567
12	6880	6923	7542	8056	8969	7674	6280	6524	6971	6039	4682	6099
Mean	6187	6840	7100	7169	8106		5511	6101	6414	4796	4649	
Mean of variety						7080						5494

a.i. - active ingredient.

These results show that with the exception of fertilizer response in H-4, diminishing yields have not yet occurred over the range of the inputs used. The diazinon was applied 3 kg active ingredient to the ha at varying intervals. Thus, for example, the 6 kg total was split into two applications of 3 kg at 2 and 22 days after transplanting. The 12 kg was delivered in 4 applications at 20 day intervals. The data indicate that continuous protection against insect pests is desirable for higher rice yields. The problem is to determine the economic combination in terms of frequency of application and quantity of insecticide to apply per application.

3.2. Interrelationships between land preparation and weeding

The Department of Agricultural Economics has been analyzing the physical and economic relationships between land preparation, weeding, fertilizer, and variety.[5/] The research was designed to supplement the work in mechanization being conducted by the Agricultural Engineering Department.[6/] It also complements the work of the Department of Agronomy described in the previous section since some of the four variables used are the same (for

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5/ For a more complete discussion of this project, see R. Barker and N. Deomampo, "An Analysis of the Interrelationships Between Land Preparation and Weeding in Lowland Rice," paper presented at IRRI Thursday Seminar, Sept. 21, 1967.

6/ See S. S. Johnson, E. U. Quintana, and L. Johnson, "Mechanization of Rice Production," paper presented at seminar on Studies in the Economics of Rice Production, IRRI, Dec. 8-9, 1967.

example, the varieties IR8 and H-4) while others differ. The tools and methods used are for most cases similar to those employed currently by farmers in the Philippines. However, for experimental purposes insect and pest control have been maintained at a high level. The experiments have been conducted under irrigation on the Institute farm during the wet season 1966 and the dry and wet seasons 1967.

3.21. Analysis of experimental results. The analysis of these experiments, which is still in process, follows the broad conceptual framework expressed by the three equations below:

(1) Yield = f (amount of land preparation, weeds removed at weeding, date of weeding, weeds not removed, nitrogen level, variety)

(2) Weeds removed at weeding time = f (amount of land preparation, date of weeding, nitrogen level, variety)

(3) Manpower input at weeding = f (weeds removed at weeding time and date of weeding)

These equations do not show all factors influencing the dependent variables, but only those allowed to vary in the experiments.

Gross returns can be measured using equation (1). From equations (2) and (3) the basic cost structure can be developed. Equation (2) shows the physical relationship between land preparation and weeding. For a given level of land preparation, the weeds removed at weeding time can be determined. The manpower requirements for weeding are shown by equation (3). Fuel, manpower, and time requirements wer   sured for land preparation. Thus, the cost of a given level of land preparation can be calculated. The total cost equation can be written as follows:

(4) Cost of inputs = cost of land preparation + cost of weeding + cost of nitrogen

The cost of land preparation involves not only input cost but a time cost, since the time lost in delay of land preparation may result in lower yields. Once the time saved by mechanization is known, this can be translated into reduction in costs, or added returns.

The three equations indicate that weed weight measurements are as important a factor as yield measurements in this experiment. Knowledge about weed weights is needed because there is a cost involved in removing weeds and likewise, a cost in not removing weeds (i.e. lower yields). In the 1966 wet season, weeds remaining in the field were dried and weighed by sampling 70 days after harvest. In the 1967 dry season, all weeding was done by hand and weeds removed were dried and weighed. Weed weights were also measured 70 days after transplanting.

3.22. 1966 wet season. Fig. 7 follows the framework illustrated in Equation (1). The equation has been modified as follows:

(5) Yield = f (amount of land preparation, weeds not removed, variety)

Only three independent variables are considered. No record was kept during this crop season of weeds removed at weeding because weeding methods used did not permit this (i.e. weeds removed by rotary weeder or herbicide could not be weighed). Without this record, the effect of date of weeding also could not be quantified. Fertilizer level was held constant.

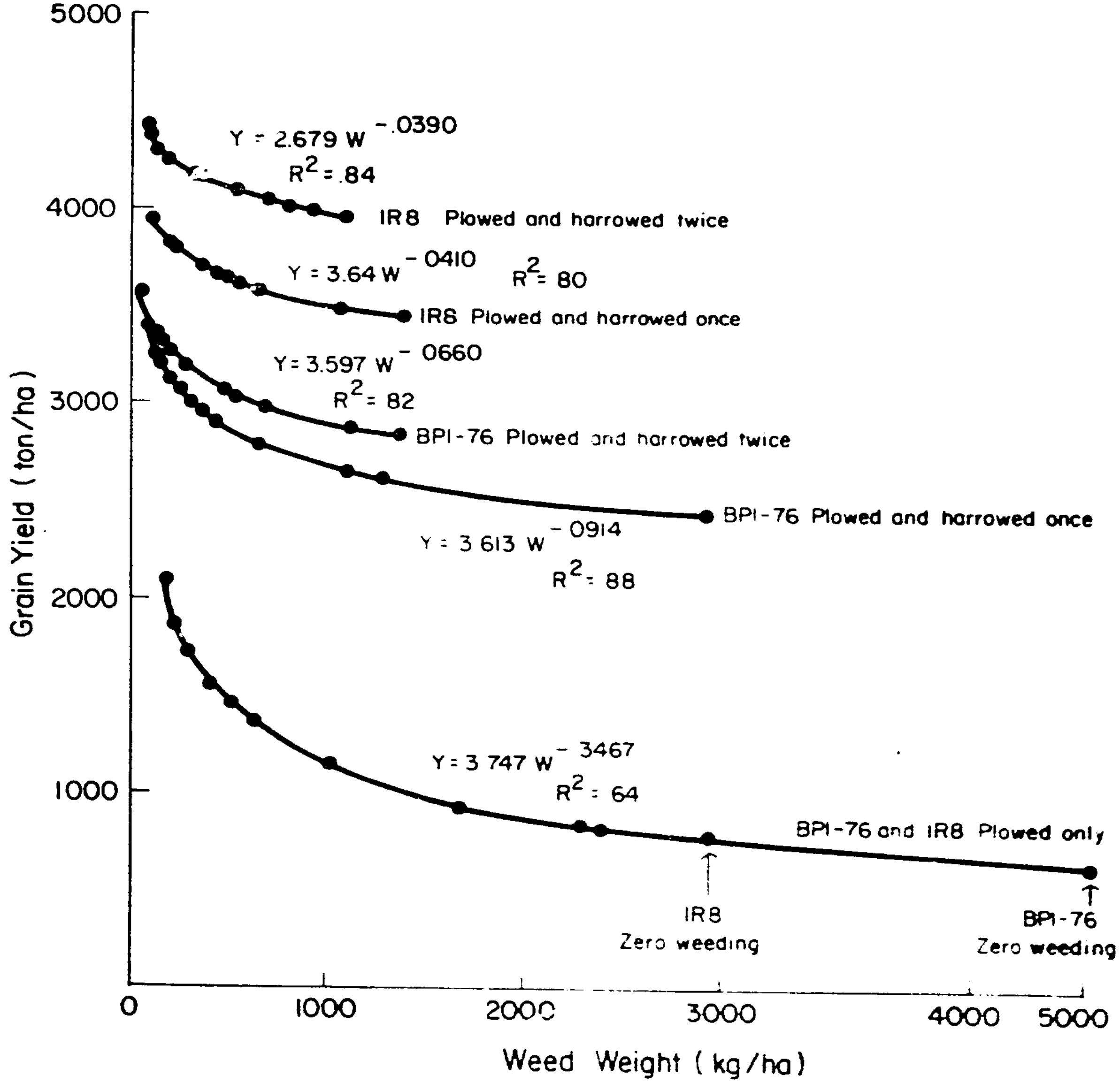

Fig. 7. Relationship between grain yield and weed weights taken at 70 DAT for BPI-76 (non-seasonal) and IR8, IRRI 1966 Wet Season

Each of the curves shown in Fig. 7 was computed in the following manner. At different levels of land preparation, observations of weed weight measured 70 days after transplanting were regressed against observations of yield. The extreme right of each curve shows the weed weight with no weeding. Moving from right to left, the level of weeding increases. Lowest weed weights were found with two handweedings and one MCPA spray, or in some cases with two handweedings alone.

At low levels of land preparation (1 plowing), the IR8 and BPI-76 responded almost identically to weeding. Thus, the observations were combined into a single equation. For higher levels of land preparation, equations for the two varieties were computed separately. The functions plotted in Fig. 7 have not been extrapolated beyond the range of observed values. The "tail" of the curve gets shorter with increased levels of land preparation reflecting the reduction in weed population. However, in obtaining highest yields, land preparation cannot substitute completely for weeding. With higher levels of land preparation, the yield gain that can be achieved from weeding becomes less. These findings are supported by the results of the Agronomy Department experiment described in the previous section.

The family of curves also indicates how the potential of the two varieties is expressed with higher levels of land preparation. At a given level of land preparation, yield of IR8 is higher. When no weeds were removed, weed weight at harvest was lower (as indicated by the "tail"). This suggests that IR8 is more competitive to weeds.

In the discussion above, the concept of weed weight is measured 70 days after transplanting sheds light on the interrelationships between land preparation and weeding. Nevertheless, from the point of view of measuring cost relationships, it would be more meaningful to measure weed weights at date of weeding. The design was revised for the 1967 dry season with this in mind.

3.23. 1967 dry season. Weeds were removed by hand, and weighed at seven-day intervals following transplanting (0, 7, 14, 21, 28, and 35). Each plot was weeded only once. Ten levels of land preparation (6 tractor, 3 carabao, and 0 tillage) were used: (1) to permit a quantitative estimate of the effect of additional passes of the tiller on weed weights at harvest, and (2) to allow a comparison between tractor and carabao performance.

Fig. 8 shows the relationship between the number of passes with the harrow and the weight of weeds removed at different dates of weeding. This set of equations is based upon the relationship set forth in equation (2) which was modified as follows:

(6) Weeds removed at weeding time = f (amount of land preparation and date of weeding)

Nitrogen treatments were averaged. There was no difference in weed weights between varieties. Therefore, data for varieties also were pooled in computing these functions.

The sharp break in the functions again emphasizes the importance of a minimum level of harrowing. Beyond a single pass with the harrow, the reduction in weed weights for additional passes with the harrow declined sharply.

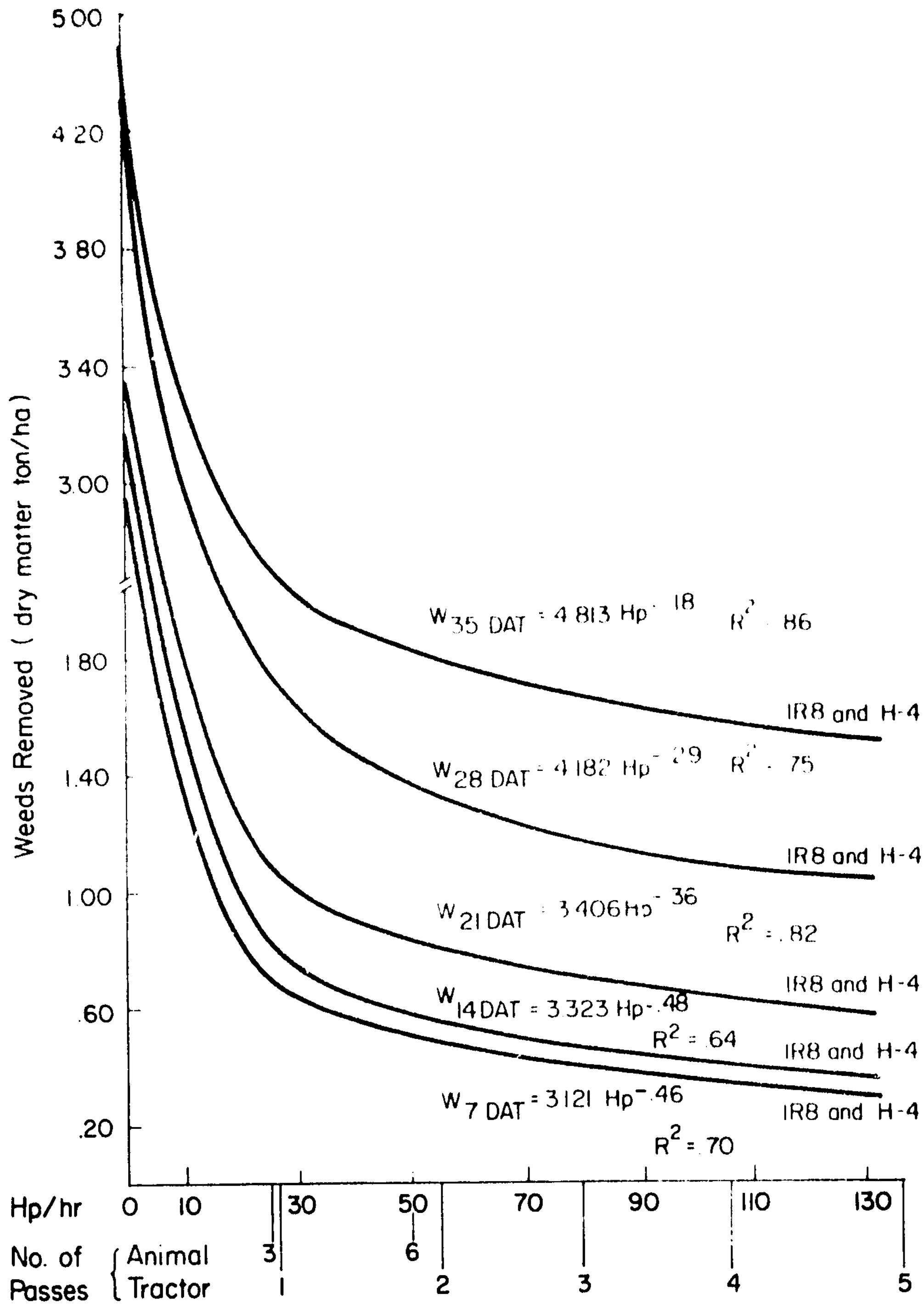

Fig. 8. Relationship between weeds removed at weeding time and horsepower-hours for harrowing, IRRI 1967 Dry Season

The final relationship is expressed in equation (3). This equation shows manpower required for different quantities of weeds removed at different dates of weeding. The functions are graphed in Fig. 9. As date of weeding is delayed further into the season, the efficiency of weeding is reduced. More man-hours are required to remove a given quantity of weeds.

3.24. Cost of land preparation vs cost of weeding. The physical relationships established in the previous section provide the basis for determining profitable economic alternatives. An illustration of the economic application is given in this section.

The results indicate that land preparation can be substituted for weeding over a fairly wide range without significant effect on yield levels. More time devoted to land preparation will mean less time required for weeding later on. What is the optimum level of land preparation? This will depend upon the cost of land preparation and the cost of weeding.

Under all but very low levels of land preparation highest yields of rice were most frequently obtained by weeding at approximately 21 days after harvest. Thus, the data shown in Table 8 are based upon this date of weeding. The table is divided into two sections dealing with harrowing and weeding. The cost of harrowing (col. 3) was determined using the custom rate for harrowing (₱35 per day per man and tractor, ₱10 per day for man and carabao). The time required for each pass of the harrow (col. 2) was almost identical, one additional pass costing approximately ₱19 (col. 4).

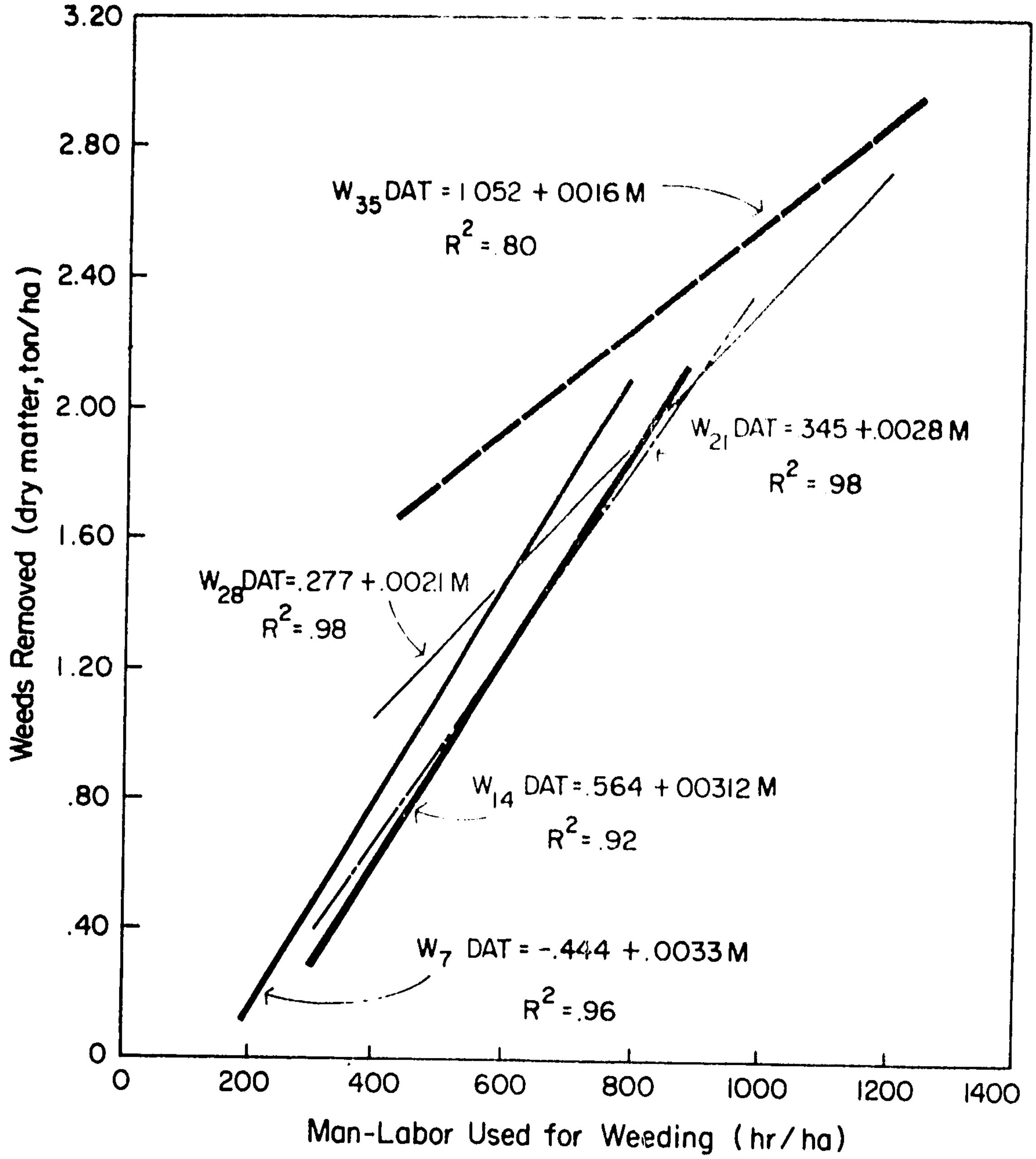

Fig. 9. Relationship between weeds removed and man-hours used for weeding at different weeding times (days after transplanting), IRRI 1967 Dry Season

TABLE 8. Relationship between cost of harrowing and weeding 1 hectare of rice 21 days after transplanting, 1967 dry season.

No. of passes with harrow (1)	Harrowing: Time used (2) (hrs/ha)	Harrowing: Total cost[a/] (3)	Harrowing: Added cost (4) (₱)	Weeding: Weed weight (5) (kg/ha)	Weeding: Man-hours (6)	Weeding: Total cost[b/] (7)	Weeding: Reduced cost (8) (₱)
6 Hp tractor							
1	4.31	18.32	-	1,040	510	204	-
2	8.62	37.68	19	800	445	178	26
3	12.93	56.50	19	700	395	158	20
4	17.24	75.33	19	620	365	146	12
5	21.55	94.15	19	580	350	140	6
Carabao							
3	25	31.2	-	1,080	520	208	-
6	50	62.50	31	840	440	176	32

a/ Based on custom rate (IRRI) of ₱35/day for tractor with two operators and ₱10 per day for carabao with operator.

b/ Based on ₱0.40/hr.

For every level of land preparation the weed weight which must be removed can be read directly from Fig. 8. For example, with one pass of the tractor at 21 days, 1,040 kg of weeds are removed per hectare. Reading from Fig. 9, removal of 1,040 kg of weeds at 21 days after transplanting requires 510 man-hours. With each pass of the harrow, the cost of weeding declines. At 3 passes with tractor, the cost of the last harrowing (₱19) is approximately equal to the cost of labor saved in weeding (₱20).

The relationship between carabao and tractor cost also is shown in Table 8. Based upon work performance in harrowing (as measured by weed removal), one pass of the tractor appears to be approximately equal to 3 passes of the carabao. There were no significant differences in yield or weed weights between: (1) treatments of 3 passes of carabao vs 1 tractor pass, and (2) treatments of 6 passes of carabao vs 2 tractor passes.

If one assumes the carabao equivalent to 1 horsepower and the tractor equivalent to 6 horsepower, the horsepower hours per hectare can be calculated by multiplying time per hectare by horsepower rating. Using time requirements for 1 pass of the harrow in col. 2 of Table 4, we obtain:

(6) Tractor horsepower hr/ha = 4.3 hr/ha x 6 horsepower

(7) Carabao horsepower hr/ha = 8.3 hr/ha x 1 horsepower

Thus, it requires almost three passes of the carabao to provide the horsepower hours per hectare equivalent to 1 pass of the tractor. Based on these assumed horsepower ratings, a horsepower hour per hectare with carabao is equal in performance to horsepower hour per hectare with tractor.[7/]

At current custom rates, however, the cost of the tractor is less than the cost of the carabao for equivalent work performed. While one pass of the tractor costs ₱18 to ₱19, three passes with the carabao costs ₱31.

Preliminary investigation suggests that the carabao is more efficient relative to the tractor in plowing than in harrowing. Plowing 1 hectare required a little over two days with the tractor and six days with the carabao. At current custom rates, use of the carabao would save approximately ₱10 per hectare. A survey of farms in Laguna conducted in 1964-65 indicates an awareness on the part of some farmers of this difference.[8/] Of 126 tractors used in custom work, 80 were used for plowing and harrowing, 34 for harrowing only, and 12 for plowing only.

3.25. Further economic analysis. The data provided by these experiments can be used for a more complete economic analysis of the potential role of mechanization. In such a study the resource situations under which mechanization is economically feasible must be determined. This can be accomplished only by budgeting costs and returns under a wide range of resource combinations. Part of the information required for such a study is contained in the functional relationships identified by these experiments.

7/ It is possible that this relationship will not hold over the full range of land preparation. The number of passes with the carabao has been extended to a maximum of 12 in the current experiment to make this tractor-carabao comparison over a wider range.

8/ RCA Project No. 5, Department of Agricultural Economics, U.P. College of Agriculture.

Graphs such as Fig. 5 also shed light on the payoffs for weeding at different levels of land preparation, and with different varieties. Information is available, although not presented here, on the payoffs for weeding at the right time. Further analysis of the experimental results will take into account the interrelationships between nitrogen levels and the other variables.

4.0. SUMMARY AND CONCLUSIONS

This paper has described two types of experiments which can provide useful information regarding the optimum level of resource inputs. First, the response of rice yield to nitrogen application for several varieties at two locations and two seasons are explained. These results indicate that recommendations for nitrogen application will differ according to differences in variety and location in the wet season and variety in the dry season Soil type will also influence the grain yield response in either wet or dry season. Wet season cloud cover (low solar energy) sets a ceiling on yields for varieties that are potentially responsive to fertilizer.

The multiple factor experiments have recently been initiated and have been only partially analyzed at the time of this writing. However, these experiments will provide insight as to the optimum "package" or combination of resources that should be employed in rice production. Again, as with nitrogen this package will vary according to variety, season, and location. For this reason, multiple factor experiments with simple designs and relatively few treatment combinations eventually should be tried in several locations. The experience obtained in the experiments conducted on the Institute farm will help in the design of such experiments in the future.

MECHANIZATION OF RICE PRODUCTION

Stanley S. Johnson, E.U. Quintana and Loyd Johnson

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1.0. INTRODUCTION

Along with improved bio-physical means of crop production, mechanization of part or all of the crop production process commonly is stressed or encouraged by developing nations. In the developing countries, the techniques of rice production especially have been lagging. However, the governments of the Southeast Asian countries, to varying extents, are accepting the thesis that mechanization is one of the essential elements of development. In the Philippines, for instance, capital at reasonable interest rates has been made available to many of the farmers to provide for purchases of machines.

Tractor purchases affect the farm production function and the economy in general in several ways with respect to such factors as capital and labor, and with respect to yield. The effect of the use of this capital on labor, yield and the "development of the country" is the general aim of studies by The International Rice Research Institute and the University of the Philippines, College of Agriculture. These research projects include the study of the bases for the introduction of machines in the Philippines, and the pattern of machinery use by farmers.

Initial emphasis of the farm machinery investigation has been in the central part of Luzon. Tractors have been sold in larger numbers relatively

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1/ Agricultural Economist, IRRI, Chairman, Department of Agricultural Economics, UPCA, and Agricultural Engineer, IRRI, respectively.

in Laguna Province and in parts of Central Luzon because of the increased earning potential and, therefore, repayment potential, made possible by irrigation. Hence, studies of tractor adoption have been started in Laguna Province by both the U.P. College of Agriculture and The International Rice Research Institute. In addition, an economic and engineering survey has been conducted in Central Luzon and other major rice-producing regions in the Philippines.

The U.P. College of Agriculture study has three years of data on 50 mechanized rice farms. Information has been compiled on the use of tractors in three municipalities, on cost and maintenance of tractors, farm area, production, disposal, capital investment and labor input.

Two studies are underway by The International Rice Research Institute. In Central Luzon, data on mechanized and animal production techniques have been gathered. Additionally, a separate study of tractors is undertaken, initially in Laguna Province, to provide data on tractor use and efficiency.

In this paper, some of the results of these studies will be presented. First, the area included in the Central Luzon study will be described, and the data pertinent to power use will be presented. Then the results of the tractor investigation in Laguna Province will be analyzed.

2.0. DESCRIPTION OF THE CENTRAL LUZON AREA

Lowland rice is grown on about two million hectares in the Philippines. Including upland hectarage and double cropping of lowland rice, the Philippines grows three million hectares of rice per year. Fifteen percent of the hectarage is irrigated double crop. Since the islands are mountainous, the rice-growing areas differ in terms of total and seasonal rainfall and streamflow. Consequently, several of the rice-growing areas need to be studied.

An initial study of the Central Luzon area has been underway for over a year on a weekly sampling basis to gather data on the farm operations sequence, the pattern of water use, and the soil and crop conditions of these areas. In order to define the sample, a preliminary observation trip was made to six of the Central Luzon provinces, Laguna, Bulacan, Nueva Ecija, Pangasinan, Tarlac and Pampanga. As a reference point for each sample site, kilometer posts along the major highways were used, measuring a "site" outward 25 meters from the road edge. A survey route of 800 kilometers was planned so as to require two men to travel five days per week and observe a maximum number of sites. A final survey list of 145 sites was determined, consisting only of rice land. Where practicable, sites were selected on alternate sides of the road.

Data are collected weekly on the status of each field. The surface water and soil depth are measured. A notation is made . the site needs weeding, nitrogen, or insecticide, if there are particular diseases, and other pertinent comments.

In addition, interviews are taken with the operators farming the sites. The data from this survey are compared with the weekly observations. Data from the site measurements and interviews lead to conclusions on the extent of and potential for mechanization.

Average rainfall and run-off for the survey area are compared with the cumulative percentages of planting and harvest cycles for the one-crop and two-crop rice farms (Fig. 1). Prior to, or at the very onset of, the monsoon season,

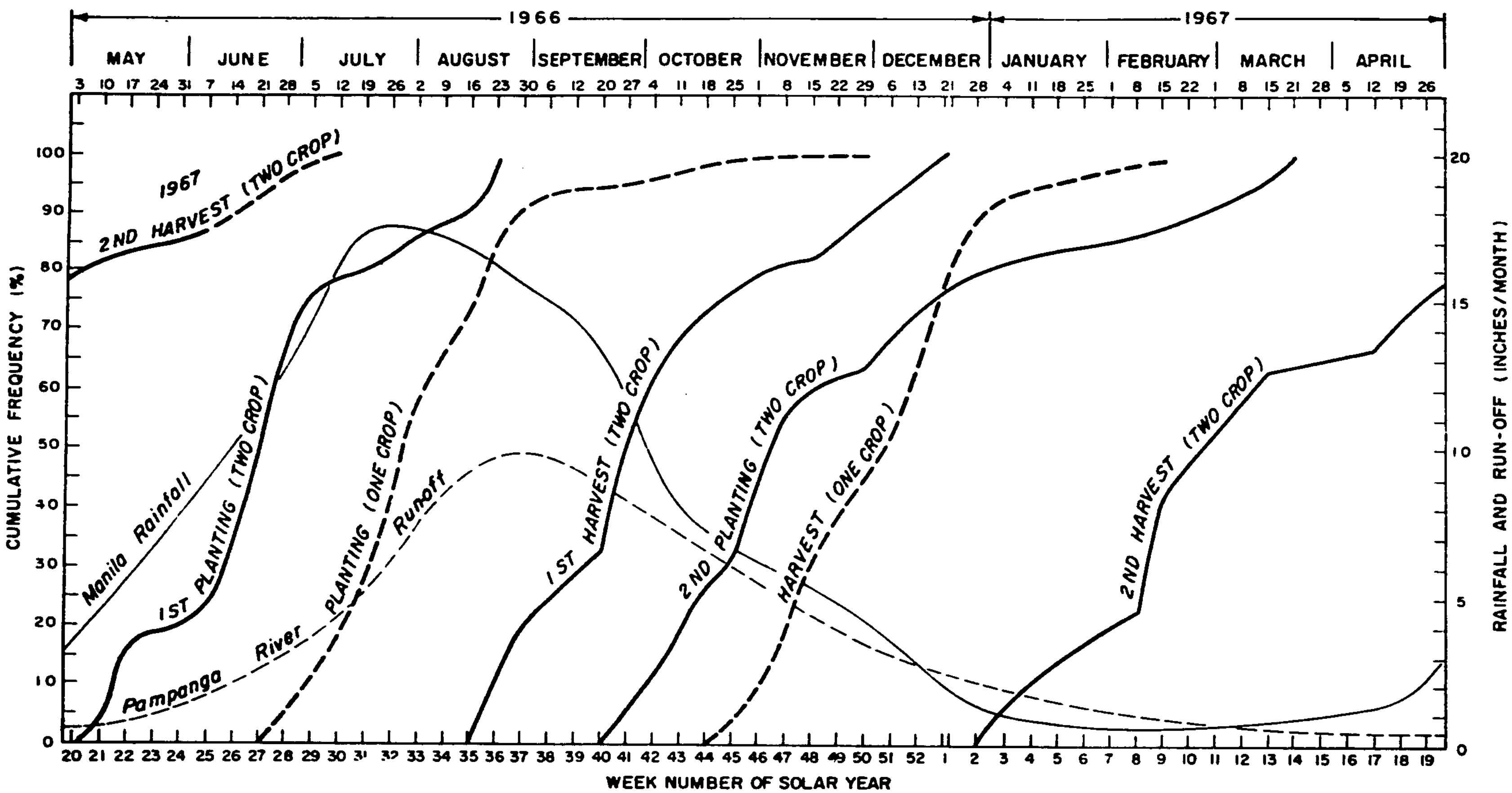

FIG. 1. Planting and harvest cycles for one- and two-crop rice sites in Central Luzon, Philippines, May, 1966 to July, 1967. (31 one-crop and 109 two-crop sites). Compared with average rainfall of Manila, Philippines and average runoff from the Pampanga River Basin.

the two-crop farmers prepared the land and transplanting was completed. This early planting required irrigation water which was available to less than 25 percent of the area. Plowing started on the one-crop farms with the first rains, but transplanting started about 5 to 6 weeks afterwards. The two-crop farms were planted to shorter season varieties that required about 14 weeks from transplanting to harvest, while the varieties on the one-crop sites required about 17 weeks from planting to maturity. The maximum rate of planting or harvesting as shown by the slope of the lines was 14 to 20 percent per week and the time between the two-crops was about 5 to 7 weeks. This would indicate that perhaps the animal and manpower available required a minimum of 5 to 7 weeks to plow, harrow and transplant and 5 to 7 weeks to harvest. Planting of one-crop overlapped the harvest of the same crop. Thus, during most of the year it is possible to locate work on land preparation, transplanting or harvesting in Central Luzon. The first crop from the two-crop sites and a major portion of the one-crop sites was harvested during the rainy season. This timing was necessary in order to have adequate water for growing the single non-irrigated crop and also to best utilize the residual run-off water for irrigating the second crop. The most favorable season for rice production is from about January 15 to April 30 when the available sunlight for plant growth is gradually increasing to a maximum. However, production in this season is not possible at the present time due to lack of irrigation water.

Yields of rice were obtained from as many of the sites as possible. The yield estimates were obtained by harvesting a four-square meter plot in the particular paddy being observed. Median yields were 3,040 kg/ha for the two-crop sites and 2,880 kg/ha for the one-crop sites. These yields are well above the estimate of the R. P. Department of Agriculture and Natural Resources of an average of 1,984 kg/ha for all of Central Luzon in the 1965/66 season.

Data were obtained on a number of factors considered as possible determinants of yield. While these observations are important alone, the data can also be utilized in a multiple regression equation. Here their effect on yield can be partially assessed.

A regression model was specified which, at the outset, included yield of rice and all observed variables. These variables are, for each site:

X_1 = Number of weeks in a rice crop

X_2 = " " " that rice crop needed weeding

X_3 = " " " that rice crop needed nitrogen

X_4 = " " " that rice crop needed insecticide

X_5 = " " " that rice crop showed dead heart

X_6 = " " " that rice crop showed white head

X_7 = Percent of reproductive weeks that rice crop was dry

X_8 = " " " " that rice crop was lodged

X_9 = Average soil depth in centimeters to a cone index of 70 psi

X_{10} = Tenure status (Tenant = 3; Part-owner = 2; Full owner = 1)

X_{11} = Number of rice crops grown per year (1 or 2)

X_{12} = Flooding of fields (No flooding = 0; Flooding = 1)

X_{13} = Rat damage (No significant rat damage = 0; rat damage severe = 1)

X_{14} = Date planted

X_{15} = Date harvested

X_{16} = Bird damage (Damaged severely = 1;
No significant damage = 0)

In the initial specification of the model, all of the above variables were included. However, variables X_{10} to X_{16} were adjudged to be either not of sufficient importance to be included or of importance but conditioned by other factors. While some, rat damage and flooding, were significant, their effect so lowered yield that other factors played no part. These few observations were withdrawn. The number of rice crops grown (one or two) was important, and later regressions were specified containing either one- or two-crop data.

Three regressions were then "run" using independent variables X_1 - X_9, and are listed as Y_1 through Y_3:

Y_1 = Yield in kilograms of rough rice (Local name: Palay) per hectare - one-crop sites

Y_2 = Yield in kilograms of rough rice (Palay) per hectare - two-crop sites

Y_3 = Yield in kilograms of rough rice (Palay) per hectare - all sites

The three regression equations are listed below. The numbers in parentheses below the regression coefficients are the standard errors of the regression coefficients.2/

$$\begin{array}{lllllll} Y_1 = 1861 + \underset{(45.7)}{83.3X_1^{**}} & - \underset{(26.7)}{55.6X_2^{*}} & + \underset{(21.7)}{10.0X_3} & - \underset{(20.9)}{15.7X_4} & - \underset{(62.1)}{39.0X_5} & - \underset{(102.0)}{145.6X_6^{***}} \\ \quad + \underset{(3.70)}{3.10X_7} & + \underset{(5.81)}{19.3X_8^{*}} & - \underset{(0.396)}{0.297X_9} & & & \end{array}$$

R^2 = .37 D.F. = 81

2/ * - Significant at 5% level or better; ** - Significant at 10% level; *** - Significant at 20% level.

$$Y_2 = 1860 + \underset{(114.3)}{202.5X_1^{**}} - \underset{(57.1)}{89.2X_2^{***}} - \underset{(76.9)}{140.2X_3^{**}} - \underset{(78.9)}{83.9X_4} + \underset{(149.1)}{299.1X_5}$$

$$- \underset{(104.2)}{113.4X_6} - \underset{(8.34)}{4.30X_7} + \underset{(10.7)}{19.2X_8^{**}} + \underset{(0.997)}{0.852X_9}$$

$R^2 = .68$ D.F. = 19

$$Y_3 = 2038 + \underset{(39.3)}{80.6X_1^{*}} - \underset{(23.4)}{57.7X_2^{*}} + \underset{(20.3)}{4.23X_3} - \underset{(19.5)}{17.3X_4} - \underset{(54.9)}{16.5X_5} - \underset{(70.5)}{146.4X_6^{*}}$$

$$+ \underset{(2.93)}{1.49X_7} + \underset{(4.89)}{21.2X_8^{*}} - \underset{(0.354)}{0.292X_9}$$

$R^2 = .39$ D.F. = 110

The regression coefficients compared with the standard errors obtained demonstrate that the data indicating weeks in rice, percent lodged, weeding need, nutrient need, and white head significantly affect yields.

A large number of the rice varieties in the survey were susceptible to lodging. Early lodging is normally expected to result in reduced yield. However, most of the varieties planted were of the type that lodge at medium yield. Thus, the sign of the regression coefficient is positive as the higher yielding sites lodged earlier. In the future, as higher yields are obtained from improved and lodging-resistant varieties, the sign of the regression coefficient should become negative for the higher yields.

Can one typify the farm and equipment in the Central Luzon area? First, one can look at the tenure status of the farmer and the typical size of farm operation. In Table 1 is listed the tenure status by both numbers of farms and hectares, of several important provinces. In the Central Luzon valley, Pampanga and Nueva Ecija Provinces are quite important. In these provinces the rate of farm tenancy ranges from 80 to 89 percent of the numbers of farms and from

TABLE 1. Rice farm tenure, selected provinces, number and hectarage of rice farm. a/

Province	Tenure							
	Full owner		Part owner		Tenant		All	
	Number	%	Number	%	Number	%	Number	%
Pampanga	1,211	6	901	5	17,250	89	19,363	100
Nueva Ecija	6,713	12	4,467	8	43,044	80	54,224	100
Laguna	1,412	15	1,176	13	6,672	72	9,260	100
Cotabato	47,888	64	5,636	8	20,673	28	74,197	100
Isabela	14,428	40	5,587	16	15,516	44	35,531	100
	Hectares	%	Hectares	%	Hectares	%	Hectares	%
Pampanga	3,389.6	6	4,084.5	7	51,693.8	87	59,167.9	100
Nueva Ecija	24,887.1	15	18,786.3	11	126,287.1	74	169,951.5	100
Laguna	4,969.1	20	4,138.1	17	15,444.3	63	24,551.5	100
Cotabato	253,890.2	73	36,396.1	10	57,353.5	17	347,639.8	100
Isabela	65,752.1	48	26,517.7	19	45,997.8	33	138,267.6	100

a/ Census of the Philippines, 1960, Agriculture, Department of Commerce and Ind., Bureau of the Census and Statistics, Manila.

74 to 87 percent of the hectarage. For the more recently developed rice farming areas, Isabela Province in the north has a tenancy rate of 44 percent, and Cotabato Province in the south has a rate of 28 percent. Thus, the highest rate of tenancy is associated with the older more established farming areas.

The average size of farm operation in the Philippines is about 3 hectares. Table 2 indicates that of 114 farms interviewed in Central Luzon, 63 reported a hectarage between 1.6 and 3.5 hectares in size.

Outside sources indicate that Central Luzon is about 9 percent irrigated for a second crop of rice. The percentage irrigation in Laguna Province, however, is quite high. The number of irrigated two-crop farms in Laguna Province contained in the sample was 8 farms out of 13 reporting, while for Central Luzon, the number was 22 out of 108.

A summary of farm equipment and animals owned is contained in Table 2. For farms below 1.5 hectares in size, the typical equipment was 1 plow, 1 harrow and 1 carabao. For farms between 1.6 and 3.5 hectares, the equipment in percentage terms was 1.4 plows, 1.5 harrows and 1.5 work animals. For farms above 3.6 hectares, the equipment was 2 plows, 2 harrows, and 2 carabaos. Of the 114 farms reporting, while several indicated tractor use, only 1 farm owned a tractor. Tractors and carabao were used almost wholly for land preparation work.

2.1. General comments on labor and power use in Central Luzon

Several questions were asked as to the demand for and supply of farm labor, and concerning power use.

TABLE 2. Farm equipment and animals owned, by area of farm, (in percent), 1966-67, Central Luzon Survey.

Hectar-age	No. of farm reporting	Tractor	Plow	Harrow[a/]	Weeder	Sprayer	Carabao	Cattle
				(percent)				
Below 1.5	1[b/]	(11)[c/]	111	123	17	11	94	5
1.6 - 2.5	30	(16)	140	140	10	3	143	0
2.6 - 3.5	33	3(36)	142	163	18	12	163	15
3.6 - 5.5	16	(6)	212	218	12	18	231	0
5.6 - above	18	(11)	250	238	22	38	244	0
All farms	114	(16)[d/]	164	171	15	14	170	5

a/ Includes upland harrows used in lowland paddies, specifically in Pangasinan.

b/ Two farmers reported no equipment owned.

c/ Tractor hired.

d/ Less than 1%.

Farm equipment and animals owned, by area of farm, (actual numbers), 1966-67, Central Luzon Survey.

Hectar-age	No. of farm reporting	Tractor	Plow	Harrow[a/]	Weeder	Sprayer	Carabao	Cattle
Below 1.5	17[b/]	(2)[c/]	19	21	3	2	16	1
1.6 - 2.5	30	(5)	42	42	3	1	43	0
2.6 - 3.5	33	1(12)	47	54	6	4	54	5
3.6 - 5.5	16	(1)	34	35	2	3	37	0
5.6 - above	18	(2)	45	43	4	7	44	0
All farms	114	1(22)	187	195	18	17	194	6

a/ Includes upland harrow used in lowland paddies, specifically in Pangasinan.

b/ Two farmers reported no equipment owned.

c/ Numbers enclosed are hired tractors.

The first questions were with respect to labor use. The purpose of the inquiry was to determine the labor use throughout the crop year. Perhaps the extent of the farm operations requiring reliance on hired labor can indicate the immediate potential for changes in the operation which are more economical. Further, indications of labor shortage at peak period may indicate production bottlenecks. Table 3 contains estimates of average labor requirements of rice farms in the Central Luzon survey.3/ There are three peak periods of labor use: land preparation, transplanting, and harvesting-threshing.

The make-up of the laborers in these farm operations may vary according to skill required or to the source of payment for work done. On share-tenant farms, a common arrangement is for the landowner and tenant to share 50-50 in total receipts. The owner usually pays for all of the costs pertaining to the land and improvements, all the transplanting labor cost, half the materials and seed used, and half of the harvesting and threshing cost. The remaining costs are borne by the tenant.

Land preparation requires some skill and is heavy work so that this operation is performed only by men. The other operations may need skill but can be done by both men, women and children. The percentage of work done by hired labor varied. Hired labor was used almost exclusively for transplanting the seedlings. Almost one-half of the weeding was by hired labor, and about one-sixth of the total for plowing and harrowing.

3/ A further listing for two actual farms is contained in the appendix.

TABLE 3. Average labor requirements of rice farms, in man-days, Laguna Province and Central Luzon Survey, 1966-67.

Operation	Irrigated				Non-irrigated	
	2 crop area		1 crop area		1 crop area	
	Tractor used	Carabao used	Tractor used	Carabao used	Tractor used	Carabao used
No. of farms	25	27	7	39	3	41
	Man-days (8 hours per day)					
Seedbed preparation and care	3.43	2.51	3.84	2.68	2.39	3.12
Plowing	3.86	5.94	3.21	7.91	7.15	8.32
Harrowing	7.71	8.06	4.96	9.30	5.82	10.42
Repair & cleaning of dikes	3.83	2.43	2.94	3.87	1.52	4.52
Pulling & rolling seedlings	2.48	2.53	2.87	2.44	5.39	2.83
Transplanting	12.77	10.85	11.33	13.47	13.82	14.11
Weeding	6.84	4.58	2.11	6.55	15.27	4.79
Fertilizing	1.09	0.28	0.66	0.72	0.73	0.48
Spraying	1.10	1.08	0.41	0.44	0.36	0.62
Harvesting-threshing	18.34	18.33	18.21	16.12	14.67	15.30
Total	61.45	56.59	50.54	63.50	67.12	64.51

The farmers stated that they had little difficulty in obtaining transplanting and harvesting labor, jobs in which women and children are available. Farmers noted some difficulty in obtaining labor for plowing and harrowing. The shortage may be intensified because of the practice of local communities to perform particular farm operations simultaneously. We anticipate that this type of labor would be in particularly short supply in some of the sparsely settled rice areas, two areas of which we will study.

There is considerable variation in the intensity of land preparation. The frequency of sequence of land preparation operations among the farms interviewed are as follows, given that each harrowing contains two "passes" of the field:

Operation	Frequency
One plow, three harrow	61
Two plow, three harrow	10
One plow, two harrow	9
Two plow, two harrow	8
One plow, five harrow	6
One plow, four harrow	5
One plow, six harrow	5
Others	17
Total farmers interviewed	121

Farmers did not view weeding labor as a problem. Weeding practices among the 121 farmers were as follows:

No weeding	30
One hand or rotary weeding	66
Two or more weedings	22
No data	3
Total	121 farms

Hence, on one-fourth of the farms there was no weeding; on over three-fourths there was one weeding or less. However, this situation is likely to change towards a greater demand for weeding labor, for the improved varieties require clean culture for the better yields.

In brief, only in one farm operation, land preparation, was there any comment made as to labor shortage. This situation arises or is intensified by the practice of the entire community (barrio) performing the farm operation simultaneously. There will be little change in this practice for rainfall-dependent operations. However, in the irrigated two-crop areas (15% of the total area or less) the practice of each barrio performing operations simultaneously is less strong. Thus, mechanizing land preparation will have the least undesirable effect on employment.

Work animals can be either owned or hired. The data on hiring a man and carabao for custom work indicate that the prevailing cost is ₱7.50 to ₱10.00 per day. The computation of the cost of maintaining one's own carabao is more difficult. Some of the data on carabao are listed in Table 4. Carabaos are asserted to have a working life of from age 3 to 25, or 22 years. These data indicate that farmers expected the animal to work to age 20. If the farmer buys his replacements (60% said they did), he may pay ₱200 for a 2-year-old animal. Other data indicate that these farmers hire little help to look after the carabao during the time the animal is not working. No pasture or grazing land is set aside for the animal, and the practice of buying supplemental feed for the animal is not common. Only 20 percent of the farmers indicated use of a

TABLE 4. Carabao data.

Province	No. of farms surveyed	No. of farms reporting no carabao	Average no. of carabaos owned	Carabaos worked	Age-years	Age limit to work	Hours/day work	Hours/week to look after carabao	Cost of 2-year-old carabao
Laguna	11	6	2	1.6	9	21	5	19	₱240
Bulacan	24	1	1.7	1.4	11	20.6	8.1	22.4	₱218
Nueva Ecija	53	5	2.2	1.8	9.1	19.7	7.5	24.9	₱206
Pangasinan	17	1	2.3	2.3	9.8	22.8	6.8	21.9	₱206
Tarlac	5	0	2.6	2.2	8.0	22.4	8.2	26.6	₱192
Pampanga	6	0	3.3	2.0	8.8	20.0	5.6	22.6	₱217

veterinarian or of medicines for the animals. However, farmers thought the carabao is getting scarce and harder to find.

In examining farmers' attitudes toward tractors, over 50 percent indicated they would use the tractor for land preparation if they could conveniently hire it done. They listed as reasons for tractor use: timeliness, easily kills weeds, less tedious, and the lack of carabaos.

3.0. THE U.P. COLLEGE OF AGRICULTURE HAND TRACTOR SURVEY

Some of the pertinent results of the U.P. College of Agriculture hand tractor survey are listed in Table 5. One hundred fifty farmers were interviewed originally, but only 50 of these were renewed for the succeeding two years. The two-year period provides an opportunity to examine any changes that have occurred. An increase was noted in the number of tractors per farm, the average horsepower per tractor, and the purchase price per tractor. The farm data indicate a similar farm size, but a sizeable increase in yield. The cost of production increased, as well, and the percentage use of inputs of fertilizer and chemicals went up. Thus, mechanization of the lowland rice farms in Laguna is continuing.

Interestingly enough, during the first year of the survey there was an indication of some sharing of tractor purchase. However, by the second year each farmer owned at least one tractor, and 50 percent of the operators owned 2 or more tractors in the third year.

Another change apparently occurred as indicated by a decreasing percentage of the tractors used for contract hire. The reason given was that repair and maintenance costs were often more than the income derived from tractor hire.

TABLE 5. Summary data from "The Economics of Using Hand Tractors in Lowland Rice Farms, Laguna, 1964 to 1967."a/

Item	Crop year 1964-65	1965-66	1966-67
I. The Tractor			
Number of tractors	187	72	83
Tractor per farm	1.25	1.44	1.66
Average horsepower	4.6	4.8	5.0
Purchase price per tractor (₱)	2,544	2,935	3,225
Days used/tractor/year	65.38	61.23	56.05
On farm	47.07	31.63	29.10
Off-farm	18.31	29.60	26.95
Area served/tractor/year	20.98	21.24	13.29
On farm	7.31	6.22	5.45
Off-farm	13.77	15.02	7.84
Number of tractors used for off-farm work	127	40	38
Percent of total tractors used for off-farm work (%)	68	56	46
II. Characteristics of Farms			
Number of farms	150	50	50
Area per farm in hectares:			
Wet season (ha)	4.77	4.56	4.61
Dry season (ha)	4.79	4.49	4.72
Effective crop area (ha)	9.56	9.05	9.33
Percent double cropped (%)	99.58	98.46	97.67

a/ Source: U.P. College of Agriculture Hand Tractor Survey, Laguna Province.

Table 5. (cont'd).

Item	Crop year 1964-65	1965-66	1966-67
III. Production per hectare (cav)	57.76	62.25	69.76
Wet season (cav)	48.78	51.58	55.55
Dry season (cav)	66.65	72.01	83.37
IV. Cost of production per hectare			
Cash cost per hectare (₱)	197.99	174.53	207.07
Non-cash cost per hectare (₱)	528.53	647.09	795.11
Total cost per hectare (₱)	726.52	821.62	1,002.18
Total cost of land preparation (₱)	153.25	127.00	133.00
V. Income per hectare			
Total revenue per hectare (₱)	810.30	989.60	1,359.12
Net revenue per hectare (₱)	83.78	167.98	356.94
Income from off-farm work (₱)	851.55	895.20	455.20
Average price per cavan (₱)	14.05	15.88	19.48
VI. Labor requirement			
Man-days per hectare (days)	74.14	64.36	66.70
Tractor-days per hectare (days)	6.23	5.15	5.33
Plowing (days)	2.18	1.62	1.59
Harrowing (days)	3.95	3.46	3.73
Animal-days per hectare (days)	0.95	1.63	1.08
Days weeding per hectare (days)	21.84	14.60	17.74

Table 5. (cont'd).

Item	Crop year 1964-65	1965-66	1966-67
VII. Other information			
Break even: Days per year	42.21	26.63	21.46
Hectares per year	5.56	4.28	3.94
Benefit-cost ratio	3:1	3:1	4:1
Variety: Highest yielder	Surigao: 84 cav	Intan: 73 cav	IR8: 94 cav
Lowest yielder	Peta: 41 cav	S. Julian: 41 cav	Thailand: 29 cav
Capital investment per ha (₱)	7,984	8,479	8,622
Tenant: Tenant (no.)	121	35	36
Part-owner (no.)	20	14	12
Owner (no.)	9	1	2
Percent of total farms that used:			
Fertilizer (%)	86	90	100
Farm chemicals (%)	87	90	90.2
Weeders (mechanicals) (%)	66	80	96
Range of yield per hectare (cav)	16-150	20-151	32-106
Range of area per farm (ha)	0.7-25	0.7-9	0.7-9

As mentioned earlier, labor use is seasonal. The number of man-days per hectare declined from an initial 74 to 67 man-days per crop. Although there was a reduction in man-days for plowing and harrowing (operators being more experienced in handling machines), this was offset by the increased labor in harvesting and threshing resulting from increased yield. Other farm operations such as weeding showed marked reduction in labor use. Perhaps this decrease is due to the use of weedicides, and to the use of rotary weeders. Handweeding was usually practiced for thoroughness since man can weed in between hills. The percentage of farmers who used rotary weeders was 66 percent during the first year, 80 during the second year and 96 percent during the last year.

Aside from transplanting, weeding and harvesting, hired labor was also employed to operate tractors for plowing and harrowing, because of the need for 2 operators so as to provide continuous use of the tractor. The labor for the 3 years was primarily hired, accounting for 80 percent of the total labor requirement. There was still some use of animal for plowing close to the levees which could not be done with the tractor. Sometimes this operation is done by hoes and mattocks instead of using an animal. Some farmers resorted to use of an animal in land preparation because their tractors were inoperative.

4.0. THE INTERNATIONAL RICE RESEARCH INSTITUTE HAND TRACTOR STUDY

During late 1966 and in 1967 a study was conducted on the use of hand tractors for tillage operations on lowland rice farms in Laguna Province. While the purpose was not to obtain an accurate count of all tractors, the listing of the number of tractors purchased by years indicated the pattern of machine introduction in the Province.

Year	No. of tractors purchased	Cumulative total
Prior to 1959	5	5
1959	4	9
1960	4	13
1961	12	25
1962	33	58
1963	35	93
1964	55	148
1965	88	236
1966	93	329
1967	102	431

The hand tractors are largely the tractive type tillers designed to pull plows, comb harrows and small trailers from 4 to 6 HP. To a lesser extent the larger horsepower (6 to 13 HP) rotary tiller types are being sold. Few standard-sized 4-wheel tractors have been noted doing rice work.

On data tabulated for the 6 HP Landmaster tractor, about one-third of the farmers owning the tractors worked between 2 to 3 hectares of paddy land. A further third had between 3 to 4 hectares, while most of the remaining third had from 5 to 8 hectares. In addition, there was usually some contract work away from the owner's farm. The most commonly mentioned numbers of days worked were 15 and 30 days of contract hire.

Several types of small hand tractors were sold in the Province. While most makes were Japanese, a small British 6-HP tractor, the Landmaster, was most numerous. Most of the tractive type tillers were of comparable size and horsepower and sold for roughly the same price. Payments made for tractors ranged from ₱1,000 to ₱4,900, depending on size, equipment, and type of payment. A typical price for a 6-HP tractive type tiller with cage wheels, plow and comb harrow was ₱3,700.00 for cash. Terms could usually be obtained by two-crop farmers extending the payments over 7 crops, or 3 1/2 years. In addition to the ₱3,700.00 base price, a service charge of ₱1,200.00 was added, making each of the 7 payments ₱700.00. The two most quoted prices paid were between ₱2,500-2,900 and ₱4,500-4,900.

The contract rate for hand tractor work was between ₱25.00-₱35.00. However, the lower rates required meals to be provided for the two operators of each tractor. The present rate around Los Baños which includes meals is ₱35.00.

During the survey, observations and timed tests of harrowing operations under farm conditions indicated that 3 to 5 passes for the harrow were required for complete land preparation on soft soils. Consumption of gasoline was about 4 to 6 liters/ha for one pass with the harrow. Only a few tests were made on the rotary tilling of flooded fields, but those few indicated that 10 to 16 liters/hectare of diesel and 10 to 27 liters/ha of gasoline were required for rotary tilling one hectare, while plowing averaged about 33 liters/ha of gasoline.

5.0. COMPARISON OF HAND TRACTORS AND ANIMALS

During 1967 a series of trials were conducted on four adjacent quarter-hectare plots at the IRRI experimental farm to compare two power units. Four 4- to 6-HP tractive type hand tractors with two operators each, and eight carabaos with their individual owners were used in the trials. One hectare was subdivided into 16 plots. Individual plots measured approximately 25 meters by 26 meters. The whole area was flooded five days before the test. The depth of soil penetrated before reaching a bearing capacity of 20 psi, 35 psi, and 70 psi was determined through the use of the WES cone penetrometer;[4/] depths were found to be approximately 18 cm, 28 cm, and 35 cm, respectively. Hand tractors and carabaos started simultaneously in adjacent plots. Two plots were each plowed once and harrowed a few times by two hand tractors. The degree of puddling and incorporation of vegetation after every pass with the comb harrow was observed. Harrowing was stopped when the operators considered the plots comparable to outside farmers' fields ready for planting. Having completed one plowing, the two carabaos were then required to pass the comb harrow as many times as necessary to approximate the quality of work done by the hand tractors. The same procedure was followed in the other plots.

Each pass with the plow and the harrow was timed; the number of passes and of rounds per pass was noted.

The effective field capacity (efc) was computed by substituting values in the formula:

$$\text{efc (sq m/hr)} = \frac{60 \times 2{:}N{:}L{:}W}{t}$$

where

60 = No. of minutes in one hour
2 = No. of trips per round
N = No. of rounds
L = Length of trip, in meters
W = Width of implement, in meters
t = Time used during operation, in minutes

4/ Knight, S. J. and D. R. Freitag, Measurement of Soil Trafficability Characteristics. Transactions of the ASAE, 5(2): 121-124 and 132, 1962.

The plowing or harrowing time is arrived at by substituting values in the formula:

$$\text{Plowing or harrowing time per single pass (hrs/ha)} = \frac{10000}{A} \times T \times P$$

where

10000 = No. of sq m in a hectare
A = Area of plot in sq m
T = Time used during operation, in hours
P = No. of passes of the implement, usually 1 for plowing and several for harrowing

Hand tractors with 18 cm moldboard plows were computed to have a mean effective field capacity of 311 square meters per hour. This would require 32.2 hours of plowing time per hectare. However, actual mean time used was only 12.90 hrs/ha. This indicates that the plows were cutting furrows 18 cm wide and covering unplowed strips about 27 cm wide.

With the 137-cm comb harrows, the same hand tractors had to make 3 to 4 passes through the test plots to complete preparation of the land for transplanting. These 3 to 4 passes took 13.90 hours to finish a hectare. However, with their mean effective field capacity of 2381 sq m/hr, it would require 14.7 hours to harrow a hectare. This shows that about 6% of the area, at one time or another, was not harrowed. Adding up the time used for plowing and harrowing a hectare of land, we have 26.80 ± 3.11 hours or roughly 4.5 days.

With 12 cm moldboard plows, the carabaos have a mean effective field capacity of 138 sq m/hr. Although it would require a mean time of 72.5 hr/ha, the actual time required was only 36.34 hours. The plows, therefore, were cutting furrows about 12 cm wide and covering unplowed strips about 12 cm wide. The animal and machine plowing methods were about the same. The mean depth of plowing was 16 cm. As in the case of the hand tractor-drawn plows, the carabao-drawn plows were operating through soft soil.

With the 137-cm comb harrow, the carabaos had to traverse the test plots 9 to 13 times to achieve a finish comparable to that in the plots prepared by means of the hand tractors. These 9 to 13 passes took 83.41 hours to finish a hectare. With a mean effective field capacity of 1554 sq m/hr, it would take 73.3 hours to harrow a hectare. This shows that there was overlapping of about 20 cm in the operation, or about 14% of the area was harrowed twice on each pass. Some 119.75 + 29.54 hours (about 20 days) are needed to plow and harrow a hectare adequately for planting.

6.0. SUMMARY

Highlights of three surveys are presented above. From the Central Luzon survey, data had been presented so as to provide a description of the area and of the type of rice farming there. Attitudes and certain data were given on the use of animal and tractor power. From the tractor studies, one can see the changes taking place in mechanization in one irrigated area of the Philippines.

One needs to look further into the questions of how or if the farmer can afford a tractor. Figure 2 presents the method used in obtaining yield and crop division data from the interviews with farmers in Central Luzon and Laguna Province. This simple method is useful as few farmers are involved in cash transactions. All obligations of the farmer are settled by division of the harvest. One can use this method to compute the share of the crop that can be available

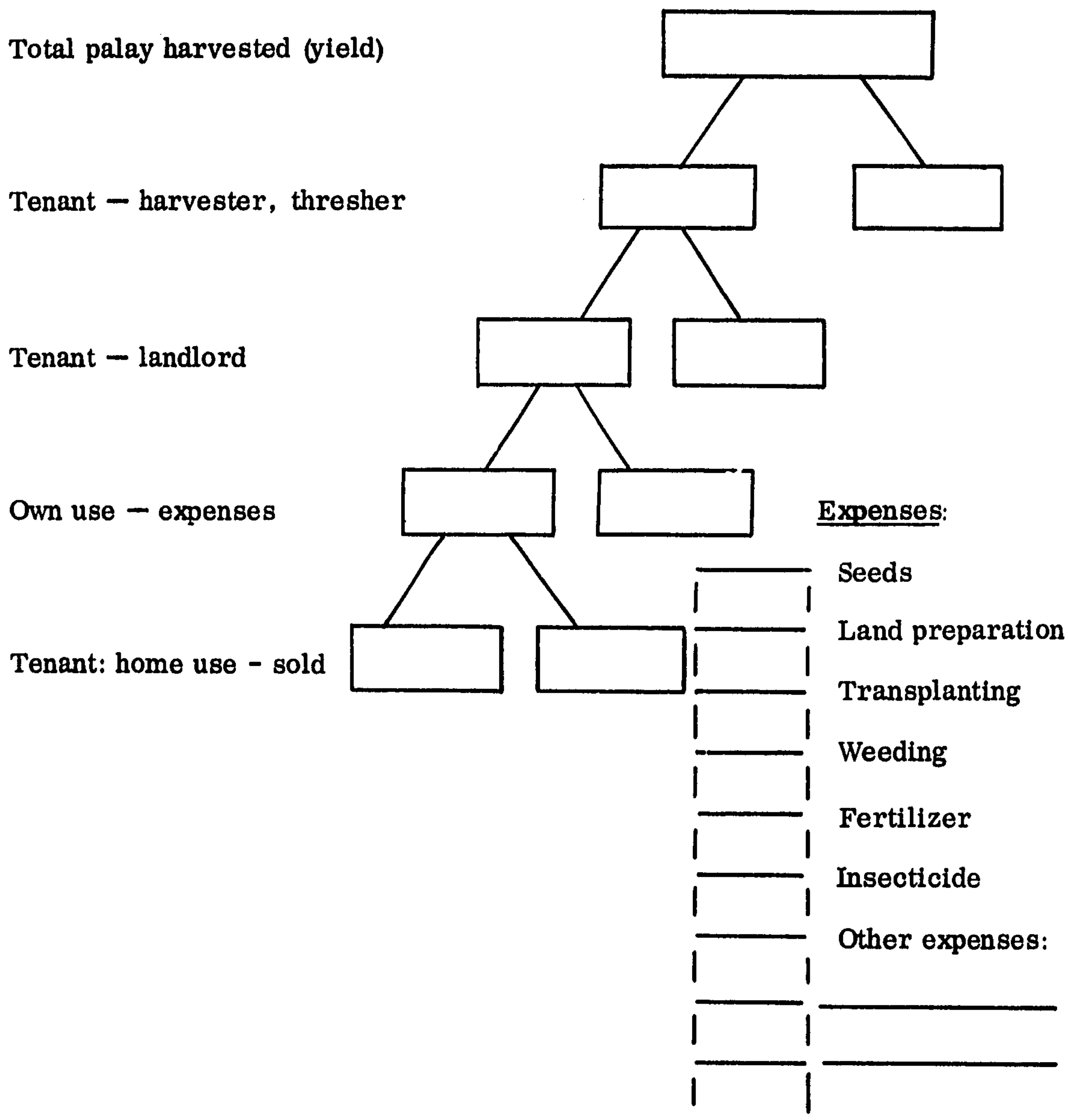

FIG. 2. Division of rice crop at harvest.

for payments on a tractor. Another method is by computation in the usual fashion of the costs of production, as presented in the two appendix tables. The two farms analyzed were chosen randomly from among the non- irrigated and irrigated farms. By partial budgeting one can compute the amount available for tractor payments.

The cost of a 6-HP tractor with equipment is ₱3, 700.00 cash or ₱4, 900.00 spread out over 42 months. Straight line depreciation for the cash price yields the following, considering a 7-year life:

$$\frac{₱3,700.00}{7} = ₱530.00 \text{ per year } \underline{5}/$$

For the tractor cost plus interest, at a more pessimistic 5-year life:

$$\frac{₱4,900.00}{5} = ₱980.00 \text{ per year}$$

And for a farmer to meet his payments of ₱700.00 per crop, he needs to earn 2 x ₱700.00 = ₱1, 400.00 per year.

We can estimate, then, the farmer's breakeven (B/E) work load to meet his payments or to compare with computed depreciation.

The simplest form of the breakeven formula is to compute a ratio of the amount of money needed to be paid or earned to the variable profit per unit of measurement. Then our ratio is:

$$B/E = \frac{\text{Fixed cost (FC)}}{\text{Total revenue - variable cost}}$$

5/ The present rate of exchange is US $1.00 = ₱3.89, or roughly, 1:4.

The variable costs of tractor operation are for hire of the tractor operators and fuel and repair costs. We can estimate the hiring cost for two men to be roughly ₱15.00 per day, which includes meals.

Two men combine to operate a tractor at a daily wage of ₱5.00 plus meals and merienda. The cost may be ₱15.00 daily in total. Fuel cost per day will be roughly ₱4.00. Not enough years of data on repairs have been collected to adequately estimate repair costs. We assume a repair cost of ₱100.00 per year, or for 100 days of operation, ₱1.00 per day.

Tractor contract costs vary from ₱25.00 to ₱35.00. The latter amount is typical of rates in which meals are included.

Using these operating costs, we obtain:

(cash cost, 7-year life):

$$B/E = \frac{₱530.00}{₱35.00 - ₱15.00 - ₱4.00 - ₱1.00}$$

$$= \frac{₱530.00}{₱15.00}$$

$$= 35.3 \text{ days}$$

(installment cost, 5-year life):

$$B/E = \frac{₱980.00}{₱15.00} = 65.3 \text{ days}$$

(to meet the yearly payment of ₱1,400.00):

$$B/E = \frac{₱1,400.00}{₱15.00} = 93.3 \text{ days}$$

Under the most favorable assumptions of depreciation and length of life, the number of tractor operating days to cover the fixed cost is 35.3. For the shortest life assumption and depreciation based on computed cost plus interest, the number of days of work needed rises to 65.3 days. And, finally, the number of working days approaches 100 in order to meet the yearly payment. These requirements could be reduced by one-third if the owner is an operator of the machine.

From Table 6, the mean time to prepare one hectare of land by tractor is 27 hours, or 3.4 days. Then the number of hectares of land prepared necessary to cover the annual fixed costs is, for the low estimate, $35.3 \div 3.4 = 10.4$ hectares, and for the high estimate, $65.3 \div 3.4 = 19.4$ hectares. Thus, if the contract rate is the appropriate measure, the farmer needs to prepare between 10 and 20 hectares of land per year in order to cover the tractor costs, or roughly 30 hectares, to meet the twice-yearly tractor payment.

Another means of comparison is to compute the cost of land preparation before tractor purchase. For instance, if the work is done by animal on a contractual basis, the cost of preparing one hectare (using mean data from Table 5) is ₱160.00. From these data, the tractor owner can calculate if his hectarage is sizeable enough to warrant tractor purchase.

One must also recognize the amount of time worked off the tractor owner's farm. If the owner works the tractor 30 days off his own farm, he contributes ₱15.00 per day to cover fixed cost, for 30 days or ₱450.00.

TABLE 6. Plowing and harrowing: Carabao and the hand tractor (6 HP). a/

	Mean time (hr/ha)	Range
Plow: Carabao	36.3	28.8-41.2
Tractor	12.9	11.2-14.6
Harrow: Carabao	83.4	55.5-109.5
Tractor	13.9	11.3-16.6

Contract rates: Tractor: ₱35.00 per 8 hr-day, or ₱4.38/hr.

Carabao: ₱8.00 per 6 hr-day, or ₱1.33/hr.

COST COMPARISONS

	Average Cost	Range	
		Low	High
Plow: Carabao	₱48.33	₱38.25	₱54.85
(at ₱10/day)	(60.69)	(48.03)	(68.87)
Tractor	56.50	49.14	63.95
Harrow: Carabao	₱110.94	₱73.75	₱145.57
(at ₱10/day)	(139.29)	(92.60)	(182.78)
Tractor	60.88	49.54	72.80

a/ Tests conducted on IRRI soils. Plowing = one pass. Harrowing = judged to be "adequate" at 9-13 passes of the carabao and 3-4 passes of the tractor.

The earlier findings in the U.P. College of Agriculture survey that there is a lessening in the days worked on contract hire will be interesting to follow. Perhaps this is an indication that, in addition to the increase in repair frequency, there is increased competition for contract work as the number of tractors has increased.

7.0. CONCLUSIONS

We can conclude, for the study area, that hand tractors are being purchased by farmers considered to have repayment potential. By mid-August 1967 the Central Bank of the Philippines had noted over 1,000 tractor loans using World Bank funds. Of these, roughly 700 of the machines were hand tractors.

Two other major rice areas in the Philippines are under study, Cagayan Valley in northern Luzon, and Cotabato Province in Mindanao. In both of these areas standard tractors are being used on some of the farms for land preparation. The average size of farm is larger in these areas, the soils probably firmer which prevents the machine from bogging down, and there is less labor to perform the less mechanized operations.

What advantages does the country achieve with hand tractors? The farmers desire to own their tractors, and they can afford a hand tractor. The country benefits by the farmer learning how to operate and repair machines. The tractor can prepare much larger hectarages than the work animal, and requires none of the care and watching during the off season that the animal requires.

What are some of the disadvantages of hand tractors? First, they may reduce the number of jobs on farms without materially adding to yield. However, land preparation and, perhaps, threshing are the only feasible operations tractors can perform at present. Another factor is that of lack of adequate access to interior fields. There is a general lack of right of ways and access roads. Furthermore, there are some 15 makes of hand tractors being sold. Spare parts and adequate servicing of these tractors is a major problem.

The prospects for hand tractor sales are good. Japan, for instance, had 16,000 hand tractors in 1951, and by 1965, 2.5 million hand tractors.

8.0. APPENDIX A - FARM BUDGETS

Appendix table A. Irrigated one-crop rice farm (Nueva Ecija): man-hours and cost of operation.

Sample No. 74 - Nueva Ecija

Irrigated l-crop Variety - Raminad Yield/hectare - 31.3 cavans Wet season

Item	Unit cost	Labor input: Man-days	Labor input: Animal-days	Cost in pesos
A. VARIABLE COST				
1. Pre-harvest cost				
Seedbed prep'n & care	₱3.50/man-day & ₱4.00/animal-day	1.2	1.2	9.00
Plowing	"	7.5	7.5	56.25
Harrowing	"	8.0	8.0	60.00
Repair and cleaning of dikes	"	2.5		8.75
Pulling seedlings	"	3.0		10.50
Transplanting	"	25.0		87.50
Weeding	"	0.8		28.00
Material application				
Fertilizer cost	14 kg of N (14-14-14) ₱20.00/bag			40.00
Fertilizer labor	₱3.50/man-day	0.5		1.75
Insecticide cost	Thiodon ₱7.50/bottle			3.75
Insecticide labor	₱3.50/man-day	0.5		1.75
Total pre-harvest cost		49.0	16.7	307.25
2. Harvest cost				
Cutting, etc.	₱3.50/man-day	12.5		43.75
Threshing by machine [a]	₱22.00/cavan			33.00
Total harvest cost		12.5		76.75

Appendix table A. (cont'd).

Item	Unit cost	Labor input: Man-days	Labor input: Animal-days	Cost in pesos
Total Variable Cost		61.5	16.7	384.00
B. FIXED COST				
Interest charged on operating capital b/				17.28
TOTAL COST				401.28

a/ Based on 31.3 cavans per ha @ 5% of gross output: 1.5 cavans @ ₱22.00 per cavan

Calculation of wage rates: Wage rate per man-day - ₱3.50
Wage rate of carabao - ₱4.00

Yield per hectare in cavans of palay - 31.3 cavans

Price received per cavan - ₱22.00

b/ Based on 9% per annum for 6 months of the operating capital (₱353.27).

Appendix table A-1. Non-irrigated one-crop rice farm (Bulacan): man-hours and cost of operation.

Sample No. 20 - Bulacan

Non-irrigated 1-crop Variety - Intan Yield per hectare - 90.0 cavans Wet season

Item	Unit cost	Labor input: Man-days	Labor input: Animal-days	Cost in pesos
A. VARIABLE COST				
1. Pre-harvest cost				
Seedbed prep'n & care	₱3.50/man-day & ₱4.00/animal day	1.1	1.0	7.85
Plowing	"	5.5	5.5	41.25
Harrowing	"	11.5	11.5	86.25
Repair & cleaning of dikes	"	2.3		8.05
Pulling seedlings	"	2.8		9.80
Transplanting	"	17.5		61.25
Weeding	"	14.5		50.75
Material application				
Fertilizer cost	20 kg of N (12-12-12) ₱15.00/bag			49.50
Fertilizer labor	₱3.50/man-day	1.0		3.50
Insecticide cost	Folidol ₱4.00/bottle			1.00
Insecticide labor	₱3.50/man-day	2.0		7.00
Total pre-harvest cost		58.2	18.0	326.20
2. Harvest cost a/				
Cutting, etc.	(7.5 cavans) ₱18.00/cavan	17.5		135.00
Threshing by machine	(5.4 cavans) ₱18.00/cavan			97.20
Total harvest cost		17.5		232.20
Total Variable Cost		75.7	18.0	558.40

Appendix table A-1. (cont'd).

Item	Unit cost	Labor input: Man-days	Labor input: Animal-days	Cost in pesos
B. FIXED COST				
Interest charged on operating capital b/				25.12
TOTAL COST				583.52

a/ Based on 90.0 cavans per hectare: Cutting, etc. - 7.5 cavans @ ₱18.00/cavan
Threshing by machine - 6% of gross output: 5.4 cavans @ ₱18.00/cavan

Calculation of wage rates: Wage rate per man-day - ₱3.50
Wage rate of carabao - ₱4.00

Yield per hectare in cavans of palay - 90.0 cavans

Price received per cavan - ₱18.00

b/ Based on 9% per annum for 6 months of the operating capital (₱546.40).

9.0. APPENDIX B - THE PRO AND CONTRA FORCES FOR MECHANIZATION

Pro

1. Drain on man-power.
2. Larger fields with controlled irrigation.
3. Lack of feed area for animals or rice production would give better profit.
4. Attempt to utilize all days available for rice growing.
5. Rice - price to justify contractors' work.
6. Operator - Ownership.

Contra

1. Abundance of man-power.
2. Small fields, irregularly shaped, irrigation under little or no control.
3. Abundant low-value feed areas - small rice yields do not offer enough incentive to convert to rice growing.
4. No desire to produce more - primarily subsistence farming to satisfy own needs.
5. No cash to pay any expenses.
6. Share cropping - where simple exploitation prevails. (Usually 50:50).

Source: Far East Trade & Development, November, 1966; Cost Elements page 1223.

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COMPARATIVE ECONOMIC ANALYSIS OF LOW-LIFT (SURFACE) AND TUBEWELL IRRIGATION PROJECTS IN THE PHILIPPINES

Leon A. Mears

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Leon A. Mears 1/

1.0. INTRODUCTION

The current strategy of the Philippine Government to obtain self-sufficiency in rice production gives high priority to increasing technical irrigation potential in rice producing areas. 2/ This will permit increased planting of high-yielding seed in the dry season as well as reduce the risk of lower yields from such seed from untimely dry spells during the rainy season. The assured supply of water enables realization of the high-yield potential from combining water and fertilizer with the new highly fertilizer-responsive seed. With highly capital intensive inputs (fertilizer together with chemicals to protect against insect losses) required to realize the high production potentials, it is essential that such assured water supply be available to minimize the farmer's risk in making such investment.

This emphasis on rapid increase of irrigation facilities places priority not only on the increase and rehabilitation of large scale gravity systems but also on surface (low-lift) and tubewell pumping of irrigation waters. And, while there has been some summary investigation of the economics of

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1/ Visiting Professor, U.P. School of Economics, Diliman and Director of the Wisconsin-Ford Foundation Program in development economics.

2/ The Rice and Corn Self-sufficiency Program "aims to expand the area under irrigation at least 1,000,000 hectares," Rice and Corn Production Coordinating Council, Four-year Rice and Corn Self-sufficiency Program, 1966-1970, Department of Agriculture and Natural Resources, July 21, 1966, p. 18.

such irrigation, little use has been made of modern methods (which take the time factor into account) to evaluate the profitability of irrigation combined with the new high-yielding seed, or to compare benefits from using either low-lift or tubewell pumps to supply the irrigation water.3/

Discounted benefit-cost analysis is applied in this study to two actual small scale irrigation projects in Luzon, one using a low-lift pump, the other a tubewell and pump. The use and shortcomings of such analysis will be illustrated as the economics of these projects are examined from both the social (national) and private investor's points of view, while comparing net benefits from both low-lift and tubewell pump irrigation. Sensitivity analysis will be employed to illustrate the degree to which net benefits will be affected by changes in the price of palay (paddy) to the farmer, in the yield potential and in the rate of adoption of a second crop on the irrigated area.

This study provides comparison of net benefits from using traditional seed and cultivation practices on rainfed paddy fields with those obtained by applying the entire package that combines the new high-yielding seed with fertilizer, irrigation, double cropping, pesticides and weedicides.4/ This

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3/ Net benefits of low-lift and pump irrigation are described in a study by Gilbert Levine, but not using present value methods, see "Irrigation Costs in the Philippines," The Philippine Economic Journal, First Semester 1966, pp. 28-41. Rough estimates are also included for specific gravity projects in Program Implementation Agency, Proposal for Financial Assistance for the Irrigation Program of the Philippines, Manila, 1965.

4/ For description of this package, see The International Rice Research Institute, "Cultural Practices for Profitable Rice Production" General Leaflet I, Manila Hotel, March 1, 1967.

study does not indicate the net benefits from irrigation alone. It does illustrate how benefit-cost analysis can be used either to establish economic priority between two projects or to determine whether an individual project will generate the economic benefit to warrant its being undertaken. And finally, as a result of this study, it is possible to illustrate the relative importance of irrigation costs, expected yields, price and credit policy on expected benefits from adopting this package of "improved" inputs.

2.0. DESCRIPTION OF THE PROJECTS

General details of the two projects are described in the Appendix, Tables 1 to 5. The low-lift pump project covers 60 hectares in Rizal Province. It has just been completed so it can be judged only on theoretical grounds. On the other hand, the tubewell project covering 100 hectares in Nueva Ecija Province has been in operation since 1960. Both projects produce palay exclusively. An unusually deep tubewell project (445 feet) was selected to give maximum contrast in comparison with the low-lift source of irrigation water.

Net benefits estimated in 1960 for the tubewell project will be discussed for comparative purposes. However, the major portion of the analysis is based on benefit-cost estimates using 1967 prices and technological possibilities. Thus, the tubewell installation and operating costs have been calculated both on a 1960 and 1967 basis. For 1967, alternative costs have been calculated for two sizes of tubewell pumps; one 1500 G.P.M. (the size originally installed but capable of irrigating not quite half the hectarage in the dry season) and a 3,000 G.P.M. pump capable of fully irrigating the entire 100 hectares in the dry season.5/

Incremental farm cost estimates were actually slightly different in Rizal than in Nueva Ecija. So, to compare benefits from the package of inputs while using different sources of irrigation water, incremental farm costs with irrigation were assumed to be the same in both projects, with the expected farm costs in Nueva Ecija taken as the standard. Similarly, incremental yields with irrigation were standardized for both regions. In the general case, incremental yields were estimated at 50 cavans per hectare in the wet and 95 cavans per hectare in the dry season. In like fashion, for both projects, similar rates were assumed of second crop adoption after irrigation becomes available. It is further assumed, in the general case, that each year an additional 10 percent of the area potentially irrigable in the dry season is actually second cropped. This assumption is probably conservative under the particular conditions now existing in the Philippines, but experience on this tubewell project and on irrigation projects elsewhere in Asia suggests the assumption may not be too unrealistic.6/

5/ Hectarage capacities of pumping units as estimated from ISU calculations of "Hectarage Capacity of Pump Units," adjusted for various soil conditions. On the soil existing in both areas, approximately 4 feet of water were considered required each crop season.

6/ For example, five years after irrigation water was first supplied to the primary canals, second cropping had been adopted on less than 25 percent of the area of the Ganges-Kobadak Project in East Pakistan. (Unpublished study of the author.) The tubewell project in Nueva Ecija was completed in 1961 but it was not until 1966 that any rice crop was planted in the dry season (in three prior years, mongo beans had been planted during the second crop but never on over half the area irrigable). In 1966, the sixth year that irrigation water had been available, 38 hectares were second cropped in rice and in 1967 the total was 45 hectares (close to the estimated pump capacity).

Thus, holding incremental farm costs and yield plus rate of 2nd crop adoption constant for all three alternative pump projects, comparative net benefits from the package when using the tubewell or the low-lift pumps for irrigation will vary depending on the individual investment, operating and maintenance costs, technical characteristics of the irrigation system, and methods of financing. As indicated in the tables in the Appendix, methods of financing do vary between the tubewell and low-lift projects. While the low-lift project is benefited by unusually advantageous financing terms arranged by the Agricultural Development Council of Rizal (ADCR), the tubewell project reflects current financing policies of the Irrigation Service Unit (ISU). Where important, the differential effects of these two methods of financing are taken into account.

3.0. THE GENERAL CASE
(Discounting at 8%, Palay Price ₱17/cavan, Incremental Yield - Wet Season 50 cavans/hectare, Dry Season 95 cavans/hectare)

Assuming a social time preference rate of 8 percent, the comparative economic desirability of the three alternatives are shown on Table 1. 7/ With positive present values in all cases, it is evident that net benefits would accrue to either the private farmers or the nation from undertaking any of the alternative

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7/ This would be the "time preference" rate from the farmers' point of view.

TABLE 1. Comparative economic desirability of projects according to different criteria.[a]

	Farmers' viewpoint			National viewpoint		
	Low-lift pump	Tubewells 1500 GPM pump	Tubewells 3000GPM pump	Low-lift pump	Tubewells 1500 GPM pump	Tubewells 3000 GPM pump
1. Present value of net benefit flow (₱000)	143.2	201.3	281.5	172.9	251.4	333.6
2. Benefit cost ratio	1.345	1.32	1.345	1.45	1.43	1.45
3. PV'/K[b]	72.6	16.2	19.4	28.4	4.71	4.93
4. Internal rate of return (%)	540	148	141	245	60	53

a/ Assumed conditions:

Palay price to farmer ₱17/cavan.

Incremental yield from "package" of inputs, in cavans/hectare: wet season 50, dry season 95.

Incremental farm costs as shown in Table 5, Appendix.

10% of potential area of second cropping added yearly.

Costs and other details as indicated in Tables 3 and 4, Appendix.

Rate of discount for criteria 1, 2, 3 is 8%.

b/ PV' = Present value of net benefit flows not including capital cost (assumed to fall due in pre-operative period).

K = capital cost (i.e. opportunity cost of resources committed in pre-operative period).

PV'/K is shown in ₱ of Present Value (not including capital cost) per unit of capital cost as defined above.

projects.[8] The present value is higher for the larger pump, given the greater investment and larger area involved. This measure thus is useful to indicate project benefits *per se* but cannot be used for setting priorities for use of scarce capital except when similar-sized investments are involved.

It is interesting that all projects show a higher present value of net benefits from the national point of view than from the farmers' point of view.[9] Also, if the palay price had been ₱12/cavan rather than ₱17/cavan, the projects would have shown a negative present value from the farmers' viewpoint but a positive one from the nation's viewpoint. (See Table 2 and Figures 1 and 2). Such cases can arise. Under varying circumstances, a project might show a positive present value from the national viewpoint and a negative one from the private viewpoint, or the opposite might be true. This is why it is important for a government planner to know the present value from both points of view. If the net benefits to the private investor are too low to induce desired investment, while the net benefits from the national viewpoint are relatively high, subsidies or tax relief might be warranted. And in the opposite situation, where the nation might suffer a net welfare loss while the private investor would realize a net

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8/ This assumes that the discount rate used corresponds to the actual social and individual time preference rates. The selection of this 8 percent rate for the general case was arbitrary and is probably slightly below the actual values, could they be determined. However, this makes little difference in any of the comparative analysis to follow as the present value of the net benefit flow remains highly positive for discount rates as high as 50% (national point of view) and 100% for the farmers' point of view.

9/ This arises with the elimination of transfer payments from the costs from the national viewpoint, which more than offsets the earlier inclusion of capital costs, see Appendix, Tables 6 and 7 for illustrative examples of these calculations.

TABLE 2. Comparison of project benefits with different palay price to the farmer.[a]

Palay price to farmer/cavan	12		17		20	
	Present value of net benefit flow (₱000)	IRR[b] (%)	Present value of net benefit flow (₱000)	IRR[b] (%)	Present value of net benefit flow (₱000)	IRR[b] (%)
Farmers' viewpoint						
Low-lift pump project	-20	neg.	143	540	241	500
Tubewell 1500 GPM project	-44	neg.	201	148	347	275
Tubewell 3000 GPM project	-41	neg.	281	141	477	235
National viewpoint						
Low-lift pump project	10.2	19	173	245	270	420
Tubewell 1500 GPM project	6.4	10	251	60	398	80
Tubewell 3000 GPM project	19.6	12	334	53	537	73

a/ Assume conditions:
Incremental costs, benefits and other details as described in Tables 3 to 5, Appendix.
Incremental yields from "package" of inputs, in cavans/hectare, Wet season 50, Dry season 95.
10% of potential area of second cropping added yearly.
Rate of discount 8%.

b/ Internal rate of return . neg. = negative benefit, government control to conserve scarce resources can take the form of credit constraints or more direct deterrents. However, as far as the irrigation projects under analysis are concerned, rates of return are high from the private investors' viewpoint and even existing subsidies might be reduced or eliminated without affecting investment.

The other three criteria shown in Table 1 are ones frequently used for determining project priorities under the conditions usually existing in developing countries where capital availability constraints must be satisfied. As all three criteria /benefit/cost (B/C) ratio, internal rate of return (IRR) and Present Value - not including original investment - per unit of original investment (PV'/K/ show different relationships, it is not surprising that their individual usefulness might differ and that they might not always provide similar ranking of projects.10/ For example, while from both the farmers' and national points of view the IRR and PV'/K criteria indicate strong priority for the low-lift pump, the B/C ratio shows no difference between the low-lift and the 3,000 GPM tubewell projects. This illustrates the difficulty in ranking with a ratio such as the B/C ratio.11/

10/ For a discussion of the precise differences between these criteria, see Joseph L. Tryon and F.E. Cookson, A Critical Survey of Project Planning, Center for Development Planning, National Planning Association, Washington, 1966, pp. 152 ff.

11/ For a complete discussion of the dangers of using ratios as indicators of importance, see Roland N. McKean, Efficiency in Government Through Systems Analysis, New York, John Wiley & Sons, 1958.

While the IRR and PV'/K both give highest priority to the low-lift pump project, their respective priorities for the other two projects differ.[12] In these later projects, which are mutually exclusive, the IRR becomes a hazardous criterion to use for selection decisions. For example, by reference to Figure 1, it will be seen that as the palay price is varied, the IRR changes, with project priorities reversing as the IRR reaches the lower range which is more likely to include the actual time preference rates. In this instance, the priority given to the two projects reverses as the IRR drops below approximately 42% return.

This difficulty must be weighed against a different problem arising with the use of PV'/K. The precision of this criterion depends on the ability to determine the social time preference rate (s.t.p. rate) for the economy and the time preference rate of the individual. The latter might be determined by questioning the individual and is apt to relate closely to the interest rate at which the individual can borrow money for financing the project. However, with no certain determination of the s.t.p. rate, arbitrary selection of a discount rate adds to the uncertainty that project selection by the PV'/K criterion will actually result in an optimum social welfare solution. For this reason, certain international financing agencies are reportedly relying increasingly on the IRR

12/ See Tryon, op. cit., pp. 152 ff. for discussion of reasons for these different results.

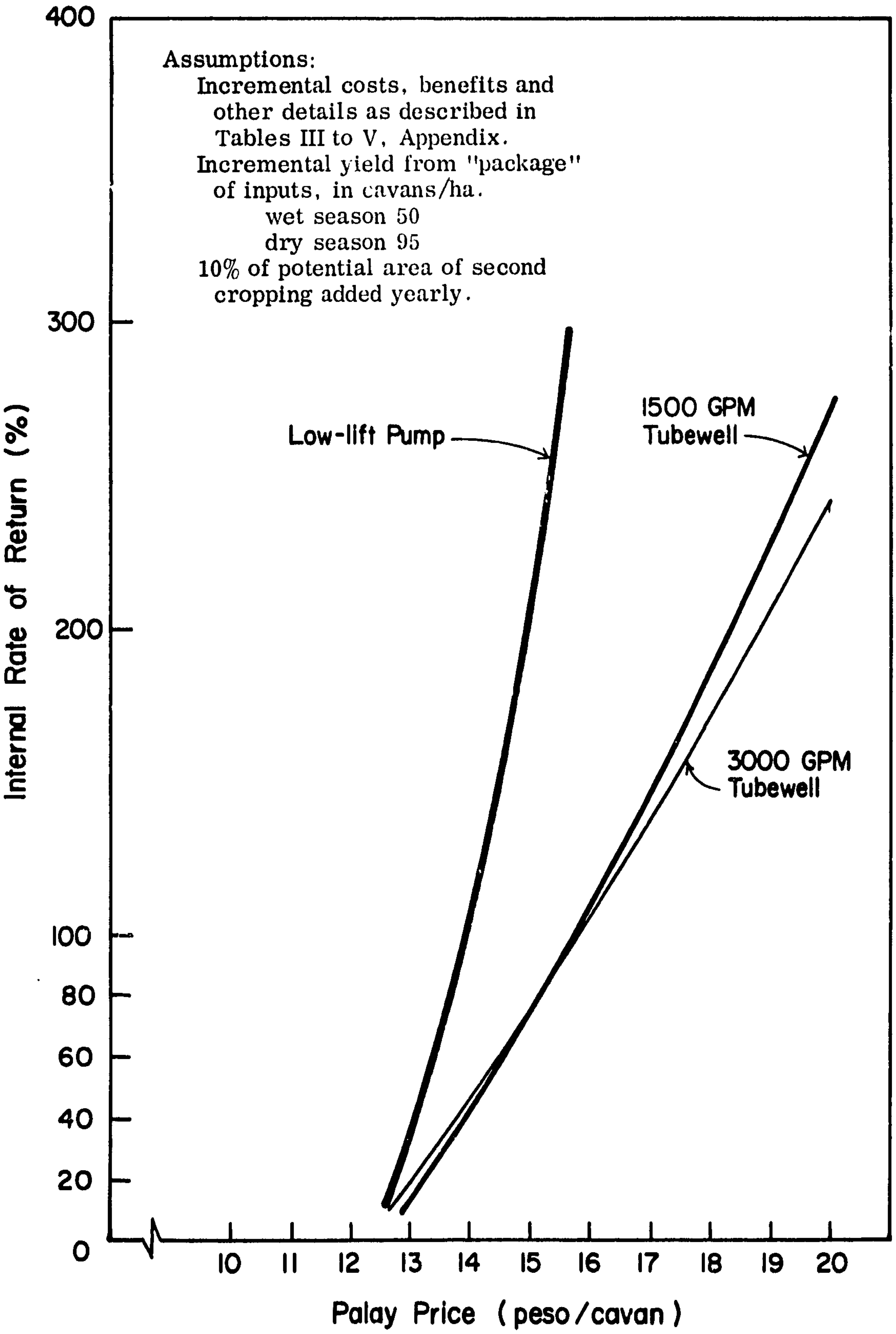

FIG. 1. Internal rate of return as farm palay price varies (Farmers' viewpoint).

as an investment priority criterion.13/ Even in such cases, other criteria are used as checks against the IRR, with project priorities more secure to the extent confirmed by other criteria. And, in using the IRR, its limitations must be remembered. If the estimated IRR is relatively high on mutually exclusive projects, their relative priority should definitely be confirmed by other criteria such as PV'/K.14/

4.0. EFFECT ON NET BENEFITS OF VARIATION IN PRODUCT PRICES, EXPECTED PRODUCTION YIELDS, INPUT PRICES, RATES OF 2ND CROP ADOPTION AND METHODS OF FINANCING

4.1. Net benefits as product prices varied

Figures 1 through 4 illustrate the high level of net benefits on all three projects that would accrue both to the country and the farmer if the palay price received by the farmer were held at ₱16/cavan of palay. In both 1967 and 1968, the floor price that the Rice and Corn Administration (RCA) attempted to maintain for the farmer was not lower than ₱16 in any region and in some regions was as high as ₱17/cavan. Thus, as long as incremental yields were realized as have been premised for the general case, any of the three projects would have proven highly beneficial in any area where rainfall did not provide a consistent two-season water supply and where other water sources were available for pumping.

13/ Recent discussion with economists of the IBRD suggest that the IRR has become one of the principle tests of economic profitability used by the World Bank.

14/ In some instances, the use of different discount rates within the probable s.t.p. range makes little if any difference in the priority given the projects. In such cases, much greater reliance can be placed upon the PV'/K criterion.

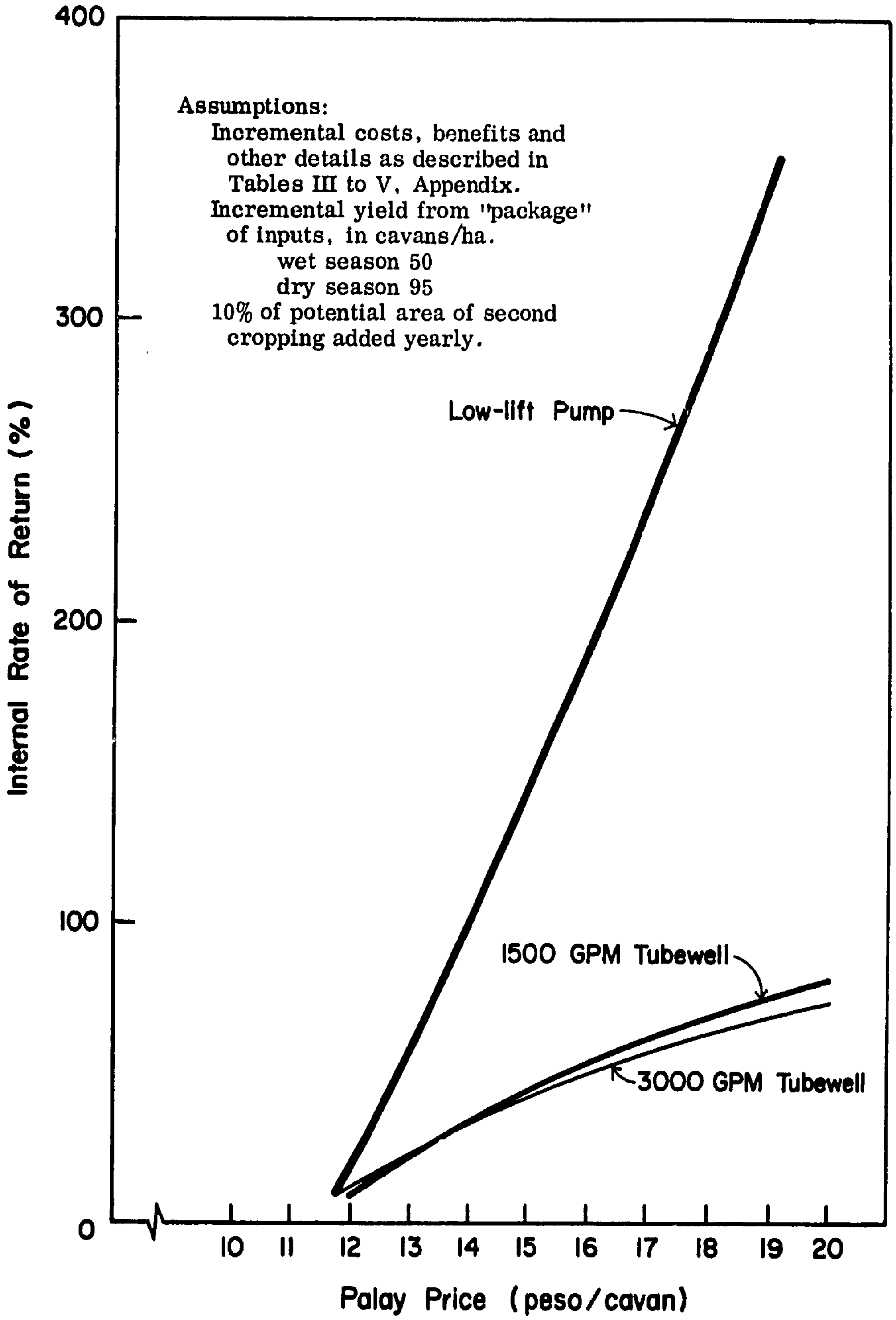

FIG. 2. Internal rate of return as farm palay price varies (National viewpoint).

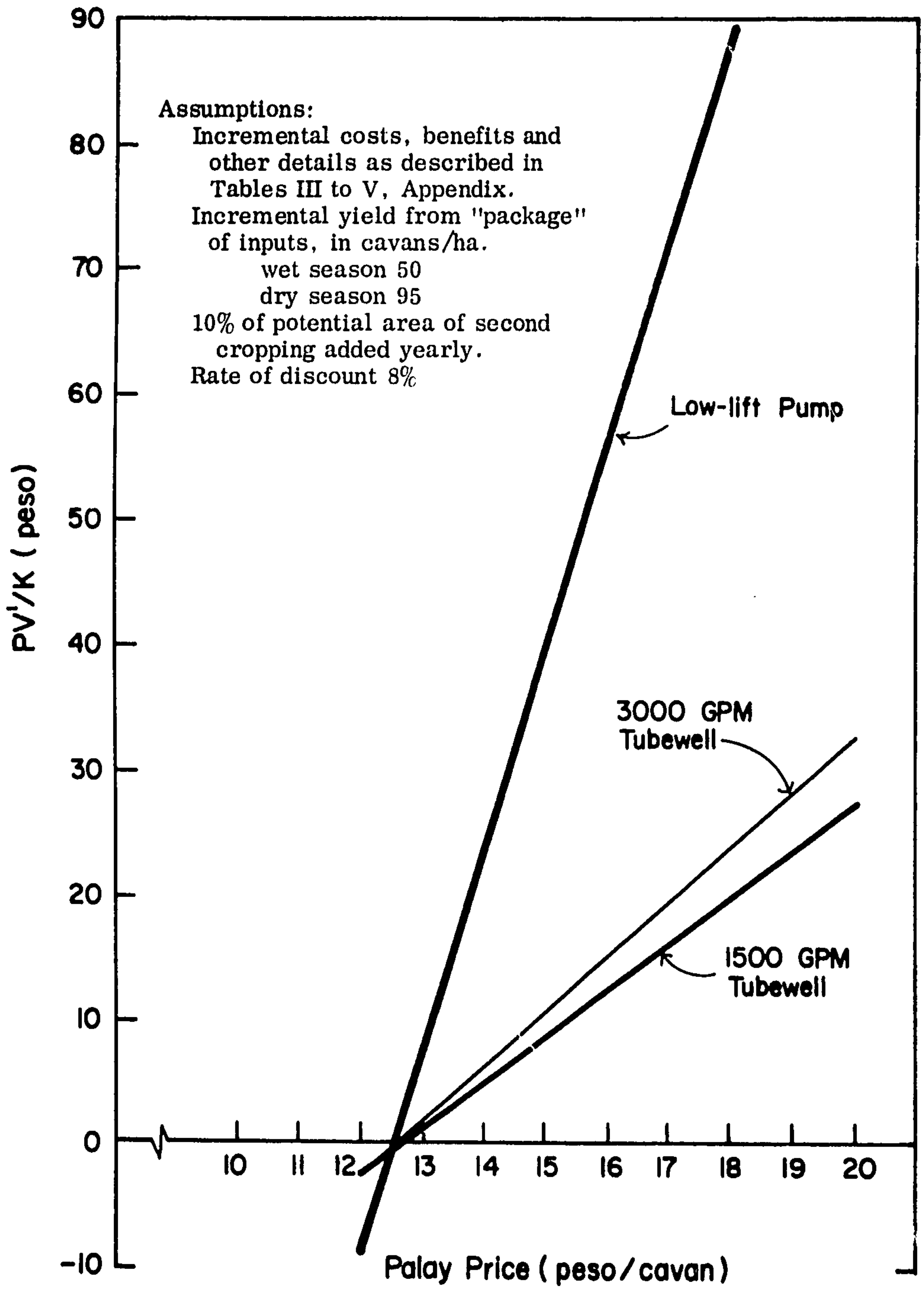

FIG. 3. PV'/K as farm palay price varies (Farmers' viewpoint).

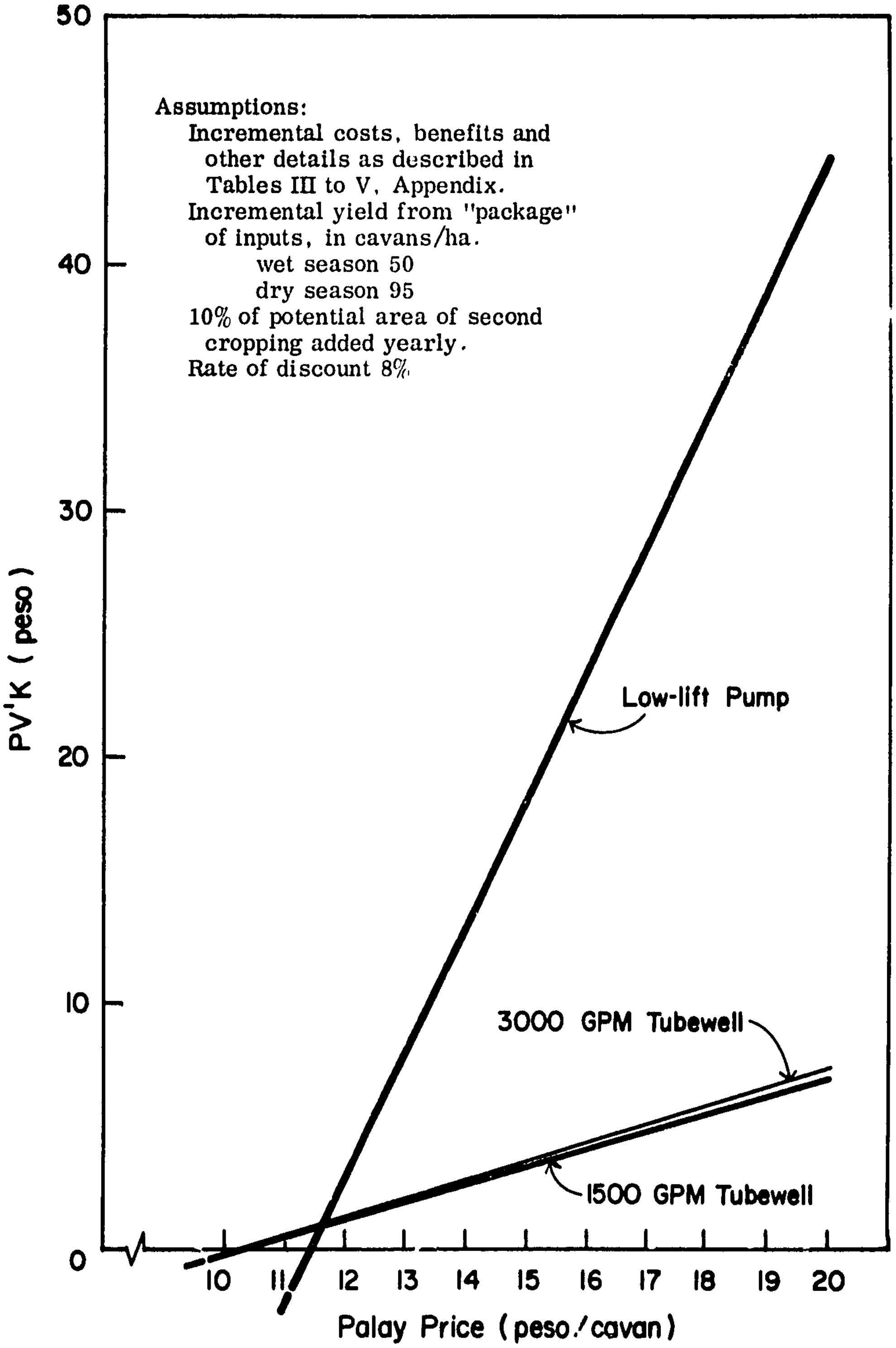

FIG. 4. PV'/K as farm palay price varies (National viewpoint).

As evident from the figures, the net return per unit of investment would be appreciably higher for the low-lift pump than for the alternative projects. This would be expected with the higher costs of deep-well drilling and more expensive pumping costs. Low-lift pumps, with their lower capital and operating costs, have been found profitable for rice cultivation in the Philippines even with lower yielding seed varieties. However, there has been a scarcity of studies examining the profitability of tubewell projects. If the results of this study are borne out by further investigation, and the author sees no reason why they should not be, then the irrigation authorities can proceed with confidence in promoting irrigation for high yield varieties of rice both from low-lift and tubewell pumping. However, it must be remembered that tubewell pumping will continue to have a risk that is not present with low-lift surface pumping. Until underground water resource surveys have been made, there is always risk of inability to obtain adequate water from a given well.[15] Also, if surface water is available for gravity irrigation or for pumping, these methods appear generally preferable to tubewell water sources.

4.2. Net benefits as expected yields vary

The advantage of the high yielding seed now available in the Philippines is strikingly illustrated by the comparative project benefits as expected yield is varied, see Table 3. None of the projects would have shown net benefits to the farmer if the expected incremental yield had been as low as 30 cavans per hectare

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15/ The ISU reports that they as yet have not designed a single 3000 G.P.M. pump for operation on one well as they do not have sufficient experience with the aquifier to have confidence that such a flow could be maintained.

TABLE 3. Comparison of project benefits with different incremental yields.[a]

Incremental yields: Wet season	30			50			65		
Dry season	75			95			125		
(cav/ha)	IRR[b]	B/C ratio	PV'/K	IRR	B/C ratio	PV'/K	IRR	B/C ratio	PV'/K
Farmers' viewpoint									
Low-lift pump project	neg.	(0.91)	-18	540	(1.35)	72.6	500/	(1.76)	157
Tubewell 1500 GPM project	neg.	(0.88)	- 5	148	(1.32)	16.2	375	(1.72)	35.5
Tubewell 3000 GPM project	neg.	(0.93)	- 2.5	141	(1.34)	19.4	340	(1.75)	41.6
National viewpoint									
Low-lift pump project	neg.	(0.98)	- 0.25	245	(1.45)	28.4	500/	(1.90)	55.3
Tubewell 1500 GPM project	neg.	(0.95)	0.58	60	(1.43)	4.71	101	(1.87)	8.5
Tubewell 3000 GPM project	9	(1.01)	1.08	53	(1.45)	4.93	92	(1.89)	8.8

a/ Assumed conditions:

Palay price to farmer ₱17/cavan.
Incremental costs and benefits as shown in Tables 3 to 5, Appendix.
10% of potential area of second cropping added yearly.
Rate of discount for B/C ratio and PV'/K = 8%.

b/ Neg. = negative.

in the wet season and 75 cavans per hectare in the dry season, incremental yields that would have been exceptional with traditional seed. From the national viewpoint, only the large tubewell project would have shown net benefits at such a low yield increment. However, it will be seen that with a yield increase of 50 cavans/hectare in the wet season and 95 in the dry season, extremely high internal rates of return would be realized.16/ These high IRR are confusing in the sense that they are not comparable with IRR from projects from other sectors of the economy or from other types of agricultural projects. The fertilizer applied is calculated as a cost while it is at the same time an important capital input. Thus, by not including it with capital costs, the IRR for the package is somewhat overstated. But, even an IRR of half the magnitude of those shown in Table 3 would make the projects appear most attractive economically. The highest incremental yield level, 65 cavans per hectare in the wet season and 125 in the dry season, that is shown is well within the range of possibilities according to reports and gives almost fantastically high benefits.17/ For example, with the 1500 G.P.M. tube-

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16/ These incremental yields appear to be conservative in relationship to actual experience with the high yielding varieties when used with the entire "package" of inputs. For example, in the rainy season in Central Luzon in 1967, the RCPCC reported yield on almost 14,000 hectares of IR8 harvested by the end of October as averaging 112 cavans/hectare, "Progress Report on the Rice and Corn Program," Manila, November 28, 1967 (mimeographed).

17/ For example, see farm yield data as reported by Randolph Barker, "Costs and Returns in Rice Production," International Rice Research Institute Seminar paper, October 7, 1967, and Barker and E.U. Quintana, "Farm Management Studies of Costs and Returns in Rice Production," Seminar International Rice Research Institute, December 9, 1967 (mimeographed).

well project, after covering all added fertilizer and other costs, from the national viewpoint the fixed capital costs is covered 8 1/2 times in terms of present value of net benefits (see criterion PV'/K = 8.5).

Table 3 also illustrates the care that must be taken in using the different project criteria. The benefit-cost ratios as absolute numbers, for example, can be given no precise interpretation. As can be seen, at the medium incremental yield basis from the national viewpoint, the low-lift pump project appears to be much more beneficial than the other projects by both the IRR and PV'/K criteria, but by the benefit-cost ratios, the low-lift pump and 3,000 G.P.M. tubewell projects both appear equally beneficial. Also, while the 1500 G.P.M. tubewell project seems to be more beneficial than the larger tubewell pump project when appraised by IRR, the reverse is true when the PV'/K criterion is used.

4.3. Net benefits as rate of 2nd crop adoption varies

As already indicated, a conservative rate of adoption of second cropping has been assumed for the general case studied.[18/] Second cropping may not be necessary to justify a project, but benefits do change appreciably depending upon the second cropping practice followed. For example, with other conditions the same as in the general case, the 3,000 G.P.M. tubewell project

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18/ 10 percent of the potential area for second cropping added yearly. For example, with the 3,000 G.P.M. tubewell pump, the total area could be irrigated in the dry season with this water flow. Thus 300 hectares additional second cropping is added yearly, with the entire project area second cropped at the end of the 10th year.

(farmers' viewpoint) would show a PV'/K of 30.4 if all the area were second cropped starting with the first year of the project - in contrast to a PV'/K of only 19.4 if only 10 percent of the potential second crop area were added annually. The reverse holds true if no second crop is planted. For example, as indicated in Table 4 for the 1500 G.P.M. tubewell project, all criteria show a decided decline in benefits when only one crop is planted. However, the farmer might be willing to invest in pump irrigation even though incremental yield did not provide sufficient benefits to cover capital and incremental operating costs providing the risk of complete crop loss without irrigation was considered high. However, a positive supply of water might assure some level of income above zero each year, even though the average annual income level would decline.

This seems to have been the approximate situation at the tubewell project when it was first installed in 1960. The farmers reported that they had experienced several years of complete loss from drought. They thus were willing to contract for the tubewell even though the project - given the low incremental yields expected at that time - would show a net loss unless second cropping was adopted at a more rapid rate than assumed in our general case.19/ With only minor second cropping of vegetables actually taking place, it was

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19/ If 10% of the potential area of second cropping had been added annually, the present value of net benefit flows would have been negative, the B/C ratio 0.97, and PV'/K 0.7.

TABLE 4. Comparison of project benefits with and without 2nd cropping.[a] (Tubewell 1500 GPM pump project.)

	No second crop			10% of potential second crop area added annually		
	PV'/K	IRR	B/C ratio	PV'/K	IRR	B/C ratio
Farmers' viewpoint	8.3	120	1.21	16.2	148	1.32
National viewpoint	3.1	42	1.32	4.71	60	1.43

a/ Assumed conditions:

Palay price to farmer ₱17/cavan.
Incremental farm costs as shown in Table 5, Appendix.
Costs and other details as indicated in Tables 3 and 4, Appendix.
Rate of discount for B/C ratio and PV'/K = 8%.
Incremental yield from package of inputs, in cavans/hectare: wet season 50
dry season 95.

hardly to be expected that the farmers could maintain loan repayments.[20]
And, it was not until the high-yielding rice varieties became available in 1966/67 that any appreciable second cropping took place. By that time, the incremental yield potential had more than doubled, apparently providing the required incentive to elicit the added effort.[21]

4.4. Net benefits as other input prices vary

Prices of inputs other than irrigation water - such as fertilizer - can likewise affect the level of benefits and the attractiveness of investing in the total "high-yield" package. These exact cost benefit relationships have not been examined in this study because they have not been of critical importance in the Philippines in recent years. However, it is well to keep in mind the importance of the price of fertilizer, a major input cost. For example, in 1967 in Indonesia, with fertilizer prices at world market levels but rice highly subsidized below world market levels, the farmer had no inducement to invest in the high-yield package while net benefits to him would be negative. At the same time, from

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20/ The contract with ISU was re-negotiated in 1964 at much more favorable terms.

21/ It is also interesting to note that the variety IR8 had not been used in this project area for the first crop because of fear of high water levels. Since 1966/67, IR8 has been planted as a second crop (with average yield of 93 cavans/ha) and starting in 1967/68, high-yielding BPI-76-1 has been used for the wet season crop.

the national point of view, net benefit levels were high.22/ At such times, if relative prices cannot be rationalized, changes in the subsidy pattern are required if the increases in yield from using the high-yield package are to be realized.

4.5. Net benefits to farmers as financing methods varied

Comparison of benefits from the farmers' point of view using mainly external financing or entirely own funds is illustrated by reference to Table 5. With payment by the farmer for fixed capital delayed by external financing, the project looks appreciably more beneficial to him that it would had he been forced to pay his own funds at the start of the project. Thus, the internal rate of return is 3 times as large and PV'/K four times as large with external as compared to own-fund financing. This illustrates another tool of policy makers, who can vary the amount of financing to increase the net benefits and thus help to induce the investor to increased activity on projects in strategic sectors. Special financing arrangements are frequently important solely because the farmers do not have funds to their own or acceptable collateral to obtain loans through normal banking channels. However, it is important to remember that special financing arrangements can also serve a second purpose, that of making the investment appear economically more attractive than if he had used his own funds.

22/ For discussion of this experience, see Leon A. Mears, "Strategy for Increasing Food Grain Production in South and Southeast Asia," to be published in The Philippine Economic Journal, First Semester 1967, Vol. VI, No. 1.

TABLE 5. Comparison of project benefits from different methods of financing as seen from farmers' viewpoint. a/ (Tubewell 1500 GPM pump project.)

Source of funds for fixed capital investment	PV'/K	IRR	B/C ratio
ISU financing procedures b/	16.2	148	1.32
Farmers' own funds entirely c/	3.7	48	1.33

a/ Palay price, incremental costs and yields as in general case, see Table 3.

b/ Farmers own funds for canals and structures only ₱8,000.

10 year loans for balance, from ISU and rural bank ₱67,300.

c/ Farmer financed by own funds ₱75,300.

4.5. Irrigation investment and operating costs

Comparative investment and annual irrigation costs per hectare are summarized on Table 6. It will be noticed that the annual irrigation costs per crop range from ₱56 to ₱134 per hectare. These rates are extremely high compared to new increased rates of the National Irrigation Administration, still not put into effect in all areas, of ₱25/hectare for the first rice crop and ₱35/hectare for the second rice crop.23/ But even at the high rates for these projects, investment in the package - including irrigation - appears to be extremely beneficial both to the private farmers and to the nation. Thus, there would appear to be no reason why farmers should not be willing to pay these new charges, or even higher charges, where it was practical to plant the new high-yielding varieties and the "package" of other inputs could be financed.

It is evident from Table 6 that the total investment cost, excluding interest charges, is much less for the low-lift pump project than for the tubewells. This is as would be expected but it emphasizes a point made above that tubewell pumping should not be considered in areas where adequate surface water is available. The investment costs for the low-lift pumps are not only lower than those for the tubewells but also are lower than average costs of gravity systems constructed by the National Irrigation Administration. Levine points out that it is logical that the Philippines should currently anticipate costs

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23/ Board of Directors, National Irrigation Administration, Resolution No. 12-64, dated, September 18, 1964.

TABLE 6. Comparative investment and annual irrigation costs (assuming 2nd crop on all potentially irrigable area). (pesos/hectare)

	Low-lift project	Tubewell project		
		1500 GPM		3000 GPM
	1967	1960	1967	1967
Area potentially irrigable (2 crops) (hectares)	100	147	147	200
Capital investment,[a] plus interest charges as indicated in project studies	17	43	50	48
Operation and maintenance	39	51	80	86
Total annual irrigation cost/hectare[b]	56	95	130	134
Investment cost (excluding interest) per hectare[b]	128	265	512	491

a/ Amortized over expected life.

b/ Per crop hectare ; counting each actual hectare of land as 2 hectares when double cropped.

for such works approximately ₱1,000 per hectare (single cropped), or ₱500/hectare if sufficient to provide complete double cropping.[24/] These figures compare closely with the costs on the tubewell projects studied as well as on recent Philippine project proposals.[25/] Thus, to the extent that low-lift pump projects are feasible, it would appear that the expansion of the irrigated land can be effected at one-quarter the cost of either tubewells or large gravity systems.

Financing to cover the investment to provide irrigation for an additional 1,000,000 hectares will apparently total somewhere between ₱125,000,000 and ₱500,000,000, but probably a greater amount of financing will be needed annually for production loans to cover the incremental cash costs associated with using the "package" of high-yielding inputs with the new seed and irrigation. On the basis of incremental costs as now estimated, financing for the second crop on an additional 500,000 hectares would come to ₱200,000,000. These will be seasonal demands, with almost as much being required for the first crop.

24/ *Op. cit.*, pp. 30-31.

25/ Investment costs per cropped hectare were estimated at ₱760 for the Dummon River Irrigation Project and ₱550 for the M'Lang River Irrigation Project, see Presidential Economic Staff, Project Studies, *Dummon River and M'Lang River Irrigation Projects,* Manila, 1967.

5.0. SUMMARY AND CONCLUSIONS

The present study comparing the discounted costs and benefits of low-lift pump and tubewell irrigation projects associated with the use of the package of high yielding inputs is based on an extremely small sample to permit any firm generalizations. However, even though costs and benefits will vary with particular situations, it is unlikely that the general conclusions of this paper will be negated with further study.

Aside from illustrating the use and limitations of time oriented investment criteria, certain substantive conclusions also can be made. While irrigation may be more cheaply provided by low-lift pumps, it would appear that tubewells can be expected to show a high rate of return both to the private investor and to the economy when the water is used together with the "package" of high yielding inputs with new fertilizer-responsive varieties of rice. Of course, this would not be true where adequate underground water resources were lacking. There would thus seem to be a high priority for rapidly surveying underground water resources in areas where adequate surface water is not available so the benefits therefrom could be tapped with a minimum of risk.

It was shown that benefits may and usually will differ depending on the point of view involved. Thus, there could be national advantage in certain situations to provide subsidies to stimulate the private sector in strategic activities (where benefits are high from the national viewpoint but appear low to farmers). At present, it may be important to maintain the existing relatively high floor price for palay to stimulate farmers to invest in irrigation and the package of high yielding inputs along with improved seed. However, as self-sufficiency is reached, this policy could well be re-evaluated. With the high profit potential as found, it is likely that production levels would continue to expand even after decreasing interest charge, subsidies or high support prices. Further, as the net benefits of an irrigation project increase rapidly as the adoption rate of second-cropping is speeded up, it might pay big dividends to direct extension efforts towards stimulating rapid adoption on irrigated land where this is not occurring.

Farmers and landlords included in this study all shared incremental costs and returns so there were no differential benefits for the two groups. For many other project areas this would probably not follow. Further study is needed to determine the differential benefits to tenants and landlords under various arrangements that might be found in practice in the Philippines.

Appendix table 1. General project information tubewell project.

Location:	Paruket, Quezon, Nueva Ecija
Irrigation Project of Irrigation Service Unit (ISU)	
	ISU provided free supervision for installation
First operations:	January 1960
Description of projects:	Turbine type deep well pump with diesel engine 10" 1500 G.P.M. 105 H.P. engine Depth of well: 445 feet 120 feet 16 inch casing 210 feet 14 inch casing 120 feet 10 inch casing Surface soil: Sandy loam Area to be irrigated: 100 hectare (not subject to flooding but water level during rainy season may rise higher than IR8 variety for extended periods). Crop: Rice, 1 crop before irrigation (average yield 35 cavans/hectare). 2 crops expected after irrigation. Area accessible by motor vehicle.
Project operated by:	Irrigation Association, Inc. 1 regular member (landlord) 20 special members (tenants)
Crop seasons:	Wet: May/November Dry: December/April
Other deepwells in vicinity:	1-6 inch and 1-8 inch within 5 kilometers.

Appendix table 2. General project information low-lift pump project.

Location:	Bilibiran, Binangonan, Rizal
Irrigation Project of Agricultural Development Council for Rizal which	provides supervision for irrigation.
First operations:	Wet season 1967.
Description of project:	Low-lift pump with engine 8" 1200 G.P.M. 25.5 H.P. Engine Soil surface: Sandy loam Area to be irrigated: 60 hectares, not subject to flooding. Crop: Rice, 1 crop before irrigation (average yield 50 cavans/hectare). 2 crops expected after irrigation. Area accessible by motor vehicle.
Project operated by:	Tagpos Farmer's Association 30 regular members (owner-operators)
Crop seasons:	Wet: May/November Dry: December/April
Source of water:	Bilibiran Creek, running into Laguna de Bay approximately 1/2 kilometer from project. Creek also used for irrigation by other farmers upstream. Stream flow test, August 1966, 1956 liters/second.

Appendix table 3. Investment and operating data - tubewell.

Part A. Direct benefits; value of added increment of production

		Yield/ hectare	Hectares cropped	Production: Quantity in cavans	Production: Value in pesos
(a) 1960 - Farm palay price ₱8.00/cavan					
Rainfall - no irrigation	1st crop	35	100	3,500	28,000
Irrigated (same seed and cultivation practices)	1st crop	45	100	4,500	36,000
Net annual increment in value[2/]	2nd crop[1/]	45	47	2,115	16,920
					24,920
(b) 1967 - Farm palay price ₱17.00/cavan					
Rainfall - no irrigation	1st crop	35	100	3,500	59,500
Irrigated - high yielding seed and inputs	1st crop	85	100	8,500	144,500
1500 GPM pump	2nd crop[1/]	95	47	4,465	75,905
3000 GPM pump	2nd crop[2/]	95	100	9,500	161,500
Net annual increment in value 1500 GPM pump					160,905
Net annual increment in value 3000 GPM pump					246,500

Appendix table 3 (cont'd)

Part B. Current farm costs (including sales taxes and labor at market prices). Increment in farm costs (see Table 5, this table for cost details).

	Cost/ha Season Wet (₱)	Cost/ha Season Dry (₱)	Ha cropped Season Wet	Ha cropped Season Dry	Total cost (₱)
(a) 1960 - no fer. ·izer or insecticides					
Farm costs - irrigated 1/	177	177	100	47	26,019
Farm costs - rainfed	163		100		16,300
Annual increment in costs					9,719
(b) 1967 - fertilizer and insecticides on irrigated crops					
Farm costs - irrigated - 3000 GPM pump 2/	795	855	100	100	165,000
Farm costs - irrigated - 1500 GPM pump 2/	795	855	100	47	119,685
Farm costs - rainfed	273		100		27,300
Annual increment in costs - 3000 GPM pump					137,700
Annual increment in costs - 1500 GPM pump					92,385

Appendix table 3. (Cont'd)

Part C. Operation and maintenance costs of irrigation works - per year.

	Wet season		Dry season		Total cost	
	1500 GPM	3000 GPM	1500 GPM	3000 GPM	1500 GPM	3000 GPM
					(₱)	
(a) 1960 1/						
Number of days	60		90			
Fuel, oil and grease costs (₱)	2,100		3,150		5,250	
Labor (mechanic/watertender) costs (₱)	250		250		500	
Maintenance and repair - Equipment (10% landed cost)					1,435	
Maintenance and repair - Canals and structure (5% of cost)					310	
Total					₱ 7,495	
(b) 1967 1/						
Number of days	60	30	90	90		
Fuel, oil and grease costs (₱)	2,400	2,400	3,600	7,200	6,000	9,600
Labor (mechanic/watertender) costs (₱)	750	1,000	750	1,000	1,500	2,000
Maintenance and repair - equipment (10% landed cost)					3,860	5,250
Maintenance and repair - canals and structures (5% of cost)					400	400
Total					₱11,760	₱17,250

Appendix table 3. (Cont'd)

Part D. Cost of equipment and construction (in ₱).

	10" - 1500 GPM pump		16" - 3000 GPM pump
	1960 prices (actual cost) 3/	1967 prices (estimates) 4/	1967 prices (estimates) 4/
(a) Engine and pump	14,345	38,600	52,500
(b) Casing and drive shoes	4,929	10,800	15,000
(c) Arrestre	212	300	400
(d) Compensating tax (7% of items 1, 2, 3)	1,364	3,600	4,750
(e) Drilling and well development	11,855	14,000	17,500
(f) Structures and canals	6,200	8,000	8,000
Total	38,905	75,300	98,150

Part E. Financing

1960 - Structures and canals - own funds ₱6,200

Balance of construction and equipment - 10 year amortization - ₱3,270.50/year 5/

	1500 GPM pump	3000 GPM pump
1967 - Structures and canals - own funds	8,000	8,000
Engine, pump, casing, drive shoes, arrestre and compensating tax, 10 year amortization, per year (ISU loan) 5/	5,330	7,265

Appendix table 3. (Cont'd)

Part E. Financing

	1500 GPM pump	3000 GPM pump
Drilling and well equipment - (Rural Bank Loan) principal, per year 6/	1,400	1,750
Interest - 12%/yr on outstanding balance 6/		
1st year	1,680	2,100
2nd year	1,510	1,890
3rd year	1,340	1,680
4th year	1,180	1,470
5th year	1,010	1,260
6th year	840	1,050
7th year	670	840
8th year	500	630
9th year	340	420
10th year	170	210

Production Loan (Rural Bank) assumes 6 month loan in both wet and dry season on incremental cash farm costs. Interest - 12%/year. Total interest per year when farmers planting second crop on maximum hectarage permitted by pump:

₱4,434 when using 3000 GPM pump and ₱3,234 for 1500 GPM pump, payments at end of year.

Total loan: 3000 GPM pump, wet season ₱33,900; dry season ₱39,990
1500 GPM pump, wet season ₱33,900; dry season ₱18,753.

Appendix table 3. (Cont'd)

Part F. Other costs.

Increment in sales tax on fertilizer and insecticides:7/	wet - crop ₱20/ha; dry - crop ₱24/ha.
Shadow price adjustment for labor Reduction in incremental unskilled labor costs, not including transplanters and harvesters (50%)	₱25/ha.

Part G. Life of equipment and structures

Pumps and engines	10 years
Balance	15 years

(Salvage value at end of 10 years: 3000 GPM Project ₱14,050; 1500 GPM Project ₱10,950).

1/ Maximum hectarage of pump at full capacity for clay loam = 47 ha in dry season.
2/ Assuming all farmers plant a second crop to extent water available.
3/ Imported item duty free in accordance with existing agreement with USAID.
4/ Includes duty of 10% (on C.I.F. cost) 1500 GPM pump = ₱4,500
3000 GPM pump = ₱6,250
5/ No interest unless payment not made in advance, then 1/2% per month plus surety bond requirement (ISU Loan).
6/ Payments at end of year, Rural Bank Loan.
7/ Included in total farm costs on Table 5.

Appendix table 4. Investment and operating data - low-lift pump.

Part A. Direct benefits, value of added increment of production - farm palay price ₱17.00/cavan

		Yield/ hectare	Hectares cropped	Production: Quantity in cavans	Production: Value in pesos
Rainfall - no irrigation - traditional seed and cultivation practices	1st crop	35	60	2,100	35,700
Irrigated - high yielding seed and inputs	1st crop	85	60	5,100	86,700
	2nd crop	95	40	3,800	64,600
Net annual increment in value, when farmers plant second crop on 40 hectares					115,600

Part B. Current farm costs (including sales taxes and labor at market prices).
Increment of farm costs

	Cost/ha Season Wet (₱)	Cost/ha Season Dry (₱)	Ha cropped Season Wet	Ha cropped Season Dry	Total cost (₱)
Fertilizer and insecticides on irrigated crops					
Farm costs - irrigated, high yielding seed and inputs	795	855	60	40	81,900
Farm costs - traditional seed and cultivation practices	273		60		16,380
Net annual increment in costs, when farmers plant second crop on 40 hectares					65,520

Appendix table 4. (Cont'd)

Part C. Operation and maintenance costs of irrigation works - per year (Assuming farmers plant second crop on 40 hectares).

	Wet season	Dry season	Total cost (₱)
Number of days	60	90	
Fuel, oil and grease costs (₱) @ ₱7.50/day	450	675	1,125
Labor (mechanic/watertender) costs (₱) @ ₱12/day	720	1,080	1,800
Maintenance and repair - equipment (10% landed cost)			791
Maintenance and repair - canals and structures (5% of cost)			193
Total annual cost			3,909

Part D. Cost of equipment and construction (in ₱).

(a) Engine and pump	7,905.00	
Cost of installation	1,000.00	8,905.00
(b) Construction costs		
Pump and engine foundation	400.00	
Engine house	1,000.00	
Stilting pool	300.00	
Sump, wooden, 600 board feet @ ₱0.50/bd. ft.	300.00	
Canals: 1,000 linear meters, 1,500 cu meters @ ₱1.00/cu meter.	1,500.00	
Contingencies, 10%	350.00	3,850.00
Total		12,755.00

Appendix table 4. (Cont'd)

Part. E. Financing

(a) Machinery and construction loan - Rural Bank
Special terms arranged by ADCR - 8% interest for 10 years
Both principal and interest payments at end of year

Amount of loan	₱11,480
Down payment on machinery and construction costs by Farmers' Association	1,275
Total cost of machinery and construction	12,755

Annual principal payments: ₱1,148

Interest payments:

1st year	₱918	6th year	₱459
2nd year	827	7th year	367
3rd year	734	8th year	276
4th year	643	9th year	184
5th year	551	10th year	92

(b) Production loan - Rural Bank - Interest 1%/month, payable at end of year. Wet and dry season loans assume to each be for 6 months in amount of needed incremental cash farm costs.
Total interest/year when farmers plant second crop on maximum hectarage permitted by pump: ₱2,178.
Total loan: Wet season - ₱20,340; Dry season - ₱15,960.

(c) Machinery portion of Rural Bank Loan (financed by Central Bank Loan received from IBRD).
Amount of loan: ₱6,000 (CIF foreign exchange cost of pump and engine).
Terms: 10 years at 5 3/4% interest plus 3/4% annual carrying charge.
Annual principal payments: ₱600.

Interest payments:

1st year	₱390	6th year	₱195
2nd year	351	7th year	156
3rd year	312	8th year	117
4th year	273	9th year	78
5th year	234	10th year	39

Appendix table 4. (Cont'd)

(d) Investment summary		
From national point of view:		
Total fixed capital		₱12,755
Less: Foreign loan	₱6,000	
Duty & sales tax on pump and engine	-- 855	6,855
Net contribution		5,900
From farmers' point of view:		
Capital paid in to Farmers' Association		2,000

Part F. Other costs (in ₱).

(a) Increment in sales tax on fertilizer and insecticides (included in farm costs on Table 5)	Wet crop	20/ha
	Dry crop	24/ha
(b) Shadow price adjustment for labor Reduction in incremental unskilled labor costs (which are not taken to include transplanters and harvestors), 50% reduction		25/ha
(c) Taxes paid on pump and engine: (Duty @ 5% ₱300; sales tax @ 7% ₱555)		855
(d) Annual administrative expenses of Farmers' Association for collection of dues, operation and maintenance		6,000
(e) Annual administrative expense of ADCR: Cost per hectare (This expense assumed to last for only 5 years).		16/ha

Appendix table 4. (Cont'd)

Part G. Life of equipment and structures.

Pump and engines	10 years
Structures and canals	15 years
(Salvage value at end of 10 years - ₱1,283)	

Appendix table 5. Cost of farm inputs, with and without irrigation (Tubewell and low-lift pump projects).
(pesos/hectare)

	Rainfed		Cultivation a/		Irrigated cultivation			
	Own labor and carabao	Cash payments	Payments in kind	Total	Own labor and carabao	Cash payments	Payments in kind	Total
I. 1960 (Palay ₱8/cavan)								
Seeds		10				10		
Labor and carabao b/	72				72			
Labor only c/	19	20			21	20		
Harvesting and threshing d/			42				54	
Total - 1960	91	30	42	163	93	30	54	177
II. 1967 (Wet season) (Palay ₱17/cavan)								
Seeds e/						25		
Fertilizer f/		20				84		
Insecticides & weedicides f/						220		
Labor and carabao b/	108				126 g/			
Labor only c/	25	30			63	60 h/		
Harvesting & threshing d/			90				217	
Total - 1967	133	50	90	273	189	389	217	795
III. 1967 (Dry season) (Palay ₱17/cavan)								
Seeds e/						25		
Fertilizer f/						144		
Insecticides & weedicides f/						220		
Labor and carabao b/					126 g/			
Labor only c/					63	60 h/		
Harvesting & threshing d/							217	
Total - 1967					189	449	217	855

Appendix table 5 (cont'd)

a/ No fertilizer or other chemicals used for rainfed cultivation. Costs not included: land tax, capital investment (land, equipment and buildings).

b/ Labor plus carabao cost imputed at ₱6/day.

c/ Labor cost imputed at ₱3/day.

d/ Harvesting and threshing in kind @ 15% of crop.

e/ 1967-regular variety seeds with rainfed high fertilizer responsive variety (IR8) with irrigated cultivation.

f/ Fertilizer and chemicals for weed and insect control approximately as prescribed by International Rice Research Institute, General Leaflet No. 1, March 1, 1967.

g/ Improved seedbed preparation and increased harrowing when using irrigation.

h/ Straight row planting after using irrigation.

Appendix table 6. Net benefit flow from farmers' viewpoint 1967, 1500 GPM Pump - assuming farmers adopt second cropping gradually - discount rate 8% - values in ₱. Incremental yield from "package" of inputs, in cavans/hectare: wet season 50; dry season 95. Palay price - ₱17.00/cavan. [a/]

Year	Pre-operational	1	2	3	4	5	6	7	8	9	10
Direct benefits											
Incremental benefit [a/]		93,075	101,150	109,225	117,300	125,375	133,450	141,525	149,600	157,675	160,905
Undepreciated structures											10,950
											171,855
Current costs											
Incremental farm costs [a/]		56,475	60,759	65,025	69,300	73,575	77,850	82,125	86,400	90,675	92,385
Operation and maintenance - irrigation		8,560	8,960	9,360	9,760	10,160	10,560	10,960	11,360	11,560	11,760
Structures & canals	8,000										
Loan - Irrigation Service Unit - Pump, casing & accessories	5,330	5,330	5,330	5,330	5,330	5,330	5,330	5,330	5,330	5,330	
Loan - Rural Bank - drilling											
Principal		1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Interest		1,680	1,510	1,340	1,180	1,010	840	670	500	340	170
Loan - Rural Bank - production											
Interest		2,154	2,274	2,394	2,514	2,634	2,754	2,874	2,994	3,114	3,234
TOTAL (current costs)	13,330	75,599	80,224	84,849	89,484	94,109	98,734	10[illegible],359	107,984	112,419	108,949

Appendix table 6 (cont'd)

Total discounted benefits	837,600
Less discounted costs	623,000
	214,600
Less pre-operational expense	13,300
Present value of net benefit flows	201,300

$$\text{Benefit/cost ratio} = \frac{837,600}{623,000 + 13,300} = 1.32$$

a/ Assumes 5 hectares of 2nd crop added 1st to 9th year and 2 hectares in 10th year. Incremental costs and other assumptions as indicated in Tables 3 and 5, Appendix.

Appendix table 7. Net benefit flow from national viewpoint 1967, 3000 GPM Pump - assuming farmers adopt second cropping gradually - discount rate 8% - values in ₱. Incremental yield from "package" of inputs, in cavans/hectare: wet season 50; dry season 95. Palay price ₱17.00/cavan. a/

Year	Pre-operational	1	2	3	4	5	6	7	8	9	10
Direct benefits											
Incremental benefits a/		101,150	117,300	133,450	149,600	165,750	181,900	198,050	214,800	230,350	246,500
Undepreciated structures											14,425
											260,925
Current costs											
Incremental farm costs a/		60,750	69,300	77,850	86,400	94,950	103,500	112,050	120,600	129,150	137,700
Operation and maintenance - irrigation		11,770	11,490	12,210	12,930	13,650	14,370	15,090	15,810	16,530	17,250
Structures and canals and equipment	87,525										
Less											
Labor shadow price		2,750	3,000	3,250	3,500	3,750	4,000	4,250	4,500	4,750	5,000
Sales tax increment		2,240	2,480	2,720	2,960	3,200	3,440	3,680	3,920	4,160	4,400
TOTAL (currents costs)	87,525	66,530	75,310	84,090	92,870	101,650	110,430	119,210	127,990	136,770	145,550

Appendix table 7 (cont'd)

Total discounted benefits	1,105,500
Less discounted costs	674,400
	431,100
Less pre-operational expenses	87,500
Present value of net benefit flows	343,600

$$\text{Benefit/cost ratio} = \frac{1,105,500}{674,400 + 87,500} = 1.45$$

a/ Assumes 10 hectares of 2nd crop added each year. Incremental costs, and other assumptions as indicated in Tables 3 and 5, Appendix.

PATTERNS OF RICE SEED DISTRIBUTION IN THE PHILIPPINES

Tomasa V. Mina and Fabian A. Tiongson

PATTERNS OF RICE SEED DISTRIBUTION IN THE PHILIPPINES[1/]

Tomasa V. Mina and Fabian A. Tiongson[2/]

1.0. INTRODUCTION

This paper reports the findings of a study on multiplication and distribution of rice seed in the Philippines. A primary objective was to find out how effectively the government program has been functioning. Effectiveness must be judged on the basis of whether or not the program meets certain stipulated objectives. The government program appears to have had the following three objectives:

(1) Multiplication and distribution of certified or "good" seeds,

(2) Approval and recommendation of selected varieties which have met specified breeding and yield performance standards, and

(3) Rapid multiplication and distribution of new and promising varieties.

1/ The study was conducted under a contract granted by IRRI to the Department of Agricultural Economics, U.P. College of Agriculture. The authors would like to acknowledge the assistance of Mr. Hegino M. Orticio, Research Assistant, Department of Agricultural Economics, U.P.C.A., who conducted the surveys, Dr. Vernon W. Ruttan, formerly of IRRI, whose support made this project possible, and Dr. Randolph Barker, Agricultural Economist, IRRI, who assisted in the preparation of the manuscript.

2/ Research Assistant and Assistant Professor, Department of Agricultural Economics, U.P.C.A.

Two government agencies have been engaged in seed multiplication. The Bureau of Plant Industry began producing certified seeds in 1957. However, in 1966 the Rice and Corn Production Coordinating Council set up a special seed multiplication plan for IR8 in order to meet the third objective. A survey was made of farmer cooperators in each of these programs. The results of this survey are discussed in the two sections which follow. A final section summarizes the major findings and presents the conclusions.

1.1. Background of study

Domestic production of rice in the Philippines today is inadequate to meet the needs of the people. The insufficiency is filled up largely by importing several million-peso worth of rice annually, thus dwindling the country's dollar reserve. As a result, numerous studies and/or researches are being made on rice and corn for the purpose of increasing production. These include the agronomical, economic, and social aspects of the rice and corn industry.

One of the bold steps undertaken by the government in trying to attain self-sufficiency in the staple foods was the establishment of the Rice and Corn Production Program. This proposes to increase the present production of rice all over the country thru effective implementation of all measures such as (1) research, (2) production and distribution of improved seeds, (3) intensified control of plant pests and diseases, (4) use of fertilizer, and (5) public agricultural information including demonstration of improved farm practices.

The Bureau of Plant Industry started implementing a Seed Improvement Program, as early as May 16, 1952. This was sponsored by the Mutual Security Agency (MSA) and the Philippine Council for U.S. Aid (PHILCUSA). The aim of the program was to provide the farmers with improved seeds of high yielding varieties found adopted to various rice and corn regions of the country.

In 1953, the program was expanded to include not only seed improvement but also multiplication, seed certification and distribution. This was done under a cooperative memorandum of understanding between the Bureau of Plant Industry, the U.P. College of Agriculture, and the Bureau of Agricultural Extension (BAE), now the Agricultural Productivity Commission (APC).

As provided for in Republic Act 2084, the Rice and Corn Production Program is jointly implemented by five agencies of the government with the following duties:

(a) Bureau of Plant Industry - Research; production of breeder, foundation, and registered seeds; seed certification; procurement and distribution of certified seeds; and control of pests and diseases.

(b) Bureau of Agricultural Extension (now CAP) - Educational campaign on improved cultural practices and use of certified seeds.

(c) Bureau of Soils - Soil analysis and recommend kind and quantity of fertilizers and method of application.

(d) Agricultural Credit and Cooperative Financing Administration (now ACA) - Procurement, warehousing, and distribution of fertilizers.

(e) U.P. College of Agriculture - Research and Production of breeder's seeds.

The implementing organizations of the program are: (1) Rice and Corn Production Coordinating Council, the highest governing body of the program which formulates policies, rules, and regulations of the program to achieve its objectives; (2) Regional Rice and Corn Production Coordinating Committee which is responsible for the proper implementation of the program by coordinating and supervising the work of the provincial committee within the region; (3) Provincial Rice and Corn Production Action Committee which has direct supervision over the action teams; and (4) Action Teams, which are the ones working on the program. There are 300 action teams and each team is composed of a plant pest control officer, an agricultural extension worker, and a soil technologist.

2.0. PROGRAM OF THE BUREAU OF PLANT INDUSTRY

2.1. Multiplication and certification

Because of the limited facilities of the government to meet all the seed requirements of the country, the services of selected farmer-cooperators were needed for the multiplication of certified seeds. This would enable the system of seed multiplication to be carried on extensively. Three types of seeds are distributed to farmer-cooperators for the production of certified seeds, namely: (a) foundation seeds, (b) registered seeds, and (c) certified seeds. Foundation seeds are produced from breeder seeds, the initial increase of which is supervised by the sponsoring plant breeder. Breeder seeds are produced by the originator of a new variety that is planted for the production of foundation seeds or stock seeds. Registered seeds are the progenies of foundation seeds. These are distributed to selected farmer-cooperators for the production of certified seeds. Certified seeds are of two types: the first generation certified seeds, which are the progenies of registered seeds, and the second generation certified seeds, which are the progenies of first generation certified seeds.

Farmer-cooperators of the Bureau of Plant Industry are those farmers selected by the Bureau to grow and produce certified seeds. These farmers buy the seeds from the Bureau and sign an agreement which contains the following conditions:

(1) Following the instructions of any authorized representative of the BPI concerning the cultural practices in the production of palay;

(2) Notifying the nearest seed inspector at least 30 days before harvesting for inspection of the field;

(3) Securing a permit from the seed inspector before moving the produce from the farm;

(4) Recleaning of the produce and other processing must be supervised by an authorized representative of the Bureau, and

(5) Providing new sacks for threshed palay, storage, and safe-keeping of them until they are finally certified and disposed in accordance with the prescribed rules of the Bureau of Plant Industry.

However, not all those who can abide with the above requirements can qualify to buy all types of seeds. Foundation seeds are sold only to a few selected cooperators approved by the Seedboard. These farmers must have a good record in the production of certified seeds for the last 2 or 3 years. Farmers with 5 hectares or more of upland farms and farmers with 10 hectares or more of lowland can qualify to buy registered seeds.

Seed certification as one phase of the seed improvement program is entrusted to the BPI as the seed certifying agency. The purpose of seed certification is to maintain and make available to the public, sources of high quality seeds. Only varieties approved by the seedboard are eligible for seed certification. Factors considered by the seedboard are high yield, resistance to lodging, good milling recovery, and good eating qualities. On the average the selection result from 3 to 4 seasons of preliminary yield tests, 2 to 3 seasons of general yield trials, and 2 to 3 seasons of regional adaptability tests conducted in the different parts of the country. However, for certain varieties that show unusual potential the time can be greatly reduced. IR8 was approved in April 1967 after only three seasons of testing.

Seed certification is divided into two phases: field certification and laboratory certification. Field certification is the inspection of the field by a seed inspector to determine if the field intended for seed certification is free from off-types, volunteer plants, weed seeds, etc. On the other hand, laboratory seed certification is the testing of the seed samples to determine whether they fall within the specific standards for purity, germination, moisture content, mixture with other varieties, red rice, weed seeds, etc. Samples that do not meet the requirements are rejected and therefore are not seed certified. The following table is the laboratory standard for the different classes of rice seeds.

2.2. Procurement and distribution

Fig. 1 shows the flow of the BPI seed materials. Certified seeds are distributed to farmer-cooperators under the program. It would be noted that there are three types of farmers receiving the seeds. We have those who are distributed the foundation seeds, the registered seeds, and the certified seeds. However, a farmer who purchases foundation seeds can also buy registered seeds or certified seeds or vice versa. The action teams of the Bureau are the ones distributing the seeds to willing cooperators. Each team is allocated a minimum quota of 80 cavans for distribution. Buyers of certified seeds anywhere in the Philippines are charged the same price by the Bureau for every cavan of 44 kilos gross-weight including the container. The cost of handling and transportation from the source of the stock to the first port of destination is borne by the rice and corn production program. The certified seeds produced by the farmer-cooperators are in turn procured by the Bureau with a premium price of ₱2.00 per cavan above the current price of commercial palay in the locality, but not lower than ₱12.50 per cavan. These certified seeds produced by the farmers are not always purchased by the Bureau.

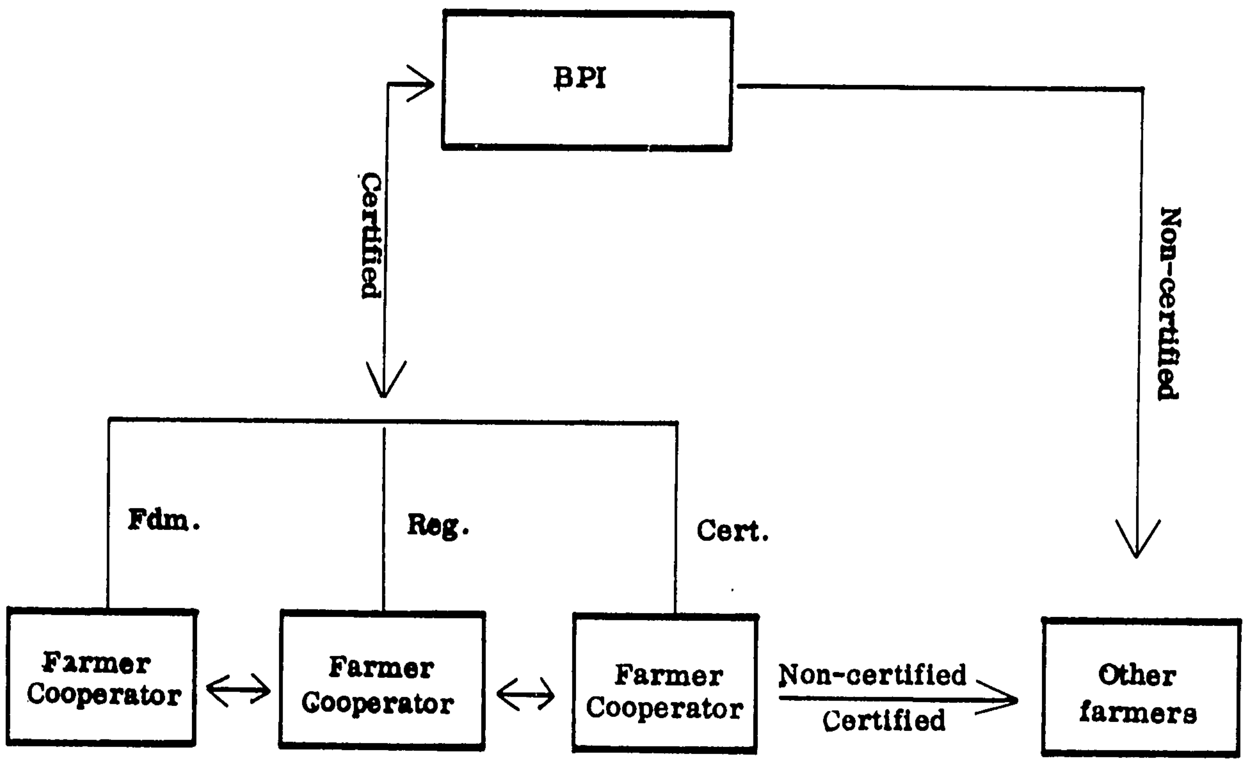

Fig. 1. Flow of BPI seed material.

The policy on purchases is subject to the seed requirements of the program, availability of fund and on the "first come first served" basis. Also, the Bureau buys only certified seeds harvested between October 1 to January 31 unless the exigency for buying certified seeds during off season may so arise. Other certified seeds then may be sold to other cooperators or to other farmers. Seeds not certified by the Bureau are sold to other farmers by the cooperators. In some cases, the Bureau sells also non-certified seeds to other farmers. These non-certified seeds were formerly certified but due to the length of time they were stored, the percentage germination was reduced and therefore did not anymore meet the standard requirements for certified seeds.

2.21. Actual distribution. In the Philippines, the procurement and distribution of certified seeds is assigned to the Bureau of Plant Industry. Procurement consists of direct purchases of certified seeds from the selected seed producers by the Bureau through its seed inspectors. The procured seeds are then sold to the farmers, preferably the cooperators under the program. The Bureau started handling the voluminous distribution in 1960. During this year, it distributed 4.3 thousand cavans of seeds and supplied .14 percent of the total seed requirements of the country. Since then, the number of farmers using certified seeds in the Philippines increased. There was a corresponding increase in the volume of certified seeds sold by the Bureau. This indicates that more and more farmers were learning to use the recommended seed varieties. However, in 1964-65 the volume of seeds distributed as well as the number of farmers using these seeds dropped. Probably this was due to the sudden increase in the price of these seeds. From 1960-61 to 1963-64, the price of foundation and registered seeds was ₱13.50 per cavan and that of certified seeds was ₱12.50. In 1964-65 the price rose to ₱25.00 per cavan of foundation seed, ₱22.00 of registered and ₱19.00 per cavan of F_1 certified seeds. The highest volume of distribution was in 1963-64, 24.8 thousand cavans (Table 1). It was also during this year where the proportion of total seed requirements of the country supplied by the Bureau was highest, .81 percent (Table 2). But this was still very small considering that the palay seed requirements of the country is about 3.2 million cavans. This shows that the country is not yet saturated with certified seeds in spite of the program launched on increased rice and corn production.

2.3. Survey of farmer-cooperators

The previous section has described the working of the system. This section reports on the reactions of farmer-cooperators who have participated in the program.

A survey of BPI farmer-cooperators was undertaken. It shows how the program has functioned at the farm level. Thirty-four percent of the foundation and registered seed farmer-cooperators in 1964-65 were interviewed. Data taken were based on 1964-65 operation. The 92 cooperators studied are distributed as follows: Nueva Ecija - 24; Pangasinan - 13;

TABLE 1. Total distribution of certified seeds by regions, Philippines, 1960-61 to 1965-66.

Regions	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66
			(cavans)			
I	542.5	875	6,545.42	3,065.88	2,793.88	2,521.64
II	126	126	1,777.74	860.43	1,293.75	1,267.29
III	2,492	2,245	8,415.45	14,036.13	6,201.61	13,061.21
IV	190	466	331.98	1,547.64	619.70	747.73
V	752	743	1,608.62	1,821.26	1,526.18	691.51
VI	74	72.75	207.98	414.11	497.38	324.67
VII	113	26	777.34	1,954.77	1,361.90	290.37
VIII	54	558	1,158.22	1,165.41	631.25	1,091.83
Philippines	4,343.5	5,111.75	20,822.75	24,865.63	14,925.65	19,996.24

TABLE 2. Proportion of seed requirement supplied by the Bureau of Plant Industry, all regions, Philippines, 1960-61 to 1965-66.

Regions	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66
			(per cent)			
I	.12	.22	1.62	.81	.66	.62
II	.04	.04	.71	.40	.46	.41
III	.40	.33	1.25	2.05	.89	1.75
IV	.06	.16	.11	.50	.21	.20
V	.20	.20	.40	.47	.40	.20
VI	.02	.02	.07	.15	.16	.10
VII	.06	.02	.40	.96	.61	.15
VIII	.02	.09	.21	.20	.11	.31
Philippines	.14	.16	.66	.81	.47	.65

Iloilo - 24; Cotabato - 24; and Laguna - 7. Of these farmers, 75 percent were owners, 10 percent were part-owners, 6 percent were farm managers, and 9 percent were tenants.

Seventy percent of the 92 farmer-cooperators studied planted both certified and non-certified seeds in their farms. Of the total quantity used, certified seeds accounted for 31 percent and non-certified, 69 percent. Twenty-four percent were purchased by the farmers and 76 percent were own produced. Almost all certified seeds were from the Bureau. Only one farmer from Nueva Ecija bought part of his seeds from a fellow seed cooperator. Certified seeds were bought from BPI at an average price of ₱19.78 and from other seed cooperators at ₱22.00 per cavan. Farmers purchased non-certified seeds at an average price of ₱21.36 per cavan from BPI; ₱18.43 from FaCoMa; ₱13.80 from the U.P. College of Agriculture; and ₱24.67 from other farmers (Table 3). Of the varieties purchased, Seraup Ketchil commanded the highest price per cavan, ₱23.61, and Managarez, the lowest ₱12.50 for certified seeds. For non-certified ones, however, BE-3 was the highest, ₱27.35, and Intan, the lowest, ₱13.25.

It is surprising to note that with the same source of certified seeds, some farmers spent for containers while others did not. For instance, only some Nueva Ecija and Pangasinan farmers provided the containers. On the average farmers spent ₱.84 for the containers; ₱.46 for transportation; and ₱.90 for handling in obtaining a cavan of certified palay seeds. For non-certified seeds, the costs are ₱1.01, ₱.35 and ₱.08 respectively. The cost

TABLE 3. Purchased price of seeds by source by province, 92 farmer-cooperators, five provinces, Philippines, 1964-65.

Province	Bureau of Plant Industry		Other farmer-cooperator	Other farmers	FaCoMa	UPCA	All sources	
	Certified	Non-certified	Certified	Non-certified	Non-certified	Non-certified	Non-certified	Certified
	(pesos)							
Nueva Ecija	18.94	12.50	22.00	15.00	-	-	18.99	14.85
Pangasinan	21.26	22.00	-	-	-	-	21.26	22.00
Iloilo	21.43	23.00	-	27.35	-	-	21.43	26.80
Cotabato	19.87	14.00	-	12.75	18.43	-	19.87	16.57
Laguna	20.48	-	-	-	-	13.80	20.48	13.80
All	19.78	21.36	22.00	24.67	18.43	13.80	19.81	23.86

differentials may be attributed to the different sources of procurement.

Only one-half of the cooperators studied, submitted samples of their seeds for certification to the Bureau. Of those who submitted, 56 percent had their harvest or portion of harvest passed certification. Only 10 percent of the total production of farmers who submitted samples for certification was approved (Table 4).

On the average certified seeds yielded 54.8 cavans per hectare, whereas non-certified ones produced only 46.5 (Table 5). A significant difference was found between the two yields. This was possibly due to the type of seeds used, input factors and supervision made by seed inspectors in growing certified seeds. In Cotabato, yield per hectare tended to increase with the length of time farmers were engaged on rice farming. In the other provinces studied, this tendency was not observed. It was found out that in the provinces of Nueva Ecija and Iloilo, the length of time farmers were serving as cooperators of the Bureau had some relations with the yield. The average production per hectare tended to increase.

Only 25 farmers studied had some sales of certified seeds. A bigger number, 37 disposed non-certified seeds. Of the total seeds certified by the Bureau, 69 percent were sold by the farmer respondents. The rest 31 percent were either reserved as seed or consumed. Also, part of it might have been sold by the tenant or landlord as his share. The study has no way of finding out what happened to the certified seeds that were shared to the tenant or

TABLE 4. Proportion of certified and non-certified seeds produced by province, 46 farmer-cooperators, 5 selected provinces, Philippines, 1964-65. a/

Province	No reporting	Total production b/	Proportion Certified	Non-certified
			(percent)	
Nueva Ecija	12	52,006	13	87
Pangasinan	8	15,764	11	89
Iloilo	7	39,278	4	96
Cotabato	14	3,931	13	87
Laguna	5	957	65	35
All	46	111,936	10	90

a/ Only 46 farmers submitted samples for certification.

b/ Only production of those who submitted samples for certification.

TABLE 5. Production per hectare by types of seeds planted by province, 92 farmer-cooperators, 5 provinces, Philippines, 1964-65.

Province	Production per hectare: Certified seeds planted	Production per hectare: Non-certified seeds planted
	(cavans)	
Nueva Ecija	51.9	44.8
Pangasinan	58.6	49.8
Iloilo	57.9	48.7
Cotabato	60.2	43.0
Laguna	40.1	38.6
All	54.8	46.5

landlord. Of the total production of non-certified seeds, 29 percent were marketed (Table 6). The most important outlet for certified seeds was the BPI to whom 99 percent went. Other farmers, as another outlet, received only 1 percent. A substantial volume of non-certified seeds was sold to other farmers. The FaCoMa received 20 percent of the total non-certified seeds marketed. The Bureau purchased the cooperators certified seeds at ₱21.66 which is ₱1.36 above the price other farmers paid for a cavan. Non-certified seeds were sold at a much lower price than certified ones. The FaCoMa price was ₱15.78 per cavan while the price paid by other farmers was ₱18.96 on the average.

Costs of disposal varied by province for certified as well as for non-certified seeds. On the average, the cost of container was ₱1.13, transportation was ₱.32 and handling was ₱.27 per cavan. For non-certified seeds, costs were quite different. It was ₱1.08 for containers, ₱.60 for transportation and ₱.66 for handling a cavan of palay.

2.33. Problems. In spite of the many advantages derived from planting certified seeds, such as low purchased price, high yield, high selling price, still the farmers complained of several difficulties they encountered in being cooperators of the Bureau. The most important of them were the following:

1. Length of time spent in the procurement. Forty-six percent of the farmer-cooperators complained of the length of time involved in securing

TABLE 6. Seed disposal by farmer-cooperators, 5 provinces, Philippines, 1964-65.

Province	Certified		Non-certified		All	
	Volume	Percent[a]	Volume	Percent [b]	Volume	Percent
Nueva Ecija	4,336	64	1,571	1.2	5,907	4.5
Pangasinan	1,542	88	187	.5	1,729	4.4
Iloilo	872	62	257	.3	1,129	1.3
Cotabato	481	96	1,734	20.0	2,215	24.6
Laguna	436	71	50	4.2	486	21.8
All	7,667	69	3,799	29	11,466	4.3

a/ Only production certified by the Bureau.

b/ Production from non-certified seeds and from certified seeds planted but not certified by the Bureau.

the approval of the BPI for application to purchase certified seeds. Eighteen percent, however, obtained their seeds two weeks before sowing. The time involved to secure the approval ranged from one day to four month sowing.

2. No follow-up supervision from BPI. Farms, on the average, were visited by the seed inspectors twice during land preparation, planting, growing, and seedbed preparation. During harvest time the inspectors sometimes visited the farms three times. Farms in Nueva Ecija were visited most frequently (five times) at threshing time. Twenty-two percent of the farmers, however, said that their farms were never visited by the seed inspectors.

3. Labor and expense. Farmers have to perform several cultural practices as embodied in the agreement they signed with the Bureau. Cost of production was greater for certified than for non-certified seeds. Costs of fertilizers used in producing one cavan of certified and non-certified seeds amounted to ₱.48 and ₱.33 per cavan, respectively. For insecticides, cost amounted to ₱.04 and ₱.02, respectively.

4. Length of time of payment. Another major complaint presented by the farmer-cooperators was the length of time involved in knowing the result of seed analysis which eventually affected the time of payment for their produce. On account of this, those who needed cash badly sold their seeds without waiting for the result of certification.

5. Other problems. Other problems met by the cooperators were distance from the BPI Office, inavailability of the palay seeds sometimes and sometimes too BPI could not buy all their seeds. Fifteen cooperators said that during the year they were not able to plant the right varieties and desired quantity of seeds because there was no available stock in the BPI. One farmer said the reason was that there was too much red tape and there is some sort of politics involved.

With the many problems reported by the cooperators, still a substantial number of them are willing to stay as cooperators of the Bureau. They said that as long as they would be in rice farming and as long as they could purchase seeds on good terms, they would remain as cooperators. They still preferred to use BPI seeds. Very few preferred to purchase seeds from other sources like UPCA and IRRI. They said that they were satisfied in the performance of the BPI seeds. However, more than one third (35 percent) have ceased to be cooperators. They were no longer cooperators during the time of the survey.

3.0. THE IR8 SEED MULTIPLICATION PROGRAM UNDER THE RCPCC

The Rice and Corn Production Coordinating Council, a government agency created under Republic Act 4642 is designated as the agency that coordinates the implementation of the program for the multiplication and diffusion of IR8, a new rice selection that has been developed by International

Rice Research Institute (IRRI) scientists. Under the program, selected seed rice are distributed to qualified rice farmers who are expected to multiply this for sale to the council thru the RCA or to other rice farmers. The RCA provides facilities for the purchase of seed and its distribution to qualified seed multipliers. It programs delivery of the seed rice to authorized seed multipliers. In the case of IR8 it sent its authorized representative to IRRI to withdraw seed rice for delivery to the seed multipliers. Seed multipliers pay the cost of the seed allocated to him by RCA to the nearest RCA agency. After delivery by IRRI of the seed rice stock, IRRI billed RCA for the total cost of all the deliveries.

The Quedan System of purchasing applied to the purchase of accepted seed rice from seed multipliers.

Farmers selected by the council to be its cooperators should have at least 10 hectares of area to be planted to palay; should have irrigation facilities; should be located in the designated areas of multiplication and is accessible. The farmer should also have facilities for temporary storage of seeds, to be produced before delivery to the RCA or direct sale to other farmers. The farmer-cooperator signs an agreement with the council which states the different requirements he has to comply with, the most important of which are the following:

(1) To grow the seeds in accordance with the instructions and cultural practices recommended for the multiplication of the seed.

(2) To allow the inspection of his farm by technicians of the government and of IRRI.

(3) To sell as much as he can of his seed harvest to the council or through the RCA or to other farmers, provided that the seed meets the prescribed specifications, and

(4) To sell all of his seed harvest only as seed rice and not for commercial purposes or for human consumption.

In July 1966, 50 tons of IR8 seeds from the IRRI farms were turned over to the government agency for distribution to selected farmers in the areas designated for IR8 multiplication. IRRI sold the rice to RCA at ₱25.00 per cavan. Eighty percent of these seeds were devoted to the multiplication areas and twenty percent were channeled to the test plots of APC and BPI (Fig. 2). The seeds were sold by RCA at cost to authorized seed multipliers.

The multiplication farms were divided into different areas and each area was assigned to a farm technician whose responsibility was to see to it that seed multipliers follow recommended cultural practices, but appropriate reports on problems in his area of responsibility are given attention.

Area farm technicians are directly supervised by a seen inspector. A seed inspector supervises not more than 5 farm technicians and a farm technician has responsibility over an area of not more than 100 hectares of

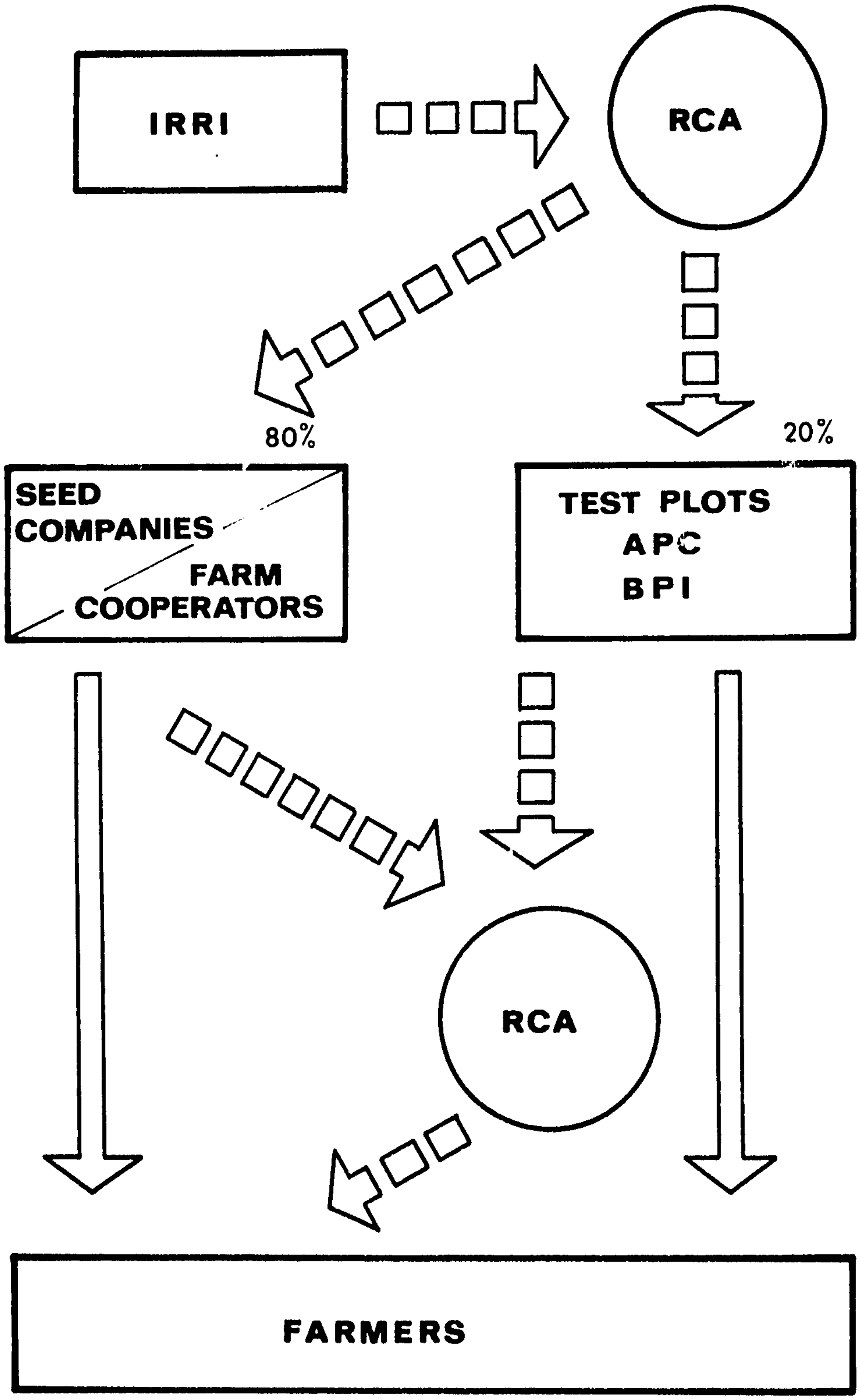

Fig. 2. Flow of IR8 seed material.

seed farm.

Table 7 shows the number of farmers served by the RCPCC and the quantity of seeds sold to them in 1966.

3.1. Survey of farmer cooperators

Forty-eight RCPCC farmer-cooperators were studied from the provinces of Laguna, Bulacan, Pampanga, Tarlac, Nueva Ecija, and Pangasinan. The number interviewed represented 52 percent of the total population.

Fifty-six percent of the cooperators were owners, 20 percent were part-owners, 20 percent were farm managers, and 4 percent were tenants.

In 1966-67, the 48 cooperators studied planted 554 cavans of IR8 seeds during the wet season and 1174 cavans during the dry season. In the first crop, 43 cooperators participated and in the second, 35. Of other varieties, 8625 cavans were planted in the wet season, and 521 cavans in the dry season. A breakdown of the volume of seeds used by province is shown in Table 8, and the average quantity planted per farm in Table 9. Purchased seeds accounted for 14 percent and own produced seeds 86 percent of the total quantity used. Seeds obtained from IRRI through the RCPCC represented 92 percent of the total procurement. The rest or 8 percent were bought from other farmers and from a private seed agency (Table 10). The average procurement price of IR8 was ₱25.98, while that of other varieties was ₱24.18 per cavan. Price varied by source. IR8 seeds procured from RCPCC cost ₱25.87, those

TABLE 7. Distribution of RCPCC farmer-cooperators, 6 provinces, Philippines, 1966.

Province	RCPCC farmer-cooperators	Quantity of seeds received (cav)
Nueva Ecija	37	284
Tarlac	24	165
Pangasinan	9	62
Pampanga	7	196
Laguna	10	301
Bulacan	6	49
All	93	1057

TABLE 8. Total seeds used, 48 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Province	Wet		Dry		All seasons		All seasons
	IR8	Other varieties	IR8	Other varieties	IR8	Other varieties	All varieties
				(cavans)			
Laguna	151.50	132.00	529.50	35.40	681.00	167.40	848.40
Bulacan	21.00	1,207.00	26.00	2.40	47.00	1,209.40	1,256.40
Nueva Ecija	87.00	3,795.75	114.60	374.50	201.60	4,170.25	4,371.85
Pampanga	155.00	876.00	250.00	-	405.00	876.00	1,281.00
Tarlac	116.00	1,362.68	231.00	87.62	347.00	1,450.30	1,797.30
Pangasinan	23.20	1,252.00	23.00	21.00	46.20	1,273.00	1,319.20
All provinces	553.70	8,625.43	1,174.10	520.92	1,727.80	9,146.35	10,874.15
Total area planted	546.8	8,586.5	1,174.10	524.05	1,709.10	9,110.55	10,819.65

TABLE 9. Volume of seeds used pe: cooperator, 48 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Province	Wet		Dry		All seasons		All seasons
	IR8	Other varieties	IR8	Other varieties	IR8	Other varieties	All varieties
				(cavans)			
Laguna	21.64	44.00	88.25	17.70	97.28	41.85	121.20
Bulacan	7.00	301.75	13.00	1.20	11.75	302.35	314.10
Nueva Ecija	7.91	271.12	10.41	37.45	14.40	297.87	312.27
Pampanga	31.00	175.20	50.00	-	81.00	175.20	256.20
Tarlac	9.66	113.55	28.87	14.60	26.70	111.56	138.25
Pangasinan	4.64	250.40	7.66	10.50	9.24	254.60	263.84
All varieties	12.87	200.59	33.54	23.68	35.99	203.25	226.54
Average area planted/farm	12.71	199.68	33.20	23.82	35.60	202.46	225.41

TABLE 10. Percentage distribution of procurement by source of seeds, 48 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Province	Percent procurement by source of seeds: RCPCC	Seed producer and other farmers	Seed corporation	All sources
Laguna	99.82	.18	-	100.00
Bulacan	100.00	-	-	100.00
Nueva Ecija	85.83	13.45	.72	100.00
Pampanga	95.80	-	4.20	100.00
Tarlac	92.09	6.78	1.13	100.00
Pangasinan	97.56	-	2.44	100.00
All provinces	92.46	5.71	1.83	100.00

from other farmers ₱30.00 and those from a private agency ₱30.00. Other varieties were obtained from IRRI at ₱25.00, from PBI at ₱24.15, from other farmers at ₱22.98 and from a private agency ₱40.00 (Table 11). BPI-76-1 was purchased at the highest price, ₱42.50 per cavan and BPI-121 at the lowest price ₱22.00 per cavan.

The total production of palay in the wet season amounted to 58,354 cavans of IR8, 393,851 of other varieties; 110,797 of IR8 and 29,613 of other varieties in the dry season. IR8 gave an average yield of 106.7 cavans in the first crop and 95.3 in the second crop. Table 12 shows the difference in yield by province. Fifty-eight percent of the cooperators submitted samples of their produce for certification during the wet season and 27 percent in the dry season. IR8 certified as good seeds represent 42 percent in the first crop and 29 percent in the second crop of the total production of those who submitted samples for certification (Table 13).

Forty-three farmer-cooperators had some seeds sales. Forty-seven percent of total IR8 production in the wet season and 21 percent in the dry season were disposed by farmers as seeds. Of other varieties produced, .61 percent and 8 percent were sold as seeds in the wet and dry season, respectively (Table 14). The largest government purchaser of IR8 was the Agricultural Credit Administration (ACA) (Table 15).

TABLE 11. Buying price of IR8 and other varieties by source, 48 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Source	Laguna	Bulacan	Nueva Ecija	Pampanga	Tarlac	Pangasinan	All provinces
IR8							
RCPCC (IRRI direct, BPI, ACA & RCA)	25.00	25.00	25.62	26.68	25.73	28.05	25.87
Seed producer and other farmers	-	-	30.00	-	-	-	30.00
Seed corporation	-	-	-	30.00	-	-	30.00
All sources	25.00	25.00	25.87	27.02	25.73	28.05	25.98
Other varieties							
IRRI (direct)	-	-	25.00	-	-	-	25.00
BPI	-	-	25.00	22.00	29.84	25.11	24.15
Seed producer and other farmers	30.00	-	22.00	-	28.33	-	22.98
Seed corporation	-	-	40.00	-	45.00	35.00	40.00
All sources	30.00	-	24.84	22.00	30.11	25.54	24.22
All sources All varieties	25.01	25.00	25.06	24.09	26.84	26.65	25.04

TABLE 12. Yield per hectare of palay in cavans, 48 farmer-cooperators, 6 provinces, Philippines, 1966-67.

Province	Wet		Dry		All	
	IR8	Other varieties	IR8	Other varieties	IR8	Other varieties
Laguna	109.08	48.32	99.11	116.71	101.23	62.18
Bulacan	28.69	43.36	80.53	70.4	56.20	43.41
Pampanga	109.83	69.68	81.89	-	92.79	69.68
Tarlac	133.06	43.90	101.8	73.28	112.04	45.92
Nueva Ecija	84.98	45.32	94.50	49.41	90.43	45.61
Pangasinan	79.73	33.14	107.05	42.38	92.63	33.33
All provinces	106.72	45.86	95.32	56.51	98.97	46.48
Total production	58,354.5	393,851.00	110,797.00	29,612.69	169,151.5	423,463.69

TABLE 13. Volume of IR8 produce certified as good seeds, 35 RCPCC farmer-cooperators, Philippines, 1966-67.

Province	Wet season				Dry season			
	Number rept'g	Volume certified	Per cent*	Total production a/	Number rept'g	Volume certified	Per cent**	Total production b/
Laguna	3	1847	13.11	14,081.00	3	20,660	42.95	48,096.00
Bulacan	-	-	-	-	1	35	37.23	94.00
Nueva Ecija	6	2856	53.97	5,291.50	2	654	7.74	8,445.00
Pampanga	5	9300	53.60	17,354.00	1	3,500	17.30	20,227.00
Tarlac	9	8169	48.50	16,840.00	5	5,133	20.58	24,945.00
Pangasinan	5	947	62.51	1,515.00	1	400	21.98	1,820.00
All provinces	28	23,119	41.97	55,081.50	13	30,382	29.32	103,627.00

*/ Percent of production, wet season of those who submitted samples for certification.

**/ Percent of total production, dry season of those who submitted samples for certification.

a/ Production of cooperators who submitted samples for certification during the wet season of 1966-67.

b/ Production of cooperators who submitted samples for certification during dry season of 1966-67.

TABLE 14. Volume of palay sold as seeds, by province, 43 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Province	IR8		Other varieties	
	Volume		Volume	
	Wet	Dry	Wet	Dry
	(cavans)			
Laguna	6111	21,635	-	5
Bulacan	-	34	10	-
Pampanga	7752	-	-	-
Tarlac	9763	1,256	670	2445
Nueva Ecija	3216	414	1235	42
Pangasinan	795	100	490	-
All provinces	27,637	23,439	2,405	2,492
Percent of total production	47.36	21.15	.61	8.42
Total production	58,354.5	110,797	393,851	29,612.69

TABLE 15. Percentage of seed sales by outlet, 43 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Outlet	Laguna	Bulacan	Nueva Ecija	Pampanga	Tarlac	Pangasinan	All provinces
IR8							
RCPCC (ACA, BPI and RCA)	80.71	-	52.19	93.03	26.74	30.68	64.98
PNB	-	77.27	3.87	3.87	4.00	-	1.95
FaCoMa	-	-	-	-	1.60	-	.40
Philsugin	.18	-	-	-	-	-	.09
Seed producer and other farmers	19.09	-	17.91	3.10	45.62	33.94	23.83
All outlets	99.98	77.27	73.97	100.00	77.96	64.62	91.25
Other varieties							
BPI	-	-	-	-	12.75	-	3.22
Seed producer and other farmers	.02	22.73	26.03	-	9.29	35.38	5.53
All outlets	.02	22.73	26.03	-	22.04	35.38	8.75
All outlets All varieties	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The other outlets were PNB, FaCoMa, Philsugin, Seed producers and other farmers. Sale price of IR8 and other varieties were almost the same, ₱29.34 and ₱29.01 per cavan, respectively. In terms of outlet, the lowest price for IR8 was paid by the government (Table 16).

The quantity of IR8 sold as commercial palay accounted for 27 percent of the total production, and of other varieties, 30 percent. The total volume of IR8 retained for seeds was 3,634.50 cavans in the wet season and 10,974.50 cavans in the dry season. These represented 6.22 and 9.91 percent of the total production in each season, respectively. Of other varieties, 2.28 percent were retained as seeds in the wet season and 6.16 in the dry season.

3.1. Problems

Fifty-four percent of the farmers complained of some difficulties they encountered in being cooperators of the RCPCC. The most important of them were the following:

1. Labor and expense. Eighteen percent of the farmers complained of the labor and expense involved in growing IR8. They said that the costs of production were very much greater than that of other varieties. For fertilizer used, the cost was ₱1.35 per cavan and for insecticides, ₱1.11 per cavan.

2. Limited market. Seven cooperators said that their marketing agreement with the RCPCC was not followed. They said that in being cooperators, there is no assurance for their seeds to be purchased by the RCPCC. Four farmers mentioned that there were few buyers for their seeds.

TABLE 16. Selling price of palay seeds, by outlet, 43 RCPCC farmer-cooperators, 6 provinces, Philippines, 1966-67.

Outlet	Laguna	Bulacan	Nueva Ecija	Pampanga	Tarlac	Pangasinan	All provinces
IR8							
RCPCC (ACA, BPI & RCA)	30.00	-	30.00	30.00	28.67	30.00	29.86
PNB	-	30.00	30.00	30.00	30.00	-	30.00
FaCoMa	-	-	-	-	30.00	-	30.00
Philsugin	30.00	-	-	-	-	-	30.00
Seed producer and other farmers	25.75	-	28.16	30.00	29.39	28.72	27.85
All outlets	29.19	30.00	29.55	30.00	29.19	29.33	29.34
Other varieties							
BPI	-	-	-	-	29.73	-	29.73
Seed producer and other farmers	25.00	23.20	25.42	-	31.20	30.00	28.59
All outlets	25.00	23.20	25.42	-	30.35	30.00	29.01
All outlets All varieties	29.19	23.20	28.47	30.00	29.44	29.57	29.31

3. Too much red tape. Four farmers said that they have to make some series of paper follow-ups in the procurement and sale of their seeds to the government.

4. Other problems. Other problems mentioned by a few farmers were presence of impurities in the purchased seeds, distance from the source of seeds, lack of available seed stock and delayed certification of their seeds.

In spite of the problems reported by the cooperators, almost all of them have expressed their desire to remain as cooperators of the RCPCC. They said that as long as the program is going on, they would stay as cooperators. Nearly one-half cited that the program is good in the sense that it encourages farmers to adopt modern methods of farming and that the program is meant to make the people self-sufficient in rice.

4.0. SUMMARY AND CONCLUSIONS

The objectives of the Seedboard are: (1) approval and recommendation of superior varieties, and (2) multiplication and distribution of "good" seeds. This study has examined the success achieved in this latter objective. BPI's seed distribution program has been functioning for over a decade but by 1964-66 still less than 1 percent of the total seed requirements of the country were supplied through this program. Thirty-five percent of the cooperators studied had ceased to be cooperators by the time of the survey. There appears to be a lack of interest among cooperators and a lack of supervision on the part of the government. To improve the efficiency of the system within the scope of the existing resources, it would seem necessary to redefine the goals and objectives of the BPI program. Even with the introduction of improved high yielding varieties, it is unlikely that the demand for certified seeds will increase since seeds will be readily available from neighbors. With proper soaking of field seeds of the dwarf indica varieties can be kept relatively pure. The BPI will gain cooperators only if they offer a package of technical or management assistance which farmers consider valuable. Certified seeds alone is unlikely to offer much attraction.

The program of the RCPCC in multiplication has been based on a different objective. The purpose here was to multiply IR8 as rapidly as possible. A few cooperators were enlisted and closely supervised. The farmers shows a better understanding and interest in the program. The RCPCC has currently selected IR5 to multiply following the success with IR8. The important question here is how the RCPCC will decide in the future what variety is worthy of rapid multiplication and distribution. As more varieties become available and the yield increases are less dramatic, it will become more important to establish such criteria.

SEED CORPORATION OF THE PHILIPPINES

Edward L. Felton, Jr. and Ralph Z. Sorenson

SEED CORPORATION OF THE PHILIPPINES[1/]

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PART I - COMMENTARY ON THE CASE STUDY[2/]

1.0. INTRODUCTION

The accompanying case, entitled Seed Corporation of the Philippines, was written as part of a program to develop local teaching materials for use in graduate business schools in the Philippines. Participants in this Ford Foundation supported program are: the University of the Philippines, Ateneo de Manila University, De La Salle College, and the Harvard Graduate School of Business Administration.

The Seed Corp case is intended primarily for use in a graduate level course in the field of marketing. The case was written out of a conviction that in countries such as the Philippines, many of the most critical marketing problems currently lie in the agricultural sector - particularly with respect to the task of achieving self-sufficiency in the production and distribution of the nation's dietary mainstay: rice.

1/ The paper is divided into two parts. Part I - Commentary on the Case Study was prepared by Ralph Z. Sorenson. Part II - The Case Study was prepared by Edward L. Felton, Jr. under the direction of Ralph Z. Sorenson. Case materials of the Inter-University Program for Graduate Business Education in the Philippines is prepared as a basis for class discussion. Cases are not designed to present illustrations of either effective or ineffective handling of administrative problems.

2/ Members of the Harvard Graduate School of Business Administration and Participants in the Ford Foundation Sponsored Inter-University Program of Graduate Business Education in the Philippines.

The immediate issue posed by the Seed Corp case is how a private firm should go about selling newly developed IR8 "miracle" rice seeds to farmers. In a broader sense, however, the case is concerned with the problem of changing age-old traditions and marketing a whole new method of farming to all the various types of people who are involved in the rice production process.

Note that Seed Corp is written from the point of view of a manager of a small, private company. Hence, the case provides a specific setting for discussing - in concrete terms - the role of the private sector in the solution of the nation's rice dilemma.

2.0. BRIEF SUMMARY OF PRINCIPAL CASE FACTS

To help the reader understand the discussion which follows, we shall attempt at the outset to recapitulate in capsule form the most salient facts of the Seed Corp case. For a fuller appreciation of the situation and problems confronting the company's management, readers are urged to read the case itself. The salient facts of the case are as follows:

1) Seed Corp was one of the first farm operators in the Philippines to plant IR8 "miracle" rice (an improved rice strain developed in the Philippines at the International Rice Research Institute) in substantial quantities.

2) Seed Corp's objective in planting IR8 was to sell the harvest as seed to other farmers, rather than to sell it in edible form as milled rice.

3) As of November 1966, the firm had approximately 9,500 cavans[3/]

3/ 1 cavan = 44 kilograms or 97 pounds.

of IR8 seed on hand. It had put the seed on the market six weeks earlier, but to date had managed to sell only 500 cavans. Management was quite disappointed with these initial results, since it had originally anticipated that its entire harvest of 10,000 cavans would be gone in the first six or eight weeks. This original estimate had been based on the fact that the new IR8 rice had been widely hailed in the newspapers as a "miracle" strain capable of increasing yields from the traditional Philippine average of 27 cavans/hectare[4/] (wet season) to about 125 cavans/hectare. Moreover, at the time of the case, supplies of IR8 seed were limited since the strain was new and had not as yet been widely planted.

4) Other operations of the company: In addition to selling IR8 seed, Seed Corp had an established business selling irrigation equipment (₱1,000,000 in sales), certified vegetable seeds (₱325,000), and insecticides (₱75,000). The following is a summarized profit and loss statement for the previous year:

Total sales	₱1,398,000[5/]	100%
Cost of goods sold	767,000	55%
Gross profit	₱ 631,000	45%
Operating expenses	518,000	37%
Operating income	₱ 113,000	8%

Apart from the foregoing operations, the company had recently formed a farm management division which was currently managing 4500 hectares of rice lands on a contract basis.

4/ 1 hectare = 2.47 acres.

5/ Philippines ₱3.90 = U.S. $1.00.

5) Sales forces: To sell its irrigation equipment, Seed Corp had a sales force of nine men, each of whom was paid an average of ₱200/month in salary, 3%-5% in commissions, and ₱200/month in expenses. For seeds and insecticides the company had a 13-man sales force. Each seed salesman was paid an average of ₱200/month in salary, 3% in commissions, and ₱200/month in expenses. The seed and irrigation sales force was assigned the task of selling IR8 seeds. Each seed salesman had a specific territory and called on both seed dealers and farmers. Eighty percent of the company's vegetable seed and insecticide sales went through seed dealers.

6) Pricing: Seed Corp was currently attempting to sell its IR8 seed for ₱40 per cavan. At this price level, Seed Corp's projected costs and profits can be calculated as follows:

	Per cavan	10,000 cavans	%
Sales	₱40.00	₱400,000	100%
Direct field costs	2.14	21,400	
Land and labor costs	9.18	91,800	
	₱11.32	₱113,200	
Seed preparation	7.00	70,000	
Cost of goods sold	₱18.32	₱183,200	46%
Selling & administrative (37%)	14.80	148,000	37%
Total costs	₱33.12	₱331,200	83%
Profit	₱ 6.80	₱ 68,000	17%

7) Competition: Others who were currently engaged in selling IR8 seed included the Rice and Corn Administration (RCA) of the national government, the Agricultural Development Council of Rizal (ADCR) - a cooperative movement backed by the Province of Rizal, and a few other large farmers on the island of

Luzon. The RCA, the most significant source of competition, was pursuing a subsidized program of purchasing IR8 palay[6/] from farmers for ₱25 per cavan and then re-selling it to other farmers for the same price. The management of Seed Corp did not believe that the RCA seed was prepared under as carefully controlled conditions as its own seed. Consequently, management estimated that the RCA seed had a germination rate[7/] of only 50%-70%. This compared with Seed Corp's guaranteed germination rate of 90%.

3.0. THE ISSUES

In deciding what future strategy to follow, management must resolve a number of specific issues. The following is a list of some of the more obvious of these issues:

1) Toward what target market should Seed Corp direct its efforts? Sharecroppers? Leaseholders? Landlords who manage their own farms? Absentee landlords? Large farms? Small farms? Certain geographic areas?

2) How should the target market(s) be reached? Direct sales force? Sale through dealers? Tie-in with the sales force or dealers of some other company?

3) Should Seed Corp continue to price its IR8 seed at ₱40 per cavan? If not, what price should be set?

6/ Palay was the term for unmilled rice.

7/ "Germination rate" referred to the percentage of seeds planted that actually sprouted.

4) Should a particular brand name be adopted or should the company stick with the generic name "IR8"?

5) How should the seed be packaged?

6) What promotional approach should be used? Basic theme? Advertising? Sales promotions?

7) Is the whole concept of having Seed Corp sell IR8 rice seed a sound one? If not, what other alternatives are open to the company?

4.0. ANALYSIS

In examining these questions, management would do well to start with the last issue first: Is the whole concept sound?

To gain proper perspective, it is helpful to examine the situation from a farmer's point of view rather than from Seed Corp's point of view. Once one does this, it soon becomes evident that the basic problem confronting Seed Corp is not just the selling of IR8 rice seed, but rather the marketing of a whole new way of life to farmers.

Why?

The main reason is that the decision on the part of a farmer to adopt and produce the new, improved IR8 rice strain involves much more than just the purchase of seed. Because of the growing requirements of the new strain, the farmer must also be prepared to do the following in order to obtain the desired production results:

1) To use greater inputs of other supplies than he typically has been accustomed to using.

- more fertilizer
- more insecticide
- more weed killer
- more rat killer

2) To make sure that his land is properly irrigated.

3) To work harder.' Compared to traditional varieties, the IR8 strain requires a greater expenditure of energy for field preparation, harrowing, roguing, and harvesting, as well as for the application of fertilizer, insecticides, weed killers, and rat killers.

4) To follow recommended agricultural procedures. This requires proper education.

5) To invest more capital:

	Traditional* varieties	IR8*
Cash expenses for supplies	₱ 60	₱ 268
Land and labor inputs	768	1,145
	₱828	₱1,413

* Figures from Exhibit 10 of the case.

Note that the out-of-pocket expenses for supplies alone is four times greater for IR8 compared to what farmers typically have been spending on traditional varieties.

Given the low per capita incomes of farmers in the Philippines, the larger required investment means that most farmers who adopt the new variety will have to borrow money in order to do so. Thus, the availability of credit facilities becomes important.

6) To take a greater risk. Given the newness of IR8 and the magnitude of the required investment, farmers who adopt it face much greater uncertainty than those who stick to traditional varieties. Consequently, they must give careful consideration to questions such as the following:

- Will the crop fail?
- Will the prices for IR8 be as high as those for other varieties?
- Are adequate facilities available for drying, storing, and transporting the crop, given the expected increases in yields?
- Will the milling recovery rate be as high? (See Exhibit 7 of the case).
- Will the eating quality of IR8 be judged by consumers to be as good as that of traditional varieties?

The problem is further complicated by the fact that more than one individual can often be responsible for deciding whether or not to adopt a new variety of rice. Depending on the particular case, a share-tenant, a leasehold farmer, a landlord, or a farm manager might be the decision maker. Moreover, a variety of other people - such as agricultural extension agents, present or potential creditors, agricultural supply dealers, other family members and friends - might also indirectly influence the final decision maker.

A final complication is that farmers and landlords have traditionally not been in the habit of buying <u>any</u> type of rice seed. Instead, the typical practice has been for them to set aside enough palay out of their own harvest to supply their needs for the next planting season. Thus, after a farmer or landlord makes the initial decision to plant a new variety of rice, the chances of obtaining repeat business from them are somewhat limited.

5.0. THE IMPLICATIONS FOR SEED CORP

Given the magnitude and complexity of the marketing job, one can seriously question whether Seed Corp, with its limited resources should attempt to sell IR8 on a mass-market basis.

From the foregoing paragraphs it should be evident that the selling of seed alone represents only a very small piece of the total puzzle. Any organization, firm, or individual interested in increasing the nation's rice production by encouraging the use of new, improved strains must also be prepared to supply the other pieces of the puzzle. Or, if not supplying them oneself, one must make sure that someone else is supplying them on a coordinated basis.

To be more specific, the task of propagating a new strain such as IR8 involves the following in addition to the mere supplying of seed:

1) Identifying the key decision makers.

2) Operating an effective education program on required agricultural practices.

3) Making available a ready supply of fertilizer, insecticide, weed killer, and rat killer and insuring that farmers use these inputs properly.

4) Making available a ready supply of credit, at a reasonable interest rate, to finance the increased costs associated with the new strain.

5) Making sure adequate irrigation facilities are available.

6) Convincing farmers, in readily understandable terms that the increased profits possible with the new strain more than offset the increased

costs, work, and risk.

7) Making sure that adequate milling, storage, transportation, and marketing facilities are available to handle the expected increase in output.

The evidence in the case suggests that Seed Corp's management was approaching the problem mainly in terms of selling seeds alone rather than in terms of marketing a total agricultural concept. This is perhaps understandable, given that Seed Corp was a small company with a limited product line and without the financial resources to finance all of the increased capital requirements of the farmers who shifted to IR8. Add to this the fact that the per cavan price of Seed Corp's IR8 rice seeds was ₱15 higher than that of the government and it is not surprising that Seed Corp's initial IR8 seed sales were quite low.

Under these circumstances, what marketing strategy might Seed Corp's management follow in the future?

One logical alternative would be to attempt to exploit a "captive" market. We know from the case facts that Seed Corp had recently moved into a farm management activity and currently was managing 4500 hectares of rice land. These 4500 hectares could potentially absorb 3000 to 4000 cavans of the 9500 cavans inventory which Seed Corp presently had on hand. In actual fact Seed Corp did subsequently sell a substantial portion of its IR8 seeds to this market.

A second possibility would be to seek a tie-up with a larger company which carried complementary products and which had larger financial resources than Seed Corp. Esso Standard Fertilizer and Agricultural Chemical Company, Inc. (ESFAC) which marketed fertilizers, insecticides, and weedicides through a nation-wide network of agricultural supply dealers and field service agents would be one such company. Seed Corp investigated this possibility but was unable to negotiate a tie-up because of existing legislation (Rice and Corn Act) which prohibited foreign owned firms from engaging in the sale of rice or rice seed. Had this legislation not existed, a tie-up with ESFAC might have made considerable sense, since ESFAC was one of the few firms in the Philippines capable of marketing a total agricultural concept to farmers.

Another alternative would be to forget about trying to sell IR8 seed on a nation-wide basis and instead concentrate on marketing seed to a few large and progressive farmers. Ideally, these large farmers would be well capitalized and would already be relatively knowledgeable about the use of irrigation, fertilizer, insecticides, proper field practices, etc. Thus, the marketing task would be simplified and management could concentrate its main efforts on explaining how IR8 could result in increased profits for the farmer and on demonstrating why Seed Corp IR8 seeds, with their guaranteed germination rate, were less risky than seeds prepared under less carefully controlled conditions.

A fourth alternative would be to explore the possibility of exporting the company's IR8 seeds to government agencies or private firms in other countries. In view of the favorable publicity which the new variety had received and the fact that Seed Corp was to date the only private firm with IR8 seeds in commercial quantities, the firm had already received several tentative inquiries from neighboring countries. These inquiries subsequently resulted in shipments of seed to Pakistan, Viet Nam, and Laos. These shipments, however, were on a one-time basis since the recipient countries intended to produce their own seed requirements in future years.

Two final courses of action would be for Seed Corp either to reduce the price of its IR8 seed and sell it at ₱25 to the RCA or to mill it and sell it for table consumption. But both of these possibilities would result in a substantial loss of potential revenues to the firm and thus should be adopted only as a last resort.

These, then, are the major alternatives available to Seed Corp's management. None of them can be considered the "perfect" solution, even though each of them does offer some possibilities for ameliorating the firm's short term inventory problem. In the long run, however, it appears that in order for a private agricultural supply firm such as Seed Corp to participate successfully in the early stages of a "miracle rice" phenomenon, it must have sufficient skills, products, financing, and foresight to market a <u>total agricultural concept.</u> In the event the firm does not itself possess such resources, it might seek out a cooperative arrangement with other firms or agencies that can supply the missing pieces. If such firms or agencies do not exist or are not willing, then the original firm would probably be wise to stay out of the business entirely.

PART II - THE CASE STUDY

1.0. INTRODUCTION

As Mr. Miguel Gonzales, the vice president of sales for Seed Corporation of the Philippines (SEED CORP), was walking down the corridor to his office, he was thinking about the poor sales performance of the company's IR8 palay[8/] seed. The preceding afternoon Mr. Gonzales had received a report which summarized the sales of IR8 seed during the first six weeks that the seed had been on the market. The report showed that only 467 cavans[9/] of IR8 palay seed had been sold between October 1 and November 12 (See Exhibit 1).

IR8 was a new variety of rice that had been developed by The International Rice Research Institute located sixty-five kilometers southeast of Manila at Los Baños, Laguna. Because of the variety's remarkably high yielding ability, it had been called "miracle rice". "Miracle rice" had received extensive publicity through news media because many scientists and agriculturists claimed that IR8 had the potential of eliminating the current shortage of rice in Asia (See Exhibits 2 and 3).

SEED CORP on its farm in Bay, Laguna, had produced ten thousand cavans of the "miracle rice" seed. The company placed this seed on the market on October 1 and had expected the demand for IR8 seed to be so heavy

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8/ Palay was rough rice -- rice that had been neither hulled nor milled.

9/ A cavan of palay was forty-four kilos.

that the company's supply would be sold quickly. Yet, six weeks after the seed had gone on sale, SEED CORP had over 9,500 cavans of unsold IR8 palay seed on hand.

While discussing the poor sales performance of the IR8 seed, Mr. Gonzales said, "I've never been so badly fooled by a product. I thought that with all the publicity about 'miracle rice' our entire stock would be almost exhausted by the end of October. Here we are now in the last half of November, and we have sold less than 500 cavans of the seed. I simply don't know what's wrong."

2.0. THE COMPANY

SEED CORP was founded six years ago for the purpose of providing products and services to the agricultural sector of the Philippine economy. In addition to the main office in Quezon City which served Luzon, the company had branches in Bacolod City and in General Santos, Cotabato, which served Visayas and Mindanao, respectively. The Bacolod branch was established four years ago; and the Cotabato branch, three years ago.

Last year SEED CORP had sales of almost ₱1,400,000[10] (see (Exhibit 4). Irrigation equipment was responsible for approximately ₱1,000,000 of these sales; seeds, approximately ₱325,000; and insecticides, approximately ₱75,000. The company was predicting that its sales during the current year would be between ₱1,850,000 and ₱1,900,000.

10/ Philippine ₱1.00 = U.S. $0.256; U.S. $1.00 = Philippine ₱3.90.

SEED CORP had carried irrigation equipment since its founding. Four years ago the company added imported vegetable and flower seeds to its product line; three years ago, forage seeds; and two years ago, insecticides and locally produced rice and corn seeds.

The company was continuing to expand the services and products that it offered to its customers. Early last year SEED CORP had formed a farm management division. By the end of October, this division was managing under contract forty-five hundred hectares[11/] of land. The ten farms making up this hectarage were scattered throughout the Philippines. The company was planning to add veterinary medicines to its product line early next year.

As Exhibit 5 indicates, each of SEED CORP'S outlets divided its sales force into two divisions: irrigation and agricultural. The nine salesmen in the three irrigation divisions had bachelor degrees in engineering. These men were responsible for marketing the company's irrigation equipment and received base salaries of two hundred pesos per month plus commissions of three to five percent on all sales.

The company had thirteen agricultural salesmen, all of whom had bachelor of science degrees in agriculture. These salesmen were assigned specific sales territories and were responsible for all seed and insecticide sales within their respective territories. The agricultural salesmen received base salaries of two hundred pesos per month plus a three percent commission on net sales.

11/ 1 hectare = 2.47 acres.

SEED CORP furnished jeeps to all of its salesmen and gave each salesman a fixed gasoline allowance of seventy-five pesos per month. In addition, each salesman received a per diem allowance of one hundred twenty-five pesos per month.

3.0. THE IR8 VARIETY OF RICE

The International Rice Research Institute (IRRI) was established in 1960 as a private, non-profit world center for the study and improvement of rice, the principal food for more than sixty percent of the world's population. IR8 was the first new variety of rice developed by IRRI that had been given an official name and released to the public.

This new strain of rice was developed from a cross between Peta, a tall Philippine variety that originated in Indonesia, and Dee-geo-woo-gen, a short variety from Taiwan. IR8 was a lowland variety[12/] of rice. The strain could be grown in any season in the tropics, and it matured approximately one hundred twenty days after seeding. Because of IR8's non-seasonal characteristic and its moderately early maturity, a farmer using the variety could produce three rice crops per year [13/]. Unlike most tropical rice varieties which

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12/ Lowland rice was any rice crop grown with impounded water (the source of the water could be either irrigation or rainfall) and was to be distinguished from upland rice which was rice grown without maintaining a layer of water on the surface of the land. Upland rice was directly seeded and was grown on rainfall as one might grow a crop of wheat.

13/ Traditionally the Filipino farmer had thought in terms of a maximum of two rice crops per year.

were noted for their tallness, IR8 was a short, sturdy variety approximately one hundred centimeters or thirty-nine inches high. IR8 was resistant to lodging[14/] which in some varieties caused a grain loss of over fifty percent.

While discussing IR8, a member of the IRRI research staff said, "The news media have labeled IR8 'the wonder rice' or 'the miracle rice.' This, of course, is exaggerated nomenclature, but IR8 does hold great promise for Asia and its food problem. Asia alone produces and consumes over ninety percent of the rice grown in the world.

"IR8 has performed remarkably in every country where it has been raised. Its response to nitrogen fertilizer in terms of yield has been impressive. Under good management, IR8 has yielded more than twice as much palay per hectare as has traditional varieties under similar management.

"Of course, the miracle of IR8 is not found in the seeds alone. It is also found in the farming practices. To get high yields the farmer must use fertilizer, have an adequate water supply, protect his paddies from rats and insect damage, and in general follow good farming practices. By good farming practices I mean giving attention to such matters as being sure the land is properly prepared before transplanting and seeing that the rice is properly weeded. These practices cost money. In fact, one of the agricultural economists here at the Institute told me the other day that the input of materials, such as nitrogen and chemicals, that a farmer must make if he is to successfully

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14/ Lodging referred to the falling over of rice plants prior to harvest.

raise IR8 costs about two hundred and fifty to three hundred pesos per hectare. A farmer who plants a traditional variety and follows recommended cultural practices spends only about sixty pesos a hectare for supplies and materials. But IR8 responds to these additional investments by the farmer, and the resulting high yields make the investment worthwhile.15/

"IR8, as you know, is not a perfect variety. The strain is highly susceptible to rice blast fungus and also is susceptible to bacterial leaf blight. This susceptibility to disease underscores the importance of using adequate fungicides and insecticides when raising IR8.

"Also, the IR8 grain has certain shortcomings. The grain is only medium length, is chalky, and seems to break easily. Despite these weaknesses, we feel that the rice will be acceptable to most consumers. But as you can see, we haven't developed the perfect rice though IR8 represents the kind of breakthrough that we are seeking in our research activities."16/

4.0. DISTRIBUTION OF IR8 PALAY SEED

SEED CORP was the first commercial firm in the Philippines to offer IR8 palay seed for sale. Up until the time that the company entered the market, IR8 palay seed had been distributed primarily by government agencies.

15/ See Exhibit 6 for information on the production costs and returns per hectare for IR8 compared with other varieties of rice.

16/ See Exhibit 7 for a comparison of the characteristics of IR8 with the characteristics of other high yielding rice varieties.

According to Mr. Antonio Zulueta, the executive vice-president of SEED CORP, "The government has a general program for dispersing the 'miracle rice' seed and is easily the biggest distributor. Under the government program the APC[17/] -- that's the old Bureau of Agricultural Extension -- and the RCA[18/] work together in the procurement and distribution of the seed.

"The APC workers have the responsibilities of telling the farmers about the 'miracle rice' and its high yields and of persuading the farmers to plant IR8. When a farmer indicates an interest in planting IR8, the APC worker puts him in touch with the nearest RCA warehouse that has the seed in storage. The APC worker, of course, also gives the farmer any technical advice or guidance that he might need in planting and growing the rice.

"The RCA under the government program is responsible for buying the IR8 palay seeds that are to be resold to the farmers and for providing the warehousing for storing these seeds. The RCA warehouses around the country are in effect distribution centers for the seed.

"The RCA obtains its seeds primarily from farmers who are producing IR8 palay from stock that they themselves obtained originally from a government agency or from IRRI. IRRI, for example, has distributed free around twenty-five hundred small two-kilo packets of IR8.[19/]

17/ Agricultural Productivity Commission.

18/ Rice and Corn Administration.

19/ A two-kilo package of palay seed should plant no less than one-tenth of a hectare. Some farmers planted only six hundred square meters with their packets while others planted as much as twelve hundred square meters with their packets.

"The farmers who sell their IR8 palay to the RCA for seed purposes have to raise their rice under supervised conditions. When the farmer plants the rice, he has to indicate that he would like to sell the harvest for seed. The APC is responsible for supervising the technical aspects of the seed production, and so one of their workers visits the farm periodically. The APC, for example, checks to see that the rice is being properly rouged.[20/] When the palay is harvested, the APC certifies that the palay is IR8 and that the farmer has followed recommended practices in producing the seed stock.

"The RCA buys rice with this certification from the farmers for twenty-five pesos per cavan, which is a premium to the farmer of about seven pesos over the regular market price. The RCA then resells this same seed to other farmers for twenty-five pesos a cavan. So you can see that under the government program, the RCA provides the money and storage facilities for the seed and the APC provides the men to supervise the seed production and to furnish technical advice to the farmers.

"In addition to the government's seed multiplication program, there is the Rizal Agricultural Development Commission. This program is financed by provincial funds and was organized by the provincial government for the purpose of promoting the production of IR8 in Rizal.

"Under this program, just as in the national program, farmers who produce the IR8 seed are not guaranteed any specific price for their palay.

20/ Rouging was the removal of alien rice varieties and other undesirable plants from a rice stand for the purpose of protecting the purity of the seed that was to be harvested.

However, if the palay is produced under supervised conditions and has been properly rouged, the provincial government has been buying it for twenty-five pesos per cavan. This palay in turn is sold to farmers in the province for the same price.

"The provincial government finances this program with its own funds. It has established IR8 demonstration plots throughout the province and has trained agriculturalists in the field working with the barrio folk. However, the provincial government does rely upon RCA warehouses for storing the palay and depends upon the RCA for the dryers needed to dry the palay. I estimate that under this program, Rizal will be distributing around five thousand cavans of IR8 seed during the coming growing season.

"Besides ourselves, we know of only one other large independent IR8 rice producer. He is a large farmer in Tarlac and has about four hundred hectares of rice land under cultivation. During this past growing season, he planted sixty-five hectares in IR8, and I understand that he produced about eight thousand cavans of palay. About fifty percent of this palay was produced under the supervision of the APC and was sold to the RCA for seed purposes at the price of twenty-five pesos per cavan. The remaining four thousand cavans he is trying to sell for twenty-five pesos per cavan to private farmers for seed purposes, but I hear that he's not having very much success in moving his inventory in this manner."

5.0. SEED CORP'S IR8 PALAY SEED

SEED CORP's IR8 palay seed sold for forty pesos per cavan. Mr. Gonzales, the vice-president of sales, said, "Nowhere in the Philippines today can the farmer purchase IR8 palay seed that compares in quality to the seed that we sell. But judging from our sales to date, everyone isn't aware of that. The problem is how do you communicate to the public that our seed is of superior quality.

"And look at who our major competitor is when it comes to selling IR8 seed. It's the government. How can a business organization compete with the government? Look at the expenses we have to cover. There are warehousing expenses, salaries of our personnel, transportation for our salesmen--now just look at that one item as an example. We furnish jeeps to all of our salesmen. We figure that each jeep we have in the field costs us about one hundred seventy-five pesos per month. That includes the costs of insurance, maintenance, depreciation--everything except gasoline. Now when you have expenses like that that you've got to cover and you've got to show the stockholders a profit, it makes it rough when you're competing against the government.

"Well--that's a favorite subject of mine as you can tell. Coming back to the palay seed -- we here at SEED CORP cannot afford to sell anything but the highest quality seed. During the past three years we've built a strong reputation for having excellent seeds, and we must be careful to avoid doing anything to jeopardize that reputation.

"We produce our IR8 palay seed under the most carefully controlled conditions. Since we want our palay to be clean of any other seed, we are continuously rouging and checking our fields. Then after the palay is harvested, it is artificially dried under closely supervised conditions. We then grade the seed, treat it chemically to protect it from fungi, and then check it for germination. After the palay has gone through these operations, we store the seed in an area where the temperature is controlled and where the seed will be protected from rats and other infestations. The government has neither the trained manpower nor the facilities to produce and store palay seed under such carefully regulated conditions.

"And, of course, our goals are different. We want to produce high quality palay seed. To be assured that we have superior seed, we spend about seven pesos per cavan in processing our palay after it has been harvested. Quality, on the other hand, is not the government's primary concern at this point. Its goal is to get as wide a distribution of IR8 palay seed as possible.

"One good example of the difference in the IR8 seeds that we sell and the seeds that the farmer can buy from the RCA is seen in the germination rates. As you know, we guarantee a germination of at least ninety percent for our seed. The germination rate for the RCA seed is much lower. I am told that it varies between fifty and seventy percent. Of course, this is higher than the farmers are accustomed to. For traditional varieties the germination rate is somewhere between forty and sixty percent."

6.0. SELLING IR8 PALAY SEED

According to Vicente Montenegro, SEED CORP's agricultural salesman in the Cagayan Valley area, "Filipino farmers for generations have been meeting their rice seed requirements by saving enough palay out of each harvest to plant their land the next season. Literally over ninety-nine percent of the farmers fulfill their seed requirements in this manner. This cycle is continued season after season and is generally not broken unless a neighbor happens to have a bumper harvest. When this happens, the farmer may decide that his neighbor has better rice and he will then barter with his neighbor for a cavan or two of the palay. In this kind of transaction, there is very rarely an exchange of money involved. The transaction involves an exchange of goods."

"Vic is right," said Nicolas Guzman, SEED CORP's agricultural salesman in Central Luzon. "This is the way that farmers handle their seed needs, and this system has been in operation for years.

"Of course, this makes it difficult when you're selling palay seed. It's not like selling vegetable seeds. Over eighty percent of our vegetable seed sales are made to independent agricultural supply dealers. These dealers, in turn, sell the vegetable seeds to the farmers.

"But with palay seed, it's a different matter. My guess is that less than five percent of our palay seed sales are to agricultural supply dealers. The farmers simply don't go to the dealers for palay seed. So selling palay seed is a hard job. You must go directly to the farmers, and this is time consuming.

"Approximately fifty percent of our rice farmers are tenant farmers. And to really sell IR8 under a landlord-tenancy arrangement, you've got to talk to both the landlord and the tenants. The landlord is important, for he is the one that has the cash. He is the one who is going to have to buy the seed, the fertilizer, and the other inputs that are necessary for a successful IR8 rice crop. And before the landlord will put out this additional outlay of capital, he has to be convinced that it is a good investment -- that the investment will pay dividends.

"There is often the problem of finding the landlord. There is a lot of absentee ownership. And, of course, farms vary in size, -- anywhere from less than one hectare up to more than a thousand hectares.

"And you've also got to talk to the tenant. He may seem unimportant, for he only cultivates one or two hectares. But he's key. He is the one who has to plant the rice and apply the nitrogen and the insecticides. When you ask the tenant to plant IR8, you're really asking him to abandon the way he has been doing things for years. Most of the tenants don't know anything about fertilizers and insecticides. They've never used them. And so there is a selling job involved here because the tenant is not going to use his time to apply the nitrogen and chemicals that the landlord has bought unless he's convinced it's worthwhile. In fact, I can recall cases where a landlord has purchased certified seed or nitrogen or some other input and has had it delivered to the tenant. Instead of using the seed or the fertilizer, the tenant has taken the item to town and has sold it, using the money for personal needs or wants.

"At any rate, calling on farmers takes a great deal of time because you really can't make more than three or four calls a day. And the irony is that in selling IR8 seed, you will seldom have a repeat customer. Once the farmer has bought the seed, he'll save his own seed out of his harvest. And if he has a good rice harvest in terms of yield, he'll become your competitor in a sense. His neighbors will want some of the seed and will barter with the farmer for some of the palay.

"Of course, I am speaking from my own experience which has been primarily in Central Luzon. I don't know whether Vic has had the same experiences up in the Cagayan Valley area or not."

"I think what Nic has said applies to all of the Philippines," responded Mr. Montenegro. "It describes the situation in the Cagayan Valley. I also worked in Visayas for a short while, and what he says applies there, too.

"And it is hard work to sell the farmer. Successfully producing IR8 requires the farmer to use new methods of rice cultivation, and he is reluctant to change. As Nic says, cash is also a problem because a farmer raising IR8 has to have fertilizers and chemicals. The average rice farm is only about one to two hectares in size and most farmers just don't have the money for these things -- unless he is a tenant and has a benevolent landlord. For the small landowner getting money for such things as insecticides is quite a problem. And even if he can borrow the money, he is reluctant to -- and for good reason. Suppose there's a typhoon that destroys his crop. It would be impossible for him to pay the money back.

"I know that Mr. Gonzales is really disappointed in the IR8 sales but I don't think he fully realizes what we're up against. IR8 is really a new product, and farmers are slow to adopt new ways of farming. They have confidence in their time-honored ways of doing things and to abandon ancient practices seems risky to them."

7.0. MR. GONZALES' VIEWS

"I know you've talked this morning to Montenegro and to Guzman," began Mr. Gonzales, "and I am sure that they have told you that selling IR8 palay seed is a hard job. And judging from the sales results to date, they may be right.

"I had lunch today with Tony Zulueta, our executive vice-president, and we discussed our poor IR8 sales. We even came up with the idea of approaching Esso Fertilizer and moving our IR8 seed through them. Esso has well-trained salesmen and over four hundred outlets. Then we remembered the Rice and Corn Act[21/] and so that's not the answer.

"As I was walking back to the office I thought that maybe we shouldn't have gotten into the production and selling of IR8 seed in the first place. But the fact is that IR8 really is a 'miracle rice.' It has the potential of solving our rice shortage.

21/ The Rice and Corn Nationalization Act provided that only Filipinos or corporations wholly owned by Filipinos could engage in the distribution of rice or corn.

"Do you realize that our rice yield per hectare in the Philippines has remained essentially unchanged during the past four decades? Let me show you the figures (see Exhibit 8).22/ This means that our increases in national production has been the result of an increase in the hectarage planted in rice rather than an increase in yields.

"IR8 can change that story and can do it quickly. Some farmers using IR8 have realized increases in yields of two to three hundred percent. I did some figuring just a few minutes ago and came out with some interesting results. Assume that there will be fifty thousand cavans of IR8 planted this coming season and that this rice will be planted on fifty thousand hectares. Now, if the harvest from these fifty thousand hectares averaged only eighty cavans per hectare, there would be four million cavans of palay seed available for the next season. That would be more than enough to plant all the rice lands in the Philippines.

"But it takes more than a little number pushing to solve the nation's rice problem, but we might be on our way if we could just sell the IR8 seed that we have on hand. I told Tony I wanted to do a little more thinking about this seed we have on hand. I made a date with him for Friday morning, the 18th. Between now and then I want to come up with a marketing plan designed to move our IR8 seed so that we can discuss the plan during our meeting."23/

22/ See Exhibits 9, 10, and 11 for data regarding rice production in the Philippines.

23/ In preparation for the task of preparing a market plan, Mr. Gonzales requested a memorandum from a member of his staff on advertising rates. See Exhibit 12 for a copy of the memorandum that was submitted to Mr. Gonzales.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 1. Sales of IR8 palay seed.

Week ending	Quezon city outlet				Bacolod outlet				General Santos outlet			
	Over-the-counter sales		Sales by salesmen		Over-the-counter sales		Sales by salesmen		Over-the-counter sales		Sales by salesmen	
	No. of sales	Amt. of sales a/	No. of sales	Amt. of sales	No. of sales	Amt. of sales	No. of sales	Amt. of sales	No. of sales	Amt. of sales	No. of sales	Amt. of sales
October 8	13	51	0	0	5	17	1	10	2	3	1	1
15	9	19	3	5	10	33	1	2	8	19	0	0
22	17	37	5	9	4	12	3	4	5	8	1	18
29	14	17	1	2	13	19	2	7	3	11	2	7
November 5	11	23	2	7	7	17	4	5	6	12	2	6
12	19	48	4	6	10	14	1	3	5	8	1	7
TOTAL	83	195	15	29	49	112	12	31	29	61	7	39

a/ Given in cavans (e.g. 51 cavans of IR8 palay seed were sold over the counter through the Manila outlet during the week ending October 8).

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 2. A miracle to feed hungry Asia. 24/

MANILA (A-ANS) -- A new strain of rice, now popularly known as "miracle rice" because of its high-yielding quality, may provide the answer to Asia's hunger problem.

Scientifically known as IR8-283-3, the new rice variety is the result of a series of crossbreeding experiments carefully studied by plantbreeders at The International Rice Research Institute in Los Baños, 40 miles east of Manila.

The IRRI, where scientists of many nations concentrate on high-yielding hybrids of rice, is a ₱7,500,000 ($1,923,000) plant. It is a joint project of the Ford and Rockefeller Foundations, with the cooperation of the University of the Philippines.

According to Dr. Robert F. Chandler, Director of the Institute, the experimental results leave no doubt about the yield potential of IR8. He said: "It is the heaviest yielding rice (from 150 to 200 cavans per hectare) so far tested at the Institute and has consistently topped yield figures, not only on the Institute's experimental farm but on the farmers' fields and in other Asian countries where it has been tested."

For the average farmer, it will spell the difference between hardship and a better standard of living. In the Philippines -- where there is a chronic rice

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24/ *The Evening News*, November 30, 1966. p.A.

Exhibit 2 (cont'd).

shortage -- the per capita income in rural communities is pegged at ₱300 (roughly $75).

With the so-called "miracle rice," which can be planted and harvested twice or even thrice a year, it will mean an estimated annual income of ₱4,000 for Filipino farmers, or a 13-fold rise.

There seems, however, to be one drawback to the campaign to increase rice production by planting the IR8. Growing the new rice strain involves added investment in terms of fertilizers, insecticides and certified seeds. And farmers are wary of the added expense involved, not to mention doing away with antiquated and outmoded practices of planting rice.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 3. The miracle rice.25/

The "miracle" rice currently being harvested could bring about a very vital transformation within the nation. We are not referring to an end of the rice shortage, although that is also very good, but to the fact that if "miracle" rice will increase yield at least three times, this is a benefit that should reach the farmer directly. Let us assume that such a rice strain could safely double the income of the farmer. This would be a very important change within the country for the farmer is the most in need of economic stimulation. In other words, if the farmer can increase his income we are assured of economic progress, political stability, and a chain-reaction of cultural benefits.

The farmer represents 80 percent of our population. The farmer has the lowest income at present, statistics say he earns less than ₱2,000 a year per family. If the farmer increases his income he will be able to purchase goods; and an increase in the buying of consumer goods would not only boost industrialization, but bring down prices through more volume of production. At present many products can be produced locally, and many barrio folk need these products, but they do not have the money. Most marketing firms have been faced with the fact that the major problem of sales in the Philippines is that of financing, so that at present long term, easy payments have been the only way to make sales.

25/ The Manila Times, November 18, 1966, p. 4-A.

Exhibit 3 (cont'd).

If the farmer can increase his yield and easily double his income, then he would not only desire and avail of more goods, he would be stimulated into using new tools, new technology, and new ideas. If he buys a radio he will be awakened to news events. When he sees how he has managed to increase his yield he will be more open to other innovations and technology that will make the rural area amenable to much-needed change. If the farmer can have a bigger income he will be able to educate his children better, whereas at present 60 percent drop out after fourth grade for diverse economic reasons.

SEED CORPORATION OF THE PHILIPPINES

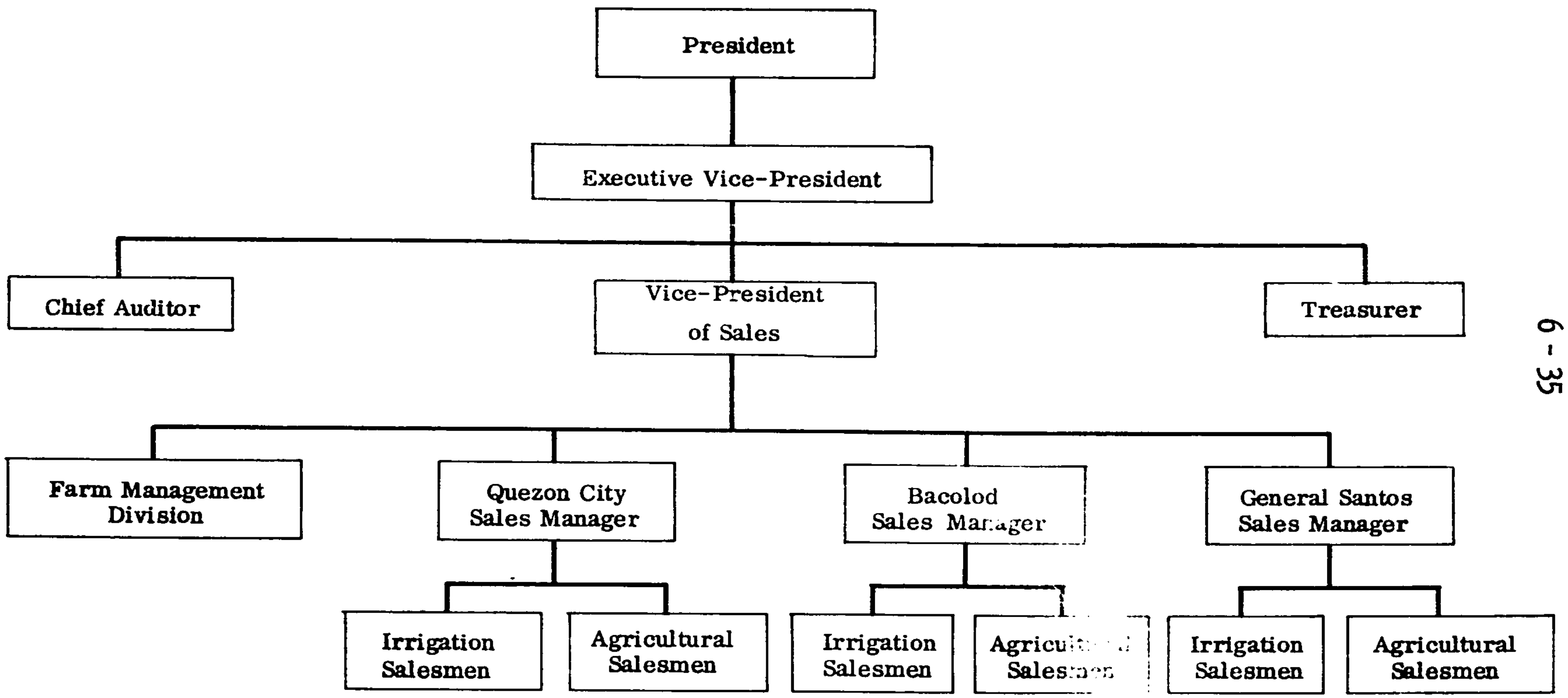
EXHIBIT 4. Operating statement (last calendar year). a/

	Pesos	Percentage	Pesos	Percentage
Net sales			₱1,398,747	100.0%
Cost of sales			767,423	54.9
Gross profit on sales			₱ 631,324	45.1%
Operating expenses:				
Salaries and wages	₱129,379	9.3%		
Commissions	87,976	6.3		
Transportation and travelling	92,136	6.6		
Packing and delivery	46,771	3.3		
Interest and bank charges	39,171	2.8		
Depreciation	28,596	2.0		
Repairs and maintenance	17,693	1.3		
Rental	11,500	0.8		
Telephone, postage and telegram	8,131	0.6		
Professional fees	6,000	0.4		
Provision for doubtful accounts	9,000	0.6		
Light and water	4,968	0.4		
Taxes and licenses	5,311	0.4		
Stationery and office supplies	4,767	0.3		
Representation and entertainment	5,994	0.4		
Insurance	4,269	0.3		
Amortization of development costs	2,219	0.1		
Social Security Contributions	2,471	0.2		
Advertising and promotion	5,317	0.4		
Miscellaneous	6,486	0.5		
TOTAL			₱ 518,155	37.0
Operating income before taxes			₱ 113,169	8.1%

a/ Figures in this exhibit have been disguised.

SEED CORPORATION OF THE PHILIPPINES

Organization Chart



SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 6. Cost per hectare to produce rice (following recommended agricultural practices).

Expenses	Wet season: Traditional variety a/	Wet season: Improved variety (BPI-76)	Wet season: IR8	Dry season: Traditional variety a/	Dry season: Improved variety (BPI-76)	Dry season: IR8
Direct:						
Seed (assumes 1 cav/ha)	₱ 18	₱ 25	₱ 25 b/	₱ 18	₱ 25	₱ 25 b/
Weed control	0	15	15	0	15	15
Insect control	10	44	132	10	44	132
Water	12	12	12	200	200	200
Fertilizer (nitrogen)	20	56	84	35	96	144
Total direct expenses	₱ 60	₱152	₱ 268	₱263	₱380	₱ 516
Land and labor inputs:						
Land preparation	₱120	₱120	₱ 120	₱120	₱120	₱ 120
Labor to apply insecticides and herbicides	3	10	28	3	10	28
Seedbed (dapog bed) c/	10	10	10	10	10	10
Transplanting (straight rows)	60	60	60	60	60	60
Handweeding	50	50	50	50	50	50
Harvesting & threshing d/	210	300	440	245	350	520
Cleaning and drying d/	25	35	50	30	40	65
Sacks d/ (₱1.50 each)	90	127	187	105	150	225
Rat control	?	?	?	?	?	?
Land rental	200	200	200	200	200	200
Total value land and labor inputs	₱768	₱912	₱1,145	₱823	₱990	₱1,278

Exhibit 6 (cont'd).

Expenses	Wet season: Traditional variety	Wet season: Improved variety (BPI-76)	Wet season: IR8	Dry season: Traditional variety	Dry season: Improved variety (BPI-76)	Dry season: IR8
Return per hectare:						
Yield (in cavans)	80	85	125	70	100	150
Value of yield at ₱18 per cavan	₱1,080	₱1,530	₱2,250	₱1,260	₱1,800	₱2,700
Less direct expenses	- 60	- 152	- 268	- 263	- 360	- 516
	₱1,020	₱1,378	₱1,982	₱ 997	₱1,420	₱2,184
Less value of land and labor inputs	- 768	- 912	- 1,145	- 823	- 990	- 1,278
Net return (profit) per hectare	₱ 252 e/	₱ 466 e/	₱ 837 e/	₱ 174 e/	₱ 430 e/	₱ 906 e/

a/Farmers planting traditional varieties seldom followed the recommended practices regarding insect control and fertilizer, and their yields were lower than those shown in this exhibit (see Exhibit 11).

b/ Assumed the use of RCA palay seed.

c/ The use of a regular seedbed would be ₱25 instead ₱10.

d/ These expenses varied with the yield. See Part II of the chart for the yield assumed for each variety.

e/ Farmers normally did not place a value on the land and the labor inputs of their families and themselves in figuring the profit made on a rice crop.

Note: These costs assumed that general agricultural recommendations were followed. In actual practice few farmers raising the traditional varieties use insecticides or fertilizer.

The costs of chemicals, fertilizer, labor and irrigation water varied with locality, as did the local customs by which harvest laborers were paid.

Source: The International Rice Research Institute and Seed Corporation of the Philippines.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 7. Characteristics of recommended high yielding rice varieties.

Variety	Region of planting	Season of planting	Days to heading	Lodging charac-teristics	Grain yield (cav/ha)	Pests and diseases	Milling recovery (%)	Eating quality
LOWLAND:								
BE-3	Luzon, Visayas	Wet season only	over 135	Medium	61-80	BB, CLS HLS, RSS, SR	68	Very good
BPI-76	Luzon, Visayas	Heads uniformly when seeded in the first	116-135	Resis-tant	80-100	BB, RR, SR	61	Very good
Peta	Philippines	Anytime of the year if water is available	115	Medium	61-80	BB, CLS, HLS, RSS, SR	67	Fair
Tjeremas	Luzon, Visayas	Anytime of the year if water is available	115	Lodged	61-30	B, BB, CLS, HLS RSS	63	Fair
IR8	Philippines	Anytime of the year if water is available	120	Resis-tant	125-150	B, BB	Uncer-tain	Fair
UPLAND:								
Azucena	Philippines	Wet season only	92	Slight	46-60	B, BB CLS, RSS, SR	63	Very good
Palawan	Philippines except Cagayan Valley	Anytime of the year if water is available	over 92	Resis-tant	61-75	B, BB, CLS, SR, RSS	68	Fair

Exhibit 7 (cont'd).

Abbreviations: B - Blast

BB - Bacterial Blight

CLS - Cercospora Leaf Spot

HLS - Helminthosporium Leaf Spot

RR - Root Rot

RSS - Rhizoctonia Sheath Spot

SR - Stem Rot

Sources: University of the Philippines, College of Agriculture & Department of Agriculture and Natural Resources, Bureau of Plant Industry.

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EXHIBIT 8. Yields per hectare (in cavans).

Decade	Average yield per hectare
1920 - 29	26.2
1930 - 39	25.9
1940 - 49	24.6
1950 - 59	26.8

Source: The Philippines: Long-Term Projection of Supply of and Demand for Selected Agricultural Products, ERS - Foreign 34, Regional Analysis Division, Economic Research Service, U.S. Department of Agriculture.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 9. Estimated palay production in the Philippines 1965-66 (in 000's of cavans).

Region	All palay			Lowland first crop			Lowland second crop			Upland and Kaingin
	Total	Irrigated	Non-irrigated	Total	Irrigated	Non-irrigated	Total	Irrigated	Non-irrigated	
Philippines	92,560	39,415	53,145	68,900	28,937	39,963	13,723	10,478	3,245	9,937
Ilocos	4,768	2,521	2,247	3,976	2,136	1,839	387	384	3	404
Cagayan Valley	12,214	6,459	5,755	9,144	4,005	5,139	2,666	2,454	213	404
Central Luzon	23,422	10,664	12,758	21,905	9,259	12,646	1,438	1,405	33	78
Southern Tagalog	12,574	5,303	7,272	7,541	3,653	3,888	2,255	1,650	605	2,779
Bicol	12,515	6,797	5,718	6,831	4,239	2,592	3,452	2,558	894	2,233
Eastern Visayas	5,098	1,481	3,618	3,709	940	2,769	1,059	540	519	330
Western Visayas	9,375	2,255	7,120	7,212	698	5,514	1,429	557	872	734
Northern and Eastern Mindanao	2,784	423	2,361	1,621	325	1,296	175	98	77	988
Southern and Western Mindanao	9,810	3,513	6,297	6,963	2,682	4,281	861	831	30	1,985

Source: Bureau of Agricultural Economics, Department of Agriculture and Natural Resources.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 10. Estimated hectarage planted in rice in the Philippines, 1965-66 (in 000's of hectares).

Region	All palay			Lowland first crop			Lowland second crop			Upland and Kaingin
	Total	Irrigated	Non-irrigated	Total	Irrigated	Non-irrigated	Total	Irrigated	Non irrigated	
Philippines	3,109	960	2,149	2,009	678	1,331	494	282	212	606
Ilocos	145	65	79	114	53	60	12	12	-	19
Cagayan Valley	354	135	219	275	86	188	58	49	9	21
Central Luzon	519	230	289	480	195	285	36	35	1	3
Southern Tagalog	467	142	325	218	91	127	90	51	39	159
Bicol	367	135	232	163	80	83	92	55	37	112
Eastern Visayas	323	58	265	209	34	175	79	24	55	35
Western Visayas	378	65	313	231	46	184	80	19	60	68
Northern and Eastern Mindanao	145	21	124	73	13	60	15	8	7	57
Southern and Western Mindanao	410	107	303	246	78	168	32	29	3	132

Source: Bureau of Agricultural Economics, Department of Agriculture and Natural Resources.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 11. Estimated number of cavans produced per hectare in the Philippines, 1965-66.

Region	All palay			Lowland first crop			Lowland second crop			Upland and Kaingin
	Total	Irrigated	Non-irrigated	Total	Irrigated	Non-irrigated	Total	Irrigated	Non-irrigated	
Philippines	29.77	41.03	24.73	34.30	42.67	30.03	27.76	37.13	15.30	16.40
Ilocos	32.94	38.50	28.35	34.98	40.04	30.50	31.72	31.71	32.12	21.46
Cagayan Valley	34.46	47.75	26.26	33.30	46.43	27.28	45.71	50.07	22.62	18.86
Central Luzon	45.10	46.28	44.16	45.60	47.38	44.39	39.96	40.15	33.19	26.44
Southern Tagalog	26.91	37.24	22.38	34.52	39.96	30.60	25.04	32.36	15.41	17.50
Bicol	34.11	50.37	24.65	41.87	52.76	31.31	37.64	46.85	24.09	19.92
Eastern Visayas	15.76	25.50	13.63	17.74	27.65	15.62	13.38	22.46	9.42	9.34
Western Visayas	24.81	34.53	22.78	31.26	36.68	29.90	17.97	29.30	14.41	20.85
Northern and Eastern Mindanao	19.19	19.94	19.06	22.27	24.80	21.72	11.62	12.08	11.07	17.26
Southern and Western Mindanao	23.92	32.72	20.80	28.28	34.26	23.45	26.62	28.34	10.03	15.09

Source: Bureau of Agricultural Economics, Department of Agriculture and Natural Resources.

SEED CORPORATION OF THE PHILIPPINES

EXHIBIT 12. Memo on advertising rates.

November 15

TO: Mr. Miguel T. Gonzales
FROM: Mario Mendoza
RE: Advertising Rates

In response to your request for information on advertising rates, I submit the following information:

I. Newspapers

The newspaper advertising rates you requested are as follows:

Newspapers	Rates	Circulation
Bulletin	₱ 8.50/col. in.	53,900
Chronicle	₱11.00/col. in.	67,500
Daily Mirror	₱ 6.00/col. in	38,900
Evening News	₱ 7.00/col. in.	36,200
Herald	₱ 8.50/col. in.	47,600
Times	₱19.00/col. in.	182,000

The above is the basic rate per column inch. Each full newspaper page is 8" x 21 col. in size or 168 col. inch.

II. Magazines

The magazine advertising rates you requested are as follows:

Magazines	Rates	Circulation
Agricultural and Industrial Life	₱320/full page	20,000
Philippine Farms and Gardens	₱420/full page	32,000

III. Radio

The advertising rates on provincial radio stations vary greatly as the following data indicates:

Length of Spot	Range in Cost
5 sec.	₱1.50 to ₱3.60
10 sec.	₱2.00 to ₱5.50
30 sec.	₱3.00 to ₱7.50
60 sec.	₱5.00 to ₱12.00

CORALAN RICE FARMERS' RESPONSE TO CHANGE IN CROPPING PATTERN: A CASE STUDY

Alice M. de Guzman
and
Conrado M. Dimaano

CORALAN RICE FARMERS' RESPONSE TO CHANGE IN CROPPING PATTERN: A CASE STUDY

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1.0 INTRODUCTION

It is common knowledge that the Philippines is counted among the countries with the lowest production per hectare of rice. Over the years, it has had a persistently low production, averaging 27 cavans per hectare. It is likewise common knowledge that farmers of other countries are able to coax a very much higher yield than our farmers from a given area. A multitude of solutions have been suggested and offered. Some would suggest we give up eating rice altogether and eat something else; others would continue the rice but overhaul the farmer and his farm. It is in other words the question of "the singer or the song." The song might indeed be a poor one judging from the voluminous disparaging remarks we can get on the disadvantages of eating rice and the laborious process required in its culture. No other crop requires such back-breaking work, plodding through water and mud barefoot under sun and rain 12 hours a day. But the inescapable fact is that more than half of the world just love the song - the Filipino second to none.

1/ The authors are extension instructors assigned in the Sta. Maria-Mabitac Development Project of the Farm and Home Development Office, College of Agriculture, University of the Philippines, College, Laguna, Philippines. They wish to thank their colleagues who helped interview the farmers and to Dr. Gelia T. Castillo for her guidance and constructive criticism.

Many programs have been put forward to combat low rice production. All of these seek the formula, if you will, of a successful rice culture derived from the crucible of the muck, grit, and grime of a rice paddy. With this end in view, various alternative approaches to extension work have been implemented among which is the pilot project called the Sta. Maria-Mabitac Development Project covering 8 barrios. The site of this project was chosen for a number of reasons but for the purpose of this paper it is sufficient to point out that it is an archetypal agricultural area that is duplicated over and over throughout the country. This project seeks "to determine the effects on agricultural production and community development of closely coordinating the work of the CAP, PACD, and the U.P. Farm and Home Development Program in a barrio setting and to determine the potentials and problems of such coordination of the work of these agencies which can serve as a basis for policy makers interested in coordination of technical agencies.[2]

This project which is supported by the Ford Foundation, the Agricultural Development Council, Inc., of New York, the University of the Philippines, College of Agriculture, the Commission on Agricultural Productivity (CAP), and the Presidential Assistant on Community Development (PACD), and is directly under the administrative supervision of the UPCA through the Farm and Home Development Office.

2/ The over-all research design for the Sta. Maria and Mabitac Development Project (A Cooperative Approach to Rural Development).

Barrio Coralan, among the 8 barrios of the project is the barrio studied in this report. While a few variations may be observed, it would not be remiss to say that when one has seen barrio Coralan he has practically "seen them all." The major occupation of the people in this barrio is farming. More than 70 percent derive their livelihood directly from lowland rice farming alone. There are 60 farmers who cultivate an average of 2 hectares each, raising two crops a year - one during the rainy season and another during the dry season. At the start of the project, farmers were producing, on the average, 30 cavans per hectare during the wet season and 25 cavans per hectare during the dry season. This yield is relatively low when compared to other rice farms in various towns of Laguna or with the 248 cavans per hectare (perhaps too optimistic) reported by the winner in the Rice Production Contest annually conducted by the Commission on Agricultural Productivity (CAP).

A benchmark survey conducted in preparation for the project identifies the reasons for this low production as: the lack of technical knowledge of the improved cultural practices on rice production, inadequate control of pests and diseases, low soil fertility, and lack of irrigation water.

After being in the barrio for only one season, the technician had raised the yield of 20 farmer-cooperators by 20 percent after adopting only 2 or more of the 12 practices he recommended such as weeding and fertilization. However, before these practices could take hold they were immediately dropped the following season. Consequently, yield of their produce reverted to the average prior to their adoption of these prac[illegible]. A cursory and almost innocent investigation disclosed that the farmers were indeed sold on the practices but the water shortage made it impossible to adopt them. Sensing that he had found a key to the solution, the technician made plans to solve the water problem.

2.0. SEQUENCE OF EVENTS

2.1. Introduction of improved agronomic practices

The crop technician of Coralan assumed his role in August 1964, a year after the project had started and the previous worker had resigned to join Operations Brotherhood. During the wet season (palagad) of the same year (August 1964-February 1965), the technician launched a campaign for improved agronomic practices such as straight row planting, use of rotary weeders, application of fertilizers and control of pests and diseases. As a start the technician: (a) borrowed two sprayers (power and duplex) from the Bureau of Plant Industry, (b) requested chemicals from the same office for demonstration purposes, (c) helped farmers hire planters from Sta. Cruz to do straight row planting, and (d) organized a cooperative way of buying rotary weeders at ₱23 each which actually retails at ₱25.

During the dry season (panahon) April to May 1965, virus infestation set in. The technician interviewed the farmers individually to trace the causative factors in the virus infestation and found that insufficiency of water prevented straight row planting, the use of rotary weeders, and application of fertilizers. Weeds grew taller than the crops and became favorable environment for leaf hoppers transmitting the virus. Of the 20 initial farmer-cooperators of the preceding season only 9 were able to apply the same practices during this season due to the water problem.

2.2. Irrigation problem

To determine the exact water supply and the cause of water shortage, the technician sought the help of the Irrigation Service Unit of Sta. Maria in May of the same year to check on the rainful observations since 1963 (see Figure 1). He was also furnished water readings for the past two years (see Figure 2). These readings show that the supply of irrigation water was highest during the period June-October and inadequate during the period November-April.

The prevailing cropping pattern then placed the planting during the months when the supply of irrigation water was inadequate, and as mentioned earlier hindered the adoption of improved farm practices.

Based on these findings, the technician proposed a new cropping pattern to take advantage of the months when irrigation water was abundant. This would move the <u>palagad</u> planting season of August-January to June-November and the <u>panahon</u> planting season of March-August to December-April.

Along with this change, a search for new varieties to suit these planting months was made. BPI-76 for <u>palagad</u> planting and Peta for <u>panahon</u> was suggested. Soon after, a written proposal of the new cropping pattern was presented to the rice specialists at the College of Agriculture for comments and approval. The objectives of the proposed new cropping pattern as presented by the technician are the following:

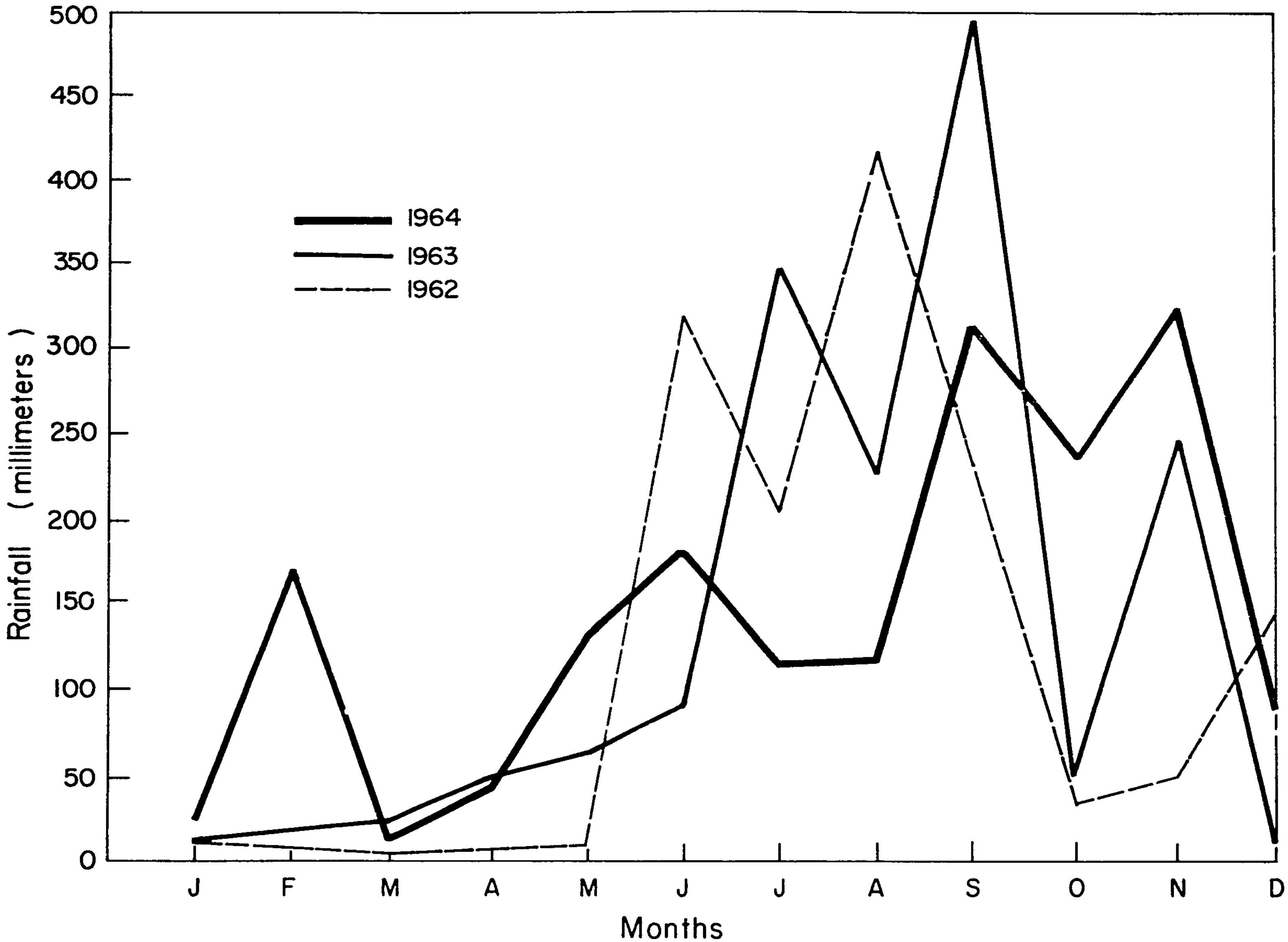

FIG. 1. Rainfall observation data, Observation Station, Bo. Sambal, Famy, Laguna.

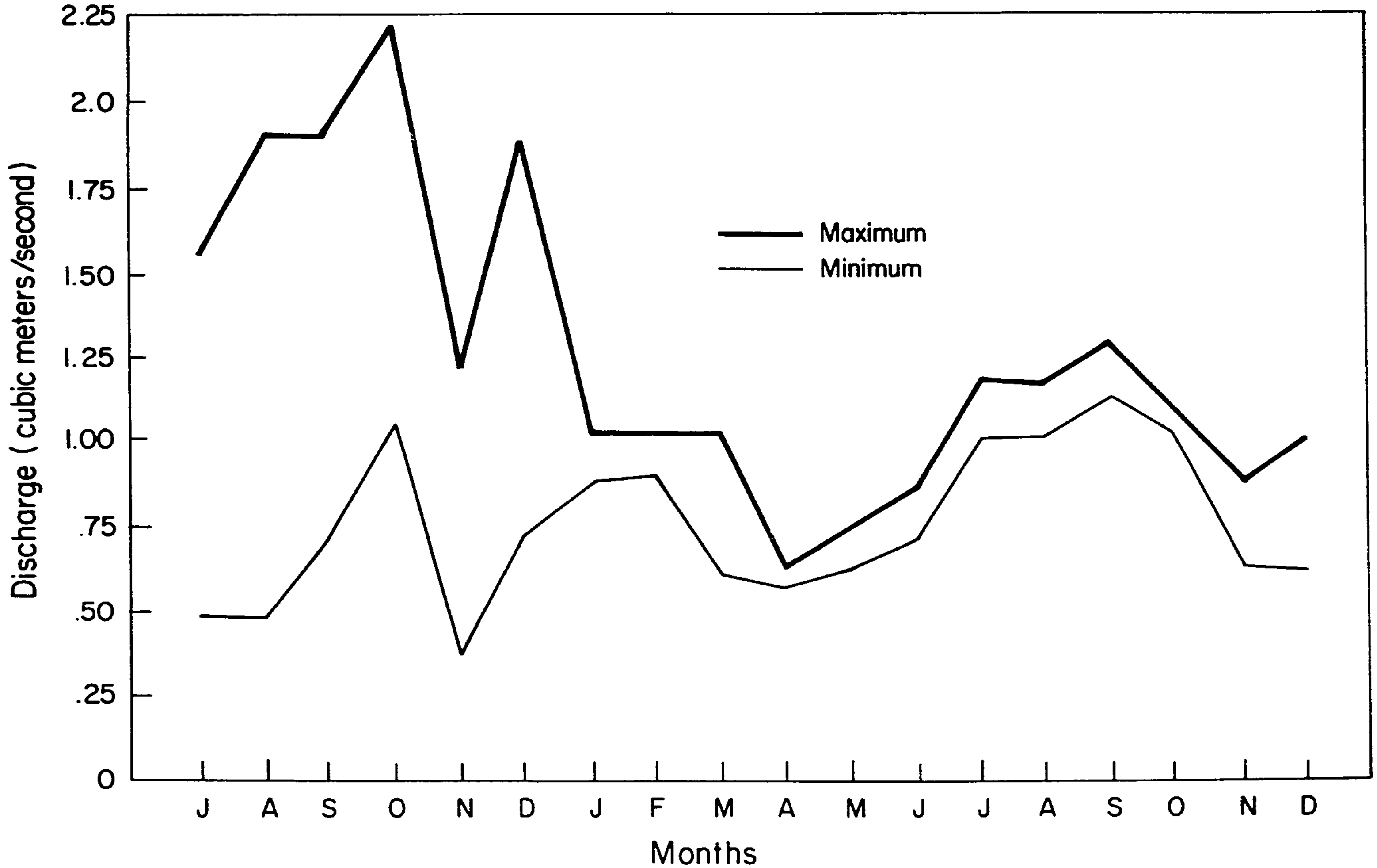

FIG. 2. Water supply data, Sta. Maria River main canal.

1. to remedy water inadequacy by changing the planting months when irrigation water was available.

2. to help farmers increase their yield by planting the recommended varieties.

3. to help farmers establish a definite pattern of planting, i.e. planting at the same time to minimize insect pests and diseases, etc.

2.3 Educational campaign

Farm and home visits were conducted on individual farmers to sell the idea of a new cropping pattern and to get their reactions. The technician found the farmers very receptive and willing to go along with the change provided the other farmers followed suit. In the course of these visits they were asked about other farm problems and such were noted down. Personal observations were also made of the rice fields. A total of 15 farmers was contacted in this manner. The last person approached was the Barrio Captain who had a relatively large farm (8 hectares) and therefore would be able to initiate a change in cropping pattern even if the other farmers did not. The technician explained his plan in detail and the Barrio Captain assured him that other farmers will agree. In consultation with the Barrio Captain, a tentative date for a farmers' meeting was set. Individual contacts were made to inform each one of the meeting.

2.4 Farmers' meeting

The first meeting was held on June 25, 1965, and attended by 20 farmers. At this meeting, the existing conditions in the barrio were discussed and problems were identified. Each one was asked to indicate his rice yield the previous seasons. The technician gave his comments and observations of their farming activities. The new cropping pattern was presented and explained giving its advantages and disadvantages especially in contrast to the prevailing cropping pattern. Despite efforts to make the proposal attractive, the farmers' response was weak. The technician made it plain that the program could not be carried out if there were only one or two farmers willing to follow. In response to the technician's threat of "a majority or not-at-all" the farmers finally decided to adopt the proposed plan. The date for land preparation was then set for November instead of December to accomodate the farmers' wishes who did not want a further delay because the previous harvest was very poor and their resources were now very low. The technician also had to compromise for the local variety Intan against the recommended variety of Peta which the farmers claimed was difficult to thresh. Intan performs creditably when planted in November or December. For the few who wanted Peta, he agreed to furnish the seeds.

The day after the meeting, the technician conducted farm and home visits to individual farmers who failed to attend the meeting to explain about the new program. However, he found that most of them already knew what transpired in the meeting, having been informed by those who had attended. Not withstanding their affinity for Intan, as demonstrated in the first meeting, a further campaign for the adoption of Peta lasting for two months was made with a promise to help those adopting it secure seeds from recommended sources. In the course of the campaign, the idea of a Barrio Rice School to help the farmers was presented.

2.5 Barrio rice school

The Barrio Rice School[3/] lasted for 5 days from August 31 to September 4, 1965. An average of 19 participants per session attended. Some of the topics taken up in the class were: (1) factors affecting rice production, (2) different rice varieties and their characteristics, (3) seed selection, (4) germination test, (5) sowing and care of seedlings, (6) land preparation, (7) transplanting of seedlings, and (8) control of pests and diseases. Slides were used to supplement the lectures together with a question and answer session after each speaker. After all these topics were taken up, a review of the cropping pattern was conducted. Actual dates for land preparation, sowing, transplanting, spraying and weeding were finalized. Field visits to follow up these operations from sowing onward were conducted by the crop technician.

2.6 Calendar of field activities

October 1965 - Sowing of seeds and land preparation. Proper guidance on seedbed preparation, care of seedlings like control of pests and diseases and fertilization were made. Preparation of the land followed soon after.

3/ Barrio Rice School is a seminar conducted in the barrio to bring to the farmers awareness of the recommended practices in rice growing, the basic principles underlying these recommendations and their interrelationships.

November 1965- Transplanting. The irrigation water could not supply the necessary requirements of the farms if all carried on transplanting operations at the same time. An agreement between the farmers was therefore made that the farms be divided into two areas - the lower half which could be easily irrigated and the upper half which had irrigation difficulties. The upper half started planting ahead on the first week of the month and the lower half in the middle of the month. Spraying before pulling the seedlings was closely supervised, and planting in straight rows to facilitate weeding was emphasized.

December 1965 - February 1966 - Spraying and fertilization. Farmers were encouraged to conduct periodic spraying of their crops to insure control of pests and diseases. Fertilizer was applied from January to February 1966 before the booting stage.

Interim Period - Preparation for the next season. In anticipation of the next planting season (May-June), the technician started his campaign on January 27 to finalize plans for the May and June planting and to launch a campaign to buy a "boom" sprayer. In order to convince the farmers of the advantage of this "boom" sprayer, he showed them how much they were losing annually from pests and diseases. More than a cavan of palay is lost per hectare to pests like rice bugs, rice birds, and to a little extent, rats. On the basis of this loss, he set one cavan to be taken from their present crop to purchase a "boom" sprayer costing ₱300. One group composed of ten related farmers with the Barrio Captain as initiator was at one point almost certain to get one. The Barrio Captain promised to give three cavans as his share.

He is cultivating a relatively large area, hence has great need for this equipment. However, in the end the plan to buy this "boom" sprayer was not pushed through. Instead three Hudson sprayers were purchased individually at ₱63 each. The plan of buying a "boom" sprayer failed because farmers could not agree on the procedure of maintaining the sprayer and rotating the use of it.

During the organizational meeting held on January 27, 1966, BPI-76 variety was discussed after which the farmers ordered a total of 23 cavans of seeds. However, the lower half of the fields which plant later could not use BPI-76 because of its longer maturity and its seasonal characteristics which would not coincide with the harvest of the upper half. The technician therefore introduced IR9-60 a short maturing variety so that their pattern would jibe with the harvest season of the upper area. They ordered a total of 16.5 cavans of it to be purchased from The International Rice Research Institute (IRRI) at ₱20.00 per cavan. At this meeting too, the farmers decided to hold a one day seminar on February 18, 1966 for the two proposed rice varieties, BPI-76 and IR9-60.

After the organizational meeting, the technician went to the College and IRRI to inquire about the availability of IR9-60 seeds. After a conference with the FHDO supervisor and the rice specialist of the IRRI, the technician found that IR9-60 was highly susceptible to virus, seeds were not available, and the IRRI did not want to release it until it has been tested over a wider area. The College Plant Breeding Division recommended C-18 a college variety which is also early maturing and of which they had 25 cavans of seeds available. The farmers were amenable to the use of C-18 instead of IR9-60. To complete the seed requirements, Liliwa, a local variety of the same maturity was chosen.

3.0. THE FOLLOW-UP STUDY

Since a change in cropping pattern is a major innovation that must be accompanied by many concomitant changes in the manner of producing rice, a follow-up study was done with the following objectives:

1. To determine the characteristics of rice farmers in barrio Coralan.

2. To find out the practices in rice production employed by the participants during the six seasons covered by the study.

3. To find out the relationship of the cropping pattern on the rate of adoption of recommended farm practices and on yield.

4. To find out the manner by which recommended varieties were introduced and the nature of acceptance of these varieties.

5. To find out reasons given by participants for their acceptance or rejection of recommended practices on rice farming.

6. To investigate some variables that may be associated with adoption of the new cropping pattern and the rate of adoption of recommended farm practices on rice.

7. To determine where information is obtained about new practices and the diffusion pattern of such information.

3.1. The respondents

A list of the names of farmers was taken from the farm and home benchmark survey conducted in 1963. A total of 69 rice farmers was obtained from this list. Out of the number, 5 were found to have ceased farming, 3 became hired laborers, and 9 were not interviewed due to some unavoidable circumstances. However, 5 rice farmers who were not in the original list were interviewed which made up a total of 57 farmers. The second interview was made one year after. Only 47 farmers of the original 57 have thus far been reinterviewed and the data obtained is used in this paper.

3.2. Research tool

The data used in this study were taken from a prepared schedule and the method used in gathering the data was personal interview. The interview schedule included: (1) demographic, social and economic characteristics, e.g. age, sex, educational attainment, number of dependents, number of years residing and farming in the barrio, occupation, tenure status, size of farm, organizational affiliation, etc.; (2) farm practices adopted by rice farmers for the six cropping seasons and their reasons for the adoption or rejection of these practices; (3) sources of information regarding farm practices; (4) comments about the new cropping pattern; and (5) relevant information regarding the cropping pattern and its effect on yield.

4.0. DISCUSSION OF RESULTS

4.1. Description of the respondents

Majority of the farmers interviewed were between the ages of 40-50. The youngest participant was 21 and the oldest was 70.

The 57 farmers interviewed have farmed from 10-20 years and cultivate more or less 2 hectare of rice land. The average Coralan farm family is composed of 7 members who supply the labor force.

There is very little geographic mobility among the respondents. The average formal education is only third grade.

Of the 57 respondents only 6 or 10 percent are members of barrio organizations - 3 of whom are Barrio Council members and the other 3 board members of the Parent-Teachers Association. Ninety percent did not belong to any formal organization.

Six out of 10 of the farmers are share tenants; the rest are leasees, part owner, tenant-leasees, and a negligible number are owner operators.

The most common sharing arrangement in this particular village is the typical 50-50 during the dry season and two-to-one during the wet season. Under 50-50 sharing agreement all production expenses are shared equally by both parties and in addition the tenant furnishes his own and family's labor. Under the two-to-one sharing arrangement the tenant shoulders most of the major expenses. For rent of the land, farmers pay as much as 5-12 cavans per hectare/season or ₱30-60 in cash per annum. During the wet season the rents are lower which could be attributed to the fact that farmers harvest less.

The rent for leasehold tenants is based on their yield for 3 consecutive seasons and by common consent between the landlord and the tenant. The leasehold arrangement benefits the farmer more when there is a greater harvest because the rent is fixed, consequently more farmers are clamoring for a shift to a leasehold arrangement. Prior to the program there were 9 lease holders but the number has now doubled to 18.

4.2. Practices in rice production employed during the 6 seasons covered

This section of the paper will give a picture of the practices adopted during the six seasons covered by this study. It will show the pattern by which one farmer uses a practice in one season, abandons it the next season, and then picks it up again. It will also show the many agronomic practices recommended by the extension worker assigned in the barrio, which of them were readily accepted and used, and which were dropped after the first trial. The causes or reasons for adopting, rejecting and re-adopting a practice will be discussed later.

4.21. Application of commercial fertilizers. During the dry season of 1964, a total of 12 (21 percent) of the farmers used fertilizers at planting time (Table 1). A greater percentage of the farmers (33 percent) generally applied commercial fertilizers from two weeks to one month after transplanting. However, because this was the initial stage in the campaign for agronomic practices, 21 percent of the total 57 farmers at least tried to apply fertilizer at planting time. In the succeeding seasons, however, very few farmers seem to have really been convinced of its effectiveness.

TABLE 1. Percentage of farmers adopting specific practices in each crop season.

Recommended practices	Dry season (Panahon)						Wet season (Palagad)					
	1964		1965-66		1966-67		1965		1966		1967	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1. Application of fertilizers at planting time (Basal)	12	21	5	9	6	13	3	5	4	9	7	15
2. Application of fertilizers in the field anytime (top dressing)	19	33	7	12	25	53	7	12	11	24	27	57
3. Planting in straight row	25	44	39	68	35	74	30	53	31	67	42	89
4. Use of rotary weeder	20	35	32	56	34	72	23	40	28	61	40	85
5. Use of weedicides	17	30	15	26	21	45	15	26	21	46	27	57
6. Spraying or soaking seedlings in chemicals before transplanting	34	60	31	54	30	64	3~~0~~	5	27	59	29	62
7. Sprayings againsts pests and diseases in the field	20	35	25	44	24	51	23	40	22	48	27	57
8. Germination test or seed treatment	22	39	27	47	22	47	21	37	21	46	23	49
9. Making and application of compost	3	5	6	11	2	*	5	9	3	7	2	*

Table 1. (cont'd)

Recommended practices	Dry season (Panahon)						Wet season (Palagad)					
	1964		1965-66		1966-67		1965		1966		1967	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
10. Seed selection before harvesting	44	77	45	79	32	68	43	75	29	63	28	60
11. Rat control	6	11	4	7	2	*	4	7	1	*	1	*
12. Planting of recommended varieties	7	12	21	37	35	74	3	5	33	72	44	94
Number of respondents	57		57		47		57		46		47	

Application of fertilizers while the palay crop is already growing seems to have been given more credit by the farmers. There's an increase of adopters as the seasons progress. Traditionally farmers don't apply fertilizers during the wet season planting because of their observation that the palay crop usually lodges. During this last wet season planting, (1967) however, a total of 27 or 57 percent applied fertilizer when most of them planted the recommended varieties. Ammonium sulfate and urea was commonly used while complete fertilizer is used sparingly.

4.22. Planting in straight row. Before the arrival of extension workers in Coralan no farmer planted in straight rows. The ordinary planting or "waray" system was used where no weeding equipment could be used. The introduction of straight row planting was deemed imperative to facilitate easy weeding by the use of rotary weeders to observe clean culture. Several approaches were devised by the team to get the farmers to adopt the straight row method such as farm and home visits, Barrio Rice School and a field trip to the IRRI. A field trip to the IRRI was found to be the most effective approach. Farmer Luis de la Cruz, for instance, tried the method after he saw the superior growth of the rice crop at the IRRI. After trying it he was more convinced by the great difference between the growth of his crop and the near-by farms. Some farmers objected to straight row planting for the following reasons: (1) the method is laborious and planters demand higher pay,[4/]

4/ Labor rate is ₱4.20 - 4.40/person/day for straight row planters, ₱5.00 for those who set the guide rows and ₱3.50/person/day in the traditional method.

(2) there are no skilled planters in the barrio, and (3) straight row planting required abundant water. To overcome these objections, skilled planters from other municipalities were contacted by the technician and brought to Coralan. The local farmers and the skilled planters made the necessary arrangement for the accommodations in the barrio. It was further arranged that the local planters join the skilled planters to learn the practice. Aside from this, actual demonstrations of the practice by the technicians were conducted to hasten the acceptance of straight row planting.

Table 2 gives a breakdown of farmers using the different methods of planting. During the dry season (1964) there were only 23 farmers (40 percent) who tried the innovation. Of this number, 16 (28 percent) planted in one direction while seven used the planting board to determine distances. This number increased as time went on so that during the last wet season planting, 42 (92 percent) of the farmers were using the practice. Only 4 (8 percent) persisted in adopting the traditional way. About one half of those who planted in straight row used the planting board, while the other half planted in one direction. Weeding in this case is still supplemented by handweeding.

4.23. Use of rotary weeder. The use of rotary weeders has been popularized along with straight row planting. However, not all the farmers who planted in straight rows used the rotary weeder but relied on handweeding and weedicides. There were 20 (35 percent) farmers who used the rotary weeder during the 1964 dry season planting. During the seasons following, there was a gradual increase of these farmers until the last season recorded when most farmers had their own rotary weeders.

TABLE 2. Types of planting adopted by Coralan farmers.

	Panahon (Dry)						Palagad (Wet)					
	1964		1965-66		1966-67		1965		1966		1967	
Type of planting	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1. Straight, one way	16	28	30	53	28	60	23	40	27	59	20	44
2. Straight, both ways	7	12	7	12	7	15	7	12	4	8	20	44
3. Both 1 and 2	-		1	2	-		-		-		2	4
4. Waray	34	60	19	33	12	25	27	48	15	33	4	8
Number of respondents	57	100	57	100	47	100	57	100	46	100	46	100

4.24. Use of weedicides. The use of weedicide to control weeds has been found convenient by some farmers. Weedicides were used in fields where sedges and broad leaf weeds abound that respond very well to 2,4-D. It is also used in cases where the rotary weeder can pass in only one direction. Harmful effects often occur due to the farmers' failure to get the correct weedicide proportion. Very few farmers adopt this practice consistently.

4.25. Chemical control of pests and diseases. During the 1964 dry season, 34 or 60 percent of the respondents sprayed their seedlings while still in the seedbed. Some farmers who did not do so, soaked the seedlings in chemicals before transplanting. There were fewer farmers who used the practice in the wet season planting although the difference is quite insignificant.

To compensate for their failure to spray in the seedbed, the crops are sprayed during the growth period after transplanting. In this instance there were more farmers who adopted the practice during the wet season planting palagad than in the dry season panahon. There were 27 farmers (57 percent) who adopted the practice during the last wet season included in the study. There were more farmers who spray in the seedbed than in the field because they found the former less laborious. Some of the common chemicals used were Malathion, Folidol, Posperno, Sevin, Thiodan, Dol granule, Endrin, Lindane, Meptox, and EPN.

4.26. Germination test or seed treatment. The data shows that to some extent germination test is done consistently by about one-third of the Coralan farmers. The most common practices used are the "ragdoll method" and floating the seeds in water to remove the empty grains. Seven farmers used salt solution while one farmer treated his seeds with the chemical Ceresan.

4.27. Making and application of compost. Application of compost as a means of increasing soil fertility is not yet widely accepted by Coralan farmers. Three farmers tried composting during the first season, 6 during the next dry season and 5 during the following wet season. Three of these farmers who made and applied compost in their farms are farmer cooperators and consistently applied it for 3 consecutive seasons. Those who have tried believe that compost "is a big help to the palay and reduces the application of commercial fertilizers." In the succeeding seasons, however, farmers eventually dropped the practice as shown in Table 3, because farmers found it too laborious and didn't have the time for it. Instead of composts, commercial fertilizers were resorted to.

4.28. Seed selection. More than two-thirds of the farmers practice seed selection before harvesting their crops. This seems to be traditional practice among them - a way of insuring harvest. During the last three seasons covered by the study, however, the number decreased because farmers started to buy new stock of seeds. More farmers employ the "paddy" than the "panicle" method of selection.5/

4.29. Control of rodents. Like compost making, rat control has not gained acceptance among Coralan farmers. Only 6 farmers have tried it so far. Half of these dropped the practice after trying it once. Coralan farmers are quite fortunate because rats are not yet considered a threat to their crops. One said that rats are also God's creation and besides they don't cause an appreciable damage. The chemicals used by those who have tried rat control are 1081 and Warfarin. One farmer used a bitter shrub locally called "makabuhay itim" accompanied by prayers.

4.30. Use of recommended varieties. During the first season covered by the study only 7 (12 percent) tried recommended rice varieties on a trial basis. These were BE-3, Tainan-3 and Tjeremas. Performance of these varieties were quite unsatisfactory due to several factors which made the farmers revert to their local varieties. With the implementation of the new cropping pattern, however, a complete change of varieties was expected as

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5/ Paddy method seed selection is done by setting aside a field and all seeds used, while "panicle" method is done by selecting only good panicles at random throughout the field.

farmers were advised to plant seedboard varieties that suited the cropping calendar recommended. Despite the campaign made by the field technician some farmers adopted the change in cropping pattern but still planted the local varieties. About 2 seasons after the introduction of the new cropping pattern the planting of new varieties began to take a foothold. About three-fourths planted at least one of the recommended varieties in 1966. In the last season covered by the study only one of the 47 farmers interviewed did not plant any of the new varieties. Varieties introduced since the change in the cropping pattern are: BPI-76, IR8, C-18, C4-28, and BPI-76-1 (Bicol selection).

4.3. Relationship of the new cropping pattern on the rate of adoption of recommended practices and on yield

4.31. Adoption of recommended practices. Table 3 shows the rate of adoption of recommended rice farm practices among 43 farmers who adopted the new cropping pattern. A comparison is made between the two *panahon* crop seasons before and after adopting the new planting calendar.

Findings show that there was an increase in the number of adopters in the second *panahon* season (1965-66). At least 50 percent of the recommended practices, viz., straight row planting, use of rotary weeder, spraying against pests and diseases in the field, germination test or seed treatment, making and applying of compost, and planting of seedboard varieties were adopted. There were 4 farm practices where the number of adopters remained the same for the two seasons. These practices were: (1) the use of weedicides, (2) spraying the seedbed or soaking seedlings in chemicals before transplanting,

TABLE 3. Rate of adoption of certain recommended practices prior and after adopting the new cropping pattern by 43 farmers. a/

Recommended cultural practices	Prior to adoption No.	Prior to adoption %	After adoption No.	After adoption %	Difference.
1. Application of fertilizer at planting time (Basal)	11	25	4	9	-7
2. Application of fertilizer in the field (top dressing)	19	44	7	16	-12
3. Planting in straight rows	23	53	33	77	10
4. Use of rotary weeder	19	44	29	67	10
5. Use of weedicides	15	35	15	35	0
6. Spraying in the seedbed or soaking it in chemicals before transplanting	25	58	25	58	0
7. Spraying against pests and diseases in the field	18	42	24	56	6
8. Germination test or seed treatment	17	40	22	51	5
9. Making and application of compost	3	7	6	14	3
10. Seed selection before harvesting	33	77	33	77	0
11. Rat control	3	7	3	7	0
12. Use of seedboard varieties	6	14	21	49	15

a/ Based on two *panahon* seasons 1964 and 1965-66.

(3) seed selection, and (4) rat control. Applying fertilizer either during or after transplanting was discontinued by about two-thirds of the farmers. There was a big decrease of farmers who used fertilizers during the next panahon season when the cropping calendar was changed. One reason is the change to the Peta variety planted. It was planted by a majority of those who followed the new cropping calendar. Since Peta is a non-nitrogenous variety, the application of the fertilizer does not increase its yield significantly. (See Figure 3 on the different rice varieties' response to nitrogen fertilizers). Another reason is that farmers strongly believe their fields are still very fertile as gleaned from the following comments: "Malakas pa ang lupa, nalagong maigi at nadapa agad." (The soil is still fertile, the plants become robust and lodge easily). Also some farmers believe that when one starts to apply fertilizer the soil will be "addicted" to fertilizers, a situation they wish to avoid. Moreover, there was a gap of three months before the second panahon planting and this allowed the straw to decompose in the field which added to the fertility of the soil. Farmers determine the rice plants need for fertilizers through external symptoms such as yellowing of the leaves before applying fertilizers.

Of the total 57 farmers interviewed, 43 adopted the new cropping pattern during the first interview while 14 did not (Table 4). At the time of the last interview, however, only 3 reported they were not following it yet but have the intentions to do so this coming dry season. Among those who followed the new cropping calendar, two-thirds adopted four or more practices. Among

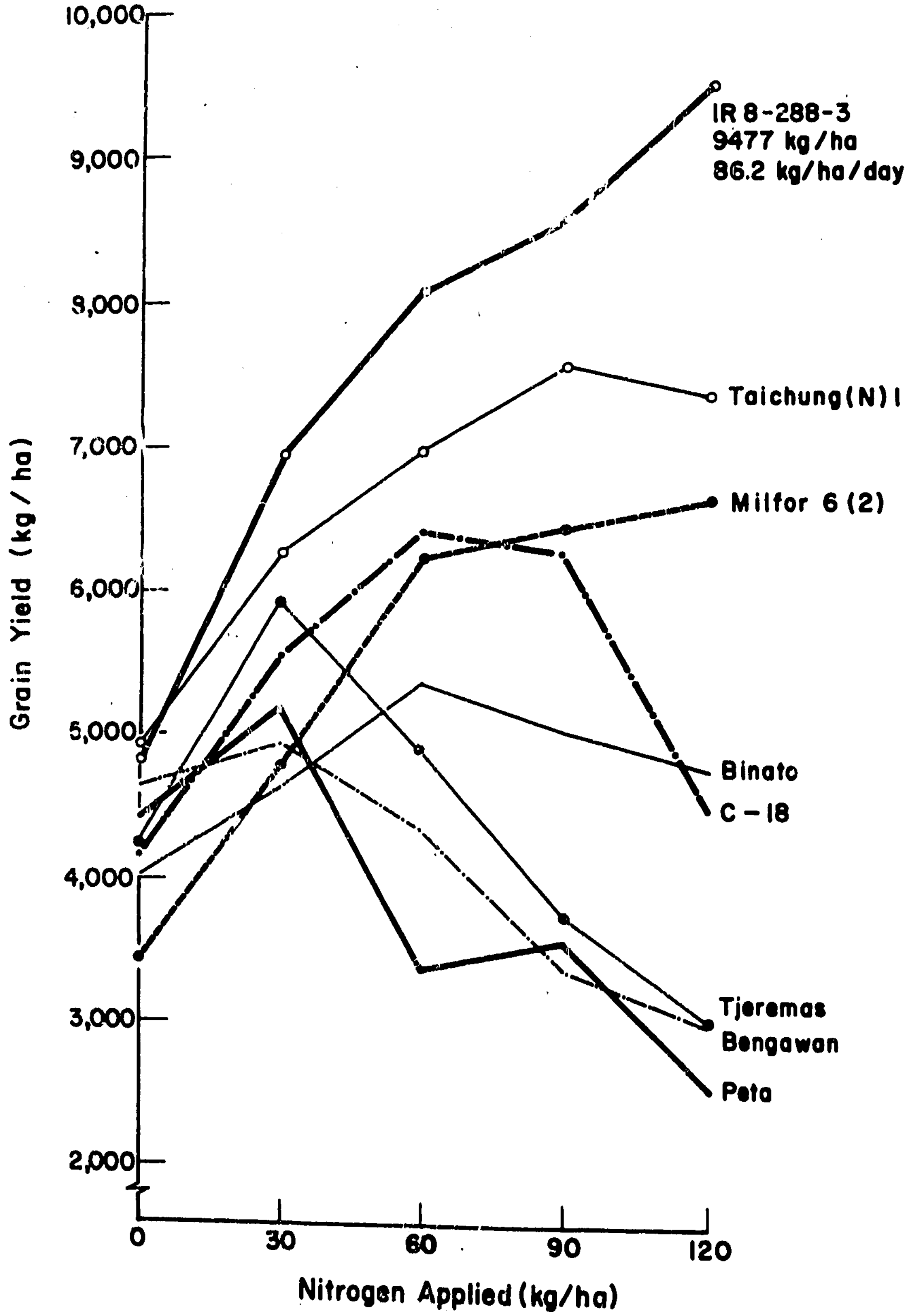


FIG. 3. Nitrogen response of indica rice, IRRI, 1966 dry season.

those who did not follow the new cropping pattern, only one-third adopted more than four practices.

Among the 43 participants in the new cropping calendar, a total of 221 adoption score was recorded for the three seasons covered in the study (See Table 4). Among the 14 non-participants the total adoption score was 38. The average number of practices per adopter among participants was 5.14 compared to only 2.7 among the non-participants.

TABLE 4. Number of practices adopted by farmer participants and non-participants in the new cropping pattern (Panahon 1965-66).

Adoption score	Participants	Non-participants	Total
One	1	3	4
Two	5	3	8
Three	5	4	9
Four	7	3	10
Five	6	1	7
Six	7	-	7
Seven and up	12	-	12
Total	43	14	57

Related information:	Participants	Non-participants
1. Total adoption score	221	38
2. Total number of adopters	43	14
3. Total number of non-adopters	0	0
4. Average adoption score/adopter	5.14	2.7

4.32. Effects of the cropping pattern on rice yield. Prior to the adoption of the new cropping pattern, the average yield per hectare among the participants during the first *panahon* was 34 cavans. The yield of the non-participants was relatively higher, 41 per hectare (Table 5). The discrepancy between these two yields accounts for the participants' willingness to change the cropping pattern. In the next *panahon* season with the introduction of the new cropping calendar, the average yield of the participants was 51 cavans per hectare which is now slightly higher than the non-participants' 49 cavans per hectare. The difference in the yield between these two seasons is 17 among the participants and only 8 among the non-participants. In other words, the non-participants initially had a higher average yield per hectare than the participants.

TABLE 5. Participation and non-participation in the new cropping pattern and yield for two panahon seasons.

Participation	Average yield/hectare: Panahon 1964 (cavans)	Average yield/hectare: Panahon 1965-66 (cavans)	Difference in the average yield between the two seasons
1. Participants (48 parcels)	34	51	17
2. Non-participants (12 parcels)	41	49	8

Although the general trend was an increase in yield for the two groups, there were some parcels where yield decreased. Among the participants, decrease was observed in 6 out of 51 parcels with a yie'd decrease averaging 5 cavans per hectare compared to the non-participants' 10 cavans per hectare decrease in yield in their three parcels, Table 6. Among the participants there was an average increase of 21 cavans in the 42 parcels where yield increase was observed while among the non-participants the average increase is 13 cavans per hectare in the nine parcels.

TABLE 6. Participation in the new cropping pattern and difference in yield between the two panahon seasons.

Participation	No. of parcels where yield increase was observed	Average increase cavans/ha	No. of parcels where yield decrease was observed	Average decrease cavans/ha
1. Participant	42	21	6	5
2. Non-participant	9	13	3	10
Total	51		9	

4.33. <u>Projection on yield</u>. Respondents were asked if there is still a possibility of increasing their yield beyond what they obtained during the first three seasons covered in the study. Among the 57 farmers interviewed, 53 or 93 percent said <u>yes</u>, 3 or 5 percent said <u>no more</u>, and only one respondent was not certain whether he can still increase his yield.

A follow-up question was asked each respondent: By what means could you increase your yield?

Most of the respondents (34 or 64 percent) feel that by weeding alone they could increase their yield from 10 to 20 percent. Another 25 farmers or 47 percent said the application of fertilizers would increase their yield. Spraying against pests and diseases was mentioned by 15 or 24 percent of the respondents. Improving irrigation facilities and good care was mentioned by 8 and 9 respondents respectively. Other means mentioned by a minority were: planting good seeds and variety, 8 percent; planting during the season, 8 percent; straight row planting, 6 percent; follow recommended practices, 6 percent; landlords should help shoulder expenses in the farm, 2 percent; adding hectarage, 2 percent; rat control, 2 percent and cooperative planting, 2 percent. The three most important factors cited that would increase yield are weeding, application of fertilizers, and control of pests and diseases.

While adopting the new cropping pattern, 34 out of 39 respondents made it a habit to visit their farms daily. Only 5 participants visited their farms other than daily. Among the non-participants, 6 or a little less than half made daily visits to their farms while more than half visited every other day to twice a week only.

4.34. Investment and returns. Because the use of improved farming methods is usually accompanied by an increase in inputs, three different case studies are presented in order to illustrate how an increase in cost of production is followed by a corresponding increase in net returns as shown below:

	% increase in cost of production	% increase in net profit
Farmer 1	63%	165%
Farmer 2	75%	63%
Farmer 3	39%	30%

Farmers 2 and 3 were giving more of the increase to the landlord than Farmer 1, which accounts for the large disparity in the increase in net profits. Farmer 1 is a leasehold tenant whose land rent was constant. Farmers 2 and 3 were on a 50-50 sharing basis. Consequently their land rent increased in proportion to their increase in yield.

Other factors that affect the increase such as seed variety, soil, number of practices adopted do come into play. Most of these of course will ultimately be reflected as a higher cost of production. In short, as production expenses and labor in-puts increase, there is a corresponding substantial increase in profits - subject of course to the law of diminishing returns.

TABLE 7. Investment and returns of producing rice in a half hectare field (leasehold tenant).

	Dry season 1967 (₱)	Dry season 1964 (₱)
I. Direct production expenses:		
1. Seeds - 1/2 cavans IR8	12.00	6.00
2. Insect control		
a. One bottle Thiodan @ ₱3.80	3.80	-
3. Fertilizer		
a. 1-1/2 bags of urea @ ₱14.00	33.25	-
4. Fee for water irrigation	6.00	6.00
Total direct expenses -	55.05	12.00
II. Labor inputs:		
1. Land preparation - 6 man days with the use of carabao @ ₱5.00/day	30.00	30.00
2. Seedbed preparation and care- one day @ ₱3.50	3.50	3.50
3. Transplanting		
a. Planting board-10 man days @ ₱4.50	45.00	
b. Waray - 5 man days @ ₱3.50		17.50
4. Pulling of seedlings 1 man day		4.00
5. Repair of dikes - 1 man day	3.50	3.50
6. Fertilization and spraying - 1 man day	3.50	
7. Weeding		
a. Use of rotary weeder - 6 man days @ ₱3.50	21.00	-
III. Land rent - 3.50 cavans @ ₱14.00	49.00	49.00
Total labor input and rent	155.50	107.50
TOTAL COSTS	210.55	119.50
IV. Value of production:		
1. IR8- 72 cavans/.5 ha @ ₱14.00	1008.00	
2. Binato - 20 cavans/.5 ha @ ₱15.00		300.00
NET RETURNS	797.45	180.50

TABLE 8. Investment and returns of producing rice in a two-hectare field (Share Tenant).

	Panahon	
	1967 (₱)	1964 (₱)
I. Direct production expenses:		
1. Seeds		
a. 1-1/2 cavans BPI-76-1 @ ₱20.00	30.00	-
b. 1/2 cavan IR8 @ ₱34/cav.	17.00	-
c. 2-1/2 cavans Intan @ ₱12.00	-	30.00
2. Insect control		
a. 3 bottles Posperno @ ₱3.50	10.50	-
b. 1 bag Dol granule @ ₱26.50	26.50	-
3. Weed control		
a. 2 bottles 2,4-D @ ₱2.80	5.60	-
4. Fertilizer		
a. 4 bags ammonium sulfate @ ₱14.00	56.00	-
5. Fee for water irrigation	24.00	24.00
Total direct expenses -	169.60	54.00
II. Labor inputs:		
1. Land preparation		
a. 14 man days with the use of hand tractor @ ₱25/day	350.00	-
b. 65 man days with the use of carabaos @ ₱5.00/day	-	325.00
2. Seedbed preparation and care		
a. 2 man days @ ₱3.50	7.00	7.00
3. Repair of dikes - 3 man days @ ₱3.50	10.50	10.50
4. Transplanting		
a. Planting board - 20 man days @ ₱4.50	90.00	-
b. Waray - 16 man days @ ₱3.50	-	56.00
5. Pulling of seedlings - 5 man days @ ₱4.00	-	20.00
6. Fertilization and spraying - 3 man days @ ₱3.50	10.50	-
7. Weeding		
a. Use of rotary weeder - 15 man days @ ₱3.50	52.50	-

Table 8. (cont'd)

	Panahon	
	1967	1964
	(₱)	(₱)
III. Land rent (landlord's share based on 50:50 sharing arrangement	795.10	371.00
Total labor input and rent	1315.60	789.50
TOTAL COST	1485.20	843.50
IV. Value of production:		
a. 80 cavans BPI-76-1 @ ₱18/cav.	1440.00	-
b. 30 cavans IR8 @ ₱14/cav.	420.00	-
c. 60 cavans Intan @ ₱18/cav.	-	1080.00
NET RETURNS	374.80	236.50

TABLE 9. Investment and returns of producing rice in a one and one half hectare field (Share Tenant).

	Panahon 1967 (₱)	Panahon 1964 (₱)
I. Direct production expenses:		
1. Seeds		
a. 1 cavan IR8 @ ₱34.00	34.00	-
b. 1-1/2 cavans Wagwag @ ₱12/cav.	-	18.00
2. Insect control		
a. 2 bottles Lindane @ ₱2.40	4.80	-
b. 3 bags Sevin @ ₱3.00	9.00	-
c. 1-1/3 bags Dol granule @ ₱48.65	60.95	-
d. 1 bottle Endrin @ ₱2.50	-	2.50
3. Fertilizer		
a. 3 bags urea @ ₱25.50	76.50	-
b. 1 bag Ammonium sulfate @ ₱14.00	14.00	-
c. 2 bags Ammonium sulfate @ ₱12.00	-	24.50
4. Fee for water irrigation ₱12/ha	16.00	16.00
Total direct expenses -	215.25	61..00
II. Labor inputs:		
1. Land preparation		
a. 6 days with the use of hand tractors @ ₱25/day	150.00	-
b. 30 man days with the use of carabaos @ ₱5/day		150.00
2. Seedbed preparation and care	3.50	3.50
3. Transplanting		
a. Planting board (contract)	76.40	-
b. Waray - 9 man days @ ₱3.50/day	-	31.50
4. Pulling of seedlings - 1 day	-	12.00
5. Repair of dikes - 3 man days	10.50	10.50
6. Fertilization and spraying 2-1/2 man days	8.75	3.50
7. Weeding		
a. Use of rotary weeder - 16 days @ ₱3.50	52.50	-
b. Handweeding - 40 days @ ₱3.00	-	120.00

Table 9. (cont'd)

		Panahon	
		1967	1964
		(₱)	(₱)
III. Land rent (Landlord's share based on 50:50 sharing arrangement)		454.00	307.00
Total labor input and output	-	755.65	638.00
TOTAL COST	-	970.90	699.00
IV. Value of production:			
a. 88 cavans IR8 @ ₱14.00		1232.00	-
b. 50 cavans Intan @ ₱18.00		-	900.00
NET RETURNS	-	261.10	202.00

5.0. INTRODUCTION OF PROMISING VARIETIES AND THEIR YIELD

The program of rice production in barrio Coralan stresses seed selection from high yielding varieties and the use of varieties recommended by the Philippine Seedboard. Among the high yielding varieties introduced are the non-seasonal BPI-76 and IR8 while recommended varieties are the seasonal BPI-76, C-18, and other College varieties, respectively detailed as follows:

5.1. The varieties

5.11. Non-seasonal BPI-76 or (BPI-76-1). During the wet season of 1966, 3 farmers planted only 6 hectares to this variety (Table 10). They would have planted more but for the shortage of seeds. Proper cultural practices such as straight row planting, weeding, fertilization and control of pests and diseases were employed. From this crop, an average of 78 cavans per hectare was realized, although the highest yield obtained was 96 cavans per hectare.

The outstanding qualities of this variety that found favor among the farmers as shown by their replies are its early maturity, high yielding capacity, and its non-seasonal aspect, (because of its non-photosensitive characteristic, it allows farmers to plant it any time of the year). These qualities attracted 13 farmers to adopt it the following wet season when 13 hectares were devoted to it or more than double the hectarage of the previous season (6 ha).

TABLE 10. Comparative yield of recommended and local varieties during the dry season planting (Panahon), November-April.

Variety	Panahon 1964			Panahon 1965-66			Panahon 1966-67		
	Number reporting	Total area	Cav/ha	Number reporting	Total area	Cav/ha	Number reporting	Total area	Cav/ha
1. Peta	3	50	55	18	27.75	56	8	10.55	50
2. C-18							23	40.10	52
3. BPI-76-1				2	3.00	50	8	13.50	48
4. IR8							3	5.50	78
5. Intan	23	42.73	39	23	25.40	44	16	23.70	57
6. Wagwag	21	41.25	41	16	25.40	47	1	1.40	25
7. Quezon	5	4.65	37	8	13.25	45	1	2.00	39
8. Other recommended variety*	7	10.41	37	1	1.00	48			
9. Other local varieties**	7	11.25	31	10	15.33	42	1	1.30	14
Average total	66	114.29	39	79	111.13	47	60	96.55	46

* Includes BE-3, Tainan-3, Tjeremas.

** Includes Pinorsegue, Binato, Binae, Pipisek, Surigao, Macan, Piniling Daniel.

TABLE 11. Comparative yield of recommended varieties and local varieties during the wet season planting (Palagad) June - November.

Variety	Palagad 1965			Palagad 1966			Palagad 1967			
	Number reporting	Total area	Cav/ ha	Number reporting	Total area	Cav/ ha	Number reporting	Total area	Actual yield cav/ha	Estimated yield a/ cav/ha
1. BPI-76	4	6.5	44	18	27.7	68	23	22.85	65	89
2. BPI-76-1	-	-	-	3	6.0	78	13	13.8	53	71
3. C-18	-	-	-	16	25.8	61	17	17.15	65	80
4. IR8	-	-	-	2	2.75	71	30	28.75	79	105
5. Intan	5	11.5	37	10	13.5	45	1	0.25	55	55
6. Wagwag	3	4.75	23	-	-	-	-	-	-	-
7. Binato	35	44.45	23	4	6.5	57	-	-	-	-
8. Surigao	4	6.33	35	2	2.1	46	-	-	-	-
9. Other recommended varieties*	4	7.16	42	2	3.5	61	4	4.5	52	86
10. Other local varieties**	4	7.0	17	4	5.5	15	1	1.4	9	18
Average total	55	81.19	29.5	61	93.35	55.77	89	88.70	66.34	88.75

* Includes Peta, Tjeremas, C4-63, C4-28, C4-113 and PB lines.
** Includes Makandalaga, Pinorsegue, Binae, Quezon, Pipisek.
a/ Estimated loss due to typhoon "Welming" is 23 cavans/ha.

5.12. Seasonal BPI-76. This was introduced in the barrio on a trial basis in the wet season of 1965, specifically in October. It may be recalled that its seasonal characteristics require it be planted in June or July to attain its highest potential. Nevertheless, the trial crop averaged 44 cavans per hectare in contrast to the 17 to 34 cavans per hectare averaged by the local varieties.

The enthusiasm of the farmers for the variety as exhibited by the trial crop was due to its higher tillering capacity, bigger panicles, non-lodging characteristics, high yield, and palatable taste. The only objections were its seasonal characteristic and late maturity.

The variety was adopted earnestly in June of 1966 to coincide with the change in cropping pattern as recommended by the field technician (see page 6). Proper cultural practices were followed by the farmers under close supervision by the technician with constant follow-ups throughout the cropping season.

The results of this crop and the subsequent one of 1967 however, could not be accurately ascertained due to the destruction wrought by two successive typhoons which came immediately prior to harvesting. The estimated losses carried away by floods were 200 and 500 cavans for both seasons respectively. It is interesting to note that in both instances most of these losses were in the form of harvested sheaves left in the fields and standing crop that would have been saved if it were possible to harvest them a few days earlier. The technician noted that despite his recommendations, some lagged behind in planting accounting for the few days difference. In spite of this, the wet season crop of 1966 averaged 68 cavans per hectare and in 1967, 65 cavans per hectare (Table 10). It is estimated that the current crop (second season 1967) would average 89 cavans/ha barring unforseen factors.

5.13. C-18 (College variety). This is another variety tried by the farmers en masse. It was first planted during the wet season of 1966 when 16 farmers planted a total of 25.8 hectares.

Community-wide acceptance of this variety was the result of its outstanding characteristics shown such as high yielding capacity, non-photoperiod, resistance to pests and diseases, etc. The most important factor, however, is the good eating quality and the high price it commands in the market. Currently, one cavan of palay sells for ₱16.00 - ₱18.00 compared to IR8 which sells for only ₱13.00 - ₱15.00 per cavan. Or one need only produce about 81 cavans of C-18 to equal the monetary value of 100 cavans of IR8. Most farmers consider the variety a good substitute for Intan, a variety they have been used to for many years now. Around 50 percent of the harvest of this first crop was used as seeds in the barrio and neighboring barrios. The following dry season, 23 farmers planted a total of 40.10 hectares. An average yield of 52 cavans per hectare was obtained, although 4 farmers obtained a maximum yield of more than 90 cavans per hectare.

5.14. IR8. Along with the other high yielding varieties, IR8 was introduced on a small scale during the wet season of 1966 as only 2 farmers planted 2.75 hectares (an average yield of 71 cavans per hectare was realized). The next season, 3 farmers adopted it and obtained an average yield of 78 cavans per hectare. Based on the good performance of this variety, thirty (30) farmers decided to plant 29 hectares to the variety during the last wet season (1967). Majority of Coralan farmers are convinced of the high yielding capacity of this variety. However, their only objection is its flat taste and its tendency to become hard in consistency when left cold. In other words it possesses generally poor eating qualities.

5.2. Acceptance of the different varieties

Table 12 shows the farmers manner of acceptance of the recommended varieties in the barrio and Tables 13 and 14 their reasons for doing so. On the average, farmers planted an area of 1.7 hectares to one of the new varieties.

5.21. Only one variety planted. Of the 45 farmers participating for the first time (i.e. planting recommended varieties for the first time), 15 33 percent planted their fields to only the one recommended variety while 30 planted 2 or more varieties. It will be noted that percentages of one-recommended-variety planters, after a sudden rise, decreased significantly. They switched to 2 or more recommended varieties and not back to the local varieties. This indicates a great desire of the farmers to try the new varieties to find out the best yielder. As Table 14 shows, this reason was given 24 times. Of 40 farmers participating for the second time, 24 or 60 percent planted only one variety, a recommended variety. Third timers registered 18 of 31 or 58 percent while fourth timers registered 4 of 18 or 22 percent against an increasing percentage of 2 or more recommended variety planters, with those planting in conjunction with local varieties finally disappearing. (Bottom portion Table 12).

The most prevalent reason given for planting only one variety is that it is a high yielder (Table 13). This conclusion must have been based on the performance of field trials conducted in the barrio or from results of neighboring

TABLE 12. Number of farmers planting recommended varieties.

Number of varieties planted	Number of times participated* One season No.	%	Two seasons No.	%	Three seasons No.	%	Four seasons No.	%
One variety	15	33	24	60	18	58	4	22
Two varieties	25	56	13	33	9	29	8	45
Three varieties	5	11	3	7	4	13	6	33
Total	45	100	40	100	31	100	18	100
No. of farmers planting both recommended and local variety at one time	24	80	11	69	3	23	-	-
No. of farmers planting recommended variety only	6	20	5	31	10	77	14	100
Total	30	100	16	100	13	100	14	100

* Not all respondents started at the same time.

TABLE 13. Reasons for planting the whole field to one recommended variety right away.

Reasons	Planting seasons First	Second	Third and Fourth	Total No. of times mentioned
1. Recommended by the technician	4	4	5	13
2. Good performance of the variety as seen in other farms	1	2	2	5
3. A high yielder	2	8	8	18
4. It is the variety agreed upon by neighbors	3	1	1	5
5. Searching for a variety suited to local conditions	5	2	1	2
6. Recommended by others	2	5	1	8
Total reasons cited	17	22	18	51

TABLE 14. Reasons for planting more than one variety.

Reasons cited	Planting seasons			Total
	First	Second	Third and Fourth	No. of times mentioned
1. Tried to find out which one will give more yield	9	5	10	24
2. Recommended by the technicians	8	-	2	10
3. It is the variety agreed upon by neighbors	1	2	8	11
4. It is a high yielder	2	2	11	15
5. Have seen its good performance in other farms	1	1	2	4
6. Other seeds have not been tested yet	2			2
7. Others say it is a good variety	1	1	1	3
8. It is imperative that we change our variety now	1			1
Total reasons cited -	25	11	34	70

barrios. The technician's recommendation was given 13 times as the reason for their choosing the variety which they ultimately planted alone. This shows the high confidence the farmer's place on the technician's recommendations, considering that they believe risks are involved in switching from time proven local varieties to the recommended varieties. Another reason given, which is mentioned 8 times is the recommendation and the say-so of neighbors that it is a good variety. A smaller segment of the respondents gave agreement among the neighbors as the reason for choosing the variety with an equal number citing the good performance of the variety as seen from other farms.

5.22. Two or more varieties planted. As mentioned in (A) above, only 15 of the 45 farmers planting the recommended varieties for the first time planted their fields to only one recommended variety while 30 planted more than one variety. Of these 30, 24 or 78 percent planted a recommended variety in conjunction with a local variety while only 6 planted in conjunction with another recommended variety (bottom portion, Table 12). The high incidence of a desire to carry on a local variety speaks of their reliance on the certainty of local varieties side by side with an enthusiasm for the new variety. The most prevalent reason (24 times) given for carrying on with 2 or more varieties is to find out which one will yield more. The second most common reason given for choosing the two or more varieties planted simultaneously is that it is a high yielder. It will be recalled from Section 5.21 that this is the most prevalent reason for those choosing only one variety. It must be stated parenthetically here that farmers were answering the question, "why did you choose this variety?" and not "why did you choose or plant two varieties?" In other words, they were being asked to give reasons for their preference of a variety and not the reasons for carrying on two varieties or a single variety. The common agreement on which variety to plant was the third most common reason being given 11 times. The technician's recommendations were mentioned 10 times. A minority gave the performance of other farmers and the unavailability of seeds proven in the barrio as the reasons.

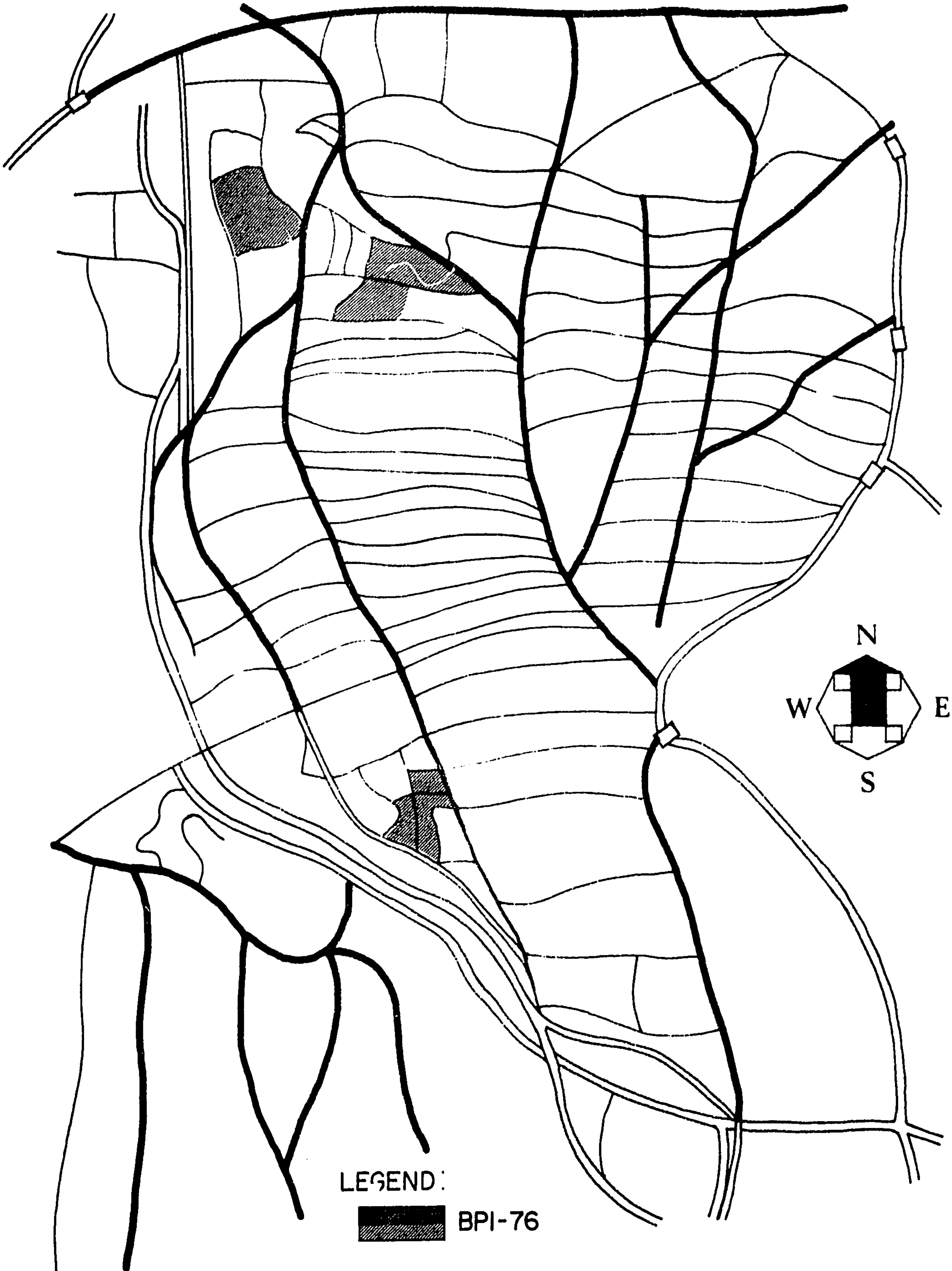
A very patent and significant development during the four seasons is the steady and definite decision to do away with the local varieties. As stated above, 78 percent of those who participated for the first time carried a local variety in conjunction with a new variety. Only 69 percent of those participating for the second time carried it, 23 percent for the third timers, and totally dropped by those participating for the fourth time, all in favor of a new variety.

5.3. Maps illustrating adoption of the different varieties

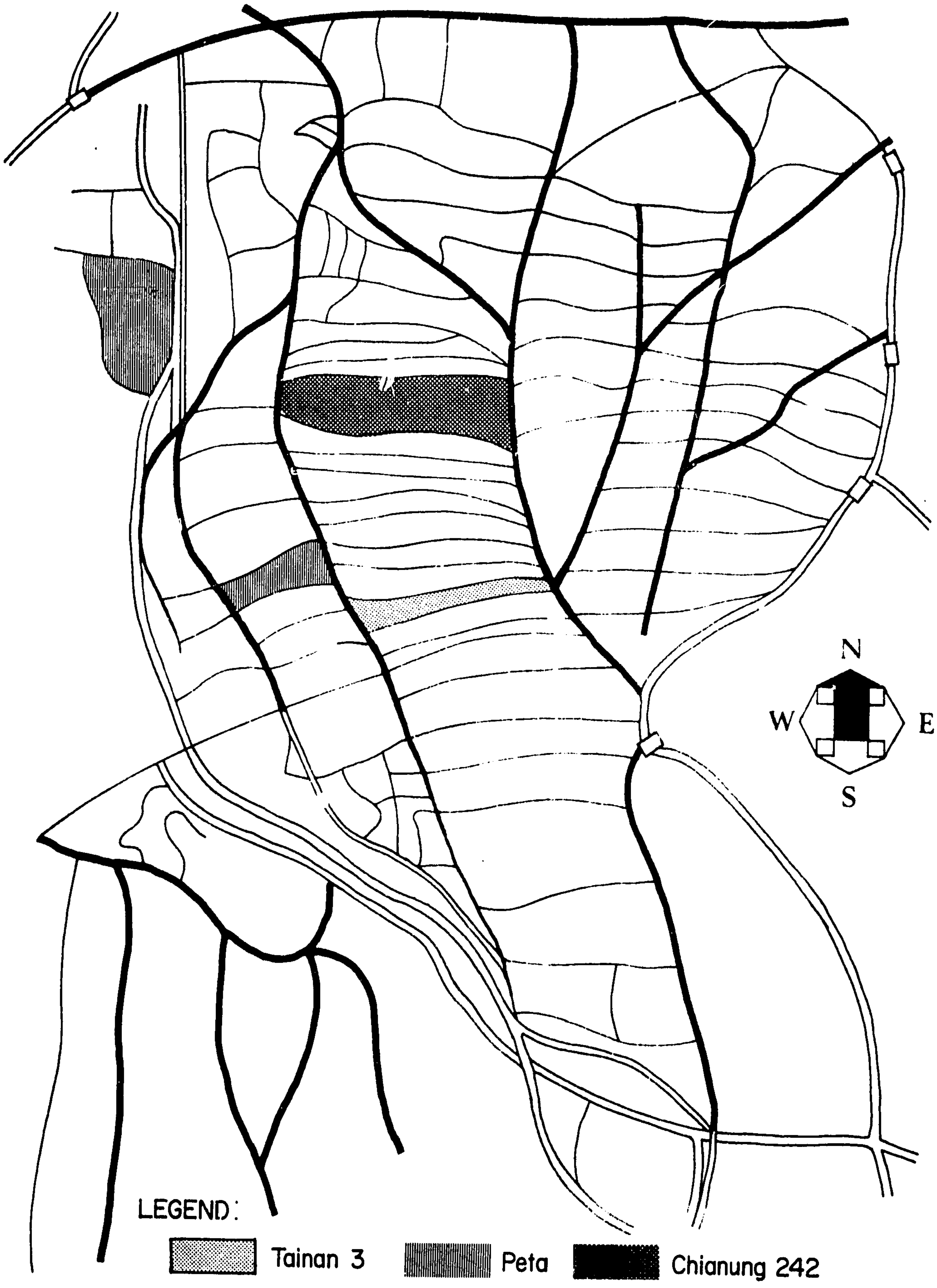
The succeeding maps summarize and pictorially illustrate the successive growth and extent of adoption of the different varieties in the 6 planting seasons covered by this report. The change can be seen gradually increasing as one leafs through the maps until a dramatic contrast is seen by comparing Map 1 and Map 6 where there is a complete reversal from local to recommended varieties.

Map 1 shows the shaky, groping and tentative initial adoption by four farmers during the wet season crop of 1964-1965 when the project was begun. These initiators had 'capitulated' mainly throughs the prodding of the technician who procured the seeds for them. This was a critical phase as the others who were unwilling to commit themselves were critical and interested observers.

Map 2 covers the dry season crop of 1965 or the second season of the project. Peta which was then a recommended variety was planted by 2 farmers. In addition, Chianung-242 and Tainan-3 were planted on a trial basis with the IRRI providing the seeds at a nominal cost. It will be recalled (see Section 2.1) that virus infestation set in, giving the impetus for a change in varieties a much needed psychological boost occasioned by the necessity of



Map 1. Showing the Fields Planted to Recommended Varieties August 1964 to January 1965 (Wet season).



Map 2. Showing the Fields Planted to Recommended Varieties February to June 1965 (Dry season).

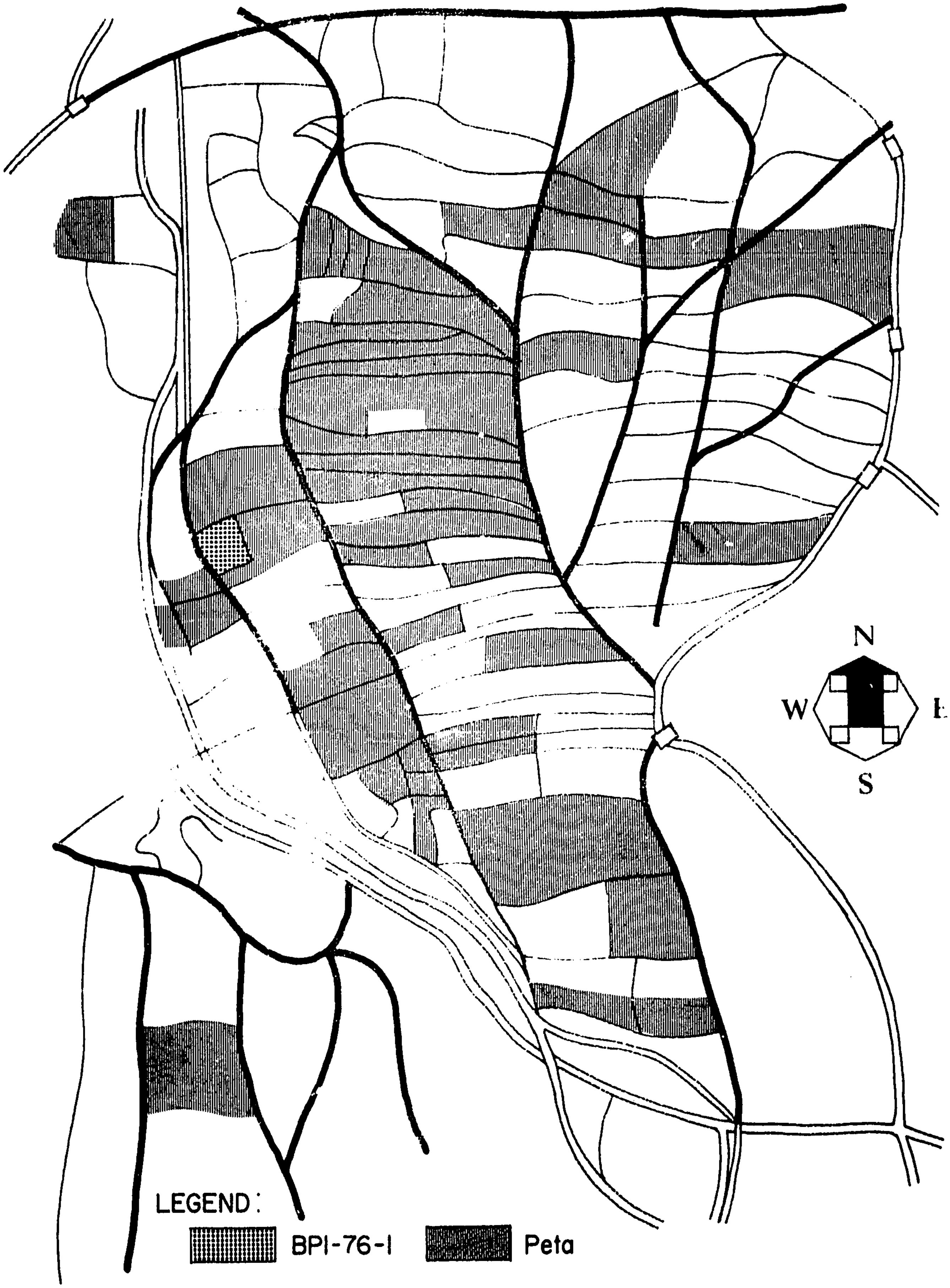
changing varieties after a virus infestation. The change in cropping calendar was also agreed upon.

Map 3 shows the start of the new cropping pattern together with the wholesale adoption of Peta. Eighteen farmers planted the variety in an area of 27.75 hectares. The small portion devoted to the non-seasonal BPI-76-1 is a trial lot of one farmer marking its debut in the field.

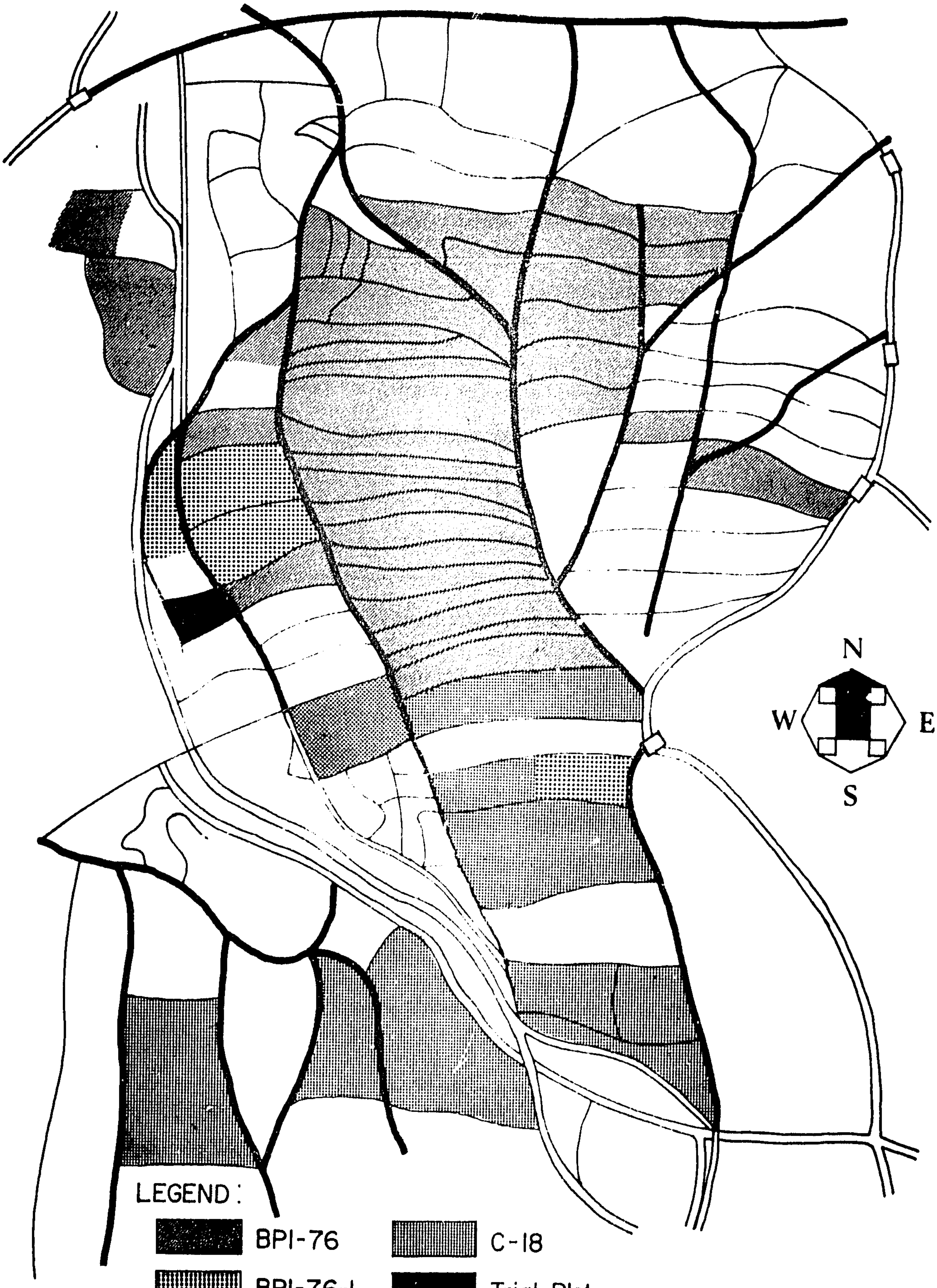
Map 4 covers the wet planting season of June-November 1966. Already it is seen that more than 3/4 of the area is covered by recommended varieties. These varieties are the seasonal BPI-76, the non-seasonal BPI-76-1, C-18 and a trial lot planted to college varieties C4-63 and C4-113.

The 5th map embraces the dry season crop of 1966-67 and marks the 3rd season of the new cropping calendar. At a glance, one sees the sprinkling of unshaded portions. These portions represent the "die-hard" farmers with their local variety Intan. Altogether, 42 farmers planted one of the following varieties, viz. C-18, BPI-76-1, IR8 and Peta. Trial and multiplication lots were devoted to C4-63 and C4-113. This was a source of seeds for the barrio during the subsequent season.

Map 6 covers the last season of the study, being the wet season crop of June-November 1967. The portion at the top left hand corner marked "X" is in honor of the only farmer hanging on to a local variety. All the rest have switched over to one or more of the recommended varieties such as, BPI-76, IR8, BPI-76-1, C-18 and PB lines released by the College of Agriculture.



Map 3. Showing the Fields Planted to Recommended Varieties November 1965 to April 1966 (Dry season).



Map 4. Showing the Fields Planted to Recommended Varieties June to November 1966 (Wet season).

Map 5. Showing the Fields Planted to Recommended Varieties November 1966 to April 1967 (Dry season).

Map 6. Showing the Fields Planted to Recommended Varieties.
June - November 1967 (Wet Season)

5.4. Some indirect results of increased income

5.41. <u>Acquisition of hand tractors</u>. The improved harvests in Coralan for the past few seasons as a result of this project has brought about a generally improved economic picture for the barrio and the farmer in particular. We could not compare their present incomes to what we like to think of as the ideal income of a farmer in an industrialized society. Still, we can safely say that relative to other barrios, Coralan is in its "take-off" stage, to use a fashionable expression. There is a general feeling among the barrio folks that they could now begin to enjoy the "luxury" of modern farming such as hand tractors, rotary weeders, and better houses.

This feeling was not overlooked by the technician who set out to help in the mechanics of acquiring a hand tractor. Utilizing the Central Bank-International Bank for Reconstruction and Development (CBIRD) program, worked out through the Liliw Rural Bank, 2 ISEKI hand tractors were bought by farmers Luis de la Cruz and Nicasio Untalan on very liberal terms in December 1966. Each tractor costs between ₱3,420 - ₱4,300 depending on the amortization plan. It featured a no down payment plan, a first installment of ₱600 payable after the dry season harvest in April, with the second payment of ₱200 scheduled for the next harvest.

This initial acquisition by two farmers started a chain reaction so that two months later ten other farmers purchased their own tractors under the same program in January and February. Aside from tilling their own land, these tractors were put to other uses during the off seasons, by renting them out to farmers in other areas at ₱30 a day, transplanting passengers, hauling produce and so forth.

5.42. Plans for a barrio farmers organization. The Sta. Maria-Mabitac Development Project envisions a gradual withdrawal from these barrios as the farmers are able to "be on their own." In preparation for a complete barrio takeover, an organization of farmers is being contemplated. This organization will handle such varied functions as marketing of produce, acquisition of loans from lending institutions, and purchasing of materials in bulk like fertilizers, chemicals and sprayers.

Another major function of the organization is to work for the eventual management of the irrigation system by the barrio. Presently the system is under the authority of the National Irrigation Administration. This system is fed by a spring situated in the barrio itself and farmers complain that it is not being fully utilized for the barrio's benefit because water is often diverted when it is most needed. Under barrio management, the farmers hope to use the present fees payable to the Irrigation Service Unit (ISU) of Sta. Maria of ₱12/ha/year or under the new paying terms of ₱60/ha/year as a revolving fund for their own irrigation needs. They also hope to be able to manage the irrigation system more efficiently especially in the distribution of the water supply.

5.43. Training of local leaders. Another transition taking place in the barrio is the transfer of leadership to local lay leaders. As a corollary to this plan, a 2-week seminar was held in College on August 7-18, 1967 to train these local leaders on rice and livestock production. Coralan was represented by 3 farmers who are recognized leaders and respected in the barrio. Three weeks after on September 25-29, 1967 another seminar similar to the one held in College was conducted in the municipality of Sta. Maria and was attended by leaders coming from the 7 pilot barrios of the Sta. Maria-Mabitac Development Project. Coralan was represented by 7 able farmers. Farmers who have come to know of the seminars have requested that another one be held in Coralan. However, this is being held in abeyance until the ten (10) who have thus far been trained can have the chance to disseminate the information they have learned. In the meantime, the technicians are busy conducting follow-ups and preparations for the next cropping season.

5.44. Construction of stronger houses. Since the introduction of the new cropping pattern in Coralan, the increase in income of the farmers has been manifested in many ways. Eight (8) houses have so far been built out of strong materials and another 6 are under construction. Construction of these houses is usually done by the farmer himself and immediate relatives on a "Bayanihan" basis (rendering of reciprocal services). The work is usually carried out just after the planting season when the farmers are not very busy in the farm. Monetary expenditures are made only on materials needed such as lumber, galvanized iron and hollow blocks. Such operation does not allow the immediate completion of these houses because of the erratic supply of labor and resources. Rather, it is completed on a piecemeal basis.

6.0. FACTORS INFLUENCING FARMER'S ADOPTION AND REJECTION OF CERTAIN RECOMMENDED RICE PRODUCTION PRACTICES

6.1. Why farmers adopt certain recommended practices (Table 15)

6.11. Demonstrated superiority or effectiveness of the practice. Among barrio people, if a new practice is to be accepted, it must demonstrably show that it is better than their traditional way of doing things. The farmer with his very meager resources wants to be sure that for every peso invested, he will get a corresponding net gain. Most often a farmer adopts a practice after it has proven to be effective or has showed its superiority. Sixty-nine percent of the farmers' responses revealed this in their answers like: "Our yield increased after applying fertilizer," "weedicides hastens weeding," "straight row planting is good because it utilizes every space of the field."

TABLE 15. Factors influencing respondents' acceptance of recommended farm practices.

Factors influencing acceptance	No. of times mentioned: First interview	No. of times mentioned: Second interview	Total: No.	Total: %
1. Demonstrated superiority or effectiveness of the practice	175	224	399	69
2. Ease in carrying out the practice	65	109	170	29
3. Availability of resources	2	1	3	*
4. Personal influence				
a. Neighboring farms	4	3	7	1
b. Relatives and ritual co-parents	3	1	4	1
c. Landlord	1	-	1	*
Total	250	338	584	100

* Less than 1%.

6.12. Ease in carrying out the practice. Twenty-nine percent of the reasons given for adopting certain practices were based on the ease in carrying out the practice as gleaned from comments of farmers. They use the rotary weeder, for example, because "it is easier and faster in exterminating the weeds." They prefer the "paddy" method over the "panicle" method of selecting seeds because the latter is very laborious. They use the traditional way of planting because planting in straight rows has several requirements.

6.13. Availability of resources. While the farmer may be convinced of the superiority or the benefits that may be derived from an innovation, lack of resources would prevent him from carrying them out. For example, it would be difficult, if not impossible to implement straight row planting, fertilization, use of rotary weeder in areas where there is no irrigation water.

6.14. Personal influence.

(1) Neighboring farmers - The influence of peer groups in the dissemination of information is a significant factor in the adoption of certain farm practices. The feeling of "pakikisama" (good public relations) among farmers is very important in order to be socially acceptable in the neighborhood. "It's what the neighbors are doing, it's hard to deviate from the group," "I plant the variety my neighbors are planting because when I fail, I will fail with them." Four farmers reported to have seen or heard about the practice from their neighbors.

(2) Relatives and "compadre" (ritual co-parents) - Some farmers use certain farm practices because it is a tradition handed down to them by their parents or grandparents. Seed selection, for example, has been one of the

oldest practices in rice farming which is done by almost every farmer. Findings show that this is one practice which exhibited the least drop out - a clear evidence that the practice has really penetrated.

(3) Landlord - As far as this study is concerned, landlord's influence in the adoption of practices was mentioned only by one respondent out of the 57 farmers interviewed. "It is what my landlord wants." Share tenants comprise at least 65 percent of the rice farmers in Coralan. This may be an indication that landlords in Coralan are becoming more democratic with their tenants as regards the carrying out of activities in the farm.

6.2. Why farmers reject certain recommended practices (Table 16)

6.21. Incompatibility of practice with existing conditions. The reason most frequently given (182 times) by farmer respondents for their non-adoption of a recommended farm practice was the incompatability or non-applicability of the practice to conditions existing. Very often extension workers make the mistake of introducing something to the barrio people just because it is new even if it does not fit the needs of the farmers. Many farmers for instance do not see the logic for using rotary weeders when they plant in the ordinary method. Why should they plant certified seeds when they still get good yield from local varieties? Why should they apply rat baits when there are no rats? Why should they plant Peta when it is hard to thresh? Why should they practice seed testing when they always put aside good seeds? In other words, an ounce-of-prevention-is-worth-a-pound-of-cure does not seem to have been inculcated in this group of respondents. This situation calls for a more thorough grounding in the fundamentals of "preventive practices."

TABLE 16. Factors influencing farmer's rejection of recommended practices.

Factors influencing acceptance	Number of times mentioned			
	First interview	Second interview	Total	
			No.	%
1. Incompatability of practice with existing conditions.	120	62	182	31
2. High cost of carrying out practice.	30	14	44	7
3. Failure to demonstrate the superiority or effectiveness of the practice.	21	4	25	4
4. Anticipation of undesirable effects and difficulty in comprehending cause-effect relationships.	20	9	29	5
5. Ignorance of the practice.	50	48	98	17
6. Lack of resources needed to carry out the practice.	50	36	86	15
7. Difficulty in carrying out the practice in terms of time and labor.	14	4	18	3
8. Refusal to deviate from traditional practice.	50	25	75	13
9. Lack of skills needed to carry out the practice.	11	6	17	3
10. Superstitious belief contrary to acceptance of the practice.	2	4	6	1
11. Landlord's objection to the practice	5	-	5	1
12. Conditioning effect of past experience	2	-	2	*
Total	375	212	587	100

* Less than 1%.

6.22. High cost of carrying out the practice. Forty-four (7 percent) of the responses for rejecting a certain recommended practice were due to the high cost in carrying out the practice. One technique involved in increasing income or profit is by reducing cost. While some farmers realize the importance or effectiveness of certain recommended practices they don't have enough cash to finance such practices as gleaned from these comments: "It's good, only it's very costly." These practices include planting in straight rows, acquisition of a rotary weeder, use of fertilizer, and spraying against pests and diseases. This attitude is felt very strongly among the share tenants whose meager income is just enough to pay the debts incurred while waiting for his crop to be harvested. If only landlords can provide a financing scheme for their tenants to enable them to maximize their production it would benefit both parties. Most often, however, landlords did not want to share with tenants the additional expenses in carrying out new practices.

6.23. Failure to demonstrate the superiority or effectiveness of the practice. After a practice has been found to be ineffective under the farmers' conditions it is likely to be dropped. When farmers were asked why they discontinued certain practices, they commented, "It did not do any good or it did not give any appreciable advantage." After having tried herbicide the comment was, "I sprayed my field with 2,4-D, it did not control the weeds in my field." Twenty-one farmers who disliked certain practices gave this reason.

6.24. Anticipation of undesirable effects and difficulty in comprehending cause-effect relationships. The anticipation of undesirable effect prevented percent of the respondents from adopting recommended practices. It is revealed in this study and in previous studies that "fertilizer addictedness" is one frequently cited objection to the use of commercial fertilizer. Farmers hesitate to spray their field for fear it will kill even their domestic animals like chickens, pigs, and work animals. One farmer when asked why he does not try using a rotary weeder retorted that the weeder agitates the soil and causes the wilting of the rice plants. Another farmer whose yield was teeming with empty grains attributed this to the over-concentration of the chemical to the solution that he sprayed in his field.

6.25. Ignorance of the practice. Inspite of the number of years the technicians have stayed in the barrio, 17 percent of the responses expressed ignorance about certain practices as revealed in the comments like "nobody has ever told me of the practice," "it is not yet known here," "we don't know of any chemical yet." This situation is certainly puzzling because all if not most of the recommended practices, e.g., straight row planting, certified seeds, etc., have been popularly adopted in the barrio. It is evident that neighborhood communication has not taken effect among these groups. The barrier could be the distance of their houses and fields to enable them to carry on personal or intimate association with each other. It is this group of farmers too that have the least contact with the crop technician.

6.26. Lack of resources needed to carry out the practice. While the farmer might be aware of the desirability of adopting a recommended farm practice, the resources and facilities needed to carry the practice might not be available in the locality. This condition was mentioned 86 times (15 percent) by the farmer-respondents as gleaned from their comments, "We lack cash to buy fertilizer," "we could not borrow any rotary weeder," "no sprayer available."

6.27. Difficulty in carrying out the practice in terms of time and labor. Four percent of farmers who did not practice control of pests and diseases said, "we can't put our hand to it as it is a hard task spraying" and another two percent "could not find time to do seed testing as we are occupied with other things." Here it can be commented that the farmers generally did not see the priority and importance of attending first to the necessary operations involved in an improved agronomic practice. Clearly their sense of priorities is misplaced when taken from the standpoint of "improved practice." Clearly too there is a need to change these priorities.

6.28. Refusal to deviate from traditional practice. Some farmers' strict adherence to traditional ways of doing things is revealed in 75 (13 percent) of their reponses for not adopting the change. Labor is not yet a scarce commodity as revealed in the comment, "kaya pa naming gawin sa kamay" (hands are available that can perform the job). "We don't test our seeds any more anyway it will germinate just the same." "Iyon na lang nakagawian na binhi ang siyang itatanim namin" (we will plant the variety we have been used to).

6.29. Lack of skills needed to carry out the practice. Awareness of the practice and possession of the skills to do it are two different factors in the carrying out of a practice. Eleven of the responses indicated lack of skill as their reason for non-adoption. This is one reason why they do not plant in straight rows and why they do not apply fertilizers. This condition has been reduced to a minimum because of the presence of the crop technician.

6.30. Superstitious beliefs contrary to acceptance of the practice. Superstitious beliefs as barriers to adoption of recommended farm practices constituted only two of the total responses. This attitude was revealed in the practice that deals with rat control. One farmer instead of applying rodenticides set off a field solely for the rats and begged of the rats to take their share and leave the rest alone. This was accompanied by silent prayers. Another farmer when asked why he does not put rat baits said, "They are God's creation that's why they don't create much destruction."

6.31. Landlord's objection to the practice. Majority of Coralan rice farmers are still under share tenancy. In this situation the landlord could still impose the practice to be adopted by the farmers. Among the 57 farmers however, only five revealed that their landlord superimposes the practices that they desired especially in deciding what variety to plant and whether or not fertilizers will be applied. This has bearing on the willingness of the landlord to share with the expenses incurred in the farm operation.

6.32. Conditioning effect of past experience. "Nadala na ako, pareho din" was a comment made by two farmers why they stopped planting in straight rows. Sad experience of a farmer greatly influences his reaction or attitude toward certain practices.

7.0. SOME VARIABLES ASSOCIATED WITH ADOPTION OF RECOMMENDED FARM PRACTICES

7.1. Size of farm

This study reveals that adoption of recommended practices is highly related to size of farm. The correlation value obtained was significant at the 1% level of probability (Table 17). Among those with a landholding of 0.5-1.5 hectares, 48 percent were classified as low adopters, 35 percent medium adopters and only 17 percent adopted 9 or more practices. Those who had bigger farms (3 hectares or more) had a minimum adoption score of 9. There is therefore a greater adoption among farmers with bigger landholdings. This contrasts with the findings of a study conducted in Paagahan6/ and the explanation advanced by the extension worker7/ that farm with smaller areas enabled the farmer and his family to perform all the additional operations necessary for the new practice without hiring extra labor.

One strong reason for the disparity between these two findings may be the introduction of hand tractors in Coralan which does not exist in Barrio Paagahan. Twelve farmers at present have purchased hand tractors and are cultivating no less than 2.5 hectares. Pedersen8/ in his study stated that "farming with a tractor is only profitable when done in a large scale........ Farming with tractors takes money and entails the production of marketable crops." Findings of Van den Ban9/ in his study of progressive farmers in

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6/ Alice M. de Guzman and Vicente Quiton, "The Barrio Rice School as a Means of Introducing Farm Practices in Barrio Paagahan."

7/ Gelia T. Castillo, "Propensity to Invest in Agriculture: Observations from a Developing Country, the Philippines," College of Agriculture, U.P., 1966.

8/ Harold A. Pedersen, "Mechanized Agriculture and Farm Laborer," Rural Sociology, 19, 2 (June 1965), p. 147.

9/ W. Van den Ban, "Progressive Farmers in the Netherlands," Rural Sociology, 22 (1959), pp. 205 - 12.

TABLE 17. Correlation between adoption of recommended farm practices and selected variables.

Variables correlated	Correlation	Level of significance
1. Adoption and size of farm	.446	.01
2. Adoption and number of dependents	.3410	.05
3. Adoption and age of respondents	-.013	N.S.
4. Adoption and loan acquired	.4376	.01
5. Adoption and farming experience	.0175	N.S.
6. Adoption and educational attainment	.2245	N.S.
7. Adoption and dry season yield (1964-65)	.5364	.01
8. Adoption and wet season yield (1965)	-.0506	N.S.
9. Adoption and dry season (1965-66)	.2975	.05
10. Adoption and wet season yield (1966)	.3569	.01
11. Adoption and dry season yield (1966-67)	-.0321	N.S.

in Holland and in a separate study of Wilson and Gallup[10] support the findings of this local study. Farmers in Coralan who own hand tractors generally belong to the high income group and own houses of strong materials.

7.2. Size of family

Another factor that is related to high adoption of recommended practices is size of family. Among those with a high adoption score, 15 (or 83 percent) have at least six or more dependents. Coefficient of correlation reveals that this is significant at the 5% level. Correlated size of farm and number of dependents showed a positive relationship which was significant at the 1% level. The average family of Coralan rice farmers is composed of 7 members (includes relatives staying with the family). Wilkening[11] stated that the "greater the size of operation and the more involvement of persons in the farm business, the greater will be the need for explicit plans for making major improvements."

7.3. Age of respondents

Coefficient of correlation between age and adoption score gave a negative result although it is far from being statistically significant. Wilkening[12]

10/ Meredith Wilson and Gladys Gallup, "Extension Teaching Methods," U.S., Department of Agriculture, Ext. Serv. Cir. 495, Washington, D.C., August 1955.

11/ Eugene A. Wilkening, *et al.*, "Communication and Acceptance of Recommended Farm Practices Among Dairy Farmers of Northern Victoria," *Rural Sociology*, 27 2 (June 1962), p. 185.

12/ E. A. Wilkening, *et al.*, *op. cit.*, p. 117.

hypothesized in their study of dairy farmers of Northern Victoria that "farmers over 40 years of age adopt fewer of all types of improved practices than do farmers 40 years of age or younger." He further stated that "the logic of this hypothesis is that the reduced physical ability and more cautious mental outlook associated with age are more important than reduced family demands or increased assistance from family members in affecting farm practices adoption." Anderson[13/] in a study of the use of fertilizers, found younger farmers are more likely to adopt a new practice. Findings in this study tend to show a curvilinear relationship with farmers in the youngest and oldest age categories showing lower adoption than the middle age ranges.

7.4. Amount borrowed (Cash or kind)

Among the 14 farmers who did not borrow, 6 (or 43 percent) have low adoption scores. Of those who borrowed from ₱12 to ₱70, only one was rated to have high adoption, 6 (or 46 percent) medium adoption, and 6 low adoption. As the amount rises from ₱71 to ₱140, there was a higher proportion of farmers who adopted more practices. Nine (or 50 percent) of those who adopted 15 or more practices borrowed no less than ₱141. Coefficient of correlation between adoption and amount borrowed gave a positive result which is significant at the 1% level of probability.

Participation in the new cropping pattern encouraged farmers to adopt more practices. The adoption of practices entails additional expenditures compelling the farmers to borrow the amount needed for such operation.

13/ Marvin A. Anderson, "Informational Sources Important in the Acceptance and Use of Fertilizer in Iowa," (Report No. 55) Knoxville, Tenn.: Division of Agricultural Relation, Iowa State College, Ames, April 1965.

Table 18 shows that 18 (or 64 percent) of the participants borrowed no less than ₱71. Among the non-participants only two (or 16 percent) borrowed more than this amount. There were more from the non-participants group that did not borrow any amount at all for farm operation.

TABLE 18. Participation in the new cropping pattern and amount borrowed.

Amount borrowed	Participant		Non-participant		Total	
	No.	%	No.	%	No.	%
1. Did not borrow	8	19	6	50	14	24
2. ₱12 - ₱70	7	16	4	34	13	23
3. ₱71 - ₱140	13	30	1	8	14	25
4. ₱141 and up	15	35	1	8	16	28
Total	43	100	12	100	57	100
Average amount borrowed in one season	₱137.62		₱70.07			

Some common sources of credit are found in Table 19. Among them are the landlord, private lenders, Agricultural Credit Administration (ACA), neighbors, relatives, private institutions and others. The Agricultural Credit Administration has been availed of by the farmers for at least 31 times in the 6 seasons covered by this study. Private lenders came next as the source of most loans. Farmers complain that they pay as much as 20 percent interest which is payable within one crop season. The Mabuhay Rice Mill located at Sta. Maria town was mentioned 25 times. The rice mill does not charge

TABLE 19. Sources of loan (Cash or in kind) for farm operation.

Source	No. of times source was mentioned			
	First interview		Second interview	
	No.	%	No.	%
1. Landlord	3	4	4	8
2. Private lenders	19	26	13	25
3. A C A	22	30	9	18
4. Mabuhay Rice Mill	15	20	10	20
5. Neighbors	2	3	2	4
6. Relatives	7	10	-	-
7. Rural Bank	2	3	13	25
8. Compadre	3	4	-	-
No. of times mentioned	73	100	51	100
No. of farmers who borrowed	41		19	

exorbitant fees but it makes sure that farmers' produce is deposited in the rice mill hence storage and milling takes place there. Private institutions like Rural Banks were availed of as sources of loans in buying tractors and other farm implements especially in the dry season of 1967. Relatives and "compadre" (ritual co-parents) were dropped as source of credit in the second interview. If ever they did borrow from these sources it is in kind rather than in cash.

7.5. Purpose for which loan was used

More than two-thirds or 70 percent of the respondents during the first interview reported borrowing money for their farming operations said that they used the amount for planting expenses (Table 20). This primarily include daily wages of planters. This number decreased in the second interview to 27 (or

TABLE 20. Purpose for which loan was used.

Source	Number of times mentioned			
	First interview		Second interview	
	No.	%	No.	%
1. Planting expenses	40	70	27	43
2. Expenses for pulling seedling	4	7	-	-
3. Land preparation	3	5	1	1
4. Weeding	3	5	7	11
5. Fertilizer and chemicals	3	5	15	24
6. Purchase of weeder	1	2	-	-
7. Purchase of carabao	2	3	-	-
8. Purhcase of tractor	-	-	13	21
9. Food for workers	2	3	-	-
No. of times mentioned	58	100	63	100
No. of farmers who borrowed	41		19	

43 percent). There were less farmers who loaned in the next 3 seasons covered by the study.

Four (or 8 percent) during the first interview reported they used the money for laborers hired to pull seedlings, while 3 (or 5 percent) said it was used for expenses in land preparation (i.e. rent for hand tractors). There were only 6 who reported they used the money for weeding, fertilization and spraying in the earlier survey and this number increased to 22 in the succeeding survey. This is a clear indication that farmers are now putting importance on the different production inputs like weeding, fertilization, and spraying against pests and diseases. Thirteen farmers obtained loans from the Rural Bank to purchase hand tractors. One farmer borrowed the amount for buying a rotary weeder, 2 used it for buying a carabao, and 2 respondents said it was used to buy food for the workers.

7.6. Attendance in the Barrio Rice School

Table 21 shows that respondents who attended the Barrio Rice School, which was conducted for one half day prior to the last panahon season 1965-66, adopted more of the recommended practices. Among those who attended 26 farmers (or 85 percent) adopted more than 9 practices. Fifteen (or 48 percent) of those who failed to attend the said Barrio Rice School have very low adoption.

TABLE 21. Relationship between attendance to the Barrio Rice School and level of adoption of recommended practice in rice.

	Level of adoption							
	Low (2-8)		Medium (9-14)		High (15 & up)		Total	
	No.	%	No.	%	No.	%	No.	%
1. Attended	4	21	10	53	12	63	26	46
2. Did not attend	15	79	9	47	7	37	31	54
Total	19	100	19	100	19	100	57	100

When attendance in the Barrio Rice School was cross tabulated with participation in the new cropping pattern it showed some positive relationship. More than one-half of the participants (57 percent) attended the said Barrio Rice School. Among the non-participants, 92 percent did not attend (Table 22). At this stage of the project, farmers attend seminars or farmers' classes with the honest intention to learn something which they could apply in their farming activity rather than for curiosity's sake or just to please the technician to maintain a good public relation or pakikisama.

TABLE 22. Participation in the cropping pattern and attendance in the Barrio Rice School.

Attendance in the Barrio Rice School	Participant		Non-participant		Total	
	No.	%	No.	%	No.	%
1. Attended Barrio Rice School	25	57	1	8	26	46
2. Did not attend	18	43	13	92	31	54
Total	43	100	14	100	57	100

7.7. Degree of wife's involvement in decision-making

Farmers were asked whether or not they consult their wives regarding the practices they undertake in the farm. Findings show that at least 86 percent of all the farmers interviewed consult their wives regarding the farm business and farm decicions (Table 23). It is an indication that the management of the farm is not entirely a function of the farmer himself. The wife is mostly concerned with the allocation of money or other resources "baka naman magastos iyan" (that might be very expensive). Based on the responses of the farmers interviewed, however, wife's involvement in farm decisions is not associated with managerial skills as gleaned from the following comments: "Ako daw ang lalaki di alam ko kung ano ang mabuting gawin sa bukid" (I till the soil and know

TABLE 23. Relationship between degree of wife's involvement in decision-making in the farm and level of adoption of recommended practices in rice.

Degree of wife's involvement	Level of adoption: Low (2-8)		Medium (9-14)		High (15 & up)		Total	
	No.	%	No.	%	No.	%	No.	%
1. Consult wife	14	74	16	89	18	95	48	86
2. Does not consult wife	5	26	2	11	1	5	8	14
Total	19	100	18	100	19	100	56	100

what is best). "Kung alin ang maigi di siyang gawin" (If we think it's best, let us do it).

7.8. Yield per hectare

Table 17 shows the coefficient of correlation between yield and adoption score obtained for each of the cropping seasons. In the dry season of 1964-65 a high positive correlation is seen between yield and adoption and is significant at the 1% level pf probability. It must be recalled that this was the time when the field technician was able to convince at least 20 farmer-cooperators to adopt 2 or more of the cultural practices. The following season farmers' harvest reverted to the previous yield due to water shortage hindering the continued use of the practices previously adopted. As a result production went down. When yield and adoption was correlated it gave a negative result although not significant at the 5% level.

At the start of the new cropping pattern in the dry season of 1965-66 farmers once more adopted several of the recommended cultural practices and were able to raise their yield by about 19 percent. Positive coefficient of correlation was obtained and significant at the 5% level. The wet season following soon after was a good year for some but bad one for those whose crops were caught by the typhoon. Despite the inclement weather, however, farmers still obtained an average yield of 56 cavans. The level of significance of the correlation made between adoption and yield for this season was significant at the 1% level.

As a result of the typhoon, land preparation was delayed which in turn delayed the dry season planting by two months to January 1967. C-18, the variety planted by most of the farmers was attacked by stemborer infestation and was not able to recover despite several application of insecticides. It may be worth mentioning that in this particular season Dol granule insecticide was first used by the farmers. As a consequence of these unfavorable circumstances a negative correlation was obtained for the 1966-67 dry season.

8.0. SOURCES OF INFORMATION ABOUT PRACTICES IN RICE PRODUCTION

Table 24 shows that majority of the information reaching the farmer is through personal contact - the technician being considered the most authoritative source of farm information. In both interviews the respondents said that they have heard of the practice through the technician which constitute 39 percent of their responses in the first interview and 59 percent in the follow-up interview. Peer groups such as neighbors, compadre, relatives, etc. were cited second highest source. Farmers from other places like Pila, Calauan,

TABLE 24. Sources of information about practices in rice production.[a]

Sources of information about farm practices	Number of times cited			
	First interview		Second interview	
	No.	%	No.	%
1. Personal contact with technician.	352	39	425	59
2. Other farmers, neighbors and relatives.	195	22	124	17
3. Practice inherited from old folks or other experienced people in the barrio.	175	19	19	3
4. Own experience.	85	9	52	7
5. Barrio rice school and seminars.	21	2	34	5
6. Landlord.	9	1	7	1
7. Government agencies - ACA, APC, and FACOMA.	7	1	2	*
8. Mass communication media (radio).	20	2	18	2
9. Commercial dealers.	5	1	5	1
10. Farmers from other places (Pila, Calauan, Calamba, Rizal).	26	3	25	3
11. Barrio captain and barrio council members.	11	1	17	2
Total number of times cited	906	100	728	100

a/ Based on 12 recommended practices for six cropping seasons.

* Less than 1%.

Calamba contributed 3 percent in the information dispersal. The Barrio Captain and other members of the Barrio Council served as local informants too. It is evident that farmers themselves are doing a vital role in the dissemination of farm information.

The Barrio Rice School or short training courses in rice production was mentioned 65 times (or 4 percent) in both the surveys. It is possible that they have heard of the practice in these classes but the personal follow-ups of the crop technician was considered more significance by them. Landlords as another source of information constitute only one percent. The high incidence of absentee landlords could be responsible for this reaction. When asked in what way their landlord is of help to them, most farmers gave unfavorable answers like "our landlord visits us only during harvest time or when it is time for them to get their share." Worse still is the reluctance of most landlords to share in the production expenses like fertilizers and spray.

Other government agencies like ACCFA, ACA, FACOMA hardly constitute one percent of the responses. Commercial dealers of fertilizers and chemicals were mentioned only 5 times. Radio programs were also found less important by Coralan farmers as source of most information at this stage of development.

Some practices like seed selection and germination test could be considered as traditional practices for it has been in the barrio even since. During the first interview, 175 (or 19 percent) reported that they inherited the practice from the old folks or from experienced people in the locality. This number was greatly reduced to 19 (or 3 percent) in the second interview. It must be recalled that these 2 practices were eventually dropped when farmers started to plant new varieties. Such comments as "kinagisnan na namin" (It has been handed down by our parents or grandparents), "itinuro ng matatanda or dati ng ginagawa sa nayon," (Taught by the old people or it is a traditional practice here in the barrio) reflect the important role of local authorities like parents and recognized elders. About 8 percent claim that the practice is based on his own personal experience "sariling karanasan." Further examination of these farmers reveals that they have very limited contact with technical agents.

9.0. SUMMARY AND CONCLUSIONS

1. The average age of the respondents was 43. They have at least three years of formal education and have been residing for 21 years and farming for 15 years in the barrio. The average number of dependents per family was 6.65, cultivating an area of 3.6 hectares. Sixty-five percent of the respondents were share-tenants. Prevalent sharing arrangement is half-and-half during the dry season panahon and two-is-to-one during the wet season palagad.

2. Certain recommended practices in rice production such as straight row planting, use of rotary weeder, spraying against pests and diseases were adopted persistently by more than 50 percent of the respondents during the first three seasons and by about 70 percent in the succeeding seasons.

3. There was almost a 100 percent adoption of the new recommended varieties in the sixth season covored by the study.

4. Practices such as applying fertilizer, making and applying compost, and rat control have not yet made a breakthrough among 90 percent of

rice farmers in Coralan.

5. Practices showing the most dropouts during the first three seasons covered by the study were on fertilization, use of weedicides, and spraying against pests and diseases.

6. Adoption rate was positively associated with size of farm, number of dependents, amount borrowed, attendance in the Barrio Rice School, participation in the new cropping pattern and degree of wife's involvement in decision-making. Educational attainment, tenure status, number of years residing in the barrio, farming experience and organizational affiliation did not affect adoption rate. Age was negatively related with adoption.

7. Participants in the new cropping pattern adopted an average of 5.14 recommended practices compared to 2.7 practices among the non-participants.

8. Average increase in yield was higher among participants in the new cropping pattern (17 cavans per hectare).

9. Among the most common sources of information about farm practices are the personal contact with the crop technician, peer groups like other rice farmers, neighbors, relatives, experienced people in the barrio and farmers' own experience. Other government agencies, mass communication media and commercial dealers played a minor part in the dissemination of farm information.

10. The common informants on farm practices were the peer groups composed of neighbors, relatives, other rice farmers and ritual co-parents (compadre).

11. The five most important factors that influenced farmers to reject recommended farm practices were: (1) incompatibility of the practice with existing conditions, (2) ignorance of the practice, (3) lack of resources needed to carry out the practice, (4) refusal to deviate from traditional practice, and (5) high cost of carrying out the practice.

12. The four most important factors that influenced farmers to accept recommended farm practices were: (1) demonstrated superiority or effectiveness of the practice, (2) ease in carrying out the practice, (3) availability of resources, and (4) personal influence like neighboring farmers, relatives and landlord.

The most significant element brought out by this case study is that there may be a basic problem from which emanates most of the other problems of a given rice planting situation and there too, exists a corresponding basic solution. The case of Barrio Coralan illustrates how an imaginative and skilled technician can fit together all the pieces of jig-saw puzzle, to dig up and excavate, so to speak, its Rosetta Stone -- its "Open Sesame." In this instance, the change in cropping pattern was the key that unlocked the door to "modernity" in rice cultivation. A host of recommended practices lay wanting of adopters due to the unavailability of water at critical points during the growing season.

As soon as the water supply was related to the needs of the plants by a change in planting time, adoption of innovations increased; production improved; farmers realized the potentialities of their farm; they acted as a group in order to make the change; they were more inclined to take risks in borrowing money for farming operations and they were also more enthusiastic to venture into leasehold arrangements with the landlord. Before these incidents, they were reluctant to shift from share tenancy to leasehold because in the latter system they will be bearing the risks alone.

But after this long and involved analysis, the moral of the case study lies in the "genius" of the scientific approach to problem-solving. Since the crop technician was able to identify and define the problem, an appropriate solution has been worked out. Quite often the right answers are not forthcoming because the right questions have not been asked.

HIGHLIGHTS OF ACTIVITIES OF SOME OF THE AGRICULTURAL MANAGEMENT FIRMS IN THE PHILIPPINES TODAY

J. D. Drilon, Jr.

HIGHLIGHTS OF ACTIVITIES OF SOME OF THE AGRICULTURAL MANAGEMENT FIRMS IN THE PHILIPPINES TODAY[1/]

J. D. Drilon, Jr.[2/]

This paper attempts to present a synthesis of the more interesting aspects in the orientation and operations of some agricultural management firms in the country today. It focuses attention on the following:

(1) The firms' rationale for entry
(2) The scope and kinds of services they offer
(3) Their criteria for project site selection
(4) Their service fees
(5) Their operational planning process
(6) Some of their operational results
(7) The future of agricultural management firms

1.0. ENTRY

The firms presently engaged in the business of farm management are new. Most of them were organized in 1966 and 1967. At least four of them are known to be corporate in form and a number of other firms are partnerships. As of this writing, a few others are in the process of being organized, and it seems that they are bound to be corporate in form.

The preference for the corporate form of organization seems to be explained by two reasons. First, the nature of farm management work is

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1/ This paper is a sequel to "Toward Self-Sufficiency in Rice," a report on case studies involving farm management and development projects handled separately by two agricultural management firms in the Philippines, published in The Philippine Review of Business and Economics, November 1967. The author is indebted to R. C. Salazar for his comments on an earlier draft of this paper.

2/ Executive Officer, IRRI.

such that a rather substantial investment is necessary to keep an adequate number of competent personnel in the organization and to support field operations. The corporate form of organization lends itself to a relatively broader capital structure than would be normally available in partnerships; naturally, it appears to be the more logical form of organization for the farm management business. Second, although the rewards are high in this business, the risks are also high and the limited liability of a corporation argues strongly in favor of the corporate form and against the partnership form of organization.

There is no doubt that a good part of the reason for their organization was the advent of IR8, the rice variety now popularly known in the Philippines as "miracle rice." Offering a rather spectacular yield increase over the rice varieties traditionally grown in the country, IR8 stirred organizers of the firms into the belief that now rice growing could be a business, not only because high yields were indeed possible but also because it was obvious that technical assistance to farmers would be needed to make these yields a reality. In one of the management firms, the notion that there will be other desirable rice varieties that will follow IR8 and that new knowledge on how to improve rice yields would be turned out by the research institutions from hereon, has filled leaders of the firm with hope that the opportunities for farm management service firms will continue into the future.

The government's interest in achieving self-sufficiency in rice at the earliest time possible was seen by the organizers as a vehicle for entry into business. They expected that such interest would generate at least a growing curiosity among many farmers in how to produce rice yields far greater than they had in the past. And they strongly felt that the government would be committed to provide the credit support that would help farmers toward the more expensive but more profitable methods of farming required by the new rice technology.

The rice supply situation was considered by the organizers. There was a consensus of opinion among them that the production-consumption gap in the Philippines was an indicator of a good local market for services aimed at increasing rice yields and that the seemingly widening disparity between rice production and rice consumption in other countries in this part of the world provide a ready market in these countries for rice surpluses from the Philippines.

2.0. SERVICES

The services offered by the farm management firms have varied in scope and kind. Some firms, particularly the partnerships, have been inclined to limit their services to technical assistance on farm operations directly related to rice growing. These include the following areas of activity: seedbedding, land preparation, transplanting, water control, soil management, plant protection, harvesting and threshing. Other firms have provided a broader slate of services covering farm and off-farm operations. Off-farm operations include marketing activities, special studies toward the optimal use of the resources available or potentially available to the farmers, and assistance in obtaining financial support for the farmers' production and marketing activities or the development of their storage and processing facilities.

The farm management firms have concentrated on rice, but already they are beginning to think about the management of other crops such as corn, sorghum, soybeans and others. The need for relatively sophisticated project studies to support applications for loans from financial institutions has opened new opportunities for these firms and some of them have handled rather substantial project studies which have led to continuing contracts for management services with clients.

A look at the articles of incorporation of some of the firms would readily reveal the anticipated scope of activities of these firms. While flexibility was the prime consideration in providing for a wide latitude of action for these firms, it is not unlikely that in the near future, they would indeed be involved in activities other than farm management services.

Below are the description of the purposes of two farm management corporations.[3/]

2.1. Primary purposes of farm management corporation of the Philippines

"(a) To engage in the development of agricultural, livestock, forestry, and fishing industries and in the production, processing or marketing of inputs for, and products of, these industries.

"(b) To engage in the buying and selling of agricultural and industrial products; and

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3/ Names of corporations are disguised.

"(c) To provide management or consulting services of interested persons engaged in agricultural, livestock, forestry and fishing industries and/or in the buying and selling of producer or consumer goods."

2.2. Primary purposes of the Sibul Development Corporation

"(a) To provide management services in the development of agricultural lands and the operation of farms, fishery enterprise, logging concessions, factories, and business organizations in any industry;

"(b) To engage in the production, buying, selling, trading, importing, exporting, barter, drying, warehousing, processing, handling and transportation of rice, corn and other agricultural crops, their products, by-products, and manufactured products;

"(c) To acquire by purchase or lease or otherwise own or hold agricultural lands and other real estates for the purpose of producing thereon agricultural products and/or on which to construct warehouses, driers, silos, factories, the offices of the corporation and such other buildings and facilities which are necessary for the prosecution of its business."

3.0. PROJECT SITES

Farms administered or assisted by farm management firms are mostly located in the provinces of Laguna, Bulacan, Nueva Ecija, Isabela, Pangasinan, Camarines Sur, Iloilo and Cotabato. It is not mere coincidence that these provinces in which the Rice and Corn Production Coordinating

Council[4] is currently concentrating effort to raise productivity in rice and corn. In these provinces, the infrastructures such as irrigation, credit facilities, roads and educational institutions, are relatively well developed and here, therefore, there are more ingredients than elsewhere for a successful operation toward increased productivity.

More specific criteria used by the firms in selecting sites are outlined below:

1. Yield should not be more than 30 cavans per hectare.

2. Water should be adequate during the dry season.

3. The farm should be accessible by road and near warehousing and processing facilities.

4. Larger sized farms should be preferred.

5. Farms with equipment such as tractors, threshers, driers, mills should be preferred.

Just a note on each of these criteria.

Yield. Farms which yield 80 cavans or more hectare are considered to be well managed farms. Yield improvements on such farms may not provide enough margin from which service fees of management firms may be drawn. On the other hand, farms which yield less than 80 cavans per hectare could provide such a margin.

4/ This government agency is charged with the management of the national rice and corn production program of the government.

Water. Water is a limiting factor in rice production. Without water, it is impossible to grow rice which is a semi-aquatic plant.

Generally, while rice can be grown during the rainy season, it cannot be grown during the dry season in non-irrigated areas. The existence of irrigation facilities in an area may make possible the growing of at least two and possibly three crops of rice a year in such an area. Obviously, irrigated areas would provide farm management firms more profit opportunities since, here, they would have more production turnouts, and they would be able to keep their personnel gainfully busy throughout the year.

Accessibility. Farms which are accessible by road are easier to supervise and if they are located near warehousing and processing facilities, the marketing of their products would be much less difficult and less costly.

Farm size. Farms which are relatively large are preferred by management firms because with larger farms, the personnel requirements become less on a per hectare basis. For instance, a firm operating in the province of Nueva Ecija assigns one rice production technician to a project of 100 hectares composed of farms of various sizes owned by different persons. To another project of about 230 hectares owned singly by an individual, it assigns also one rice production technician.

Equipment. Farms with equipment and facilities for land preparation, threshing, drying, or milling are preferred by the management firms since operation in these farms is expected to be more convenient and probably more efficient than on farms without such equipment.

4.0. SERVICE FEES

The fees charged by the farm management firms for their services are generally of two categories, namely:

(1) A share of the harvest on the farm administered or assisted by the management firm, and

(2) A combination of this plus payment of part of the operational expenses of the management firm.

Under the first category, the following schemes have been tried in various projects:

(1) The farm management firms get 10% of the gross harvest on an operational unit.

(2) The firm gets 10% of the gross harvest on an operational unit only if the yield on the unit is more than 80 cavans per hectare.

(3) The firm gets 50% of the surplus in yield, the surplus being understood as the remainder of the harvest after deducting harvesting and threshing expenses, the extra cost of production and the basic yield on the farm. (The basic yield is usually the average yield in the last three years while the extra cost of production is that portion of the cost of production in excess of the average cost of production in the last three years).

Under the second category, the farm management firm is paid in accordance with any of the schemes described above, and in addition, it receives an amount each month ranging on the average from 300 to 500 pesos per project to cover salaries of the production technician assigned to the project and part of the overhead expenses of the firm.

Due to difficulties experienced in establishing adequate records systems and in computing the variable costs, there is a tendency for most of the management firms to simplify service fee arrangements by charging a fee in terms of a flat quantity of palay per hectare or a percentage of the gross harvest on a farm project.

Some of the difficulties of a management firm are listed below:

1. Record keeping. The farmer-clients have a tendency to cling to their old system of record keeping inspite of agreements between them and the management firm to install an accounting system which would be useful to them and to the management firm. The maintenance of the system has proved difficult because this has remained as the responsibility of the farmer-clients.

2. Cash flow. Although the contract provides that the farmer-client is to furnish the needed cash funds at designated periods (usually on a monthly basis) which would be needed for the purchase of necessary inputs such as fertilizers and insecticides, the funds are not made available on schedule, thus disrupting operations on farm projects. In certain cases, where the management firm advances funds in the interest of getting the schedule of operations implemented according to plan, reimbursements of expenses from farmer-clients has proved quite a problem.

3. Variation in practices. The differences in farm practices even within provinces, have resulted in the inadequacy of the contract between the firm and farmer-client. The variation in labor cost and sharing arrangements

which were not initially known to the firm has created complications in the computations of "surpluses" in the harvests from which fees of the management firms are to be obtained.

4. Lack of equipment. The lack of equipment such as moisture meters and driers in farm projects has made it difficult for the firm to keep track of the actual production on farm projects. This has created some degree of suspicion on the part of firms that the farmer-client does not provide an accurate report on the yield on his farm.

5. Landlord-labor relationship. The adverse relationship between landlord and labor in some of the farm projects was not known to the firm. During periods of peak labor demand on a farm project (such as harvesting), the adverse relationship between landlord and labor resulted in the lack of labor hands and as a consequence, a seven hectare harvest rotted in the field.

To avoid these difficulties, the management firm has inclined toward the lease of lands simply because under such arrangements, it would have better control of the circumstances which made planned farm operations possible.

5.0. OPERATIONAL PLANNING

Various approaches have been used in operational planning by the farm management firms. The planning procedure followed by one of the firms which particularly appealed to the writer is outlined below:

5.1. Planning cycle

A. Set-up activities.

1. Receipt of information from agents

2. Negotiations

(a) Preliminary

(b) Final

3. Contract

4. Briefing client on planning steps

5. Organization, recruitment, appointment, orientation, introduction, location, payment plan, communication, etc.

6. Survey of resources, sketch map

7. Determination of operational unit and number of operational units

8. Determination of sequence of operations by unit

9. Timetable and requirements, all units

10. Operational unit operations schedule

11. Opening of Journal

12. Master chart by crop season

B. Operations, reviews, appraisal.

13. Maintenance of time and requirements tables, operational unit files, Journal, master chart

14. Survey of boundaries of operational units

15. Review of journal and accomplishment of pre-harvest summary

16. Estimation of harvest

17. Appraisal of fields per operational unit

18. Conference with clients to evaluate operations

C. <u>Repeat operations.</u>

19. Re-evaluate resources, methods and goals

20. Follow 6 to 18

It should be noted that the first phase of the outline described in general the various stages followed in setting up a farm project and the phase includes the negotiations toward the signing of project contracts, briefing the client on the planning process and planning the initial operations. The second phase consists of the implementation of the plan and appraisal of results.

Usually, management firms appoint agents in certain areas which they have tagged as operationally promising. These agents interview prospective farmer-clients and report to their principals, those who appear to be the good prospects. Preliminary negotiations between the representative of the management firm and the prospective farmer-client follows. The pattern of negotiation in a particular area tends to be the same, but they vary from area to area because yields and farm practices vary from area to area.

The contract, usually, is for a period of at least 2 years and as much as 3 years. However, in cases where the contract is a lease agreement, the period is as short as one year.

As soon as a management contract is signed, the farmer-client is briefed on the planning steps that will be followed by the management firm.

This gives him an idea of the technical services needed in the management of the farm and provides him an opportunity to make a contribution to the planning process. Soon thereafter, the firm organizes for starting the project under the contract. The needed production technicians are recruited, given a brief orientation with respect to their work and are placed "on the site."

One of the first steps taken immediately by the production technician assigned to a farm project is to make a survey of the resources of the farm. This survey would cover characteristics of the land and the equipment and personnel available on the farm. A sketch of the farm is then made and this has proved to be very useful particularly in the determination of operational units.

An analysis is made of the operational units on the farm project in relation to land ownership and the equipment and personnel available. If a farm is tenanted and a tenant's land holding is not more than five hectares, his land holding is usually considered as one operational unit. The determination of the operational unit is particularly helpful in the allocation of the resources available on the farm and the segregation of the accounts covering farm operations on the farm.

The operational units are then arranged in sequence, and plotted on the timetable and requirement chart which enables the production technician to determine the manpower, equipment and other input requirement on a weekly or monthly basis.

The timetable and the requirement data are translated into an operational schedule which chronologically lists the activities on each operational unit. The operational schedule, together with the summaries on manpower, equipment and other production input requirements, are presented to the farmer-client by the management firm. The accounting system is then set up. The main document of the system is the Journal which identifies the expenses by activities.

The production technician may have several operational units under his responsibility. One of the tools he uses to oversee these units through a crop season is a master chart which summarizes all the activities in his area of responsibility.

A periodic check-up is made by a representative of the firm on the maintenance of the time and requirement table, the operational unit files, the Journal, and the master chart.

The crux of the operational system can be described more clearly by referring to the various forms used in operational planning. and the "Basic Operational Information" preceding these forms. These forms are shown in Figures 1—4.

Figure 1 shows a sample of the farm survey forms, the main purpose of which is to obtain information which can be used for planning purposes. Examples of some items of information needed in planning are shown on the following pages.

TABLE 1. Basic operational information. Project PR (A mixture of administration and tenant farming).

I. Administration	
1. Land preparation (by 50 hp tractor)	
Dry plowing	3 - 4 ha/day
Dry harrowing	3 - 6 ha/day
Wet harrowing	2 - 3 ha/day
Wet plowing & harrowing	2 - 3 ha/day
Final harrowing	2 - 3 ha/day
2. Seedbedding (5 persons)	
Soaking and spreading	
10 cavans	3 days
3. Planting (20 persons)	
Planting	1 - 1/2 ha/day
4. Fertilizing	
Basal (2 men)	2 ha/day
Side dressing (2 men)	1 - 1/2 ha/day
Top dressing (2 men)	1 - 1/2 ha/day
5. Weeding operation	
Weeder (4 to 5 men)	1 ha/day
Spraying (2 men)	1 - 1/2 ha/day
Handweeding (20 men)	1 ha/day
6. Pesticide	
Granular (2 men)	1 - 2 ha/day
Liquid (2 men, pump)	1 - 1/2 - 2 ha/day
7. Harvesting	
(20 men)	1 - 1/2 ha/day (19% of gross)
8. Threshing (machine 12 hrs.)	800 bags/day (5% of input)
9. Selling	Prevailing price
II. Tenants (2 hectares in one month)	
1. Plowing (5-6 hrs.)	1 ha/10 days
2. Harrowing (5-6 hrs.)	1 ha/5 days
3. "Palita"	1 ha/day
4. Other operations (same as Part I)	

Figures 2, 3 and 4 give the forms which are used in determining the timetable and resource requirements of operation on a particular operational unit, the record of permanent information covering a unit, and the financial records which both the client and the management firm are expected to keep.

One aspect of the planning procedure which seems rather significant is the use of the timetable and materials requirement chart which is used in plotting the activities on an operational unit under a time bar. Considering the limited resources the client usually has, this device seems of great value, particularly in progamming the use of available resources toward full employment. At a time when advances in technology indicates that it would now be possible to have 3 crops a year, the timetable and material requirement chart promises to be of increasing importance. The activities once plotted against the time bar can then be translated into requirements of time, money, people and equipment which should be made available at particular points of the operational period. If a project is rather substantial and is operating on borrowed funds, this planning device could facilitate the determination of optimal cash flows which could save the clients substantial amounts of interest money.

6.0. SOME OPERATIONAL RESULTS

Table 2 on the next page shows part of the operational results of farm projects in the province of Nueva Ecija under the management of the Farm Management Corporation of the Philippines (FMCP). It is impossible to

Hacienda

Survey List

1. ______ ______ ______
Family Name — Given Name — Middle Name

2. ______ ______
Date of Birth — Place of birth

3. Married /__/ Single /__/

4. ______ ______
Name of wife — Date of Birth

5. Children:

Name	Date of Birth

6. Date settled in the Hacienda ______

7. Area cultivated by crop

Area	Crop	Date Planting	Date Harvesting

8. Cropping Practice

Seed ______

Planting ______

Fertilizer ______

Insecticide ______

Weeding ______

9. Past Yields, by crop

Rice ______

Corn ______

Others

______

______

10. Equipment/Power

Carabao /__/

Plow /__/

Harrow /__/

Power tiller /__/

Others: ______

______

11. Are you willing to increase your yields?

12. Would you like technical assistance?

13. Sources of Financing: ______

______

14. Time and Place of Marketing

Crop	Time	Place	Usual Price

15. Are you willing to be employed in farming operations instead of being just a tenant?

Yes /__/ No /__/

16. What can you do?

Plow /__/

Harrow /__/

Weed /__/

Spray /__/

Fertilizer /__/

Harvest /__/

Thresh /__/

Transport /__/

Others: ______

______

17. How many hectares can you cultivate effectively?

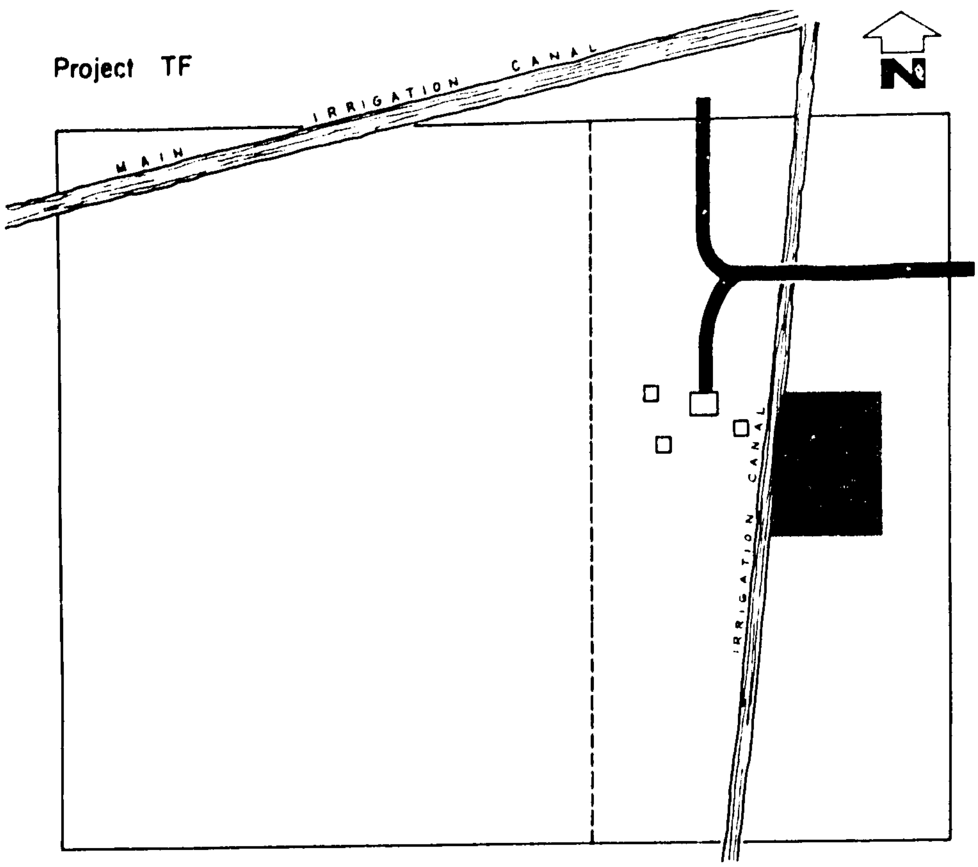
18. In one day, how much

Land can you Plow? ______

Land can you Harrow? ______

Land can you Plant? ______

Can you Harvest? ______
(Volume and area)



[redacted] MANAGEMENT CORPORATION

Timetable and Requirements Chart

Operational Unit ___________
Dry/Wet Season, 196 ______
Crop: Rice

Project: ______________________________
(Landowner/Tenant/Location)

Activities	DAYS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Remarks
Seedbed Preparation																	
Land Preparation																	
Fertilizing																	
Planting/Transplanting																	
Weed Control																	
Water Control																	
Harvesting																	
Threshing																	
Drying																	
Others																	
Main Materials																	

Fig. 2

[redacted] MANAGEMENT CORPORATION

Calendar of Operations

Land Owner	Location
Tenant	Season
Area	Crop

Date	Farm Operations	Remarks

Fig. 3

		Year:	Year:	Year:	Year:	Year:
CROP INFORMATION	Crop and Variety					
	Date Planted					
	Seed Germination					
	Seed Purity					
	Seed Treatment					
	Seeding Rate					
	Harvest Plant Pop./					
	Date(s) Harvested					
	Harvested					
	Yield Per					
FERTILIZATION	Manure: Tons Per					
	Commercial Fertilizer					
	Analysis					
	Pounds / Kilos Per / Ha					
	Method and Date Applied					
INSECTICIDES & HERBICIDES	Chemical Used					
	Rate Applied Per					
	Results					
	Chemical Used					
	Rate Applied Per					
	Results					
TOTAL HOURS	Total Man Hours					
	and/or Machinery Hours					

[redacted] MANAGEMENT CORPORATION

PRODUCTION COST
DRY/WET SEASON, 196___
CROP: RICE

PROJECT: ______________________________
(Landowner/Tenant/Location)

OPERATIONAL AREA: ______________________

PARTICULARS	USUAL	PLANNED	ACTUAL	EXTRA	REMARKS
A. LABOR					
Seedbed preparation					
[illegible]ration					
Land Preparation					
Transplanting					
Others					
B. MATERIALS					
Seeds					
Fertilizer					
Pesticide					
Others					
C. OTHERS					

[illegible]
[illegible] ____________ Return ________
[illegible] ____________ [illegible] ______

[redacted] MANAGEMENT CORPORATION

JOURNAL
DRY/WET SEASON, 196____
CROP: Rice

OJECT: ______________________________
(Landowner/Tenant/Location)

erational Area: ______________________

DATE	REMARKS	LABOR: Seedbed Operation	LABOR: Land Preparation	LABOR: Other Operations	MATERIALS: Seed	MATERIALS: Fertilizer	MATERIALS: Pesticide	MATERIALS: Others	MISCELLANEOUS
TOTAL									

SUMMARY:

Income: ________________
Expenses ________________
Difference: ______________

Fig. 4

TABLE 2. Reports on 10 operational units, Nueva Ecija Projects, July-August 1967 harvest.

Operational unit	Area (ha)	Gross production (cavans)	Basic yield/ha	Net production	Harvester's share	Gross surplus	Extra cost of production	Net surplus	Management firm's service fee (cavans)
1. A. Soriano	1.00	68.88	60.00	8.88	1.48	7.40	12.00	-4.60	None
2. A. Cruz	1.40	59.86	84.00	-24.14					None
3. C. Gonzales	3.00	255.84	180.00	75.84	12.60	63.24	37.80	25.44	13.00
4. E. Herrera	0.60	45.10	36.00	9.10	1.52	7.58	8.00	-0.42	None
5. A. Bumanlag	1.00	75.44	60.00	15.44	2.58	12.86	6.00	6.86	3.60
6. J. Veloria	0.60	41.00	36.00	5.00	0.83	4.17	8.55	-4.38	None
7. A. Mendoza	0.98	108.20	58.80	49.40	8.20	41.20	29.50	11.70	5.85
8. A. Manuguit	1.00	88.58	60.00	28.58	4.76	23.82	14.88	8.94	0.45
9. A. Manuguit	0.25	18.49	15.00	3.49	0.58	2.91	0.53	2.38	1.20
10. R. Pascual	1.20	153.00	60.00	93.00	25.00	68.00	20.00	48.00	24.00

Average yield per hectare: 82.90 cavans

Average revenue per hectare: 4.72 cavans tell by this table how the corporation has fared in its over-all operations in that province, but one could readily see the returns the corporation could possibly obtain in successful projects.

It should be noted that operational units 1, 4, and 6 did not yield net surpluses and, therefore, did not contribute to the profits of FMCP. Low yields in these units were generally attributed to soil deficiency which was not immediately detected by FMCP.

It should also be noted that operational unit number 10 was the most successful, contributing as much as 20 cavans per hectare to the revenue of FMCP. This particular unit had the same operational plan as that of the other operational units but its owner, Mr. R. Pascual, was known to have kept his farm relatively devoid of weeds throughout the crop season. Also, the harvest of this unit occurred during good weather while the harvest on the less successful and the failures happened during a rainy period.

The average fee of 4.72 cavans of palay per hectare partly indicates how many hectares, FMCP should assign to a production technician in order to make such an assignment profitable. A production technician is paid a range of ₱300 to ₱500 a month, and a cavan of palay may be reckoned at a cost of from ₱11 to ₱17.

7.0. THE FUTURE

The presidents of two management firms interviewed by the writer agree that there seems to be "not much money" in farm management services, considering the effort that has to be exerted to provide such services and the distance of farm projects from the headquarters of the firms. The services in certain respects run counter to the traditional experience of farmer-clients and this naturally creates impediments to planned management of the projects. The distance of the projects from the headquarters of the firms generate problems of administrative control and executives of the firms often have to make visits to these projects.

Both of these firms are in the process of shifting their activities from management contracts to lease agreements. Under lease agreements, they foresee a more profitable business. Their rental of farms ranges from 10 cavans to 15 cavans of palay per crop-hectare and on the basis of some ₱500 to ₱600 per hectare of expense, the break even yield would be somewhere in the vicinity of 50 to 60 cavans per hectare. Yields on the farms they have managed have ranged from 80 to 110 cavans per hectare.

This shift of activities is probably in the right direction, particularly insofar as making the work of the management firms easier and improving their chances for more profits are concerned.

The traditional experience of Filipino farmers constitutes to some degree an impeding factor against the adoption of new knowledge in rice technology and of the management services that could be useful in the use of this technology.

Yet, the Filipino farmer, like most other farmers in other parts of the world can "figure" and because of this, traditional experience will eventually give way to any new arrangement that would mean more income for him.

He is now living in an age when technology is upon him, technology which aims at increasing his income and his level of living.

In general, therefore, the future holds more promise than disappointment for the agricultural management firms in this country. How much that promise could be would much depend upon: (1) the ability of such firms to be entirely flexible in their orientation and to be constantly aware of what and where the opportunities are toward the more profitable endeavor -- in management contracts, in lease agreements, or in some other arrangements.

(2) Their recognition that their services would probably be needed more under arrangements that would resolve or simplify the difficulties of the farmer and yet assure him of higher income.

(3) Their belief that their competitive position in the market for their services would be closely associated with the quality of their services in relation to the fees they would be willing to receive for such services.

(4) The continued policy-support the government can provide for the agricultural development of the country.

RICE PRODUCTION: INSTITUTIONAL FACTORS AND ECONOMIC INCENTIVES

A. M. Weisblat and P. R. Sandoval

RICE PRODUCTION: INSTITUTIONAL FACTORS AND ECONOMIC INCENTIVES

A. M. Weisblat and P.R. Sandoval[1/]

1.0. INTRODUCTION

In a developing country like the Philippines where food production lags behind population growth, emphasis is invariably placed towards accelerating the production of food crops. Without an adequate surplus of food, the industrial population can not grow; nor can industry develop unless the agricultural sector would be able to absorb a substantial part of the consumption goods produced by industry. This suggests that a mutual inter-dependence between agriculture and industry is desirable.

Meanwhile, with rice and corn being the staple foods in the country, tremendous pressure is generated upon any incumbent administration to formulate and implement a national program which is designed to increase the production of these food crops. Any program therefore that aims at reaching at least the self-sufficiency level of these staples must be able to identify the sources of output growth. It must also be able to delineate the problems which could become the bottlenecks in the attainment of the program objectives.

This need for defining the problems of rice and corn production has been recognized before any policy could be formulated. A Special Rice and

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1/ Associate, Agricultural Development Council, Inc. (New York) and Associate Professor, University of the Philippines, College of Agriculture, respectively.

Corn Committee for instance was created in 1965 and was assigned the task and the responsibility of identifying the problems associated in the production of these staple crops.2/ In its report, the committee pointed out four basic aspects of the problem as political, economic, sociological, and administrative. As an offshoot of this report, an action program -- the Rice and Corn Master Program for FY 1966-1970 was formulated. This program embodies most of the committee's recommendations, but it narrowed down the problem to two aspects, i.e. economic and sociological.3/

Hsieh and Ruttan considered that activities centered around (a) diffusion of practices employed by the best farmers, (b) the transfer of known agricultural technology from the high productivity to the low productivity countries, (c) the development of more effective rural marketing, credit and land tenure institutions should result in rapid growth in agricultural productivity and output.4/

This paper has two main parts. The first section deals with the identification of economic and institutional factors affecting rice production, while the relationship of institutions to the over-all agricultural development will be extensively discussed in the second.

2/ Rice and Corn Study Committee, "A Realistic Program for the Philippines," Submitted to President-Elect Ferdinand E. Marcos, Manila. December 14, 1965 (Mimeographed).

3/ Rice and Corn Production Coordinating Council, "Four Year Rice and Corn Self-Sufficiency Program - Fiscal Year 1966-1970," Office of the Secretary, Department of Agriculture and Natural Resources, Diliman, Quezon City, July 21, 1966 (Mimeographed).

4/ S.C. Hsieh and V.W. Ruttan, "Technological, Institutional and Environmental Factors in the Growth of Rice Production: Philippines, Thailand and Taiwan," paper proposed for publication by Food Research Institute of Stanford University, U.S.A., 1967, (Mimeographed).

2.0. RELATIONSHIP OF INSTITUTIONS AND INCENTIVES TO INCREASING PRODUCTION

The main thesis of this section of the paper is that increased rice production could be accelerated if economic and institutional factors could be mobilized to maximize their contributions to output growth. In the following discussion, therefore, evidences will be presented to show the possible role of institutional factors and economic incentives in order to increase rice production.

2.1. Institutional factors

In 1964, IRRI data was presented which indicated that share tenure acts to increase adoption of output-increasing innovations, such as the use of higher levels of fertilizer. However, further analysis of experimental data indicates that share tenure may actually increase incentives to adopt cost-reducing innovations particularly when the landlord shares part of the cost.[5/]

The analyses made possible a test of the implications of the theory of the firm. This is with reference to the effect of share and fixed rent lease tenure system for the use of purchased technical inputs and family labor. In this analysis, 1965 data from five Bulacan town were utilized. Specifically, the following hypotheses were tested:

1. Farms operated under lease tenure achieve higher levels of land productivity (kilograms of rough rice per hectare) and higher levels of labor productivity (kilograms of rough rice per day of available family labor) than

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5/ See Agricultural Economics section of IRRI Annual Report, 1965. pp. 301-302.

farms operated under share tenure.

2. A higher percentage of farms operated under lease tenure use purchased technical inputs (fertilizer and insecticides) than of farms operated under share tenure.

3. A higher percentage of the family labor potentially available for rice production is employed off the farm on farms operated under share than under lease tenure.

It is interesting to note that the data appeared to be consistent with the first two hypotheses. Both land and labor productivity is higher on lease tenure than on share tenure farms. A higher percentage of lease than share tenure farms use fertilizer and insecticides. Meanwhile, a higher percentage of the labor force on lease tenure farms work off farm than on share tenure farms.

A major implication of the data, however, points to the reasonableness of hypothesizing that the relationship between land tenure and productivity varies (a) with the extent of commercial (or subsistence) production, (b) with the level, rate and direction of technological development, and (c) with the extent of diffusion (or concentration) of political and economic power.

The report further concluded that share tenure clearly encourages inefficient use of the tenant labor relatively early in the development process. Furthermore, it acts as a tax on the adoption of output-increasing technology - dampening tenant's incentives to adopt output-increasing technology embodied in current inputs, and the landowner's incentive to increase output with new capital equipment. The strong negative relationship between farm size and productivity on farms operated by share tenant acts as an incentive for the for the landowner to keep the size of unit operated by the tenant small.[6/]

The same hypotheses were similarly tested by Sandoval et al. utilizing data from the first land reform district in Bulacan. The conclusions in this study were consistent with those found in the preceding study.[7/]

The prevailing land tenure system in the Philippines as in other developing economies is often considered a barrier to agricultural development. A major argument in favor of this statement contends that the prevailing tenure arrangement does not provide enough incentives for increased production. In an economy where agricultural productivity is low, a large share of the product goes to the landlord and the latter is not interested in reinvesting in agriculture or is unable to do so. In addition the tenant may not have the necessary capital investment or he may not be interested in further investment because the land is not his own. Hence, under the Philippine Land Reform Program, the emphasis is on the need for shifting to an owner-based agriculture. Note the assumption that land ownership will provide the incentive for increased productivity since the operator will no longer share with somebody else.

Recently, an exploratory study of rice and coconut farm-owning landlords and their role in agricultural development was completed. The study attempted to classify landlord, and analysis started with the use of conventional categories of resident and absentee landlords. On the basis of management of farms, the landlords were classified into managing and non-managing landlords.

6/ Ibid. p. 302.

7/ P.R. Sandoval, S.C. Hsieh and B.V. Gaon, "Productivity Status of Lowland Rice Farms: A Case Study of Pre-Land Reform Conditions," The Philippine Agriculturist, Vol. LX, June, 1967. (In Press).

In terms of their relation with tenants, the categories depended on the landlord's outlook on development and outlook on personal relations with the tenants. This classification yielded the following landlord types: (1) traditional-paternalistic; (2) traditional-non-paternalistic; (3) modern-paternalistic; and (4) modern-non-paternalistic.[8/]

Farms owned by the respondents were under the management of either the landlord, the overseer, or the tenants alone. There was no considerable difference in yield under the three types of management. Managing landlords, however, introduced more improved farm practices than managing ones.

Aside from being a prestige-laden individual, the landlord's role, if he is interested in the management of the farm, could be that of a manager, innovator, capitalist and bearer of risk. Hence, he is in a position to persuade the tenants to adopt improved farm practices.

The study made also another interesting observation that majority of the landlords, whether managing or non-managing, are apt to invest in whichever offers the opportunity for greater returns. Although many agree that additional investments will increase farm output, not all of them are willing to invest their money in financing improved farm practices.

2.2. Price as an economic incentive

Price has generally been considered as a useful device for resource allocation. In this regard, it has been used as a tool for influencing aggregate

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8/ E.A. Bernal-Torres, P.R. Sandoval and A.M. Weisblat, The Role of Landlords in Philippine Agricultural Development: An Exploratory Study, Research Project under an Agricultural Development Council, Inc. (New York) grant, 1967, (Mimeographed).

agricultural output. This notion has found usefulness in the form of price support programs as formulated by policy makers and as given legislative sanction by law-makers.

A recent study which was undertaken by IRRI estimated the statistical supply and market surplus relations for rice for major geographic regions using DANR time series data.[9/] Estimates were made of the price elasticities of hectarage, that is, the percentage change in price, derived from the estimated statistical supply functions.

Short run elasticities typically range from .1 to .3 (Ilocos, Southern Tagalog, Eastern Visayas, and Southern & Western Mindanao). In two regions with the largest share of irrigated land, Central Luzon (which produces more rice than any other region), and Bicol, elasticities range from .4 to .6. Western Visayas has an elasticity of more than .6. Meanwhile, Cagayan, Northern and Eastern Mindanao elasticities could not be shown to be positive under any criteria. (see Table 1.)

The study concluded that the supply elasticity for rice is highest in areas with strong commercial markets and/or relatively extensive irrigation development. This suggests that rice producers are responsive to price changes as producers of commercial crops. It was also noted that the marketed portions range from .37 to .65. Therefore, the marketed surplus elasticities are at least 1.5 to 2.5 times as large as the output elasticities.

9/ IRRI Annual Report 1965, pp. 299-300 and IRRI Annual Report 1966, pp. 247-250.

TABLE 1. Estimated short run price elasticities of rice hectarage and marketed surplus in postwar Philippines.

Region	Price elasticity of hectarage	Average marketed proportion (Rice - 1959/60) M/Q	Price elasticity of marketed surplus (Low estimates)
		RICE	
Ilocos (2)	.11 to .23**	.37	.30 to .62
Cagayan Valley	neg	.40	neg
Central Luzon (2)	.13 to .55**	.65	.20 to .85
Southern Tagalog (2)	.19 to .64**	.50	.38 to 1.28
Bicol (2)	.38** to .41**	.49	.78 to .84
Eastern Visayas (1 & 2)	.15 to .35	.43	.34 to .81
Western Visayas (2)	.09 to .91	.51	.18 to 1.78
N & E Mindanao (2)	.21 to .22	.54	.39 to .41
S & W Mindanao (2)	.25 to .34	.44	.57 to .77

a/ Two asterisks indicate that the coefficient is significant at the 20% level. neg indicates that all estimated price coefficients are negative. The figures in parenthesis after each region refer to the regression trials from which the price elasticity ranges were taken.

Source: IRRI Annual Report 1966, p. 248 Table 10.

The study implies that farmers are reasonably responsive to changes in the price of rice and to other commodities. This suggests that changes in relative prices are effective in determining the allocation of land among the several agricultural commodities. It also indicates that price support, subsidy or import programs, undertaken with other objectives, are rapidly reflected in shifts of production.[10/]

Recognition of the importance of these relationships is apparent in a report of the Special Committee on rice and corn which advocated the use of price support as one of the incentives needed for increasing palay production. In its report, the output responses in terms of an increased supply of the cereal were estimated at varying levels of support prices (see Tables 2 and 3). Estimates were also made of the financial magnitude involved in such an undertaking.

The discussion in the foregoing sections point out evidences on the possible and effective role of institutions and economic incentives which might be used to help increase rice production. From the institutional standpoint, landlords and the type of tenure system were shown to be capable of making effective contributions in order to accelerate output growth. From the economic standpoint, there are also strong indications that rice farmers respond positively to price changes. Therefore, these institutional and economic factors, along with the introduction of new technology and availability of inputs, should be considered as major determinants of output growth in rice production.

10/ *Ibid*, IRRI Annual Report, 1965, pp. 299-300.

TABLE 2. Estimated changes in palay production due to farmers responsible to different levels of floor price.

Costs of production and levels of prices a/	Percent change	Changes in production by nature of response: Favorable response c/ — Change in production b/	Favorable response c/ — Total production	Very unfavorable response d/ — Change in production b/	Very unfavorable response d/ — Total production
	per cavan			million cavans	
A. Low cost farms:					
₱12.96 - ₱16.00	23.45	2.05	89.35	12.30	99.60
₱12.96 - ₱18.00	38.89	3.40	90.70	20.40	107.70
₱12.96 - ₱20.00	54.32	4.74	92.04	28.44	i15.74
B. Medium cost farms:					
₱14.36 - ₱16.00	11.42	1.00	88.30	6.00	93.30
₱14.36 - ₱18.00	25.35	2.21	89.51	13.26	100.56
₱14.36 - ₱20.00	39.28	3.43	90.73	20.58	107.88
C. Medium high cost farms:					
₱15.74 - ₱16.00	1.65	0.14	87.44	0.64	87.94
₱15.74 - ₱18.00	14.36	1.25	88.55	7.50	94.80
₱15.74 - ₱20.00	27.06	2.36	89.66	14.16	101.46

a/ Figures in first column are costs of production of various categories of farms; those in the second column are various levels of price support.

b/ Basis of change; 1964 estimated production of 87.3 million cavans.

c/ Price elasticity of output is 0.1) IRRI data, 1965 (Unpublished).

d/ Price elasticity of output is 0.6)

TABLE 3. Estimated quantities of marketable palay to be purchased to raise farm price to different levels of floor price. a/

Farm price and levels of floor price b/	Percent change	Changes in quantities by nature of response: Favorable response c/ 32% MS	Favorable response c/ 55% MS	Very favorable response d/ 32% MS	Very favorable response d/ 55% MS
	per cavan	million cavans			
A. Low					
₱12.96 - ₱16.00	23.45	6.54	11.26	19.62	33.78
₱12.96 - ₱18.00	38.89	10.85	18.67	32.55	56.01
₱12.96 - ₱20.00	54.32	15.16	26.08	45.48	78.24
B. Medium					
₱14.36 - ₱16.00	11.42	3.19	5.48	9.57	16.44
₱14.36 - ₱18.00	25.35	7.07	12.17	21.21	36.51
₱14.36 - ₱20.00	39.28	10.96	18.86	32.88	56.58
C. Medium-high					
₱15.74 - ₱16.00	1.65	0.46	0.79	1.38	2.37
₱15.74 - ₱18.00	14.36	4.01	6.89	12.03	20.67
₱15.74 - ₱20.00	27.06	7.55	12.99	22.65	38.97

a/ Basis of change. 1964 estimated production of 87.3 million cavans.
b/ Figures in left column are farm prices: those in the second column are assumed floor prices.
c/ Price elasticity of marketable surplus is 0.1) IRRI data, 1965 (Unpublished).
d/ Price elasticity of marketable surplus is 0.3)

3.C. RELATION OF INSTITUTION TO OVERALL AGRICULTURAL DEVELOPMENT

The first part of this paper indicates the positive role institutions can play in increasing rice production. This is in line with current economic thinking which views the role of institutions as the framework within which better resource allocation takes place.

It is also so clear that even within the context of maximizing agricultural growth much still needs to be done, and can be done. Much has been written on the need for considering the role of institutions in agricultural growth. 11/ A neglected area within this framework is what can be done for individuals operating in low productivity areas. Dr. A.T. Mosher, in an unpublished manuscript, indicates a number of possibilities.

> Design the procedures of all local agri-support activities particularly to meet the needs of operators of smaller farms and the less responsive farmers no matter what the size of their farms. Each nation has a strong interest in seeing that all of the land in its better agricultural regions is farmed as efficiently as possible. It is not enough that only the better and more venturesome farmers use their land resources with top efficiency. Therefore, the operating procedures of all agri-support activities, particularly publicly operated ones, should be such that the less able and less venturesome farmers find them easy to use and are encouraged to use them.
>
> With respect to credit, this means that procedures must be tailored to the needs of smaller farmers and that some form of supervised credit will probably be needed in many cases.

11/ Hsieh and Ruttan, *op. cit.*

With respect to extension education, it probably means that a given percentage (35%?) of the time of each extension agent should be devoted to trying to get the less responsive farmers started on the road of innovation.

With respect to farm supplies and equipment, it means that equipment available should include types appropriate for the smaller farms, and supplies such as fertilizers and pesticides should be available in the small amounts that small farms need.

Designing the procedures of local agri-support activities particularly to meet the needs of operators of small farms and of the less-responsive farmers does not mean that the more able and responsive farmers will not have access to them. They will. The danger is that because certain farmers are more responsive the procedures of local agri-support activities are likely to grow up around their needs and not be appropriate for the less able and less responsive farm operators.

Get started with the long-term investments needed to turn the future potential of other regions into an immediate potential: research, or irrigation, or road right of ways. 12/

But the role of institutions should be looked at as having significance for the total process of agricultural development. Institutions can and have played other important contributive roles as a means of dealing with a host of problems such as land reform, welfare problems, income distribution and so forth. The real need is to consider ways and means of creating these institutions to play this role. All the discussion on ways and means of increasing food production should not obscure the critical problem in the development process -- the upgrading of human skills and capacities of people so they may have a wider access to income earning opportunities. 13/ Yet even in the United States, it is

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12/ A. T. Mosher, "Promoting Agricultural Growth," preliminary draft, August, 1967.

13/ P. Dorner, "Land Tenure Problems and Policies," to be published by the U.S. Department of Agriculture.

only recently that analyzing data on improving human welfare as a significant measure of progress has begun. The problem in part is one of getting the low-income unproductive segment of the population to become a highly productive system. In the United States, the job is staggering, even though 20% of the population is in this situation. In developing countries, the percentages are reversed and we are concerned with rural development for 80% of the population.

We agree with the emphasis and concern these days over increasing the world's food supplies. One look at the current population growth rates is all the evidence needed. But we should also bear in mind that production gains which are achieved without also contributing to the task of human development may be illusory gains and quite temporary. The pressure is understandably great to emphasize increased production for the market to feed the growing population in the cities and for export to earn foreign exchange. It might even seem simpler to concentrate efforts on large farms or plantation type operations. The results of these policies may yield optimistic measurements in the short run, but progress will only be meaningful if the growing masses of rural people benefit from this increased production.

A system should be devised which permits them to benefit from a direct share in the new wealth produced, and of even greater importance in developing the skills so they can help to produce the increased wealth which is so vital to their own development. We can illustrate this point by examining a current problem in a number of developing areas -- increasing food production. Neo-classical economics has real value in dealing with this problem because it indicates that this can only be done by changing the level of technology. The agricultural scientists have now contributed the new technology -- and the economist has helped work out the required cost/benefit relationships. The pattern has worked quite well in Western agricultural development. Yet, one can predict that it will not be as effective a means for increasing production in developing areas unless we recognize the difference between the two situations. The most important is that in most developing areas, 80% of the farms are subsistence, in developed areas 80% are commercial. Since the new technological inputs are usually more capital intensive, they will primarily help farmers with the higher or larger resource endowments who have the necessary capital and skill to move ahead and use the new input package. This means the income gap between the rich and poor within developing areas will become wider, and it is probable that the growing masses of rural people will not benefit much from this increased production. One might argue that this always occurs in the short run when new technology is introduced. But the consequences of this approach in developing areas with income levels far below anything the West has seen will cause many a government official to wonder whether he should move ahead with an agricultural program that can have enormous political consequences as well as offering little or no relief for the majority of his small landholders and tenants.

Peter Dorner has pointed out that this is not a simple "either/or" proposition -- that we need constantly be aware of the fact that the manner in which increased production is achieved and the number of people who are able to participate and reap benefits from the experience may be as important as the production increase itself. 14/

We are not arguing that applying the resource allocation principle is not important and useful, but it is equally important to pay attention to the effect of this principle in areas of activity that we ordinarily do not worry about in a developed economy.

Let us now look at the role institutions can play in the total process of agricultural development. In what ways can we achieve increased rural development without losing sight of the need for increased production? Let us suggest some institutional factors that may be relevant to this question.

One area is taxation. We must remember the important role the United States' tax structure has played in its development. How to utilize the increased income emerging from the agricultural sector so that it is utilized for the total population -- rural and urban -- needs further attention. The difficulty is that it must be achieved without affecting production incentives and combating political pressures. This means changing attitudes towards taxing the agricultural sector. In most developing areas taxation of the agricultural sector is considered minimal, so as to encourage farmers to increase production. But in fact indirect taxation of the farmer has been very heavy. The whole system of price controls which set prices below what farmers would have received if the government had not interfered is found in many of the developing areas.

14/ Ibid.

Many countries have introduced an export tax on agricultural products and the major share of this revenue is not used in the agricultural sector.

Land tenure is another critical area where institutional arrangements need further study. A study carried out in the Department of Agricultural Economics, UPCA, indicated that operating arrangements are critical since they determine the distribution of, and access to, income earnings and decision-making opportunities on the tenants' farm.[15] The initial findings indicate that farms which have the highest productivity potential are those where the landlord makes most of the managerial decisions. This is in contrast to the more traditional pattern, in which the tenant is an independent farmer. It is true that in the latter case, the share of the crop retained by the tenant is smaller than landlord-managed operations, but tenants operating small independent units develop entrepreneurial skills, which make the transition to independent family units quite feasible. This is the system which lends itself to a leasing system and the relative ease of the transition to owner-operatorship family farming. Our study does indicate one possible alternative. This is the emergence of semi-skilled and skilled hired agricultural workers as an alternative to being small owner-operators. Certainly, further attention to this question is needed.

Less controversial, but quite important in areas with large segments of tenancy are programs to provide secure and legal title for present occupants. Providing technical and financial assistance in land title is one important area.

15/ Bernal-Torres, *et al.*, *op. cit.*

There is also the need for institutional procedures which will modify current barriers to development. This is in contrast to so many recommendations on "how to get the job done" which assumes the total erasure of whatever the current set of institutions are. The fact of life is that in most of the developing areas, you must start with the given system and then determine the means of getting around the procedures that are limiting your goal. The creation of the Rice and Corn Production Coordinating Council (RCPCC) in the Philippines is a good example of how this can be done. Clearly, the administration felt that the existing set-up would not be able to meet the increasing demand for the new seed variety. The RCPCC, therefore, established a modified system to facilitate seed multiplication and distribution.

What is important to note is that the problems we have discussed up to now will not be solved by merely increasing productivity. The needed reforms require an institutional procedure through which the orderly legal process can be carried out. The difficulty in many developing countries is that there is no such process, or the political power necessary to implement a policy of change rests in large part with those who control access to the land.

Looking at the total farm operation instead of increasing production on a specific enterprise is another neglected area of research. In the Philippines, there seems to be the view that rice production is synonymous with total farm production. But it is only by looking at the total farm enterprise that one can help the farmers develop his skills and capacity for greater economic opportunity.

The role of farm machinery in the process of agricultural development needs further research area. Too much emphasis has been given to machinery as a substitute for labor. The point is that for the next 25 years, human and animal labor will still be the major sources of power. This does not mean farm machinery can not be or should not be developed to meet the peasants' need. The new grain and rice varieties require more precision work in fertilizer spreading, weeding, sowing, etc. We need to develop supplemental machinery to meet these needs. The introduction of farm machinery also changes the view of the farmers concerning how to operate his farm. The significance of the introduction of the small tractor in Japan was not increased production in a given area but the reorganization of the total farm enterprise.

These are some examples of areas in which there is a role for institutions in agricultural development.

There is one point that still must be dealt with. Many economists accept the role of institutions in agricultural development but argue that institutions must be developed in a sequential process. The first priority must be given to increasing food production, and only then does one move on to other problems of agricultural development.

This position has no meaning in the abstract. The critical question is what problems are the government policy makers facing. There are situations where emphasis on production maximization is not the critical one. The most extreme case is one noted by Professor Kenneth Parsons in his review of

Professor D. Gale Johnson's book, Forward Prices for Agriculture.[16/] In this book, Professor Johnson was critical of U.S. agricultural policies during the New Deal. He noted that they led to a malallocation of resources. Professor Parsons agreed with Johnson's analysis concerning resource cost, but he noted that this was not the critical question facing the U.S. government. The real problem was how to get money into the hands of farmers as quickly as possible.

Today, one of the critical problems is how to develop skills and capacities among the rural people, through a wider access to decision-making income-earning capacities. This is not an automatic by-product of increased production. In the long run, agricultural production is important as a source of rural development, but there is a growing conflict which is taking place between the criterion of production and the criterion of welfare.

> Among the farmers of any developing country, there are already existing differential levels of development. There are always a few farmers who are technologically advanced, highly profit oriented, and relatively well to do; and then there are the masses who are quite poor and are living at the threshhold of subsistence. The governments of these nations have limited capital and human resources. Given the race between food and population, the governments face the following alternatives which pose a serious dilemma in the use of these limited resources. Either they can invest in the "growth points" in the economy, the more responsive farmers who will produce the food, and meet the race. But, if they invest in the more responsive areas, they are immediately faced with the fact that they are increasing the maldistribution of income because the "growth points" are the better farmers. Increased maldistribution of income leads immediately to the increased possibility of political instability among the poorer, more numerous farmers because only the richer farmers are growing and being aided.
>
> On the other hand, if the governments invest in the slower growing points or not as much in the advance growing points, they may

16/ K. Parsons, "The Problem-Solution Basis of Forward Pricing," Journal of Land Economics and Public Utility, 1949, pp. 423-27.

lose the race between food and population because per capita incomes will go down. Then again the governments will face a problem of political instability due to reduced incomes and food availability.

> This conflict is becoming of increasing importance at the policy levels among the developing countries . . . . What is there from our experience which could help these nations cope with the serious conflicts generated by their attempts to meet this race between food and population without the detrimentally aggravating forces of political instability? 17/

The basic task in development is creating skills and capacities among the mass of rural people to reach higher income earning opportunities. This is a need to be conscious of the manner in which increased production is achieved and the number of poeple who are able to participate and reap some benefits from the experience. It is clear that the role institutions can and must play in agricultural development goes far beyond resource allocation. This is a critical area which needs further study.

What is badly needed is a far broader approach to economics than we now seem to have. Historically, the wider approach to economics has made possible innovations in public policies. This is particularly true in the humanization of the economic system, including creative work on social security, cooperatives, land tenure, and many more. Such an approach has great value for the study of the problem of economic development. It does not need to be destroyed in order to explore and enjoy the possible contributions of a resource allocation approach to agricultural economics.

17/ C.R. Wharton, Jr., "Remarks to a Panel on Design for Cooperation, before a conference on The World Food Problem: Private Investment and Government Cooperation," New York, N.Y., April 12, 1967.