ECONOMICS OF PRODUCTION AND PRICING OF RICE IN THE PHILIPPINES

by

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D E C L A R A T I O N

Except where otherwise indicated, this sub-thesis is my own work.

March, 1973 L.R. Pamatmat

A C K N O W L E D G E M E N T S

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A B S T R A C T

The response to price of an underdeveloped country's agricultural sector is a factor relevant to its economic growth. Knowledge of the extent of response to price change may lead to formulation of a sound and effective price legislation policy.

This study attempts to contribute towards this end. First, an attempt is made to estimate a supply function for rice. How do farmers respond to changes in the price of rice and to prices of alternative crops? An attempt is also made to measure the extent to which changes in the production of rice have arisen from the changes in acreage planted and changes in yields. Second, to a lesser extent, we examine the farm prices of palay, the secular and the seasonal trends.

While prices of rice in the Philippines have apparently been fairly efficient in their resource allocation function, there is little evidence to indicate that price changes represent an effective device for influencing aggregate rice output. In spite of the economic evidence that prices represent an important incentive in some developing countries, the analysis obtained from the study showed that rice farmers in the Philippines did not show a <u>significant</u> response of hectarage relative to price change. However, there were indications of positive responsiveness. This implies that the role of price as a development tool is much less promising if the price change does not produce changes in hectarage as well as total production.

The analysis on yield response infers that the relative importance of the input factor to yield varies among regions of the country. Rainfall, for instance, may increase yield for Southern Tagalog, Eastern Visayas and Northern and Eastern Mindanao but the effect was the opposite for Central Luzon, Western Visayas and Southern and Western Mindanao regions. Similarly, a greater proportion of tenancy cultivated area was found relatively important to yield in Cagayan Valley, Bicol, Southern Tagalog and Northern and Eastern Mindanao. Meanwhile, the adoption of the new rice variety proved a crucial factor in increasing yield for all regions, except Cagayan Valley where the majority of non-irrigable areas exist.

The yield response estimate for the Philippines revealed that rice yield responded to increases in rainfall and adoption of the new rice variety. The presence of an irrigated area also contributed positively to yield. A greater proportion of unirrigated and upland ricelands will reduce the yield per hectare indicated by the negative coefficients.

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CHAPTER 1

INTRODUCTION

Rice is one of the most important agricultural commodities produced in the Philippines. Up to the present time rice has been produced for local consumption but the government has plans for encouraging rice production so that eventually a surplus of rice will be produced for export.

Rice is planted throughout the country and occupies about three million hectares of the total six million hectares devoted to food crops (fig.2). In addition to absorbing a major share of the resources that were allocated by the government for the general development of the agriculture sector, the formulation and implementation of rice policies has become a major administrative and legislative concern. Needless to say, officials of the national government were constantly pressured by (a) producers who wanted the government to raise the support price levels in their favour and, (b) consumers who wished that rice imports would be constantly forthcoming so as to make rice available to low income consumers at subsidized prices. Indeed, the clamour from both the producers and the consumers was of great concern to the government.

To formulate a sound and effective price policy for rice, the production and consumption response of rice to changes in prices and policy variables should be understood.

This study attempts to contribute toward this understanding by concentrating upon two aspects of market behaviour. First, an attempt is made to estimate supply

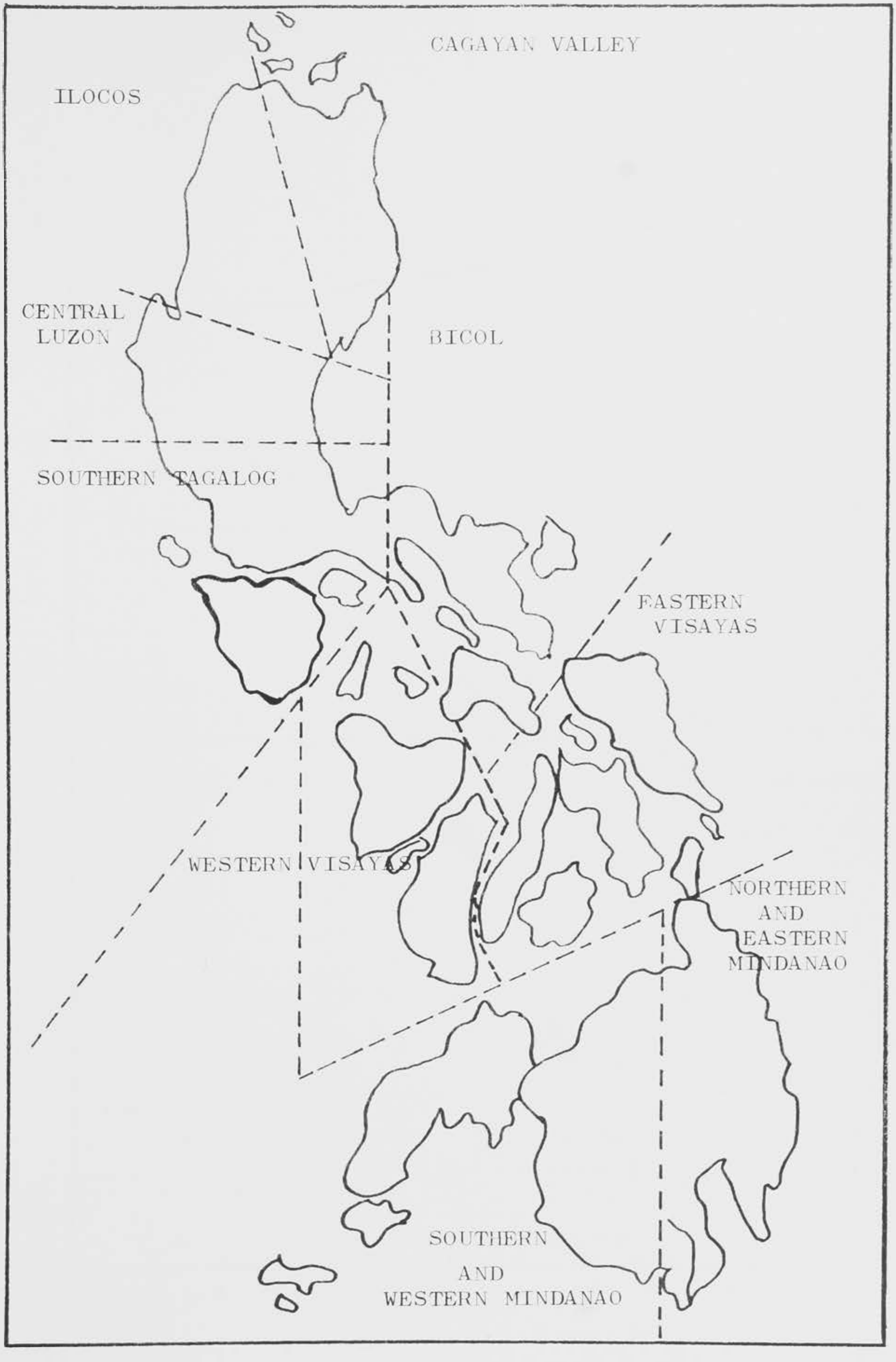


FIGURE 1

GEOOGRAPHICAL LOCATION OF THE VARIOUS REGIONS OF THE PHILIPPINES

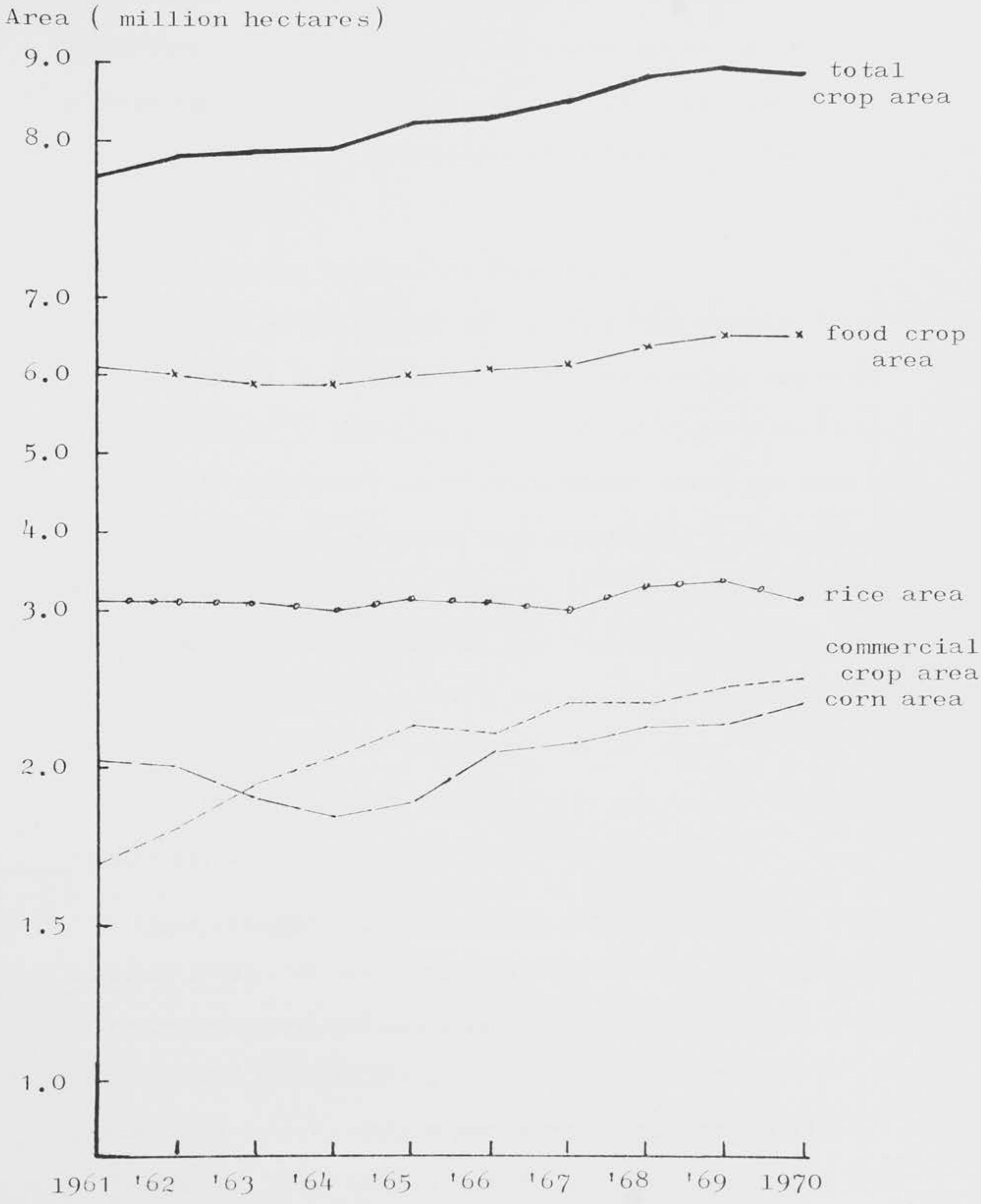


FIGURE 2

COMPARATIVE LAND UTILIZATION (CROP AREA)
FOR SELECTED SUBSISTENCE AND COMMERCIAL CROPS, PHILIPPINES
1961-1970

functions for rice. How do farmers respond to changes in the price of rice and to prices of alternative crops? An attempt is also made to measure the extent to which changes in production of rice have arisen from changes in the hectarage planted and from changes in yields. Secondly, to a lesser extent, to examine the farm prices of palay, the secular and seasonal trends.

1.1 Supply Models for Rice and Other Crops

Many of the current and proposed farm programs and policies reflect different views with respect to the nature of supply responses in agriculture. Indeed, an economic analysis, if carefully undertaken, could substantially reduce the role of 'intuitive judgment' and areas of disagreement. A supply analysis for rice, for example, could improve (a) the understanding of the mechanism of supply response, (b) our ability to forecast supply changes and, (c) quantify the possible effects of a number of proposed solutions to increasing rice supply.

Before beginning the study a brief review of previous studies may be useful.

Price response of output of individual crops: There are numerous studies of price response of individual agricultural crops in underdeveloped countries. Some early works along this line appeared to establish a positive price-response of agricultural output, while others imply no response at all.

Bauer and Yamey (1958), for example, reported that in Uttar Pradesh, India, cocoa producers reacted positively when the government Marketing Board offered growers a higher price for

Grade 1 cocoa relative to lower grade cocoa. Whereas Grade 1 cocoa constituted 47 per cent of the Marketing Board's purchases in 1947/48, upon an increase in relative price it increased to 98 per cent in 1953/54. Price incentives generated a more intensive management of farm areas to produce a higher quality cocoa when the rewards for quality were increased.

In 1960, the price response question stimulated debate at the annual meeting of the American Farm Economics Association, during which papers were read on the 'Impact and Implications of Foreign Surplus Disposal on Underdeveloped Economies'. At this meeting, Schultz (1960) expressed the opinion that total food output in underdeveloped countries responds positively to increases in farm prices of food. Schultz devoted much of his comment to an attack on the view that the price response of agricultural output was either zero or negative. Olson (1960), a discussant, opposed Schultz' view thus:

> 'I am not sure if it is a misconception to believe that the price response of Indian cultivators is very low; on the contrary, there is convincing evidence that there is a negative supply response by way of income effect. For the the vast majority of farmers, the marketable surplus is very small. The response to price may well be to retain more for consumption.'

Olson's 'supply response' is, more precisely, marketed-surplus response which differs from Schultz' 'production response'. An economic model which incorporates income and substitution effects can be constructed to support either view, but, in the absence of empirical information, the direction of the price response cannot be known in advance.

Krishnan(1963), demonstrated a positive price response in his study of eleven crops for the undivided Punjab in 1961. He estimated the acreage response functions for each individual crop and found significant short run (1 year) elasticities in seven cases. These ranged from +.08 for irrigated wheat to +.72 for American cotton. The following year (1964), Falcon found price elasticities of acreage of +.04 for cotton and +.20 for irrigated wheat in Punjab area of West Pakistan, during 1933/34 to 1958/59. Like Krishan, he did not find a significant elasticity for unirrigated wheat. Added to these series of studies was that of Khan (1964), who reported that in a sample survey conducted to determine the price elasticity of wheat (or rice), West Pakistan wheat farmers indicated that they would respond positively if the price rose, while East Pakistan rice farmers indicated that they would not respond to any significant extent.

The response to price of agricultural output shown by the results obtained from the previous studies done in underdeveloped countries, has been found to be almost always positive. The extent of response, however, varies with individual crops.

Price response of rice output: Included in the study of acreage response function done by Krishnan(1963) for Punjab, India, was rice, where he found a short run elasticity of +.31 and a long run elasticity of +.59. Then Mubyarto (1965) estimated the price elasticity of rice acreage in Indonesia to be +.30 during the period 1951 to 1962. The major independent variables used in the above studies were the lagged (1 year) ratio of price of crop under study and of the competing crop.

A contrary finding has been reported by Hsieh and Lee (1966) who estimated yield response to price change for Taiwan, using time series for the period 1922/38 and 1950/60. Their study revealed that price and fertilizer variations did not explain a significant amount of variation in yield. Although Taiwan's farmers utilized fertilizer as an input for rice production, Hsieh and Lee claimed that the recommended amount had never been used by the majority of the producers, hence there was very little effect of fertilizer on yield. They further elaborate on this point that, 'In rural areas, the marginal propensity to consume is very high. The additional money earned is likely to be spent on consumption rather than for production purposes.' In other words, for the farmers to invest their additional income in the purchase of production inputs the return must be exceptionally high with a minimal amount of projected risk.

It is apparent from these studies and those considered in the previous section that a statistically significant and positive price response of yield, acreage and output is not always found in studies of particular crops grown in underdeveloped countries. The results obtained from this study are summarized below.

The Yield and Hectarage Responses of Rice in the Philippines: In this study the supply or output response function for rice in the Philippines was measured in terms of hectarage and yield response estimates. The product of hectarage and yield determines the total quantity of rice that can be produced for a specific region as well as for the Philippines. The model can be written as -

$$Q = HY \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$H = f \ (P_t/F_t,\ A_t/F_t,\ W_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$Y = g \ (LO_t,\ TO_t,\ HI_t,\ HN_t,\ HU_t,\ SF_t,\ W_t,\ T_t) \ldots (3)$$

where: Q = quantity of rice produced

H = palay hectarage

Y - yield per hectare

The definition of the independent variables will be discussed in detail in chapter 4.0.

Hectarage response: The use of the price expectation series (equations 2 and 3 of the trial) in the empirical hectarage function, plus the additional rainfall variable, improved the estimates of the total explained variations (R^2) for the Philippines and five out of its nine regions, namely: Central Luzon, Southern Tagalog, Bicol and the two Visayan regions. The coefficient of the parameters, however, was found insignificant in all the trials. The coefficient of palay price ratio was consistently positive for the Philippines estimate and all its regions, except the Cagayan Valley. It was further observed that while rainfall positively induces a higher yield in some regions, it can create reduction in yield in other areas as shown by the results derived from Ilocos, Central Luzon, Southern Tagalog and the two Visayan regions.

The evidence obtained from the study, therefore, shows that rice farmers in the Philippines responded positively to change in price, the extent of which differs among regions.

Yield response: The majority of the trials performed for the yield response estimate showed significant coefficients for the parameters. Rice yield responded positively (significant) to increases in the amount of rainfall and the adoption of new rice variety for the Philippines and the majority of the regions. As expected, a greater proportion of irrigated areas positively contributes to yield, while an extended portion of non-irrigated and upland cultivated lands tends to reduce the average yield in each region as well as in the Philippines.

The study also attempted to measure the yield responses for irrigated, non-irrigated and upland palay lands. The estimate showed that the adoption of the new rice variety is the most crucial contributing factor to yield for irrigated areas, while for non-irrigated and upland yield it is rainfall. The effects of the other variables used in the estimate - like average size of farm and tenure of farm cultivators (tenant or leasehold) - on yield differ among regions. For example, a greater proportion of palay area cultivated by a tenant or leasehold operator positively contributed to yield for regions like Central Luzon, Bicol and Northern and Eastern Mindanao. While we should expect large size of farms to be a major factor in obtaining higher yield per hectare, in the above group of regions it contributes to lower yields.

The result of the estimates on yield response, therefore, shows that yield in various regions responded differently to the various input factors. While one input factor is found of relative importance to yield in some regions, it was observed to be a minor one to others, and in some cases it turned out to affect the yield negatively.

CHAPTER 2

LONG-TERM TREND IN PRODUCTION, AREA AND YIELD OF RICE

A good deal of information on long-run trends in rice production in the Philippines has been presented by Mangahas, et al, (1967). Their study demonstrated that while production had been on an upward trend during the period 1920 to 1949, the productivity per hectare remained relatively low. The increment in total output over this period was mainly caused by expanded acreage rather than higher yields. This trend has continued beyond 1949. Lawas (1968) for example, after discussing the production of rough rice from 1949 to 1960, concludes:'production of rice increased from 2.49 million metric tons in 1949 to about 3.74 million tons in 1960. This increase was largely attributable to <u>land expansion</u> from 2.2 million hectares to 3.3 million hectares between the two periods.' The data presented in his paper show that yield declined from 26.16 cavans in 1949 to 25.70 cavans in 1960.

This chapter will add to these previous studies and review the behaviour of rice production, area and yield for the period 1961 to 1970. The appraisal will aim to:

(a) determine the features of yields, acreage and production for the Philippines and its nine regions,

(b) make preliminary observations on the causes of production and yield increases for the Philippines and its nine regions, and

(c) assess the implications of regional area shifts and regional differences in production patterns on yields.

(d) further, it will be shown that the behaviour of acreage and yield of rice during the 1960s was very different from that of previous periods. During the 1960s the yield per hectare increased quite considerably but the total quantity of hectarage devoted to rice did not.

The data on rice area and yield will be later used in a statistical supply analysis.

2.1 The Data: Sources and Collection Methods

Statistical information on rice production, area and yield were made available from the Bureau of Agricultural Economics (DANR). The data were obtained from a sample census for the entire country on provincial levels, and then aggregated into regional totals.

In 1954, the BAEcon (formerly Agricultural Economics Division of the DANR) made its first major attempt to collect sample data. The first nationwide Crop and Livestock Survey, designed to estimate rice production, was conducted from April to June, 1954. Improvements in the survey design were made in 1955, 1958 and 1961, which permitted reductions in sample fractions as follows: 1:333 in 1958-60 surveys and 1:350 in 1961 and on subsequent years surveys.

Although elements of personal judgment are still undoubtedly involved in the present collection method, recent data are to be considered more reliable. Trinidad's (1964) review of Philippines economic statistics contains what is probably the best objective appraisal to date of the Crop and Livestock Surveys. His paper emphasizes the following points:

(a) Since the sample was expressly designed to obtain maximum accuracy for rough rice (palay or padi), the coefficients of variation calculated for palay production in 1962 were only 3.39 per cent for the entire country and below 10 per cent for the regional level. The coefficient of variation for other crops and livestock items have been much greater.

(b) As farmers seldom keep systematic records the data collected are subject to memory bias. The estimates of rice acreage are thought to be less reliable than the production estimates, and to be biased upwards.

(c) The surveys do not cover agricultural activities carried on by non-farm households farming a physical area less than 1,000 square metres and keeping less than 100 head of poultry.

The sample results are inflated separately by the sampling fractions for each year in order to estimate the aggregate data. For example, to calculate regional production an estimate of provincial hectarage is made. This figure is then multiplied by the average yield taken from the sample data.

2.2 Long-term Changes in Rough Rice (palay or padi) Production, Area and Yield

In this section we describe the trends of rice production, area and yield. In the following sections we will turn to a description of annual variations in these aggregates.

2.2.1 The Philippines

From 1961 to 1970, the area devoted to rough rice decreased by approximately 3 per cent. Production of rice, however, increased by 41 per cent, and yield per hectare by 45 per cent. The rate of increased production was not constant over the period. Much of the increase occurred in 1968 and 1970.

For the year 1968 production increments resulted primarily from significant increases in hectarage. For the year 1970, however, production increases resulted from a large increase in yield. The area planted in that year was lower than that of the previous year. The data on yield, acreage and production for the Philippines as a whole are presented in Figures 2.1a, b and c.

2.2.2 The Regions

The summary statistics of production, area and yield for each of the regions for the years 1961 and 1970 are listed in Table 2.2 and summarized in Figures 2.2a and 2.2b. The main features of these data are as follows.

Two regions considerably reduced the hectarage of rice planted but at the same time achieved large increases in yield so that production was largely unaffected, or increased slightly. In the Cagayan Valley regions, the area planted declined by 44 per cent. This was offset by a 50 per cent increase in yield per hectare, such that the overall regional production increased by 4 per cent over the 1961 production levels. The Western Visayas provinces reduced the area planted by 4 per cent. Production also increased, however, as a result of higher yields.

Five regions showed simultaneous increases in acreage and yield as a basis of increased production. These were Northern and Eastern Mindanao, Southern and Western Mindanao, Bicol, Central Luzon and Ilocos regions.

Central Luzon remained the prime producer of palay, with an increase of around 10.5 million sacks (or 64 per cent) over the period. Hectarage increased by 16 per cent. The Ilocos region, the lowest regional producer, showed great improvement, with a production

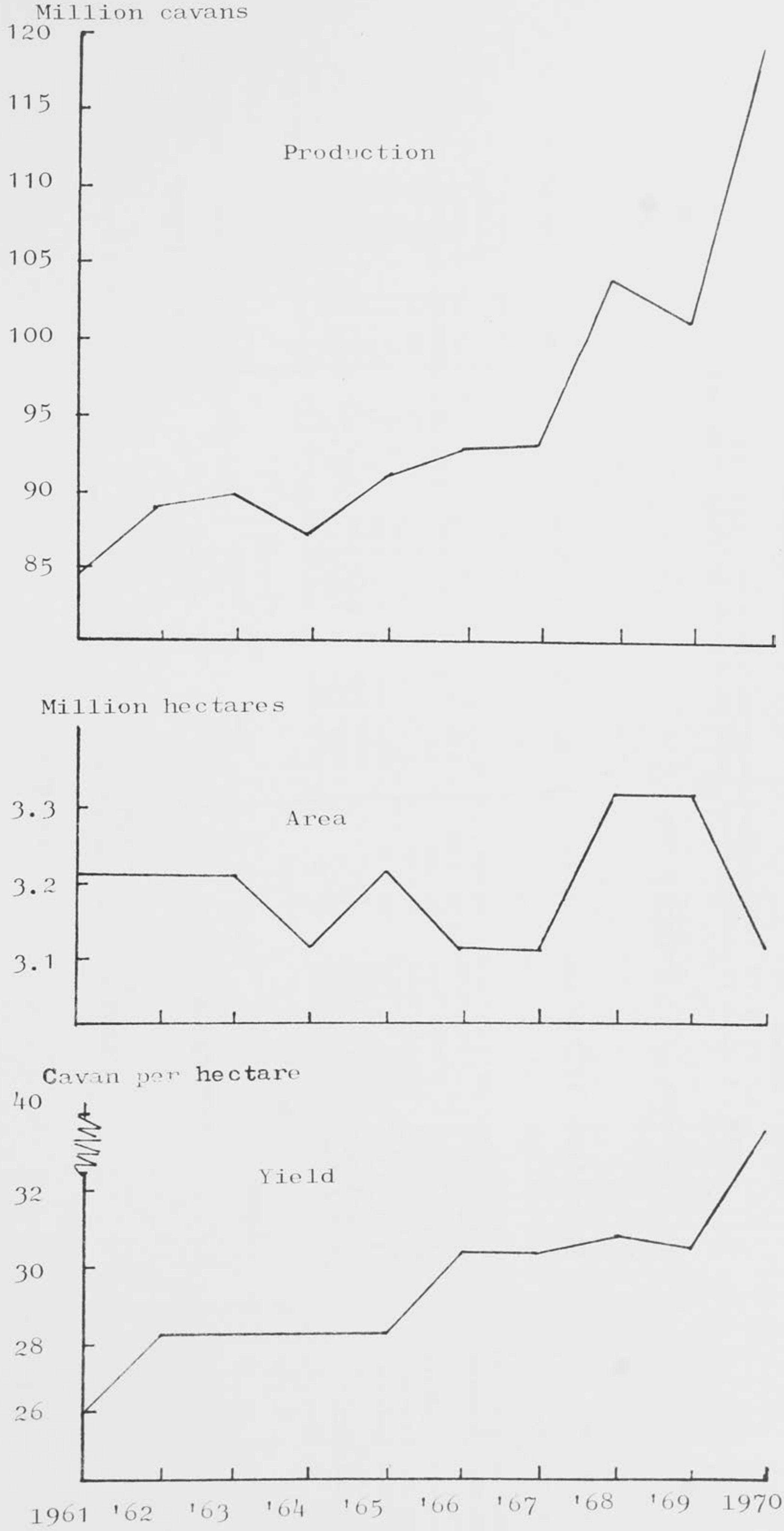


FIGURE 2.1

TREND IN PRODUCTION, AREA AND YIELD FOR PALAY (ROUGH RICE), PHILIPPINES, 1961 - 1970

TABLE 2.2

REGIONAL CHANGES IN PALAY (ROUGH RICE) AREA
AND YIELD, PHILIPPINES, 1961-1970

	PRODUCTION			AREA			YIELD		
	1970	1961	Change[a/]	1970	1961	Change[a/]	1970	1961	Change[a/]
	cavans		Per cent		cavans				
Philippines	118,941,100	84,199,000	41.26	3,113,440	3,197,750	(2.71)	38.20	26.33	45.08
I. Ilocos	5,217,200	3,212,750	62.39	144,820	110,630	30.90	36.02	29.04	24.04
II. Cagayan Valley	11,671,500	11,217,900	4.04	314,040	453,890	(44.53)	37.16	24.71	50.38
III. Central Luzon	32,085,100	19,517,570	64.39	634,750	545,730	16.31	50.54	35.76	41.33
IV. Southern Tagalog	13,981,400	8,677,790	61.12	345,370	363,850	(5.35)	40.48	23.84	69.80
V. Bicol	12,681,800	7,402,040	70.48	357,960	317,800	12.64	35.25	23.29	51.35
VI. Eastern Visayas	6,358,100	7,650,920	(20.33)	256,580	377,940	(47.30)	24.78	20.24	22.43
VII. Western Visayas	13,657,100	11,895,710	14.81	397,810	414,310	(4.15)	34.33	28.71	19.57
VIII. Northern & Eastern Mindanao	6,344,800	3,318,840	91.18	194,330	172,380	12.73	32.64	19.25	69.56
IX. Southern & Western Mindanao	17,007,100	11,305,480	50.43	467,780	441,220	6.02	36.35	25.62	41.88

[a/] Computed by $\frac{x\ 1970}{x\ 1961} \times 100$

where: x 1970 is production, area or yield in 1970 crop year
x 1961 is production, area or yield in 1961 crop year
( ): minus

Source of basic data: Crop and Livestock Survey Series, Bureau of Agricultural Economics, D.A.N.R.

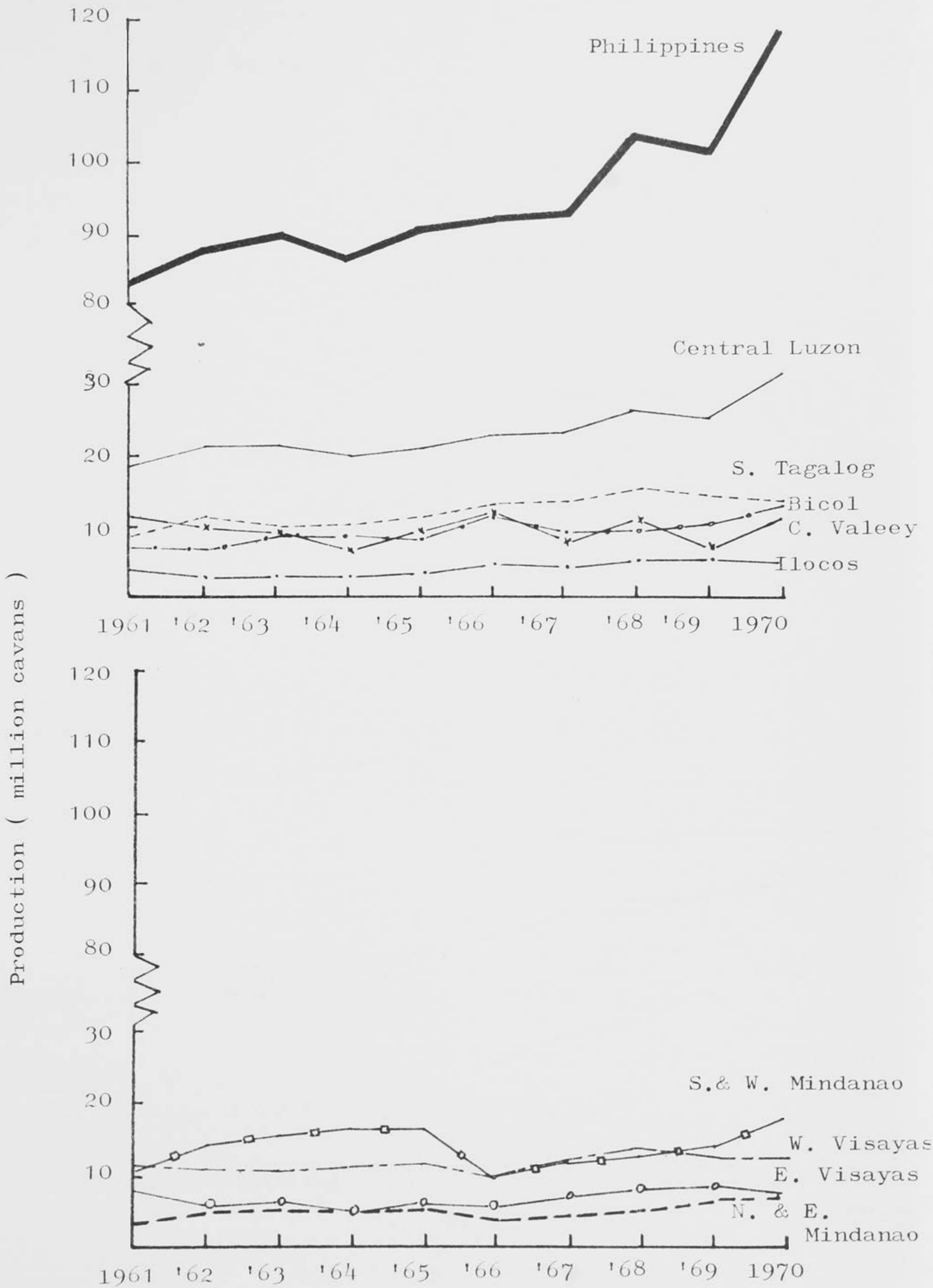


FIGURE 2.2a
TRENDS IN ROUGH RICE PRODUCTION IN VARIOUS REGIONS, PHILIPPINES
1961 - 1970

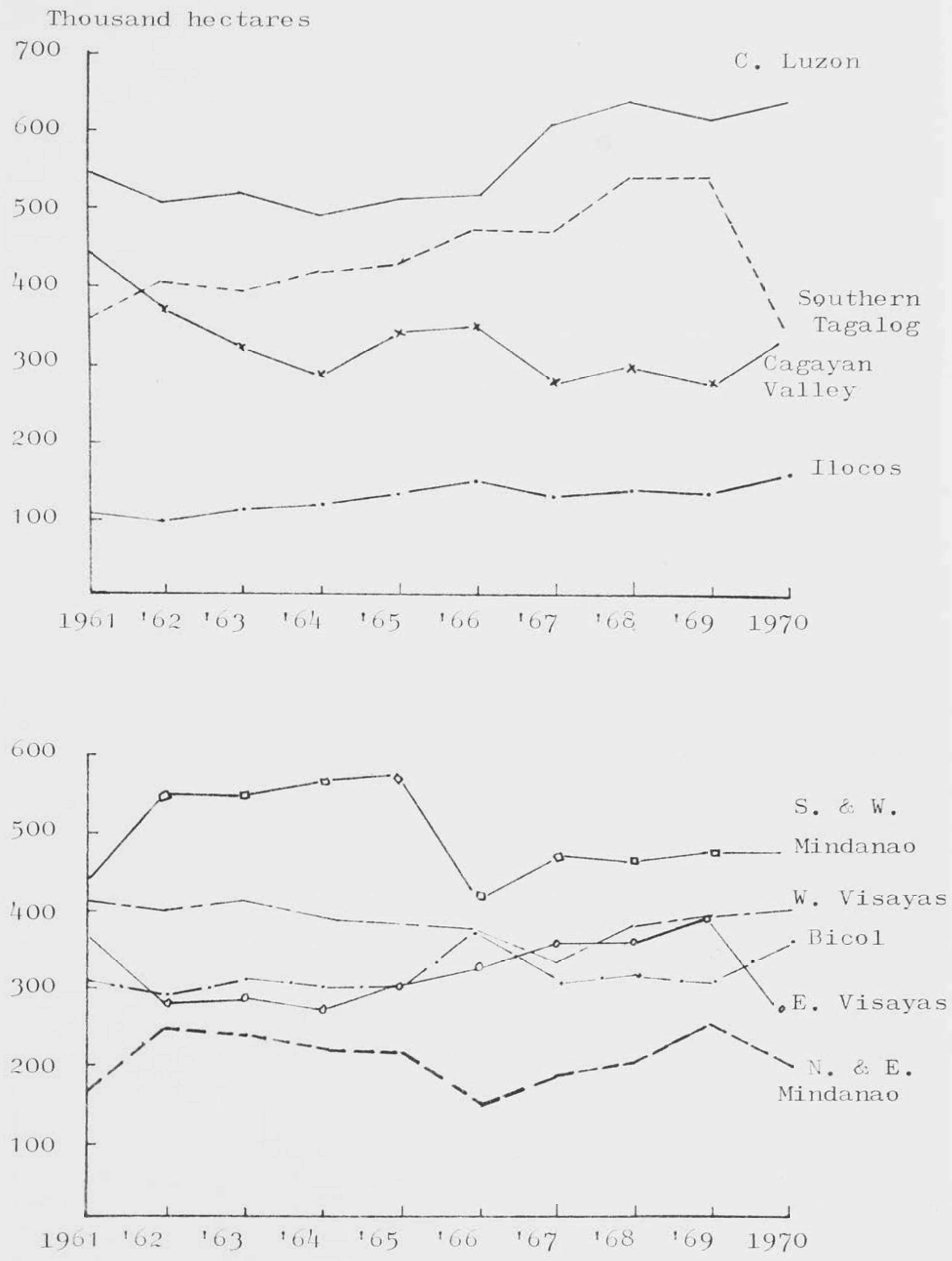


FIGURE 2.2b
RICE AREAS IN VARIOUS REGIONS, PHILIPPINES
1961 - 1970

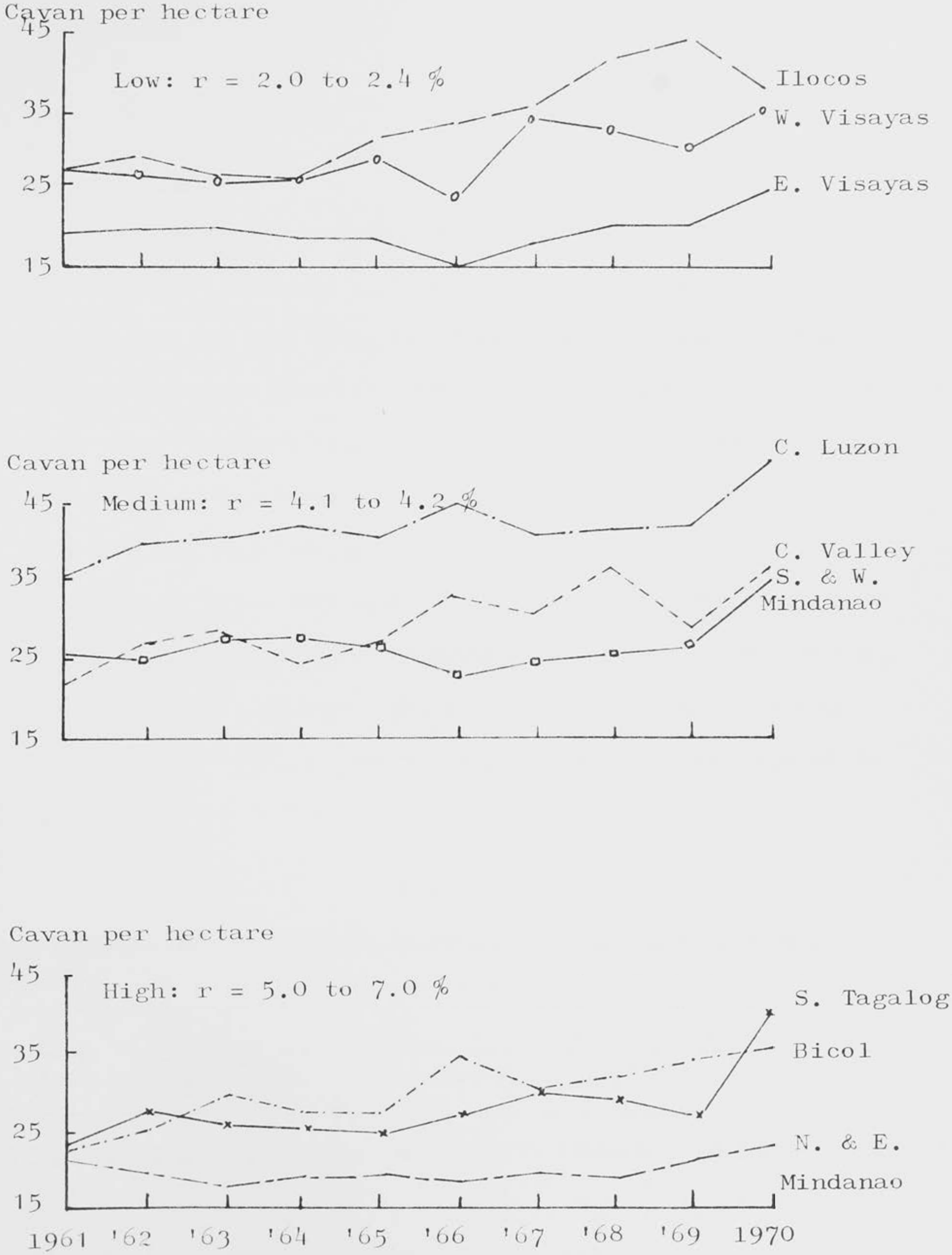


FIGURE 2.2 c

TRENDS IN RICE YIELD IN VARIOUS REGIONS
PHILIPPINES, 1961 - 1970

increase of 62 per cent despite an increase of only 31 per cent in area planted.

2.2.3 Annual Variation

The Philippines

Aggregate production has tended to increase annually by 4.1 per cent. There was a slight fall in 1964, when output was reduced by 3 per cent (from 90.2 to 87.3 million cavans). When typhoon Dading had spent its fury that year, six regions reported heavy damage in their standing rice crops.[a] The consequence, therefore, was a reduction in the overall national production. The year 1970 was characterized by an unprecedented rice increase amounting to 21 per cent over the previous year. This was largely obtained by the planting of high-yielding rice varieties. During the period, 1970, 43.5 per cent of riceland had been planted to high-yielding varieties, for which a hectare can yield from 80 to 100 cavans.

TABLE 2.3

RECENT TRENDS IN RICE VARIETY ADOPTION IN THE PHILIPPINES

- Hectare -

Crop Year	Total Harvested Area	Area Harvested of High Yield Varieties				% of Total
		IR*	BPI**	C***	Total	
1967/68	3,303,660	428,570	254,670	18,260	701,500	21.2
1968/69	3,332,150	899.530	292,580	159,660	1,351,770	40.6
1969/70	3,113,440	1,037,190	114,590	202,150	1,353,930	43.5

Source: The Philippine Recommends for Rice (1970): Published by the National Food and Agriculture Council (NFAC).

* International Rice Research Institute (IRRI) strains

** Bureau of Plant Industry certified variety

***College of Agriculture certified variety

[a] 'The Philippine Rice Industry', Status Report.

There was little annual variation in area harvested from 1961 to 1963. From 1964, however, there have been erratic movements in area harvested with a sudden increase in 1968; a slight levelling off in 1969, and an abrupt decrease in 1970.

The national average yield per hectare was approximately constant from 1962 to 1965 after an initial increase of 6 per cent over the 1961 figure. Over the subsequent years the yield grows at an increasing rate. The national average yield per hectare has increased from 26.33 cavans in 1961 to 38.20 cavans in 1970.

The Regions

The annual variation in relative contribution of various regions to total rice production is reflected in figure 2.3a. Central Luzon maintained the greatest share, ranging from 23 to 27 per cent of the national output. This was followed by Southern and Western Mindanao and Southern Tagalog.

Figure 2.3b illustrates the relative participation of various regions to total area harvested during the 10-year period. In 1961, Central Luzon reported the highest area devoted to rice followed by Cagayan Valley, Southern and Western Mindanao and Western Visayas regions. After a 5-year period, Southern Tagalog ranked second to Central Luzon in area planted with Western Visayas running third. During the 1970 cropping season, Southern and Western Mindanao surpassed Central Luzon and contributed 15 per cent to the total aggregate area.

Annual yield variation among regions for the ten years period is shown in Figure 2.3c. It can be seen that Central Luzon possesses the highest yield of 50.5 cavans per hectare in crop year 1970. This was the highest regional yield ever attained.

FIGURE 2.3a

RELATIVE CONTRIBUTIONS OF VARIOUS REGIONS
TO TOTAL ROUGH RICE PRODUCTION, PHILIPPINES, 1961 - 1970

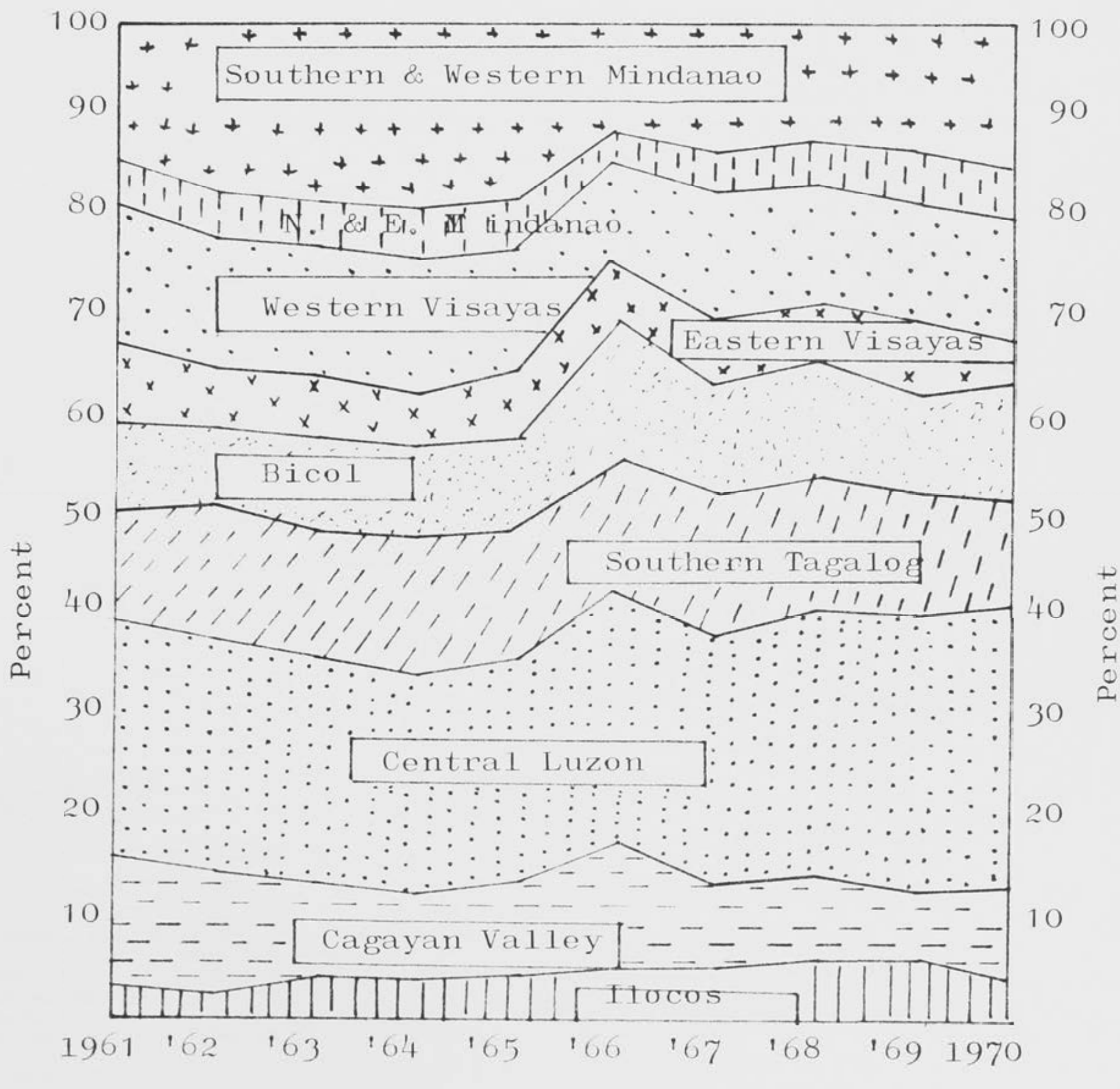
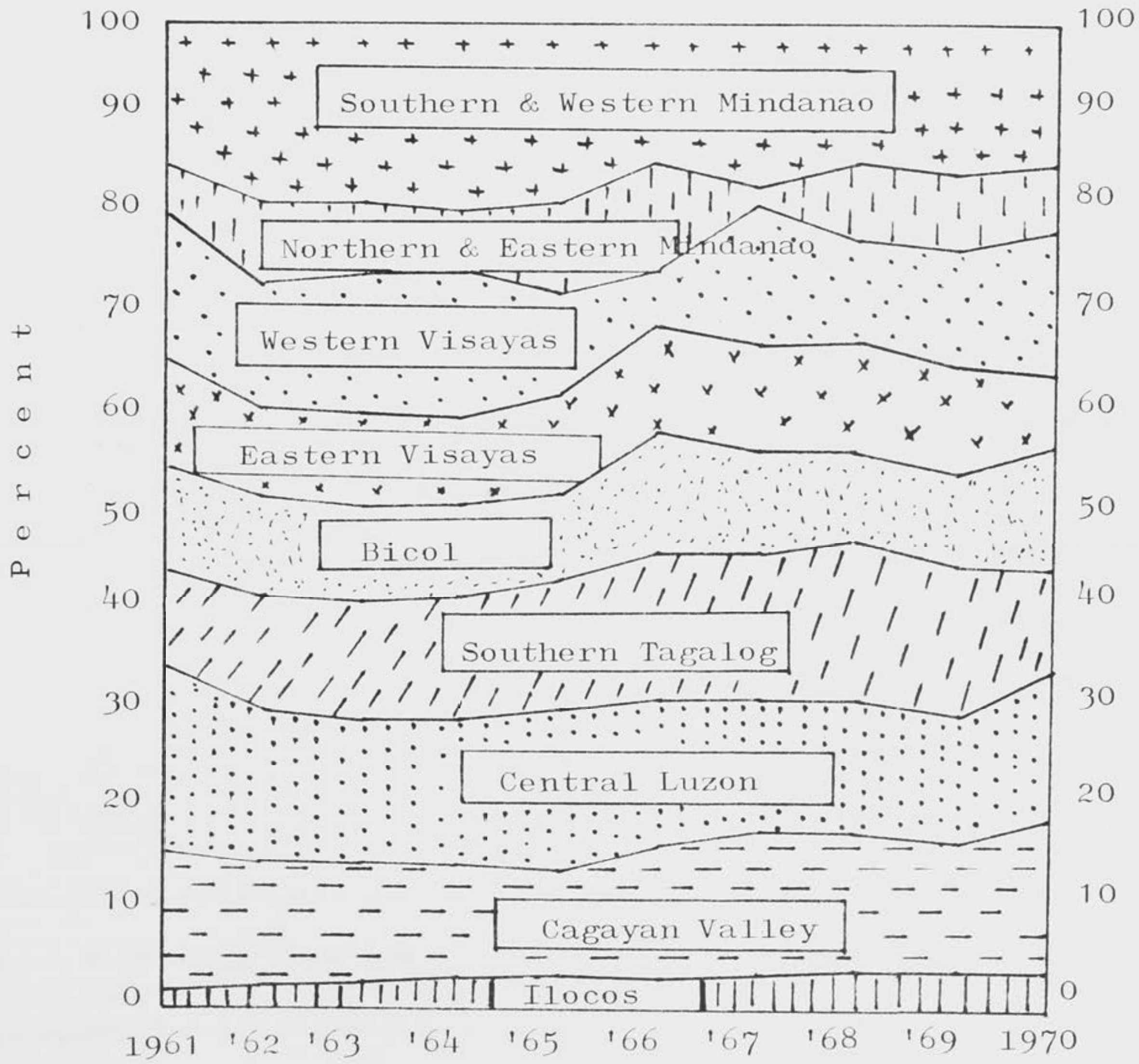


FIGURE 2.3 b

RELATIVE CONTRIBUTION OF VARIOUS REGIONS TO TOTAL RICE AREA, PHILIPPINES, 1961 - 1970



The region with the lowest yield reported in the early part of the study (18.7 to 19.3 cavans/hectare) was Northern and Eastern Mindanao (from 1961 to 1963). From 1964 onward Eastern Visayas was found to be lagging behind with an average yield ranging from roughly 16 cavans to only 25 cavans per hectare.

2.3 Implications of Regional Area Shifts on Yields

Changes over time in national average yields reflect the interaction of both changes in average yield per hectare in each region and changes in regional distribution of the area planted to rice. Similarly, differences in average yields within each region reflect differences in seasonal distribution of rice production and in the relative amount of irrigated, rainfed and upland rice planted in each season. This section attempts to explore the effects of both sources of yield differences.

Prior to the period under study, rough rice yields per hectare remained relatively stable at around 25 to 26 cavans. These yields are weighted yield averages in the various regions, the weight depending upon the rice area and production in each area. If yields differ sharply among regions, changes in the regional distribution of palay production over time can affect national average yields. An increase in area planted in low-yielding regions like Eastern Visayas would depress the average yield.

2.3.1 Effects of Regional Area Shifts

The calculation of the impact of the regional shifts in acreage distribution in rice yields was based on the procedure used by Johnson and Gustafson (1962)[a]. The procedure aims at determining, through possible combinations of area and yield, whether the shifts in the distribution of acreage between regions are likely to account for the change in the national average yield from one point to another.

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[a] The method can be described as follows: To measure the effect of changes in acreage distribution based on 1961 yields, the following averages were calculated:

(1) $$\frac{\sum_{i=1}^{9} A_i\ (1961)\ \ Y_i\ (1961)}{\sum_{i=1}^{9} A_i\ (1961)}$$

(2) $$\frac{\sum_{i=1}^{9} A_i\ (1962)\ \ Y_i\ (1961)}{\sum_{i=1}^{9} A_i\ (1962)}$$

(3) $$\frac{\sum_{i=1}^{9} A_i\ (1963)\ \ Y_i\ (1961)}{\sum_{i=1}^{9} A_i\ (1963)}$$

(4) $$\frac{\sum_{i=1}^{9} A_i\ (1964)\ \ Y_i\ (1961)}{\sum_{i=1}^{9} A_i\ (1964)}$$

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(10) $$\frac{\sum_{i=1}^{9} A_i\ (1970)\ \ Y_i\ (1961)}{\sum_{i=1}^{9} A_i\ (1970)}$$

Where:

A_i = rice area in the ith region

Y_i = yield per hectare in the ith region and

summation in each case is over Philippines.

The impact of changes in acreage distribution on the national average yield of palay from 1961 to 1970, is presented in Table 2.4. Underlined figures show the actual national yields for the respective years. An analysis of the figures in each row explains the effect of shift in rough rice production among the regions on the national average yields if the regional average remains unchanged in each region. Each successive row uses the yield of a different year as weights.

If the yield in each region had remained unchanged at the 1961 level between 1961 and 1970, the regional area shifts that occurred since 1961 would have resulted in an increase in national average yield from 26.33 to 26.84 cavans per hectare. These numbers are read from the first row of Table 2.4.

Holding the yield at the 1962 level, for example, the national average yield in 1961 would be 28.13 cavans per hectare, while in 1970, the national yield would have increased to 28.73 cavans (second row). This exercise can be completed for each year. As one final example, the procedure can be done from right to left across the rows. For example, if the average yield of 38.20 cavans in 1970 were obtained in 1961, the acreage distribution in 1961 would have resulted in a slight decrease of yield to 37.41 cavans. These examples are sufficient to illustrate that the distribution of acreage between regions that has occurred is a relatively minor factor in explaining the change in the national yield. The conclusion, therefore, will be that the considerable increase in yield that has occurred has not been the result of a shifting distribution of acreage across areas.

TABLE 2.4

EFFECTS OF CHANGES IN ACREAGE DISTRIBUTION ON ROUGH RICE YIELDS, PHILIPPINES, 1961-70

	Acreage Distribution Used As Weight									
Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					Cavans per hectare					
1961	26.33	26.22	26.30	26.28	26.26	25.77	26.52	26.49	26.30	26.84
1962	28.13	27.95	28.00	27.97	27.99	26.90	28.43	28.40	28.15	28.73
1963	28.66	28.48	28.51	28.50	28.52	28.70	28.89	28.80	28.50	29.28
1964	28.25	28.21	28.29	28.28	28.23	28.32	28.65	28.56	28.31	29.06
1965	28.46	28.37	28.43	28.39	28.35	28.47	28.68	28.63	28.37	29.17
1966	29.59	29.18	29.17	29.11	29.20	29.76	29.67	29.66	29.20	30.36
1967	30.07	29.81	29.86	29.82	29.83	30.23	30.05	30.03	29.82	30.62
1968	31.48	31.05	31.06	31.00	31.10	31.57	31.32	31.37	30.97	31.99
1969	28.15	27.54	27.73	27.34	27.35	28.40	28.18	28.58	30.31	28.97
1970	37.41	37.57	37.56	37.58	37.56	37.67	37.95	37.98	38.76	38.20
					Index 1961 = 100					
1961	100	100	100	100	100	98	101	101	100	102
1962	107	106	106	106	106	102	108	108	107	109
1963	109	108	108	108	108	109	110	109	108	111
1964	107	107	107	107	108	108	109	108	108	110
1965	108	108	108	108	108	108	109	109	108	111
1966	112	111	111	111	111	113	113	113	111	115
1967	114	111	113	113	113	115	114	114	113	116
1968	120	118	118	118	118	120	119	119	118	121
1969	107	105	105	104	104	108	107	109	115	110
1970	142	143	143	143	143	143	144	144	147	145

Moving down a column the actual yield in each year of each area is used but the area distribution is fixed. For example, the first column indicates that if there had been no change in area distribution among regions between 1961 and 1970, the national average yield would have risen from 26.33 cavans in 1970. Similarly, if the acreage distribution of 1962 had prevailed throughout the period, the national average yields would have decreased in 1961 and 1969, but increased to 37.57 cavans per hectare in 1970 (second column). Further, if the 1970 hectarage distribution had prevailed throughout the period, the national average yield for the first eight years would be greater than the actual yield reported for the period, with the exception of 1969. Shifting production patterns across regions from low yield to high yield regions made very little contribution to the increase in the national yield over the decade.

2.4 Effects of the Regional Production Pattern on Rice Yield

Rice is produced almost everywhere in the Philippines and under various production conditions. Such is the production propensity for rice of the country that in any of the prevailing seasons of the year, for instance wet or dry, any one of the rice-producing regions could grow the staple cereal either on an upland, irrigated or non-irrigated land. Production efficiencies differ, however, among regions and among riceland condition

TABLE 2.5

DIFFERENCES IN YIELD FOR VARIOUS REGIONS BASED ON DIFFERENT LAND CONDITION DISTRIBUTION PHILIPPINES 1970

Region	National average (cavans/ha.)	Land condition: Irrigated		Non-irrigated		Upland	
		% of Total	Yield (cav/ha)	% of Total	Yield (cav/ha)	% of Total	Yield (cav/ha)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Philippines	38.20	43.22	46.63	43.54	34.36	13.24	23.33
Ilocos	36.02	52.86	38.13	43.64	35.00	3.51	17.07
Cagayan Valley	37.16	67.47	41.33	29.98	29.46	2.56	17.55
Central Luzon	50.54	51.57	55.46	46.69	45.96	1.74	28.28
Southern Tagalog	40.48	44.44	48.78	30.02	35.39	25.52	32.08
Bicol	35.25	45.82	49.47	30.56	30.27	23.62	14.11
Eastern Visayas	24.78	24.93	36.64	67.50	21.52	7.57	14.78
Western Visayas	34.33	18.20	44.60	72.54	33.28	9.26	22.42
N. & E. Mindanao	32.64	28.86	46.91	43.92	27.82	27.24	25.32
S. & W. Mindanao	36.35	47.04	41.43	30.30	37.31	22.65	24.55

Source: Bureau of Agricultural Economics

TABLE 2.6

EFFECTS OF DIFFERENCES IN PROPORTION OF LAND CONDITION ON REGIONAL AVERAGE YIELD, PHILIPPINES 1970

Region	Actual Yield		Standardized Yield a/		[(3) ÷ (5)] x 100
	Cav/ha	Index	Cav/ha	Index	
(1)	(2)	(3)	(4)	(5)	(6)
Philippines	38.20	100.00	38.20	100.00	
Ilocos	36.02	94.29	28.74	75.24	125.32
Cagayan Valley	37.16	97.28	29.40	76.96	126.40
Central Luzon	50.54	132.30	39.74	104.03	127.17
Southern Tagalog	40.48	105.97	46.44	121.57	87.17
Bicol	35.25	92.28	25.40	66.49	138.79
Eastern Visayas	24.78	64.87	20.98	54.92	118.12
Western Visayas	34.33	89.87	29.97	78.46	114.54
N. & E. Mindanao	32.64	85.45	37.13	97.20	87.91
S. & W. Mindanao	36.36	95.18	37.69	98.66	96.47

a/ Yield weighted by the distribution of Philippine rough rice area into irrigated, non-irrigated and upland. The weights are computed by dividing the hectarage devoted to a specific culture, e.g. irrigated, by the total hectarage.

classifications[a]. The classification into further detail of the irrigated and non-irrigated lands by the Bureau of Agricultural Economics (that is, into 'first cropping' and 'second cropping') may have some significance, but because of insufficient data the analysis is confined to the three general classifications - upland, irrigated and non-irrigated (rainfed).

An attempt will be made first, to examine and analyse the production capability of each region given that upland, irrigated and non-irrigated exist in each region and secondly, to examine the effect on yield over the decade of changing proportions of land conditions in each region.

Cross-sectional analysis: An attempt to measure the effect of different land conditions on regional average yield is given in Table 2.6. The data in the second column were the actual average yields obtained in 1970 for each region. The data presented in the fourth column were the average yields that would have been estimated for each region if the proportion of hectarage in land conditions were similar to that of the national level. To calculate these

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[a] In 1965, for example, BAEcon has estimated the rice area distribution in the Philippines as follows:

Philippines	per cent
Upland	19.82
First crop -	
(a) Irrigated	20.79
(b) Non-irrigated	44.03
Second crop -	
(a) Irrigated	9.17
(b) Non-irrigated	6.19

An upland or 'kaingin' land is utilized once a year only and with planting season between May to September. The 'first cropping' falls between the months of May to August, and the 'second cropping' starts somewhere between November to February.

numbers the yield of each land condition in each area is multiplied by the proportions of land conditions that prevailed at the national level. In Southern Tagalog, for instance, the actual average yield in 1970 was 40.48 cavans per hectare or almost 6 per cent above the national average. If the distribution of area among the different land conditions had been the same as the national level, the average yield for the period would have been 46.44 cavans, or a 13 per cent increase over the actual yield obtained. Similarly, in the Mindanao regions if the land condition proportions were the same as the national average, the yields that would have been obtained from the regions would have been higher than the actual yields.

If the national average distribution of irrigated and non-irrigated areas were adopted for the remaining regions, their yield per hectare would decline.

Therefore, the limited proportion of the total area devoted to irrigated palay, both in the dry and the wet seasons, is a major barrier to increased production and to higher average yields in most regions. In Central Luzon, for example, where yield is relatively high in comparison with other areas, a reduction of one per cent in irrigated land utilization would probably reduce the yield per hectare by more than 3 per cent.

The analysis could be conducted for each year. This one example, however, is sufficient to demonstrate the importance for regional yields of different proportions of land condition in each region. Similarly, to calculate the effect of variations in yield of each land condition, the actual proportions of land conditions in each area were used and multiplied by the national yields of each land condition. This is done in Table 2.6a.

TABLE 2.6a
EFFECTS OF DIFFERENCES IN PROPORTION OF LAND
CONDITION ON REGIONAL AVERAGE YIELD, PHILIPPINES
1970

Region	Actual Yield		Standardized Yield		
	Cav/Ha	Index	Cav/ha	Index	[(3) ÷ (5)] x 100
(1)	(2)	(3)	(4)	(5)	(6)
Philippines	38.20	100.00	38.20	100.0	
Ilocos	36.02	94.29	40.45	105.89	89.05
Cagayan Valley	37.16	97.28	42.35	110.86	87.75
Central Luzon	50.54	132.30	40.49	105.99	124.82
Southern Tagalog	40.48	105.97	31.63	82.09	129.09
Bicol	32.25	92.29	37.36	97.80	94.37
Eastern Visayas	24.78	64.87	36.57	95.73	67.76
Western Visayas	34.33	89.87	35.56	93.09	96.54
N. & E. Mindanao	32.64	85.45	34.89	91.34	93.55
S. & W. Mindanao	36.36	95.18	34.62	98.48	96.65

The data presented in column (4) were the average yields that would have been estimated for each region if the yield in each land condition at the national level had prevailed in the regions. In Ilocos, for example, the actual average yield in 1970 was 36.02 cavans per hectare. But if the yield variations for each land condition were the same as the national level, the average yield would be 40.45 cavans per hectare or 11 per cent above the actual yield reported for the region and 6 per cent above the national average. For Southern Tagalog, if the yield distribution in each land condition were similar to that of the national level, the average yield for the region would decline by 29 per cent from the actual yield reported and be 18 per cent below the national average. The same declining regional averages were observed for Central Luzon and Southern and Western Mindanao regions if the national yield distribution among the different land conditions had persisted.

The estimates obtained for the rest of the regions, repeating a similar procedure, indicated that if the national variations of yield in each land condition had existed in the area, their actual average yield would have increased. Therefore, the analysis suggests that increased yield for the majority of the regions during the period was attained through change in yield and not in proportion to each land condition.

Time-series analysis: Table 2.7 presents the proportions of land conditions in the Philippines and Figures 2.7a to 2.7c in the regions for each year since 1961.

TABLE 2.7
DISTRIBUTION OF ROUGH RICE (PALAY) AREA HARVESTED BY LAND CONDITIONS, PHILIPPINES
1961-70

Year	Total		Irrigated		Non-irrigated		Upland	
	Hectare	Per cent	Hectare	Per cent	Hectare	Per cent	Hectare	Per cent
1961	3,197,750	100.00	959,790	30.01	1,660,120	51.92	577,840	18.07
1962	3,179.190	100.00	987,370	31.05	1,510,000	47.50	681,820	21.45
1963	3,161,320	100.00	1,013,570	32.06	1,450,890	45.90	696,860	22.04
1964	3,087,450	100.00	929,880	30.12	1,530,500	49.57	627,070	20.31
1965	3,199,670	100.00	958,380	29.95	1,607,030	50.23	634,260	19.82
1966	3,109,180	100.00	960,460	30.89	1,542,880	49.62	605,840	19.49
1967	3,096,120	100.00	1,170.640	37.81	1,480,130	47.81	445,350	14.38
1968	3,303,660	100.00	1,309,020	39.62	1,514,020	45.83	480,620	14.55
1969	3,332,150	100.00	1,482,820	44.50	1,406,790	42.22	442,540	13.28
1970	3,113,440	100.00	1,345,730	43.22	1,355,630	43.54	412,080	13.24

Source: Bureau of Agricultural Economics, D.A.N.R.

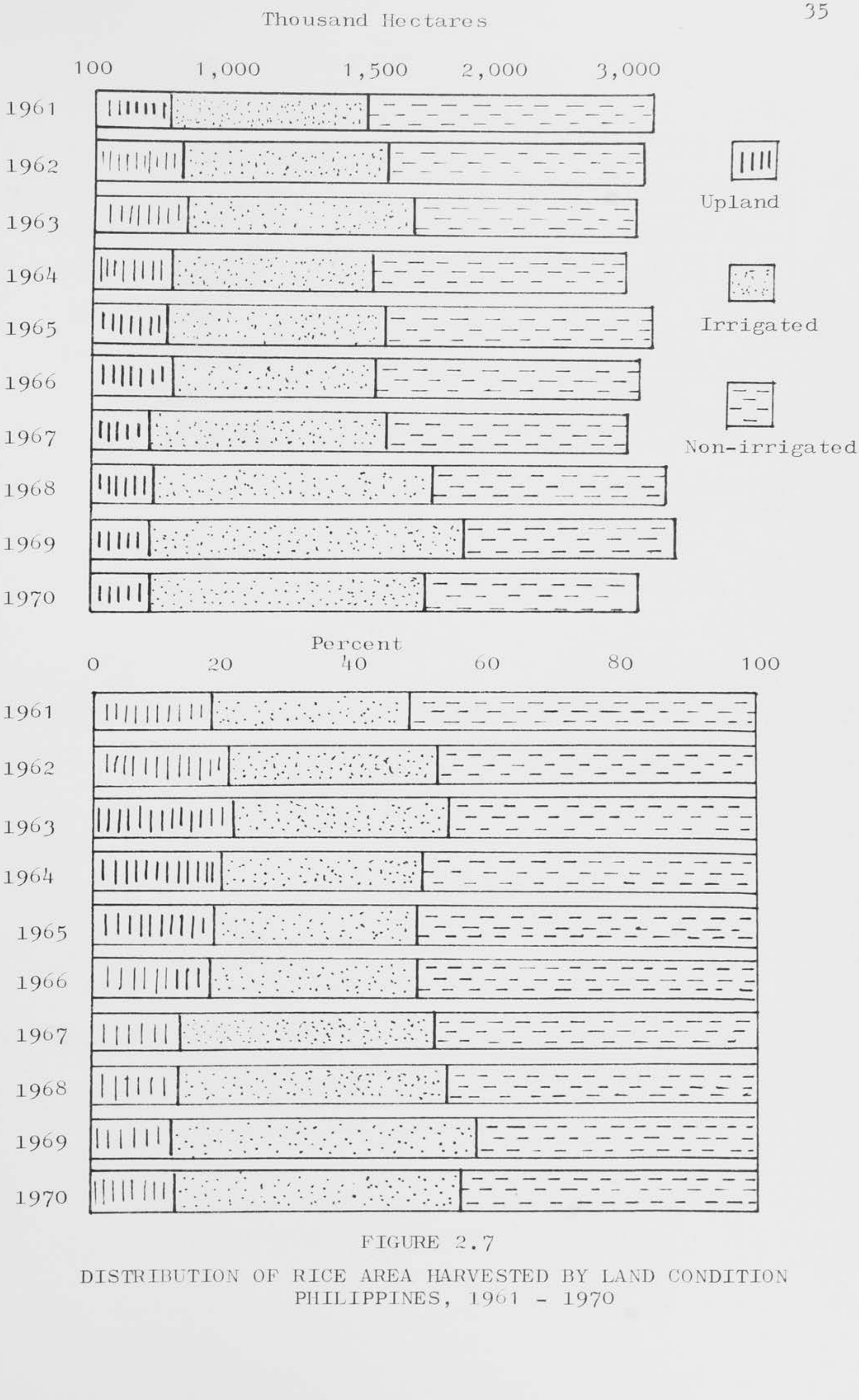


FIGURE 2.7

DISTRIBUTION OF RICE AREA HARVESTED BY LAND CONDITION
PHILIPPINES, 1961 - 1970

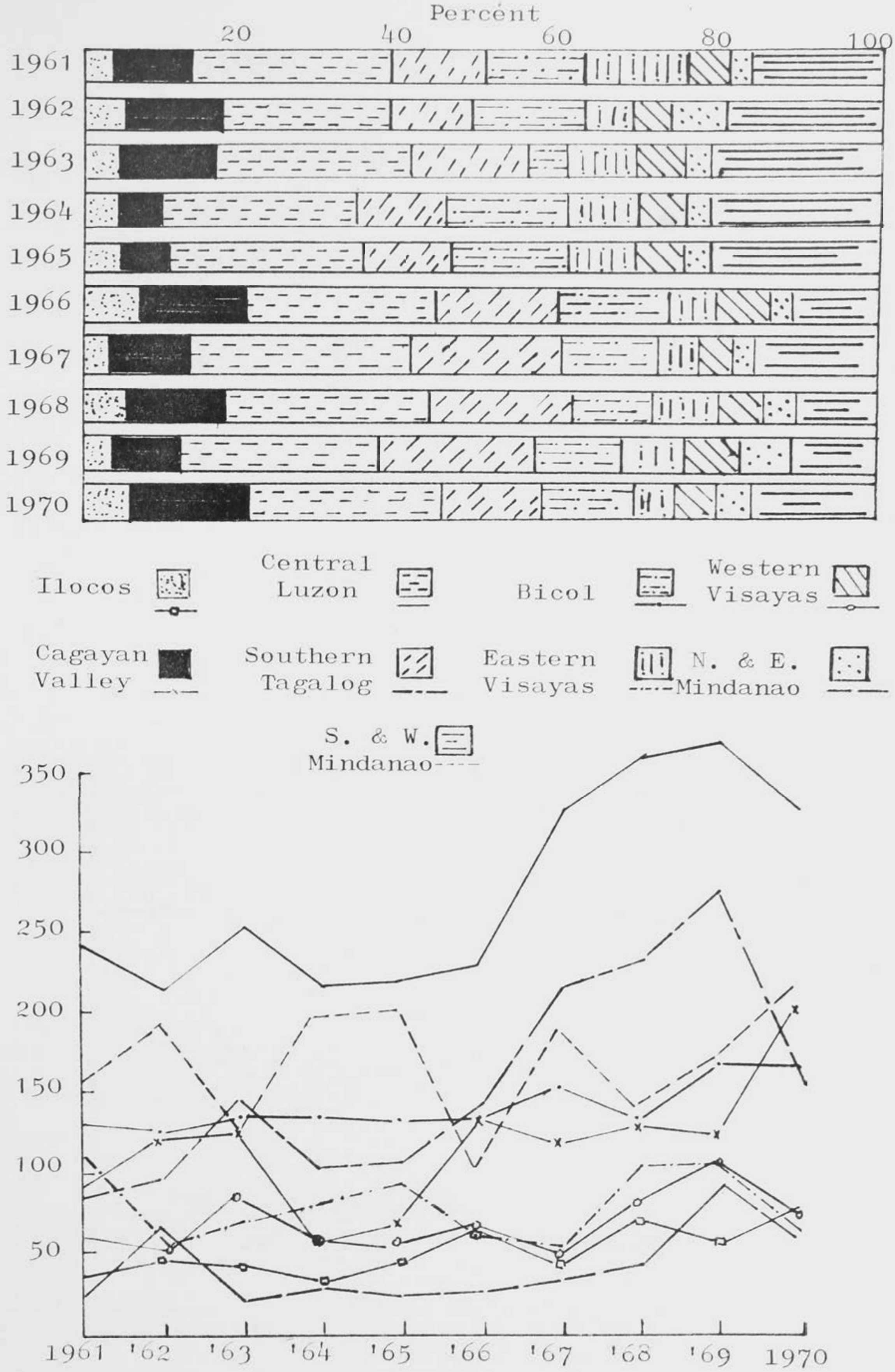


FIGURE 2.7a

REGIONAL DISTRIBUTION OF IRRIGATED AREA HARVESTED, PHILIPPINES, 1961-1970

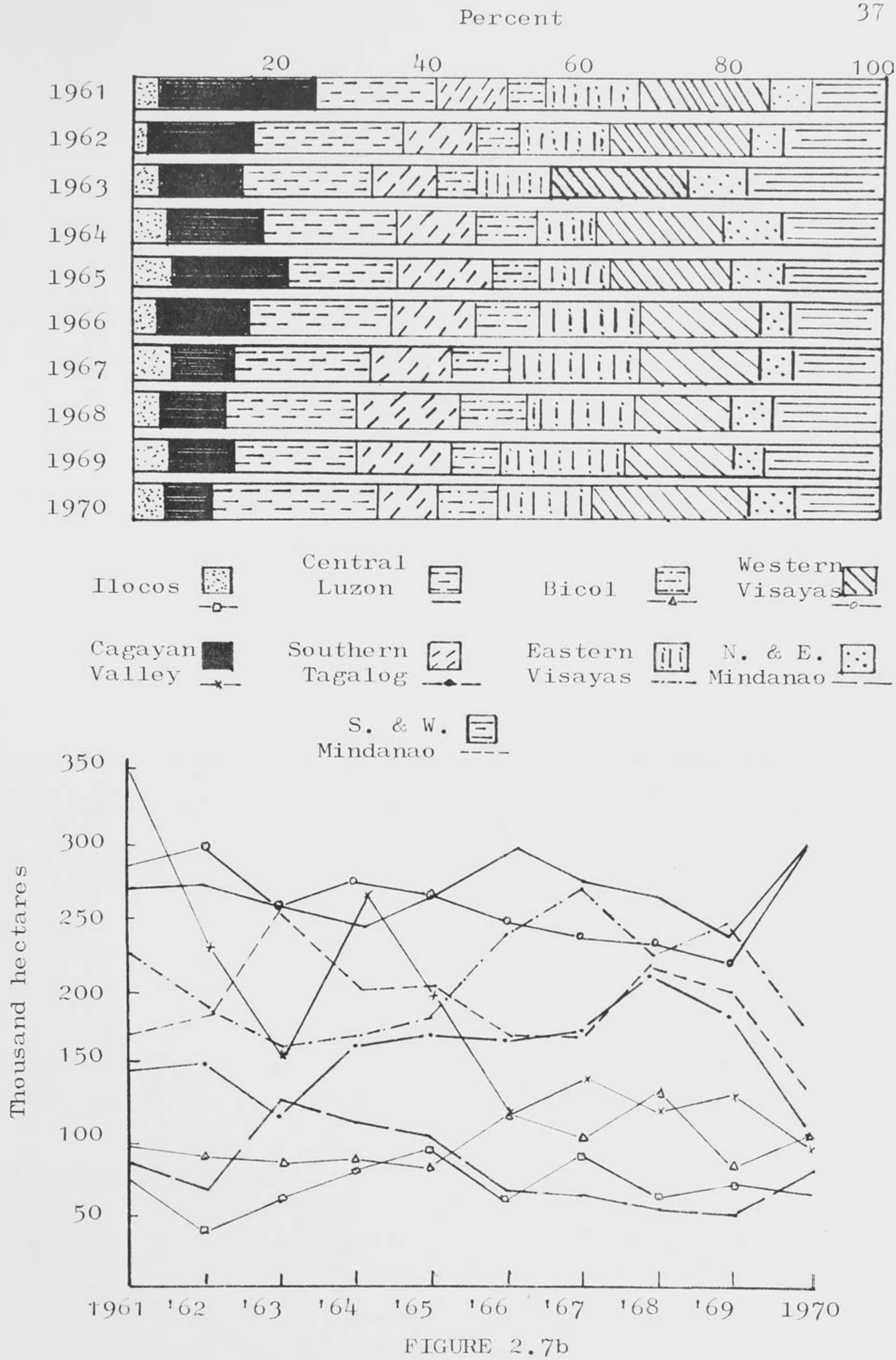
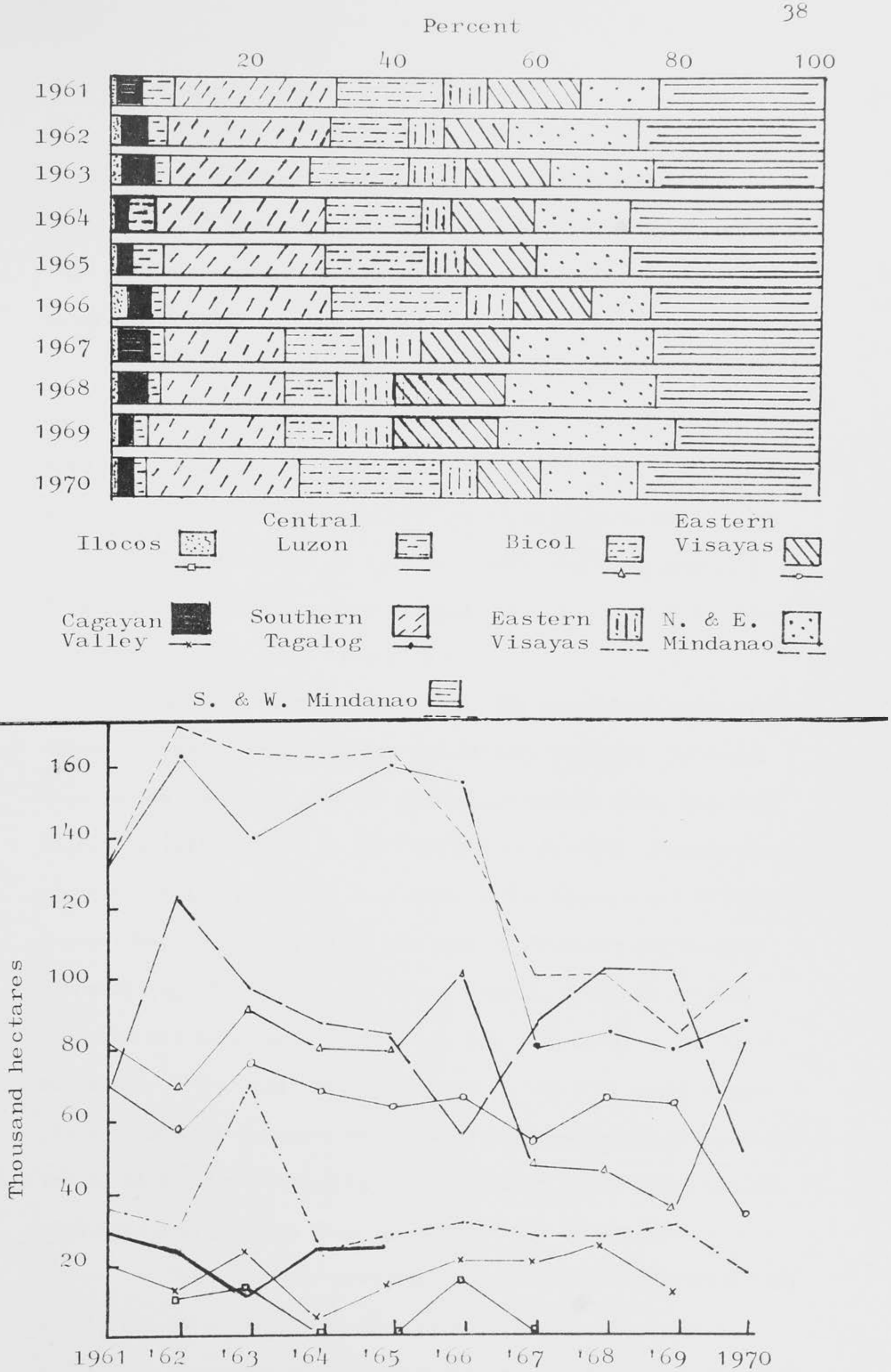


FIGURE 2.7b

REGIONAL DISTRIBUTION OF NON-IRRIGATED AREA HARVESTED, PHILIPPINES, 1961-1970



Note: Broken lines means less than 10 thousand hectares

FIGURE 2.7c

REGIONAL DISTRIBUTION OF UPLAND AREA HARVESTED

PHILIPPINES, 1961-1970

In 1961, the majority of the palay crops were grown in non-irrigated and upland lands which altogether comprised about 52 per cent of the total rice area in the Philippines. By 1969, this area was reduced to 42 per cent, due partly to the government's rice program.

Since rice is so important to the country's economy, the government in 1968 embarked on a massive rice development program. Potential regions throughout the country were selected and financial assistance was then provided to farmers in these areas so that extensive irrigation schemes could be promoted. As a result, the country saw a rapid transformation of most of its non-irrigated areas into rice land.

As a further consequence of the government's irrigation drive, Central Luzon, Southern and Western Mindanao, Southern Tagalog and the Bicol regions eventually ranked among the most highly irrigated areas in the Philippines by 1970. Twenty-four per cent of the irrigated rice area in the country was in Central Luzon (327,000 hectares); 16 per cent in Southern and Western Mindanao (220,700 hectares); 13 per cent in Southern Tagalog (164,000 hectares) and, finally, 12 per cent in Bicol (153,000 hectares). The total area irrigated in the four regions came close to 865,000 hectares and this almost reached 68 per cent of the total for the Philippines. Distributed among other regions with lesser rice areas were the rest of the 32 per cent.

The effect of changing proportions and yields on land conditions over the decade for the Philippines and its nine regions is presented in Table 2.8 and Table 2.8a. The procedure aims to determine whether the increase in yield at the national

TABLE 2.8
EFFECTS OF CHANGES IN LAND DISTRIBUTION AND YIELD OF VARIOUS LAND CONDITION BY REGION, PHILIPPINES, 1965 & 1970

1961 Used as Weights

Region	Actual Yield	Proportion [a]		Yield [b]	
	(1965 - cav/ha)	(cav/ha)	(% change)	(cav/ha)	(% change)
(1)	(2)	(3)	(4)	(5)	(6)
Philippines	28.35	28.36	.04	26.17	-8.34
Ilocos	26.69	26.74	.19	25.00	-6.76
Cagayan Valley	27.42	27.50	.29	24.65	-11.24
Central Luzon	41.32	41.48	.39	35.64	-15.94
Southern Tagalog	24.96	24.97	.04	23.85	-4.65
Bicol	27.78	27.81	.11	23.28	-19.33
Eastern Visayas	19.15	18.97	-.95	20.25	5.43
Western Visayas	29.08	28.99	-.31	31.15	6.65
N. & E. Mindanao	20.93	20.95	.10	19.24	-8.78
S. & W. Mindanao	27.79	27.77	.07	25.64	-8.39
	(1970 - cav/ha)				
Philippines	38.20	36.04	-5.99	27.96	-40.20
Ilocos	36.02	32.52	-10.76	27.79	-29.66
Cagayan Valley	37.16	32.74	-13.50	35.76	-3.94
Central Luzon	50.54	49.34	-2.43	37.14	-36.08
Southern Tagalog	40.48	37.37	-8.32	27.63	-8.32
Bicol	35.25	34.57	-1.97	23.58	-49.49
Eastern Visayas	24.78	25.53	2.93	20.12	-23.16
Western Visayas	34.33	33.06	-3.84	30.36	-13.11
N. & E. Mindanao	32.64	29.21	-11.74	19.83	-64.46
S. & W. Mindanao	36.35	35.03	3.77	26.47	-39.65

[a] Yield estimated using the 1961 proportions of land condition and the 1965/1970 actual yield of each land condition.

[b] Yield estimated using the actual 1965/1970 proportion of land condition and the 1961 yield of each land condition.

TABLE 2.8a

EFFECTS OF CHANGES IN LAND DISTRIBUTION AND YIELDS OF VARIOUS LAND CONDITION, BY REGION, PHILIPPINES, 1961 & 1965

1970 Used as Weights

Region (1)	Actual Yield (1961 cav/ha) (2)	Proportion a/ (cav/ha) (3)	 (% change) (4)	Yield b/ (cav/ha) (5)	 (% change) (6)
Philippines	26.33	27.96	5.83	36.04	26.94
Ilocos	29.04	27.79	-4.50	32.52	10.70
Cagayan Valley	24.71	35.76	30.09	32.74	24.53
Central Luzon	35.76	37.14	3.72	49.34	27.52
Southern Tagalog	35.76	27.63	-29.42	37.37	4.31
Bicol	23.29	23.58	1.24	34.57	32.63
Eastern Visayas	20.24	20.12	-.60	25.53	20.73
Western Visayas	28.71	30.36	5.43	33.06	13.16
N. & E. Mindanao	19.25	19.83	2.92	29.21	34.10
S. & W. Mindanao	25.62	26.47	3.21	35.03	26.86
	(1965 cav/ha)				
Philippines	28.35	30.10	2.92	35.84	20.90
Ilocos	26.69	28.14	5.15	35.46	24.73
Cagayan Valley	27.42	40.41	32.15	31.24	12.23
Central Luzon	41.32	43.20	4.35	49.25	16.22
Southern Tagalog	24.96	29.07	14.14	37.36	33.19
Bicol	27.78	28.17	1.38	34.55	19.59
Eastern Visayas	19.15	18.90	1.32	25.53	24.99
Western Visayas	29.08	30.83	5.68	33.13	12.22
N. & E. Mindanao	20.93	21.63	3.24	29.08	28.03
S. & W. Mindanao	27.79	28.15	1.28	35.09	20.80

a/ Yield estimated using the 1970 proportion of land condition and the 1961/1965 actual yield of each land condition.

b/ Yield estimated using the 1961/1965 actual proportion of land condition and the 1970 yield of each land condition.

level, as well as the regional, over the years, is likely to be due to shift in proportion of land conditions or the change in yields in the different land conditions in each area for each time period.

The impact on changes in yield, measured in terms of 1961 proportions of land condition and using the 1965 yields as weights, is presented in column (3) of Table 2.8. For instance, if in 1965, the proportions of land conditions that prevailed in 1961 do exist, the national average yield will increase by .04 per cent over the actual yield obtained in 1965. Meanwhile, if the distribution of land conditions remained as is in 1965, but yield obtained from the different land conditions is similar to the 1961 yield, the national average yield will decline from 28.35 cavans per hectare to 26.17 cavans per hectare, or roughly 8 per cent below the actual yield obtained for the period (column 5). Therefore, we can conclude that the increase in yield that has occurred is not really attributable to shifting proportion of land conditions but rather to the overall increase in the yield of each land condition.

Again, using the 1961 proportions of land conditions and the 1970 yields as weights, the national average yield will decrease from 38 cavans to 36 cavans per hectare or 6 per cent below the actual yield reported for the period. Similarly, if the 1961 yield distribution of each land condition and the 1970 proportions had existed, the national average yield would have declined by as much as 40 per cent below the actual yield. The same pattern of declining regional average yield would have been noticed for the regions if the above assumptions had been adopted in the area. Therefore, the increased yield that has occurred during the period is due mainly to both increases in proportion and yield obtained from each land condition.

To further illustrate the effect of the shifting proportion of land condition and yield, the above exercise can be repeated, using the 1970 proportions and yields as weights (Table 2.8a). If the 1970 distribution of land conditions had persisted in 1961, the average yield for the Philippines would increase from 26.33 cavans per hectare to 27.96 cavans per hectare, or about 6 per cent above the actual yield obtained for the period. And if the same yield reported in 1970 for the various land conditions had occurred in 1961, the national average yield would have increased from 26.33 to 36.04 cavans per hectare, almost 27 per cent higher than the actual yield. This suggests, therefore, that changes in proportion and yield for the different land conditions would have brought forth an increase in the national average yield in 1961, with yield a more crucial factor. The same pattern of effect was found in each region. If the distribution of land conditions and yields in 1970 had existed in 1961, the regional yields would all have increased.

The same exercise can be done for each region using different year's proportion and yield distribution as weights to determine the influencing factor to increase yield in each area for each year.

2.5 Summary and Conclusions

The analysis just made of the long-run rice production trends in the Philippines revealed that from crop year 1961 to 1970, total production and average yield by region have steadfastly increased throughout, in spite of the total area harvested eventually declining in later years.

The regions which contributed most to the total rough rice production were the Central Luzon, Southern and Western Mindanao and Southern Tagalog. Productions from the other regions were not as large as those of Ilocos and Northern and Eastern Mindanao.

It was also deduced from the study that the rice yield is affected by the proportion of land that is unirrigated. Regions which have expanded most rapidly in terms of rice area have used an increasing proportion of their upland and non-irrigated lands (Appendix Table A 1.2). The resultant yield per hectare of this extension, however, is relatively low. Regions which reportedly have reduced their area available for rice on the other hand, have heavily concentrated on producing rice on the most efficient rice-producing lands. Yields obtained from these lands were reportedly high in turn. For instance, in Southern Tagalog, while a reduction of 5 per cent in hectarage was noticed in 1970, the total production attained by the region still increased by 61 per cent over the 1961 production figure. This could be explained by the increase in proportion of irrigated area reported for the region which amounts to 43 per cent, and the increased yield obtained for this land condition which was 23 per cent above the 1961 report.

The cross-sectional analysis performed to measure the effects of the land condition distribution and the yield variations of each land condition to regional average yield was illustrated for the different regions, using the 1970 production data as an example. If the distribution of the land conditions existing in the national level had occurred in the regions, the regional yield for the majority of the area would have declined from the actual yield. For this matter, the increased yield attained by the regions can be attributed to yield variations of each land condition rather than the proportion of each land condition that prevailed during the period. Similarly, if the yield of each land condition reported at the national level had been adopted, most of the regions would have indicated yield increments against their actual yield. Therefore, increase in yield of each land condition is the influencing factor that shifts the yield to a higher level.

The effects of changing proportions and yields on the different land conditions over the decade were covered in the time-series analysis. It was observed that if the distribution of land conditions, as well as their relevant yields that were reported in 1970 for the regions and the Philippines, had prevailed in the previous years, the national and regional average yields would have been increased during those periods. Conversely, if the 1961 proportions and yield variations among the land conditions had remained constant in 1970, the resulting yield for the regions and the Philippines in 1970 would have been reduced.

CHAPTER 3

FARM PRICES OF PALAY (ROUGH RICE)

Palay prices vary seasonally as do prices of other agricultural crops with a similar seasonal harvest pattern. Palay prices, however, exhibit longer-run cyclical variations due largely to factors of demand and supply which decisively influence the domestic market (Mangahas, et al, 1967). That is, palay farm prices tend to oscillate widely after times of peak harvest and lean harvest.

If a large swing in palay price fluctuations were allowed to persist, their effects, both on consumers and producers, would result in economic, as well as political repercussions. In the past history of the country's political life, the success and/or failure of any one administration is generally measured against its capability to ensure price stability, sufficiency in production and efficiency in distribution of rice. It is for this reason that the government of the Philippines has always kept a close watch on any variable price fluctuations since rice, as an industry, plays a very important role in the economy of the country.

Through the years the government has adopted policy measures designed to minimise the swings in rice prices. These include tariffs, production input subsidies, floor and ceiling price guarantees and other indirect procedures.

One purpose of this study is to estimate the influence of farm price on rice output; thus, it is necessary to examine closely the different available farm price series. This chapter discusses the consistency of the series with one another, and describes the secular and seasonal patterns that they have revealed.

3.1 The Data: Sources and Collection Methods

Two farm price series are available for analysis in this study: the average price of the national palay output and the average farm price reported in each region. The data are taken from the annual and monthly Prices Received and Prices Paid by Farmers series, published by the Bureau of Agricultural Economics.

The Bureau of Agricultural Economics first attempted to conduct a sample survey of the annual farm price series in December of 1956. The series reported the average monthly price received by farmers in each region for crops and livestock. The price data then were sifted from questionnaires that were mailed to 3,000 farmers distributed among 16 strata, in proportion to the distribution as estimated from the Crop and Livestock Survey of the Philippine farms (Maulit, 1957)[a]. Because of the low response rate, from 35 to 50 per cent[b], the Bureau revised the sampling design.

In 1959 and thereafter, the design used the barrio[c] as the primary sampling unit instead of the farm. The number of simple barrios was set at 1,000, and distributed among the provinces' farm area. The barrios in a province were grouped according to area: those with more than 500 hectares each in one group, and those with less than 500 hectares in another, the province's

---

[a] Each stratum refers to a cropping pattern. The strata or cropping patterns were classified as (1) palay, (2) palay and corn, (3) coconut, corn and other crops, (4) abaca, (5) palay and other crops........(16) root-crops and other crops. These classifications are mutually exclusive.

[b] The explanatory note on the series reported that low response rate was attributed to the fact that 'letters are not delivered to the farmers if the barrio is beyond 5 kilometres from the nearest post office'.

[c] A barrio is the smallest political unit; the majority of the population comprise farming households.

allocation of sample barrios was apportioned to these groups in proportion to the groups' farm area. The barrios in each group were further classed by crop pattern, and a group's allocation of sample barrios was apportioned further to the crop-pattern classifications in proportion again to farm area. Finally, the barrios to be sampled were picked out of those classified into a crop-pattern and area category, with probability proportional to area.

From the sample barrios, which were selected at random, the Bureau representatives carefully picked farmers and designated them survey co-operators. At the least, a selected farmer co-operator must be able to observe barrio prices about twice a week, compute the average price for each month and must fully understand the importance of the survey scheme purpose.

The immediate results derived from the implementation of the newly revised sampling design were encouraging. The response rate improved greatly. However, in the succeeding years, the design became unreliable. The reasons for this were that the Bureau changed the names of the designated farmer co-operators once every four years and it was discovered that in this length of time some farmer co-operators either died or migrated to another barrio, municipality or province. In some instances, the number of returns from a particular surveyed region varied with the time schedule for reporting. Often, what should be reported in the survey form for a particular month may in fact reflect a previous month's average price.

All these deficiencies in the sampling design led consequently to difficulties in completing an individual province's survey return form. Also, difficulties in breaking down reports from the regional to provincial levels were noted.

Where no sale occurred during a month, the corresponding cell in the survey form for this item was left blank.

The national price for a particular month was intended primarily to represent the monthly average price weighted by the existing number of sample farmers in that particular region[a].

The average price for the year for each region was calculated, using the unweighted mean of the monthly prices.

The national average price for the year was also calculated, using the unweighted average of the monthly national prices.

The prices reported in the series were for the rice varieties <u>waq-waq</u> and <u>macan</u>, categorized as first class (special) and second class (ordinary) varieties, respectively.

It is felt important to mention at this stage that the prices of <u>Macan Ordinario</u>, a popular variety during the early part of the study, are assumed to be representative of all other rice varieties for the purpose of this analysis.

The current price used in the regression analysis to follow is the annual average price reported in each region, calculated as discussed on the preceding page. An expected price series was also used. This is calculated by applying exponential declining weights to four or eight monthly prices before May of each year. A description of the weights and mathematical formula is given in Chapter 4.0.

---

[a] Though the numbers of farmers actually sampled in each region varied from month to month, still it was presumed that the weights used were the same numbers of farmers that were originally sampled.

3.2 Secular Trend

The Philippines

Philippines farm prices for palay (rough rice) have increased by 43 per cent over the last ten years, or at an average annual rate of 4.3 per cent. In absolute value, the price increased from ₱ 10.92 to ₱ 15.67 per cavan of 44 kilograms. Sharp increases occurred in the years 1966 and 1967 (the price index reached 138 per cent based at 100 in 1961) and in 1970 (the price index reached 143 per cent) as shown in Figure 3.1.

It was further noted in the analysis that; except for 1965, when prices fell seven per cent from the level of the previous year (1964), the general trend of the farm prices is that of an apparent rise in the 10-year period.

The Regions

The rough lines in Figure 3.2 indicate the regional price movements from 1961 to 1970, and it is shown that the patterns followed by the price lines are very similar to those of the national average - except for Ilocos. In this region (upper graph), farm prices have fallen since 1968, which may be attributed to the continuously rising production obtained by the region as compared to other areas in the island of Luzon. In the Ilocos region, by 1970, the increment in total rice output registered a 24 per cent increase over the 1967 figure - the highest reported increase for all regions. (See Appendix Table A 2.0).

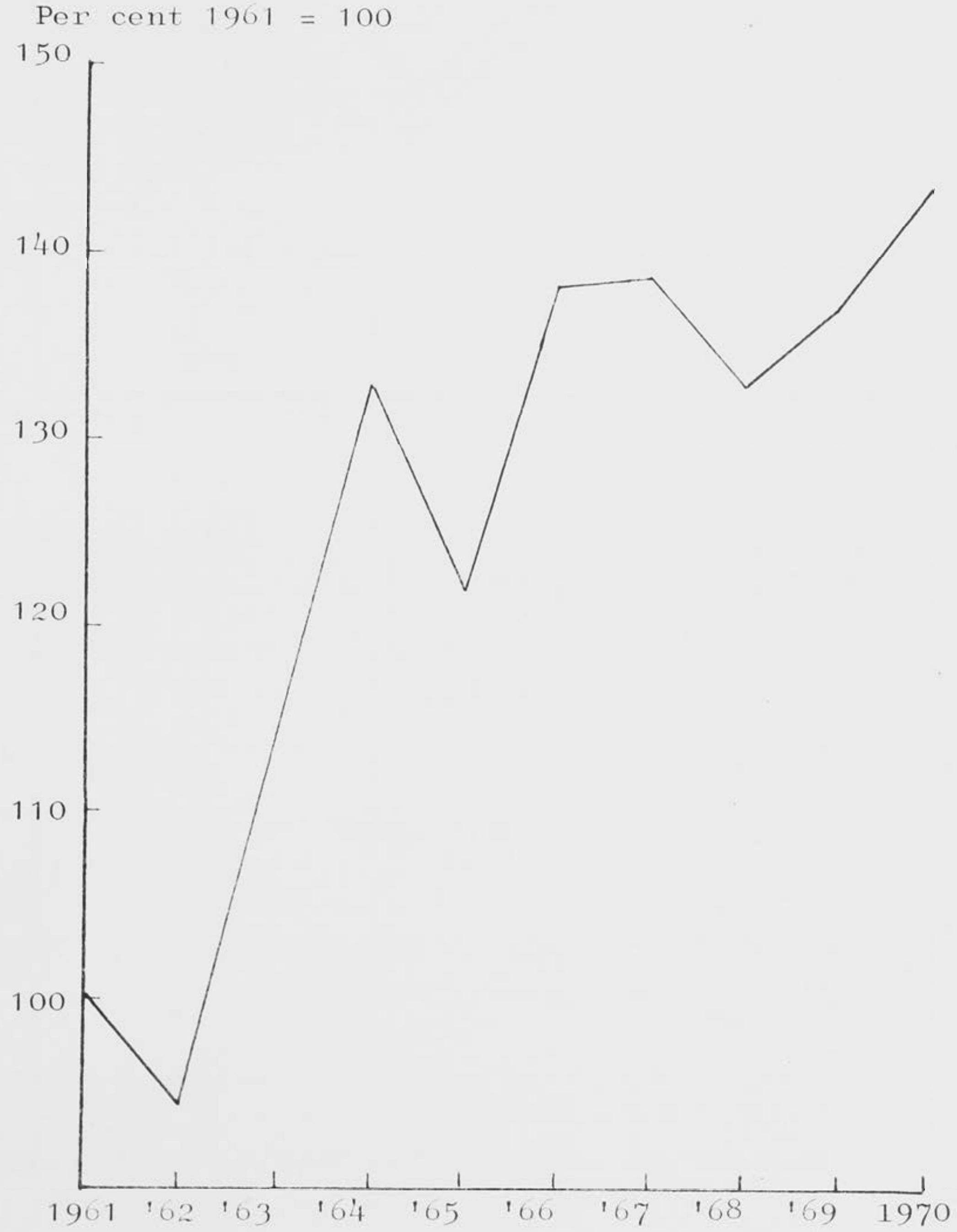
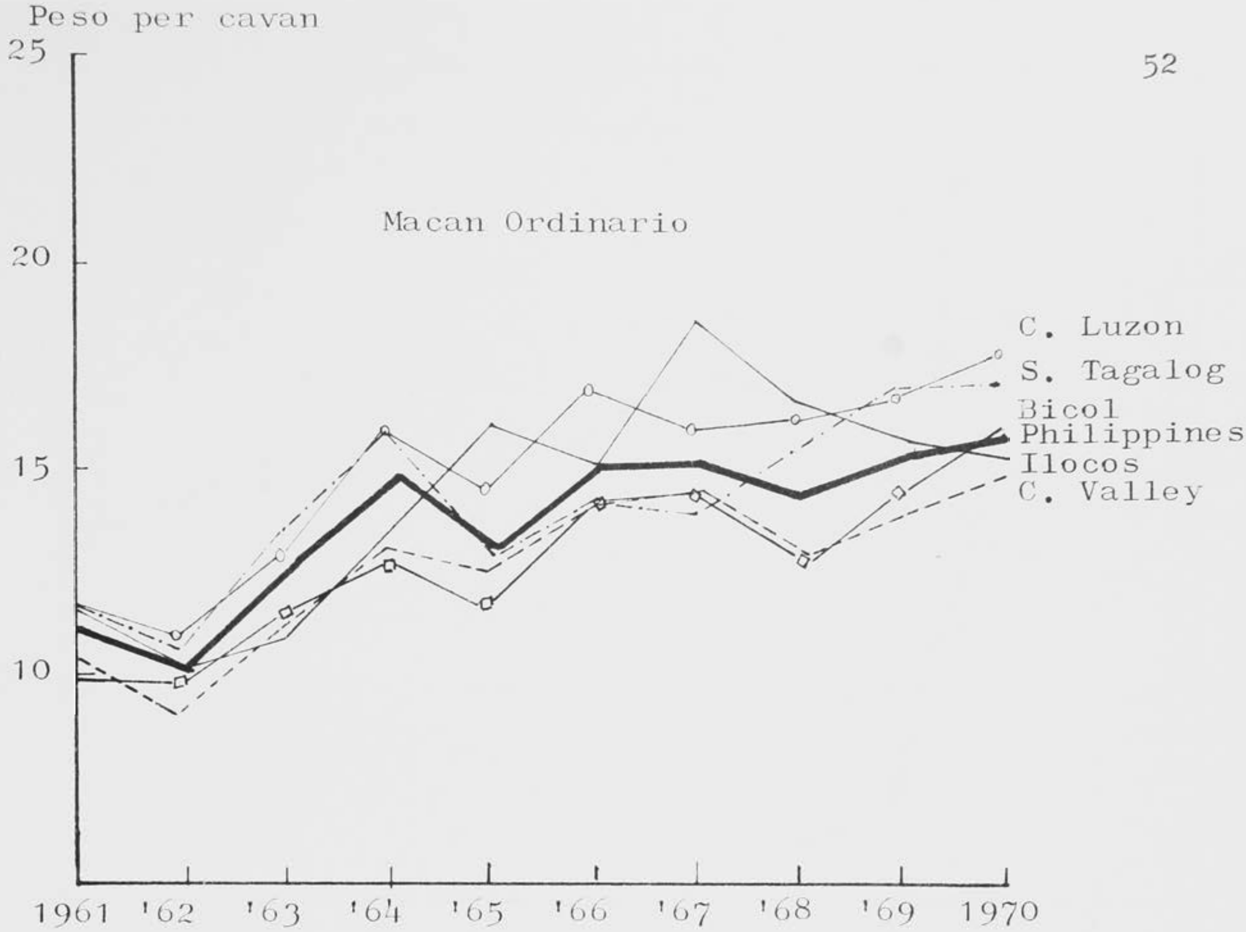


FIGURE 3.1

SECULAR TREND - FARM PRICES OF PALAY (ROUGH RICE), PHILIPPINES, 1961-1970



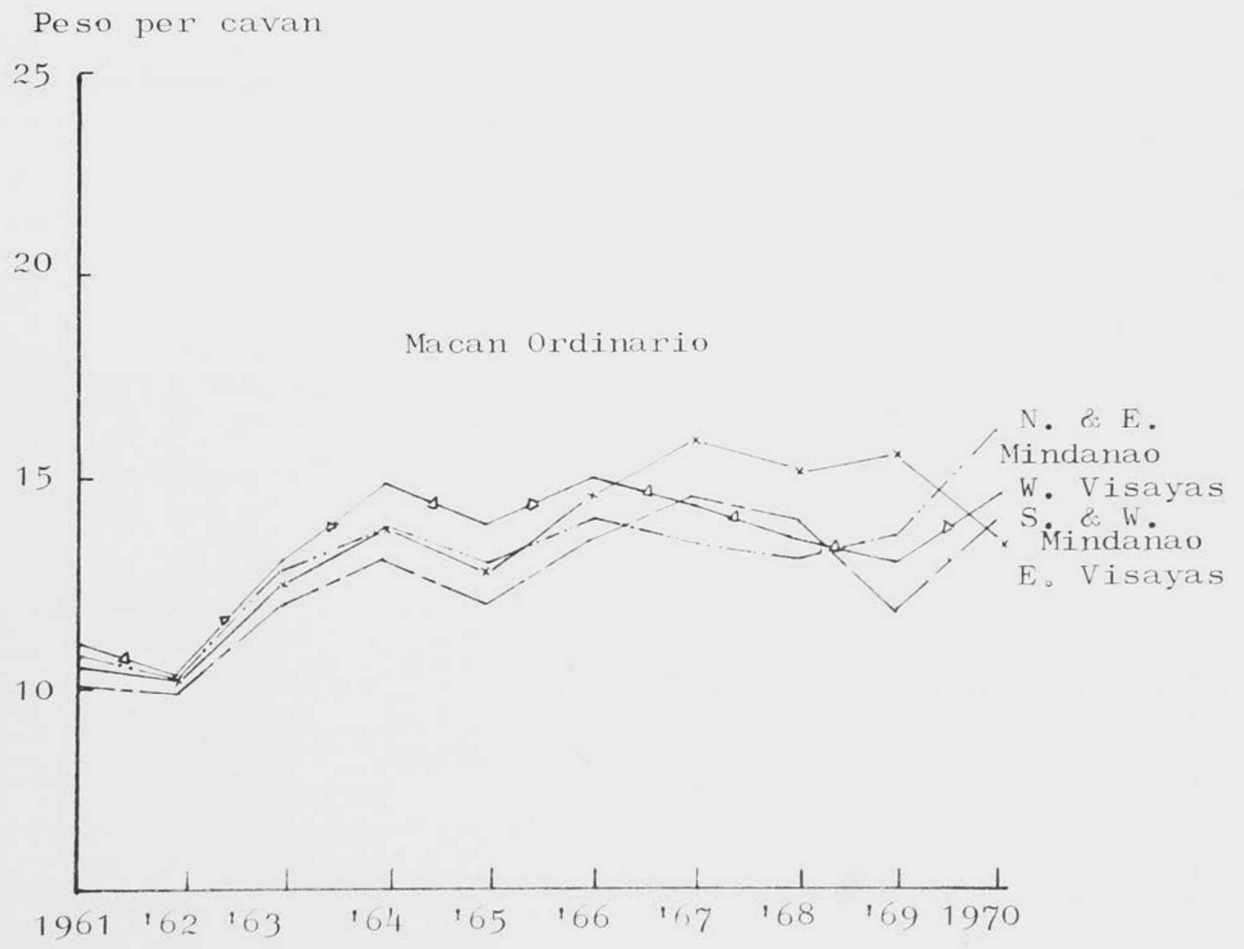


FIGURE 3.2

THE NATIONAL AVERAGE FARM PRICES COMPARED TO REGIONAL FARM PRICES, PHILIPPINES
1961 - 1970

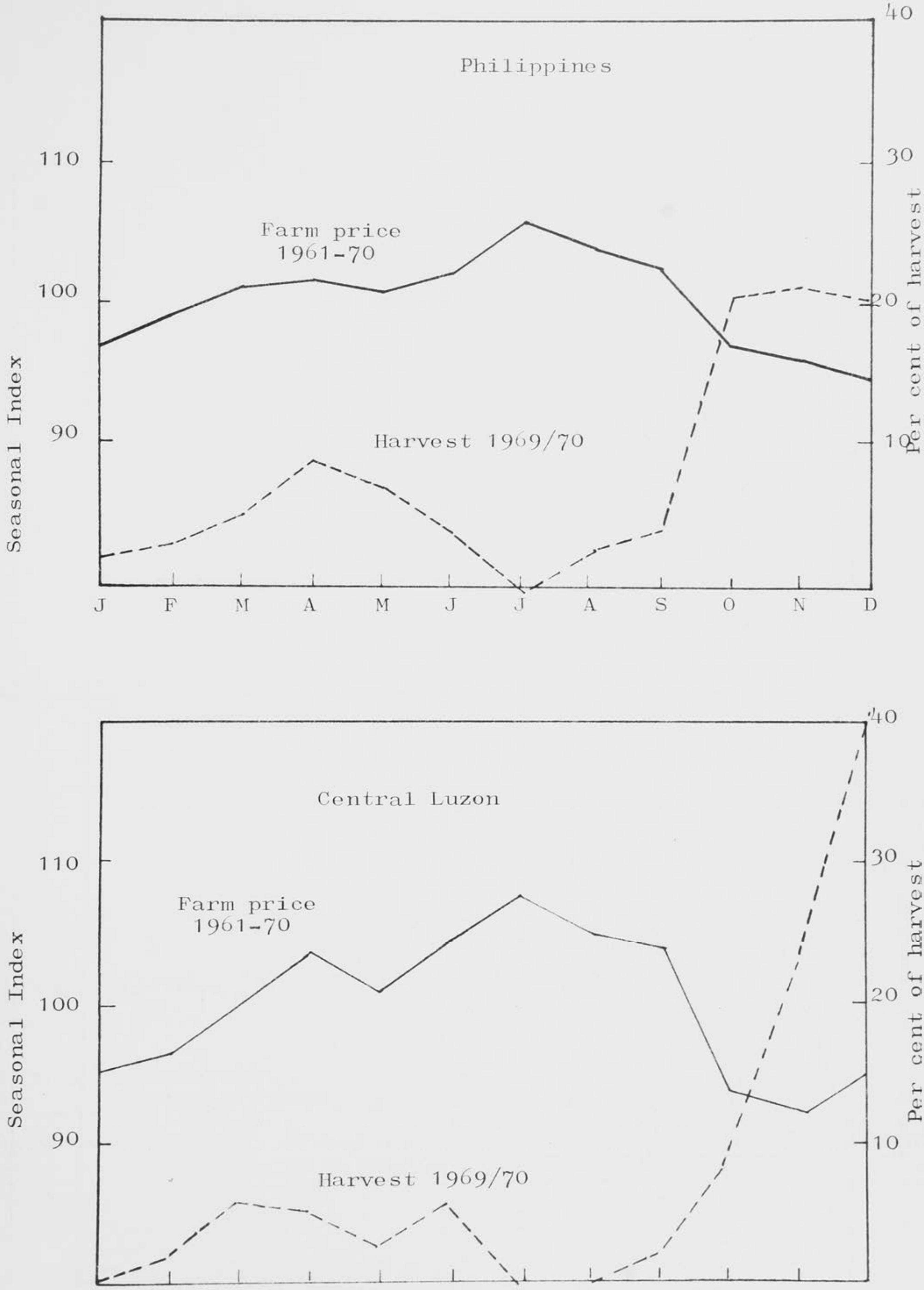


FIGURE 3.3

SEASONAL DISTRIBUTION OF HARVEST AND FARM PRICES
PHILIPPINES AND SELECTED REGIONS

CROP YEAR 1969 - 1970

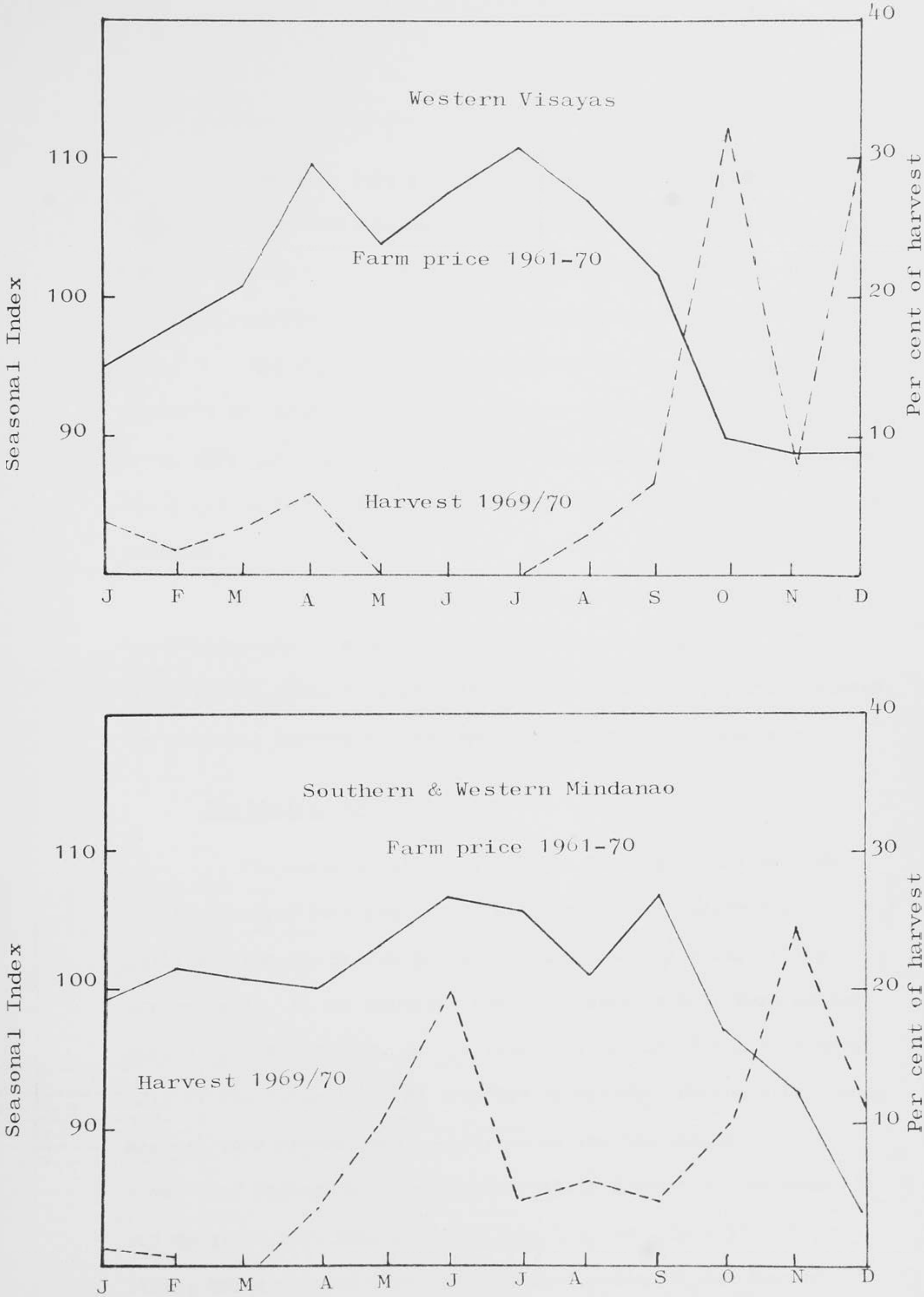


FIGURE 3.3 (Con't)

3.3 Seasonal Variations

Seasonal farm prices presented in this section typically explained the monthly behaviour of rice prices at the national and regional levels. The series, as previously mentioned, is utilized in the calculations of the expected prices for rice.

The expected price series and the current prices reported for each region in the 10-year period, were used in the price response functions along with other variables for estimating the possible magnitude of change in hectarage during the period of coverage.

In Figure 3.3 is shown the seasonal price pattern for the Philippines as a whole, for the period from 1961 to 1970. The seasonal pattern clearly shows an inverse relationship between the national harvest pattern and the seasonal price pattern.

The Philippines

The harvest pattern available for comparison was that of the observed crop year 1969/70, summarised in Table 3.2, collated from the Bureau of Agricultural Economics statistical survey data. It was apparent that the lowest prices were quoted during the last quarter of the year, the period of the year when half of the nation's palay crop was harvested. On the other hand, highest farm prices were registered during the months of July, August and September. During this third quarter of the year, it was apparent that harvests were very lean and, in spite of the stocks being carried over from the last season's peak harvest, total supply available still fell short of total demand. Thus, higher prices continued to prevail.

TABLE 3.2
PERCENTAGE DISTRIBUTION OF PALAY HARVEST BY MONTH FOR THE PHILIPPINES AND FOR EACH REGION, 1969/1970 CROP YEAR

Month	Philippines	Ilocos	Cagayan Valley	Central Luzon	Southern Tagalog	Bicol	Eastern Visayas	Western Visayas	N. & E. Mindanao	S. & W. Mindanao
1969										
July	0.7	0.2	1.8	0.1	1.2	0.1	0.0	0.2	1.3	1.8
August	2.6	0.2	10.6	0.4	1.1	0.4	0.1	0.9	5.2	6.1
September	4.4	0.1	8.4	1.5	5.3	2.7	0.6	5.8	8.5	7.9
October	20.6	10.2	7.1	8.2	18.5	51.0	13.7	33.5	13.7	14.3
November	21.7	47.5	7.8	23.3	25.1	15.0	27.3	14.6	19.6	33.0
December	20.1	23.8	6.1	42.6	14.6	3.9	3.8	25.9	23.5	12.0
1970										
January	2.0	0.0	10.4	0.9	3.0	0.4	0.0	2.2	0.0	0.1
February	3.0	0.0	15.3	2.6	1.7	0.7	0.0	3.2	0.7	0.4
March	5.0	0.0	18.5	6.4	2.9	1.4	2.6	6.5	1.1	0.8
April	9.0	1.7	6.0	5.3	8.6	14.2	37.8	6.4	16.9	2.8
May	7.0	10.4	6.6	2.8	13.9	7.7	10.6	0.6	5.2	13.0
June	4.0	5.9	1.4	3.9	3.1	2.4	3.5	0.2	4.3	7.8
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Bureau of Agricultural Economics, D.A.N.R.

TABLE 3.3
SEASONAL VARIATION IN PALAY FARM PRICES IN SELECTED REGIONS, PHILIPPINES

1961 to 1970

(Means of ratio to a 12 month moving average)

Month	Philippines	Central Luzon	Western Visayas	Southern & Western Mindanao
		Seasonal Index		
January	97.3	95.4	95.2	99.5
February	99.3	96.6	98.1	101.7
March	101.2	100.0	100.7	101.3
April	101.6	103.8	109.4	100.7
May	101.1	101.3	104.1	103.3
June	102.2	104.7	107.7	106.8
July	105.8	107.7	110.5	106.2
August	104.0	105.0	107.2	101.3
September	102.8	104.0	101.6	107.0
October	97.3	93.8	90.0	97.2
November	96.2	92.2	89.2	92.7
December	94.9	95.0	89.0	83.9

The Regions

Seasonal farm price patterns for most of the major rice-producing regions were also noted to relate inversely to their harvest pattern. When a peak harvest occurs (during the fourth quarter), prices are very low and when the harvest is lean (during the third quarter), prices are high.

Seasonal fluctuations of farm prices in Central Luzon were noted to follow also the same pattern. During the months of October, November and December (when about 74 per cent of the region's total harvests for the year is done) prices of rice are at their lowest.

In Western Visayas, considered the rice granary of the Visayan Islands, the seasonal price variation has also behaved in the same manner. During the last quarter of the year the region was accredited with 72 per cent of the year's total harvest so that farm prices instantaneously suffered a reduction of 11 per cent from the preceding quarter.

In Southern and Western Mindanao, however, it was discovered that a slight change in price trend took place throughout the seasons. Peak harvests were reported in two quarters of the calendar year, April to June, and October to November. The second quarter's harvest amounted to 35 per cent and for the fourth quarter another harvest output of 47 per cent took place. With rainfall more or less evenly distributed throughout the area and all through the year, the farmers were able to plant at least twice a year even with minimal amount of irrigation. The effect on prices, therefore, of the seasonal harvest pattern slightly differed from the other regions. While harvest was reportedly at peak in the second quarter, prices were still at their high level. The reason for this was that surplus harvest in the area during the period found its way to the neighbouring regions with low palay stock and as a consequence prices were still kept high.

3.4 Summary and Conclusions

Farm prices of palay in the Philippines for the 10-year period apparently exhibit a rising trend except in 1965, when prices went down by 7 per cent over the previous year (1964). The secular paths of palay farm prices in the regions do not differ markedly from the national level, except that of Ilocos, where prices have fallen from 1968 onward.

Seasonal variation in palay farm prices is, in general, inversely related to the harvest pattern. Prices are lowest in November, December and January, when half of the nation's palay is harvested, and highest in August, September and October, when harvests are small and stocks are carried over from the last harvest season.

CHAPTER 4

SUPPLY RELATIONS FOR RICE

This chapter represents the results of an attempt to measure the response of rice hectarage and yield per hectare in various regions of the Philippines from 1961 to 1970. Quantitative estimates are also presented for the yield response of irrigated, non-irrigated (rainfed) and upland ricelands. All estimates were obtained by fitting regression lines to the time-series data gathered and compiled from various Philippine statistical agencies, some of which were discussed in the previous chapters.

An analytical model for rice production can be formulated in the following sets of equations:

$$Q = HY \quad \ldots\ldots (1)$$

$$H = f_1(P_t, A_t, F_t, W_t) \quad \ldots\ldots (2)$$

$$Y = f_2(LO_t, TO_t, HI_t, HN_t, HU_t, SF_t, W_t, T_t) \ldots (3)$$

Where:

Q = quantity of rice produced

H = hectarage of rice

Y = yield per hectare for rice

P_t = price of palay (rough rice)

A_t = price of corn (competing crop)

F_t = agricultural wage (factor input)

W_t = annual rainfall (weather)

LO_t = leasehold-owner ratio

TO_t = tenant-owner ratio

HI_t = % irrigated palay area

HN_t = % non-irrigated palay area

HU_t = % upland palay area

SF_t = average size of palay farm

T_t = rice variety (technology)

$_t$ = for the period

Previous researchers have measured the response of hectarage (equation 2) to price more often than the response of output itself. They felt that significantly large disparities exist between actual and intended output due to unforseen crop-growing conditions (Nerlove, 1958). The price elasticity of hectarage with respect to price can be traced as a minimum estimate of the price elasticity of output under the assumption that the price elasticity of yield is non-negative.

4.1 Hectarage response (equation 2)

4.1.1 The Variables: Sources and Methods

A major challenge in an empirical supply analysis is the identification and measurement of the variables which cause agricultural supply to change over time. The variables employed in the statistically estimated hectarage (H_t) relations in this study are defined in this section.

The hectarage (H_t) of rice planted is assumed to be dependent on the following variables -

Price of palay (P_t): This variable should be positively related to palay hectarage. If, prior to the planting period, the price of palay increases, rice producers may expand the physical area devoted to rice.

Palay farm prices used in this study were taken from the annual and monthly <u>Prices Received and Prices Paid by Farmers</u> series published by the Bureau of Agricultural

Economics, Department of Agriculture and Natural Resources (DANR). A detailed discussion on methods of collection and estimation was presented in Chapter 3.0.

Price of corn (A_t): Corn is regarded as the competing crop to palay. If the price of corn increases at a rate faster than palay, rice farmers may be induced to produce corn by reducing palay hectarage.

Price statistics for corn at the farm level were compiled from the series Prices Received and Prices Paid by Farmers, published monthly and yearly by the Bureau of Agricultural Economics. Although separate estimates were made available for white and yellow corn, the unweighted arithmetic average price of both corn classifications was used in this study.

Expected price series: In addition to the annual prices compiled for palay and corn, expected price series for both crops were estimated and used in the regression to obtain a more precise estimate of the hectarage response of rice farmers.

The expected price was derived as a weighted average of recent monthly prices where the weights decline exponentially over a fixed number of months. The particular expectation process that was adopted is written as -

$$P_t^* = \sum_{i=1}^{N} \frac{\lambda^i}{\sum_{i=1}^{n} \lambda^i} P_{t-1} \quad \text{(for palay)}$$

and

$$A_t^* \quad \sum_{i=1}^{N} \frac{\lambda^i}{\sum_{i=1}^{n} \lambda^i} A_{t-1} \quad \text{(for corn)}$$

where i runs to four or eight months and λ is .95 or .80.

Agricultural wage (F_t): Factor prices are measured in this study by agricultural wages. Lack of useful series on the prices of other input factors precluded a better measure of factor prices.

An upward movement in the agricultural wage rate relative to the price of rice may cause a reduction in hectarage for palay being a labour intensive crop.

The series for agricultural wages was taken from the following reports -

1961: Central Bank Annual Report, 1962.

Original Source, Department of Agriculture and Natural Resources (DANR).

1962: Central Bank Annual Report, 1963.

Original Source, DANR.

1963 - 1969: Bureau of Census and Statistics, Journal of Philippine Statistics, 16(3) 1970.

Original data, Central Bank Annual Reports.

1970: Central Bank Annual Report, 1971.

The reported data were computed as follows: For a given type of agricultural labour, the average wage in a municipality was taken to be the mean of the lowest and the highest wage rates. The provincial average was the simple mean of such municipal averages. The regional average was, therefore, the mean of the provincial average weighted according to farm population. The average wage for all types of agricultural labour was simply the mean of the averages for each type.

Rainfall (W_t): The weather variable was represented by the amount of annual rainfall (January to December) recorded for each region. This variable can affect hectarage response in two ways: a negative effect will occur for wet, highly frequented cyclones' regions and positive for regions of lengthy dry season. Climatic description of the regions can be seen in the attached Climate Map of the Philippines.

Estimate of hectarage response was done in three trials, each regression line fitted with different sets of independent variables and written as -

$$H_t = f_1(P_t/F_t, A_t/F_t) \qquad (2.1)$$

$$H_t = f_1(P_t^*/F_t, A_t^*/F_t, W_t) \qquad (2.2)$$

$$H_t = f_1(P_t^{**}/F_t, A_t^{**}/F_t, W_t) \qquad (2.3)$$

where P_t and A_t are the current prices for palay and corn during the period; P_t^* and A_t^* are expected prices at λ equal to .95 and P_t^{**} and A_t^{**} are expected prices at λ equal to .80.

4.1.2 Hectarage response functions empirical results

The results of the hectarage response estimate for the Philippines and the nine regions are contained in this section. A statistical analysis for each area is presented in Table 4.1 and Tables 4.1a to 4.1i for the Philippines and the regions respectively. Data in brackets are the t-values of the relevant coefficients.

Ilocos Region (Table 4.1a)

The expected price series, when used in the empirical hectarage response function plus rainfall variable slightly improved the value of R^2, but not the coefficients of the parameters. It was also noted that the signs of the coefficients for P_t/F_t and

A_t/F_t were both positive. None of the variables are significant at conventional levels.

Cagayan Valley (Table 4.1b)

All trials performed for this region on hectarage response proved unsatisfactory. The estimated coefficients for all the parameters were insignficant, and yield a negative sign for P_t/F_t and positive for A_t/F_t.

Central Luzon (Table 4.1c)

The expected prices for palay and corn and the addition of rainfall, improved the estimates of R^2. The P_t/F_t coefficient in the second and third trial is with a positive sign and significant to 10% and 20% significant levels. The actual and predicted values for hectarage is compared in Figure 4c.

Southern Tagalog (Table 4.1d)

The obtained coefficient for current price and agricultural wage ratio (P_t/F_t) as revealed in the first equation, proved insignificant at a conventional level. The use of expected price series with additional rainfall variable slightly improved the R^2 estimates (2nd and 3rd regression equations), but yielded insignificant coefficients for price parameters. The rainfall variable is significant with a negative coefficient.

Bicol Region (Table 4.1e)

The current and expected prices coefficients were insignificant in all the trials. The expected price improved the R^2 estimates and also gave positive significant coefficients for rainfall (equation 3) at a lower significant level (20%).

Eastern Visayas (Table 4.1f)

The use of current price ratio to agricultural wage proved effective in the estimate of the coefficients of the parameters. Both coefficients yielded significant value as expected, P_t/F_t positive (5% level) and A_t/F_t negative (10% level).

Meanwhile, expected price and rainfall variables failed to improve the value of the total explained variations. In both trials, however, rainfall showed negative significant coefficients at a lower level.

Western Visayas (Table 4.1g)

None of the trials performed for hectarage response resulted in significant coefficients.

Northern and Eastern Mindanao (Table 4.1h)

The expected price series and rainfall variables slightly improved the R^2 estimate, but the coefficients of the variables were found not significant in all the trials.

Southern and Western Mindanao (Table 4.1i)

Like Northern and Eastern Mindanao hectarage responses estimate, the price expectations and rainfall did not improve the explained variations estimates. Neither of the variables (independent) used in the regression equations presented a significant coefficient.

Philippines (Table 4.1)

The poor results of the hectarage response estimates evaluated in terms of statistical significance, sign and stability of the coefficients, obtained from the regions has led us to aggregate the regional data. Perhaps the poor results may be attributed to the small number of observations. Regional dummy

FIGURE 4

CLIMATE MAP of the PHILIPPINES

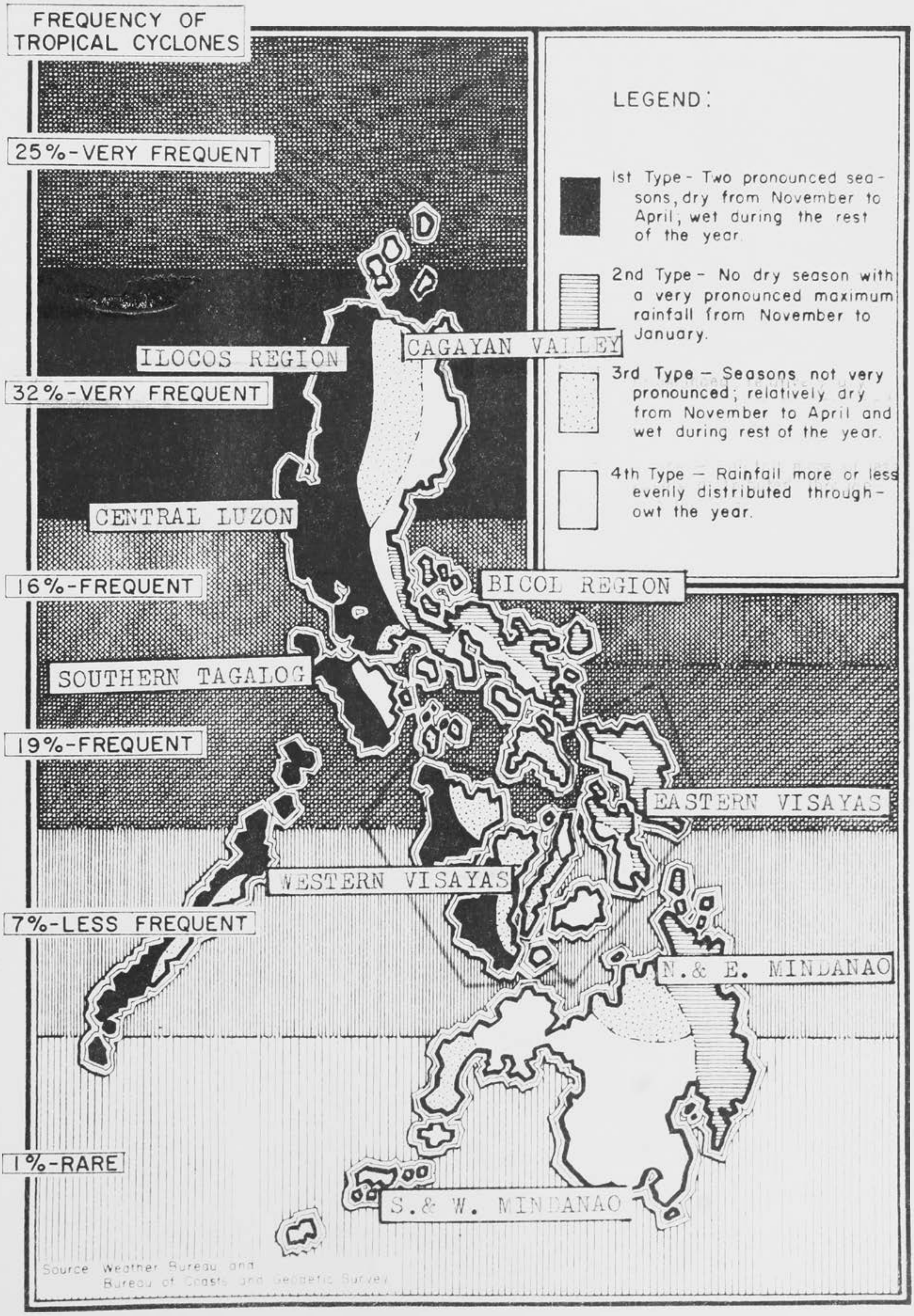


TABLE 4.1

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR PHILIPPINES 1961 TO 1970

(Dependent variable in thousand hectares)

Trial	Constant	Ilocos	Cagayan Valley	Southern Tagalog	Bicol	Eastern Visayas	Western Visayas	N. & E. Mindanao	S. & W. Mindanao	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	55.89244	-424.37859**	-233.06462*	-123.34589*	-241.33773*	-238.33029*	-172.77465*	-350.42598*	-65.83317*	5.67791	-5.02504		.89738	45.73444
		(-19.88250)	(-10.63547)	(-5.65433)	(-10.59584)	(-10.99504)	(-7.44401)	(-16.75368)	(-2.98488)	(.62337)	(-1.62373)			
* Current prices														
Second (1)	571.00463	-421.56625*	-231.96772*	-118.89117*	-228.52585*	-228.49839*	-179.07531*	-337.88735*	-73.15416*	4.53882	-1.80085	-.01266	.89947	45.55541
		(-18.59441)	(-11.16041)	(-5.78233)	(-10.26737)	(-9.79569)	(-8.05563)	(-15.33210)	(-3.25729)	(.54232)	(-.23871)	(-1.23917)		
* Expected price at .95														
Third (1)	565.44098	-422.04731*	-231.10883*	-118.27488*	-227.18480*	-229.87451*	-181.32680*	-337.56319*	-73.00345*	4.98806	-1.23027	-.01291	.89968	45.50675
		(-18.85204)	(-11.06372)	(-5.74358)	(-10.11565)	(-9.94721)	(-7.91749)	(-15.33278)	(-3.23744)	(.60488)	(-.17163)	(-1.26262)		
* Expected price at .80														

* Significant at 5% level

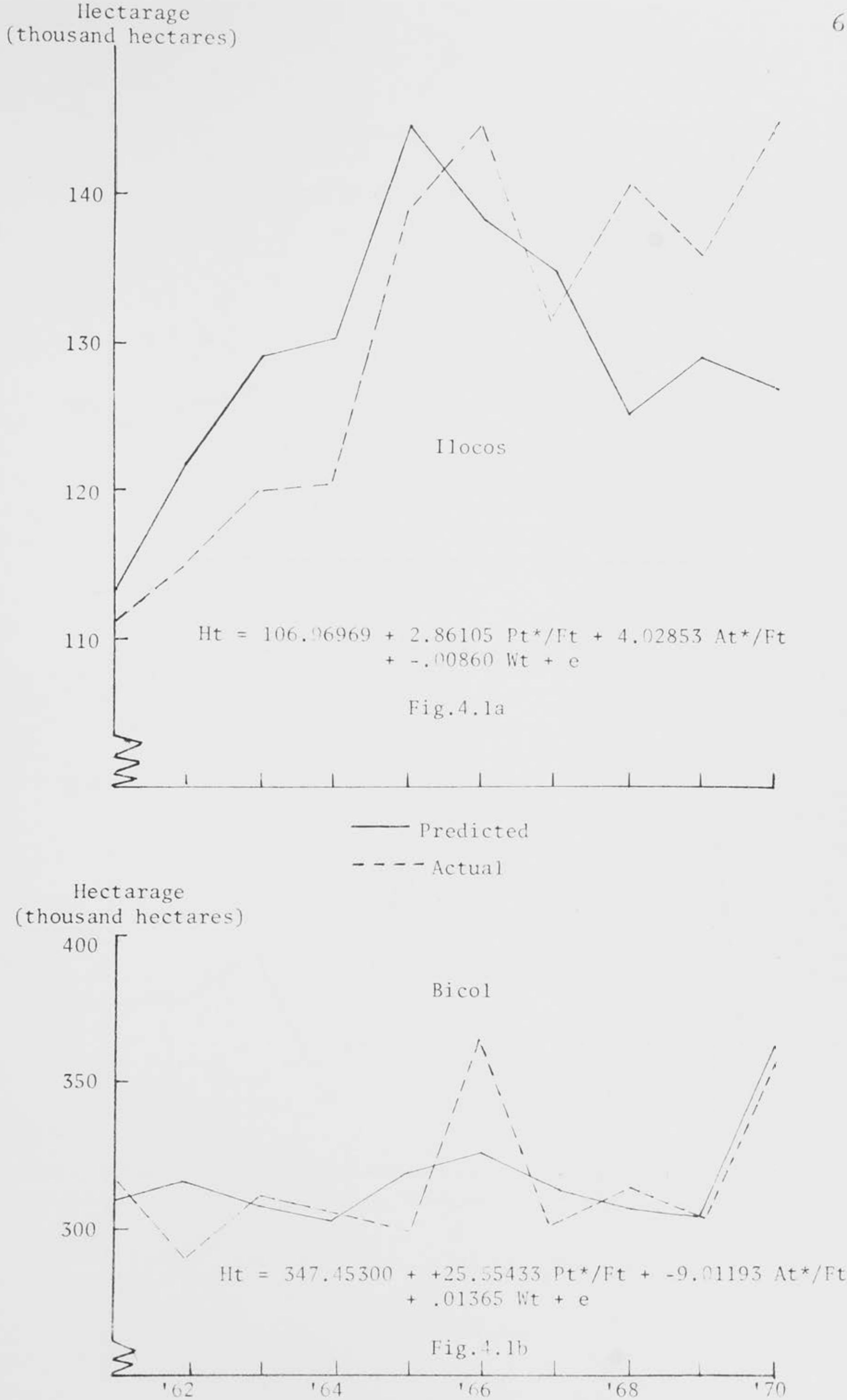
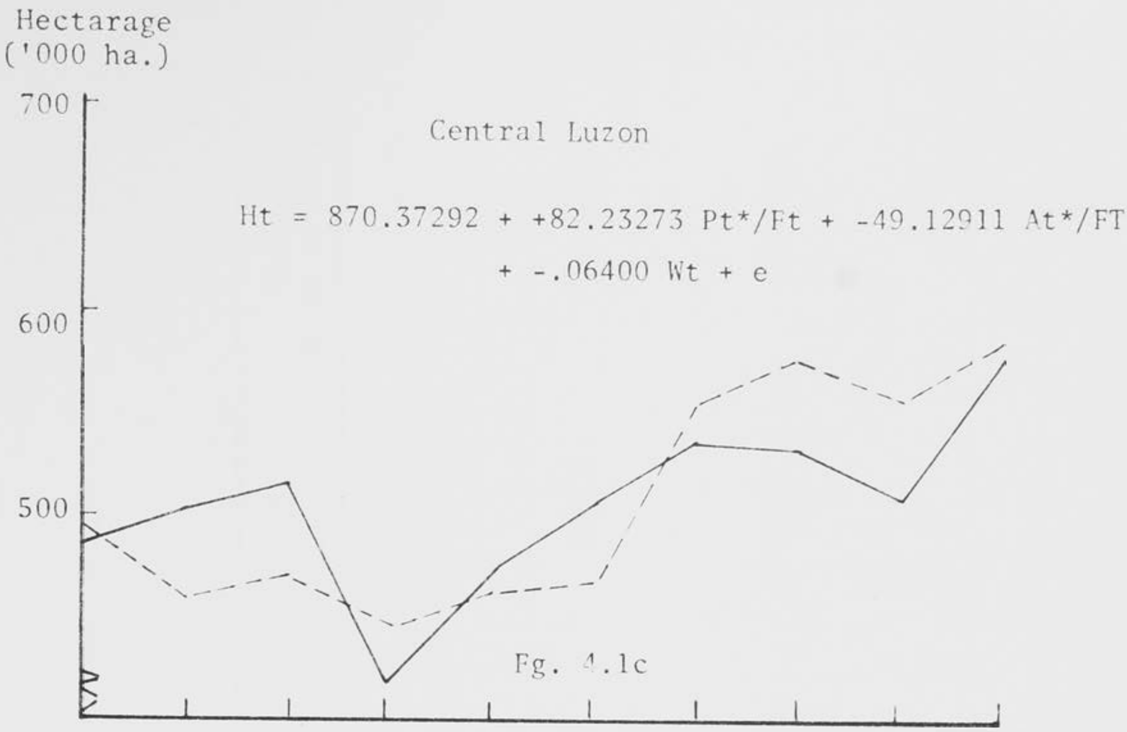


FIGURE 4.1

COMPARISON BETWEEN ACTUAL AND PREDICTED PALAY HECTARAGE IN VARIOUS REGION, PHILIPPINES 1961 TO 1970



Fg. 4.1c

— Predicted

--- Actual

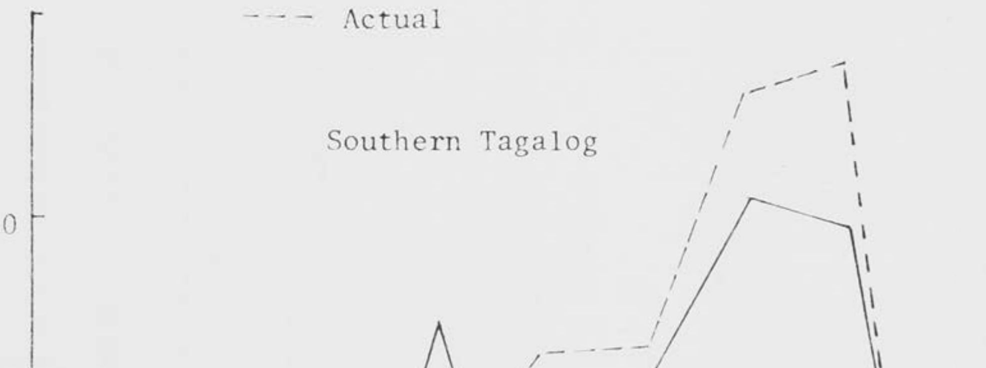


Fig. 4.1d

TABLE 4.1a

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR ILOCOS REGION, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	+69.72538	-.90419	9.13491***		.34707	13.30772
		(-.18776)	(1.58612)			
* Current prices						
Second (1)	116.51110	1.92071	3.89177	-.00651	.35612	16.40318
		(.22173)	(.31211)	(-.42000)		
* Expected prices at λ .95						
Third (1)	106.96969	2.86105	4.02853	-.00860	.37635	14.04381
		(.32781)	(.35395)	(-.53071)		
* Expected prices at λ .80						
*** Significant at 20% level						

TABLE 4.1b

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR CAGAYAN VALLEY, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P_t^*/F_t	A_t^*/F_t	W_t	R^2	Standard Error of Estimate
First (1)	558.68605	-65.94770	23.20876		.18375	58.49099
		(-1.25498)	(.68567)			
* Current prices						
Second (1)	188.45752	-7.12962	25.25646	.02609	.12342	65.47066
		(-.11277)	(.37839)	(.58229)		
* Expected prices at λ .95						
Third (1)	162.42945	-8.98013	31.60841	.02717	.12672	65.34729
		(-.14612)	(.47503)	(.60398)		
* Expected prices at λ .80						

TABLE 4.1c

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR CENTRAL LUZON, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	544.00946	6.27660	-3.77939		.00140	61.46003
		(.09869)	(-.08317)			
	* Current prices					
Second (1)	870.37292	+82.23273**	-49.12911	-.06400	.65958	38.75977
		(+1.84020)	(-1.26602)	(-1.07484)		
	* Expected prices at λ .95					
Third (1)	907.23936	+101.52865***	-65.03258	-.07298	.61576	41.17857
		(+1.56598)	(-1.146300)	(-1.21850)		

* Expected prices at λ .80

** Significant at 10% level

*** Significant at 20% level

TABLE 4.1d

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR SOUTHERN TAGALOG, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	278.04703	68.50803	-39.70505		.20086	65.31492
		(1.30164)	(-1.09660)			
* Current prices						
Second (1)	596.29516	19.91995	-12.22382	-.08625**	.55368	52.72283
		(.47420)	(-.39209)	(-2.59373)		
* Expected prices at λ .95						
** Significant at 5% level						
Third (1)	594.26219	17.02098	-8.95206	-.08697**	.54933	52.97921
		(.40485)	(-.31039)	(-2.61128)		
* Expected prices at λ .80						
** Significant at 5% level						
*** Significant at 20% level						

TABLE 4.1e

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR BICOL REGION, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	213.18074	29.52755	-7.86045		.19422	26.08510
		(1.12630)	(-.39713)			
	* Current prices					
Second (1)	335.01643	+23.65564	-10.40584	.01234	.45822	23.10387
		(+1.07457)	(-.50404)	(1.26157)		
	* Expected prices at λ .95					
Third (1)	347.45300	+25.55432	-9.01193	.01365***	.48960	22.42487
		(+1.24414)	(-.48117)	(1.43346)		
	* Expected prices at λ .80					
	*** Significant at 20% level					

TABLE 4.1f

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR EASTERN VISAYAS, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	384.18070	37.93517***	-42.73406**		.42740	37.97406
		(1.87000)	(-2.06266)			

* Current prices

** Significant at 5% level

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
Second (1)	485.97076	-15.15716	5.42203	-.05659***	.38659	42.45336
		(-.15330)	(.18877)	(-1.72925)		

* Expected prices at λ .95

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
Third (1)	455.81422	15.25022	-11.30276	-.04974***	.42522	41.09499
		(.66005)	(-.60676)	(-1.79613)		

* Expected prices at λ .80

** Significant at 5% level

*** Significant at 10% level

TABLE 4.1g

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR WESTERN VISAYAS, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	438.23135	-7.89934	1.47545		.08111	25.82820
		(-.53422)	(.10890)			
	* Current prices					
Second (1)	376.27191	3.43764	.19092	-.00782	.09295	27.71736
		(.28179)	(.01525)	(-.18649)		
	* Expected prices at λ .95					
Third (1)	357.01653	2.16612	2.93835	-.00368	.11941	27.31005
		(.18621)	(.25225)	(-.08713)		
	* Expected prices at λ .80					

TABLE 4.1h

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR N. & E. MINDANAO, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	282.05765	4.19184	-8.14901		.07580	39.21921
		(.14999)	(-.43589)			
	* Current prices					
Second (1)	72.22371	16.11845	-5.46945	.02738	.26415	37.79933
		(.86257)	(-.38274)	(1.16867)		
	* Expected prices at λ .95					
Third (1)	60.65549	17.01751	-3.58944	.02567	.27448	37.53317
		(.87136)	(-.25850)	(1.10140		
	* Expected prices at λ .80					

TABLE 4.1i

ESTIMATED RICE HECTARAGE RESPONSE FUNCTION FOR S. & W. MINDANAO, 1961 TO 1970

(dependent variable in thousand hectares)

Trial	Constant	P^*_t/F_t	A^*_t/F_t	W_t	R^2	Standard Error of Estimate
First (1)	433.60096	-9.64575	21.87346		.05313	64.61381
		(-.26803)	(.62480)			
	* Current prices					
Second (1)	221.22823	26.29726	2.81961	.09521	.30314	59.87245
		(.85110)	(.09822)	(.65771)		
	* Expected prices at λ .95					
Third (1)	157.62807	31.15743	6.14626	.10854	.35502	57.60079
		(1.04201)	(.22907)	(.76836)		
	* Expected prices at λ .80					

variables are fitted in the three equations in addition to the existing independent variables. The purpose of the procedure is to obtain a more precise estimate of the coefficients.

The use of current price ratio (equation 1) and the expected price ratio plus rainfall variable (equations 2 & 3) yield almost consistent R^2 and inexplicable signs of the price parameters - that is, positive for P_t/F_t and negative for A_t/F_t. It was observed that the value of the coefficients of the price ratio differs between equation (1) and that of equations (2) and (3). None of the parameters in the three trials, however, showed significant coefficients.

4.1.3 Summary and Conclusions

The use of the price expectation series and the additional fitting of rainfall variable to the empirical hectarage response function improved the estimates of total explained variations (R^2) in most regions, namely: Central Luzon, Southern Tagalog, Bicol and the two Mindanao regions.

The three regression equations used to estimate the hectarage response in each region failed to show any significant coefficient of the parameters at the conventional level. It was also observed that the coefficients varied from one equation to another. The majority of the regions, however, showed positive coefficient of P_t/F_t and negative coefficient of A_t/F_t.

It was also deduced from the results of the hectarage response estimates that the following regions - Ilocos, Central Luzon, Southern Tagalog and Western Visayas, will respond negatively to an increased amount of rainfall. The possible explanation could be that the above regions are geographically located in cyclone-frequented areas (see Climate Map of the

TABLE 4.1.1

SUMMARY OF HECTARAGE RESPONSE ESTIMATES FOR THE PHILIPPINES AND ITS REGIONS, 1961 TO 1970

(dependent variable in thousand hectares)

Variable / Region	Constant	P_t/F_t	A_t/F_t	W_t	R^2	Standard Error of Estimate
Philippines	565.44098	4.98806	-1.23027	-.01291	.89968	45.50675
Ilocos	106.96969	2.86015	4.02853	-.00860	.37635	14.04381
Cagayan Valley	162.42945	-8.98013	31.60841	.02717	.12672	65.34729
Central Region	907.23936	101.52865***	-65.03258	-.07298	.61576	41.17857
Southern Tagalog	596.29516	19.91995	-12.22382	-.08625**	.55368	52.72283
Bicol	347.45200	25.55432	-9.01193	.01365***	.48960	22.42487
Eastern Visayas	384.18070	37.93517***	-42.73406**	-	.42740	37.97406
Western Visayas	357.01653	2.16612	2.93835	-.00368	.11941	27.31005
N. & E. Mindanao	60.65549	17.01751	-3.58944	.02567	.27448	37.53317
S. & W. Mindanao	157.62807	31.15743	6.14626	.10854	.35502	57.60079

** Significant at 10% significant level

*** " " 20% " "

Philippines), and they, too, exhibit either a pronounced lengthy wet season the year round or no dry season at all.

The analysis, therefore, showed that although rice farmers in the Philippines did not show significant response to hectarage relative to price change, there were indications of positive responsiveness.

4.2 Yield Response (Equation 3)

4.2.1 The Variables: Sources and Methods

The variables employed in the statistical estimates of yield response for this particular study are as follows -

Average size of farm (SF_t): The data on average size of farm was taken from the results of the Crop and Livestock Survey of the Bureau of Agricultural Economics (BAEcon). The average size of palay farm is estimated by dividing the total hectarage under rice in a region by the number of rice farm cultivators in that region.

It is possible that large farm holdings will facilitate the adoption of modern technology and that the yield per hectare may surpass that of small size farms.

Tenure of farm operator/cultivator: The tenure status of palay farmers is classified into three broad categories: owner-cultivator, leasehold-cultivator and tenant-cultivator. The source of data is the Bureau of Agricultural Economics. The original data is taken from the Annual Crop and Livestock Survey series.

It may be presumed that owner-cultivators will achieve higher yields per hectare as compared to cultivators belonging to other categories. Therefore, if there is a greater proportion of owner-cultivators in the region the yield per hectare may be expected to be high.

Technology (T_t): Technology is represented, in principle, by the adoption rate of new rice variety recommended by the Philippine government for adoption in all rice producing areas. Although the new line of rice variety gained tremendous acceptance in 1968, no record of the regional breakdown of adoption can be presented in this study. To obtain an estimate for the regional adoption of the new rice variety, an indirect approximation was attempted. It was assumed that the extent to which the new rice variety has been adopted was dependent upon irrigation facilities. Therefore, the per cent irrigated area in each region for the year 1968, and onward is used to depict the extent of the new rice variety adoption in each region.

Irrigated palay area (HI_t): The presence of a greater proportion of irrigated riceland can, as shown in Chapter 2, lead to a shift upward in the yield per hectare reported for the region. Conversely, if the reported rice hectarage in an area consists largely of non-irrigated (HN_t) and upland (HU_t) riceland, it can be expected that the obtained yield per hectare for the region will be much less. Preliminary results of the effect of irrigation upon yield was discussed in section 2.4, Chapter 2.0.

Two trials for the yield response estimate were done for each region. Each trial-run is made up of different sets of regression equations each fitted with different sets of variables. The functions are as follows -

First trial-run:

$$Y_t = g_1(TO_t, HI_t, HN_t, SF_t) \quad \ldots\ldots \quad (3.1)$$

$$Y_t = g_1(TO_t, HI_t, HU_t, SF_t) \quad \ldots\ldots \quad (3.2)$$

$$Y_t = g_1(LO_t, HI_t, HU_t, SF_t, W_t) \quad \ldots\ldots \quad (3.3)$$

$$Y_t = g_1(LO_t, HN_t, SF_t, W_t) \quad \ldots\ldots \quad (3.4)$$

$$Y_t = g_1(LO_t, HI_t, SF_t, W_t) \quad \ldots\ldots \quad (3.5)$$

$$Y_t = g_1(TO_t, HU_t, SF_t, W_t) \quad \ldots\ldots \quad (3.6)$$

$$Y_t = g_1(TO_t, HU_t, HN_t, SF_t, W_t) \quad \ldots\ldots \quad (3.7)$$

Second trial-run:

$$Y_t = g_1(LO_t, HI_t, HU_t, SF_t, W_t, T_t) \quad \ldots\ldots \quad (3.8)$$

$$Y_t = g_1(TO_t, HI_t, HU_t, SF_t, W_t, T_t) \quad \ldots\ldots \quad (3.9)$$

$$Y_t = g_1(TO_t, HN_t, HU_t, SF_t, W_t, T_t) \quad \ldots\ldots \quad (3.10)$$

The yield response function was further subdivided into irrigated, non-irrigated and upland yield response in an attempt to identify the variable(s) that will cause a change in yield in each category. The trials composed the following equations -

$$YI_t = g_2(TO_t, SF_t) \quad \ldots\ldots \quad (3.1.1)$$

$$YI_t = g_2(LO_t, SF_t, W_t) \quad \ldots\ldots \quad (3.1.2)$$

Non-irrigated yield response:

$$YN_t = g_3(TO_t, W_t) \quad (3.2.1)$$

$$YN_t = g_3(LO_t, SF_t, W_t) \quad (3.2.2)$$

Upland yield response :

$$YU_t = g_4(TO_t, SF_t, W_t) \quad (3.3.1)$$

$$YU_t = g_4(LO_t, SF_t, W_t) \quad (3.3.2)$$

4.2.2 Yield Response Functions Empirical Results

Yield response estimates for various regions are presented in Tables 4.2a to 4.2i. Included in the tabular presentations are the trials comprising different sets of equations, each equation using different sets of variables. The t-values are figures in brackets found underneath the relevant coefficients.

ILOCOS REGION

All rice areas (Table 4.2a): Equation (2) of the second trial implied the best estimate of the total explained variation (R^2 = .93). In this equation the coefficients for the parameters used in the regressions were significant at the conventional level, except for rainfall. As expected, increases in proportion of irrigated area, rice variety adoption and average size of farm positively contribute to yield. Likewise, expanded proportion of tenant and leashold palay farms; non-irrigated and upland areas negatively affect the yield (equations 2 and 3).

Considering the three best equations of the last trial, it was apparent that the coefficients of the same parameter differ in each equation. Rice variety, for instance, showed positive significant coefficients in equations (2) and (3) but the value declined in the last equation. The sign of the coefficients of the other variables remains the same in all the three equations.

Analysis by land condition (Table 4.3a): Yield on irrigated riceland did not show significant responsiveness to any of the variables except to the amount of rainfall at a lower level of significance (equation 2). The sign of the rainfall coefficient denotes that for the region, in spite of the presence of irrigation, an increased amount of rainfall could provide increased yield per hectare for this type of land. The situation implies that the source of irrigation water in the region may have come from rivers or streams which are highly dependent on rainfall for its supply.

Equation (2) of the trial for unirrigated yield inferred significant coefficient of SF_t and W_t - negative for SF_t and positive for W_t. The coefficient of TO_t in the first equation was also observed as positively significant, though at a lower level. This implies that an increased proportion of tenant-cultivated riceland may assist in increasing yield for the region.

Upland yield, on the other hand, was found to be positively responsive to the average size of the farm as shown by the coefficient in the two trials. The significance, however, is not at the conventional level.

CAGAYAN VALLEY

All rice areas (Table 4.2b): Equation (7) of the first trial and equations (2) and (3) of the second trial obtained a fairly good estimate of the total explained variations (R^2) ranging from 82 to 84 per cent. However, the coefficient for % unirrigated only gave a significant negative value at the conventional level. Variable TO_t in the three equations consistently showed a positive sign but was only significant at a lower level.

The weakness of the estimated coefficients for the other parameters can be traced partly to the problems of multicollinearity. The following variables were found to be correlated (r = greater than .70): HN_t and SF_t, HN_t and W_t and SF_t and T_t.

Analysis of land condition (Table 4.3b): Yield for irrigated riceland was found to be positively responsive to tenant-owner ratio variable (equation 1). Similarly, leasehold-owner ratio signified positive effect for both unirrigated and upland yields as shown in both equations (2) of the yield response function for these two classes of ricelands. Therefore, the coefficients of the above parameters did not support the expected effect of tenancy on yield for this particular area.

The pronounced and lengthy wet season characterized by the region may have explained the insignificant coefficient obtained for rainfall.

CENTRAL LUZON

All rice areas (Table 4.2c): The second sets of the regression equations used to estimate yield response for this region did give a good estimate of R^2. The majority of the parameters showed significant coefficients; however, there is something to be explained on their signs.

While it was expected that an increase in the proportion of irrigated areas and the amount of rainfall will positively contribute to yield, it was found that the relationship was the reverse for this region.

It could be recalled that from 1961 to 1970, Central Luzon reported the highest proportion of irrigated riceland among the regions of the Philippines (discussed in Chapter 2.0). Any increase in the amount of rainfall, therefore, may cause excessive water in the irrigated fields and reduce the expected yield.

Another coefficient with the wrong sign is that attached to the leasehold-owner ratio. It contradicts our previous presumption that a greater proportion of leasehold cultivated area will negatively contribute to yield. In this region, it was observed that the relationship was positive. This means expanded proportion of riceland of leasehold cultivated will increase the average yield per hectare in the area.

Analysis by land condition (Table 4.3c): Only two parameters used in the estimate revealed a significant positive relationship with yield in irrigated land. Tenant-owner ratio variable showed significance at 10% significant level, while SF_t at a much lower level. Both signs attached to the coefficient of TO_t and SF_t denote the reverse of our previous assumption on the effects of these two variables on yield.

The analysis on unirrigated yield shows that the increased size of a farm may reduce the expected yield as indicated by the negative significant coefficient obtained for this parameter. Again, the result contradicts the general presumption. It may be possible that, in the region, the extension of unirrigated palay area already covered marginal land unfit for palay cultivation, that the yield obtained was too low and upset the average regional yield per hectare for this class of riceland.

The estimate for the upland yield indicated that yield was negatively responsive to a greater proportion of tenant cultivated area (equation 1 of the trial).

For all the three types of land conditions, rainfall did not show strong influence on yield as indicated by the insignificant coefficients. It was, however, observed that it denotes positive relationship.

SOUTHERN TAGALOG

All rice areas (Table 4.2d): Equations (2) and (3) of the second trial showed a fairly good estimate of the total explained variations. The coefficients obtained for four of the parameters were relatively stable in both equations.

The coefficient for rainfall is positive and significant in two out of the three equations that comprised the second trial. The new rice variety consistently results in a positive coefficient in all trials and is significant in two equations. Increase in average size of a farm can assist in improving the yield per hectare as indicated by the significant positive coefficient of the parameter. Tenant-owner ratio (TO_t) showed significant relationship with a positive coefficient which is not the sign that was expected.

Analysis by land condition (Table 4.3d): Rainfall coefficient obtained from the yield responses for the different land conditions indicated positive significance in all the equations where this variable was fitted. The average size of a farm (SF_t) was noted to be significant with positive coefficient for upland yield but not at the conventional level.

BICOL REGION

All rice areas (Table 4.2e): Three equations of the second-round trial for yield response estimate, attained a higher R^2, ranging from .84 to .86. However, the regression lines showed that only the coefficient for the new rice variety to be positively significant (lower level). The weakness of the estimate of the coefficients may be partly due to problems of multi-collinearity among the variables employed in the equations. Independent variables were found to give correlation (r) greater than .70 were as follows: adoption of the new rice variety and leasehold-owner ratio; adoption of rice variety and % irrigated area; size of farm and leasehold-owner ratio, and size of farm and % upland area.

Analysis by land condition (Table 4.3e): None of the variables used in the estimate yield a significant relationship with yield on irrigated riceland. Rainfall, as expected, was observed to have a positive effect on yield of unirrigated and upland palay areas.

EASTERN VISAYAS

All rice areas (Table 4.2f): Equation (5) of the first trial, and equation (1) of the second trial were presumably the best equations to estimate the yield response for the region. Apart from the fairly good estimate of R^2, the coefficients of the majority of the parameters were significant and satisfy our prior expectations. Yield was found to be positively related to the proportion of irrigated riceland, the adoption of the new rice variety and the size of farmholdings. A negative effect of expanded proportion of leasehold cultivated land was also suggested.

Analysis by land condition (Table 4.3f): Irrigated yield response was best calculated by using equation (2) of the trial which gave R^2 equal to .94. Coefficients of SF_t and W_t were all significant with a positive sign, while LO_t exhibited a negative sign which was significant.

Analysis for the unirrigated yield revealed that average size of farm and rainfall variables will simiarly affect the yield as shown by the positive and significant coefficients of both parameters.

For upland yield response estimate, size of farm was found to have a negative relation with the yield indicated by the negative and significant coefficient obtained in equation (1) of the trial.

WESTERN VISAYAS

All rice areas (Table 4.2g): Four equations in the two trials obtained a reasonably high R^2, and were able to show significant coefficients of the fitted variables. These are equations (6) and (7) of the first trial and equations (2) and (3) of the second trial. Rainfall and TO_t variables were consistently observed to indicate significant negative coefficients in the four equations. Their coefficients, however, were noted to vary between the trials.

Adoption of the new rice variety was not significant but the coefficient was positive in the last three equations of the second trial.

Analysis by land condition (Table 4.3g): All the regression equations used to estimate yield responses for the different land conditions failed to produce a good estimate of the total explained variations. Moreover, the obtained coefficients of the parameter were found to be insignificant in all the trials with the exception of TO_t variable in equation (1) of the estimate for upland yield. The coefficient of TO_t parameter indicated negative significance at a lower level.

NORTHERN AND EASTERN MINDANAO

All rice areas (Table 4.2h): Satisfactory estimates of total explained variations were obtained from six out of the ten regression equations tried, to estimate the yield response for the region. Most variables fitted in the functions possessed significant coefficients. Yield was noted to be positively related to increased adoption of the new rice variety, amount of rainfall and greater proportion of tenant cultivated area. The attached sign of the coefficient of TO_t did not satisfy the prior expectations. This may be explained by the fact that in tenanted ricelands of the country intensive cultivation is often employed to raise production and consequently give a better share for the tenant-farmer. This occurs in regions like Southern Tagalog, Cagayan Valley and Eastern Visayas. It was also deduced from the results that SF_t and HU_t have negative significant coefficients. There were instances, too, that the coefficients were inconsistent in the different equations.

Analysis by land condition (Table 4.3h): Rainfall consistently showed a positive and significant coefficient in the response estimates for irrigated and upland yield. Meanwhile, the coefficient of SF_t indicated negative influence to yield for the same classes of land condition. The coefficient obtained for the parameters was observed to be unstable.

The analysis on yield response for unirrigated yield failed to obtain significant coefficient of the variables used.

SOUTHERN AND WESTERN MINDANAO

<u>All rice areas (Table 4.2i)</u>: In the second trial-run most parameters showed significant coefficients. Yield indicated positive response to increases in adoption of the new rice variety, the proportion of irrigated, as well as upland area, and leasehold cultivated area. The sign of HU_t and LO_t coefficients, which were positive, contradicted the general assumption as to the effects of these variables. Moreover, the negative sign attached to the rainfall variable is significant and of contrary sign to prior expectations.

<u>Analysis by land condition (Table 4.3i)</u>: Yield on irrigated riceland was found negatively responsive to increased size of palay farm (SF_t). This was indicated by the negative sign attached to the SF_t coefficient and significantly shown in both equations used to estimate the irrigated yield response.

PHILIPPINES

<u>All rice areas (Table 4.2)</u>: The yield response estimates, like hectarage, indicated weaknesses in the obtained coefficients for some parameters in some regions. Apart from the inconsistency of significance, the sign attached to the coefficients varied from one equation to another. In general, the results were superior to those obtained from the hectarage equations. To increase the degrees of freedom the data of all the regions were pooled and fitted to region dummy variables in the equations in addition to variables previously tried.

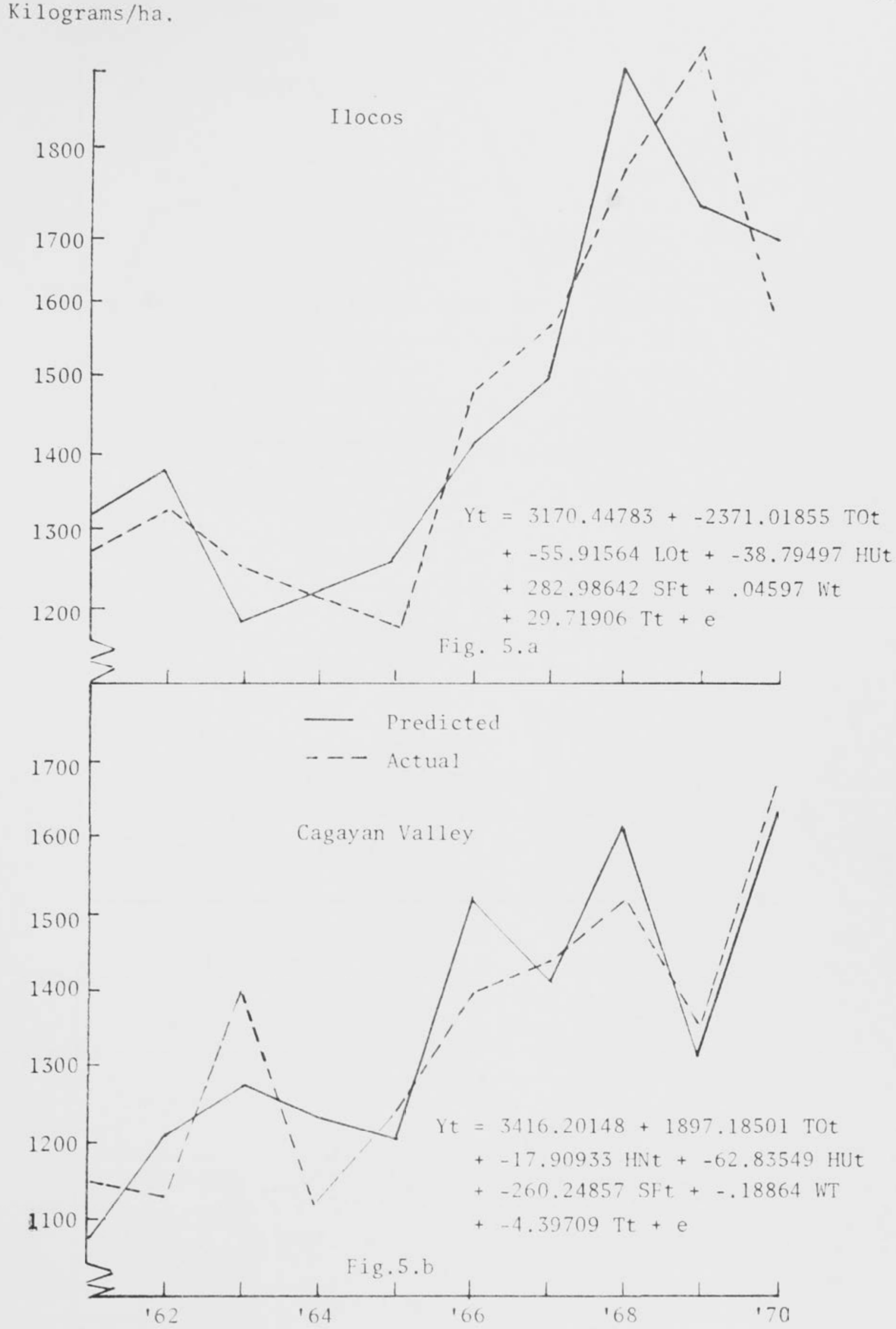


FIGURE 5

COMPARISON BETWEEN ACTUAL AND PREDICTED PALAY YIELD IN VARIOUS REGION, PHILIPPINES 1961 TO 1970

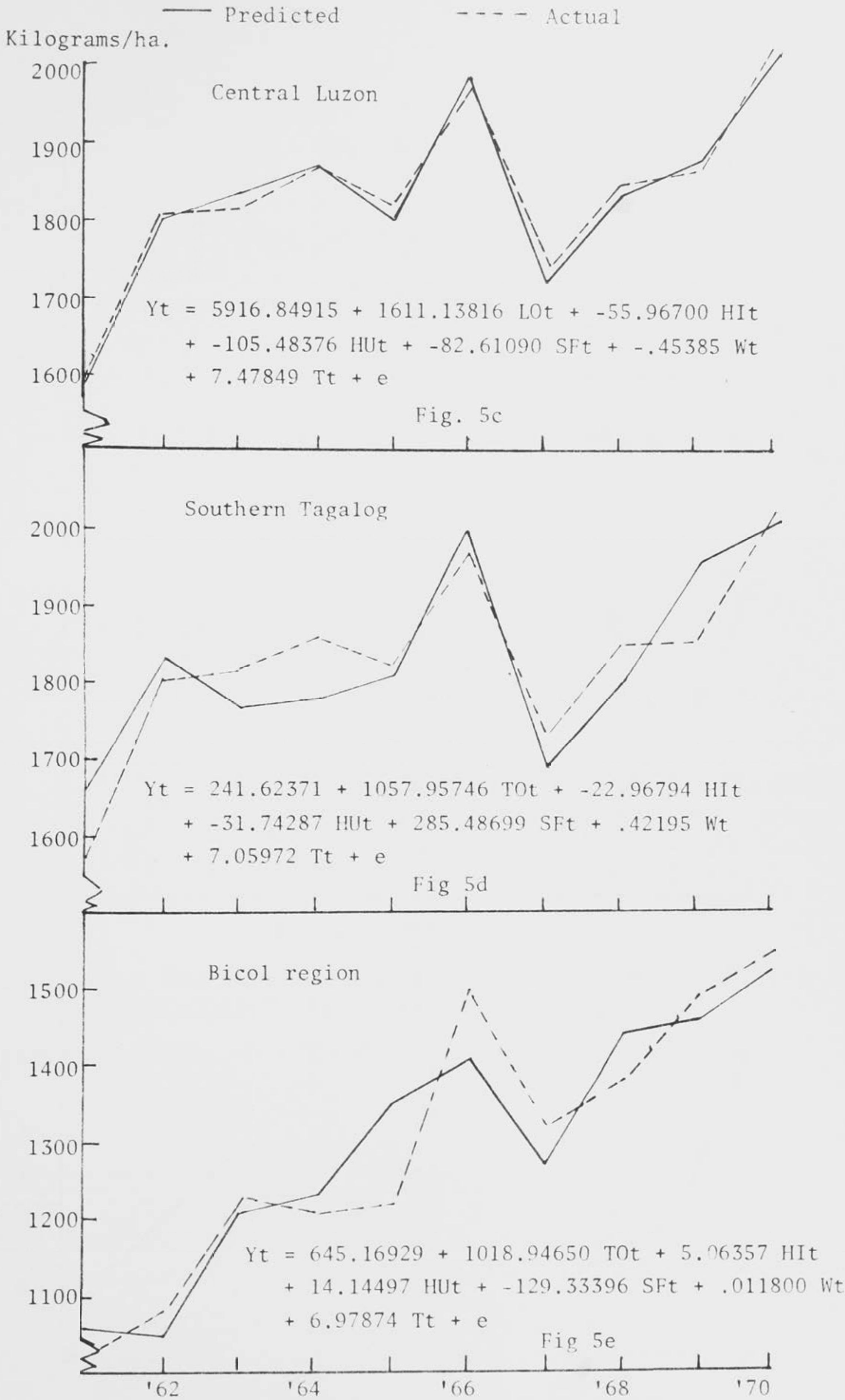


FIGURE 5 (cont)

COMPARISON BETWEEN ACTUAL AND PREDICTED YIELD IN VARIOUS REGION, PHILIPPINES 1961 TO 1970

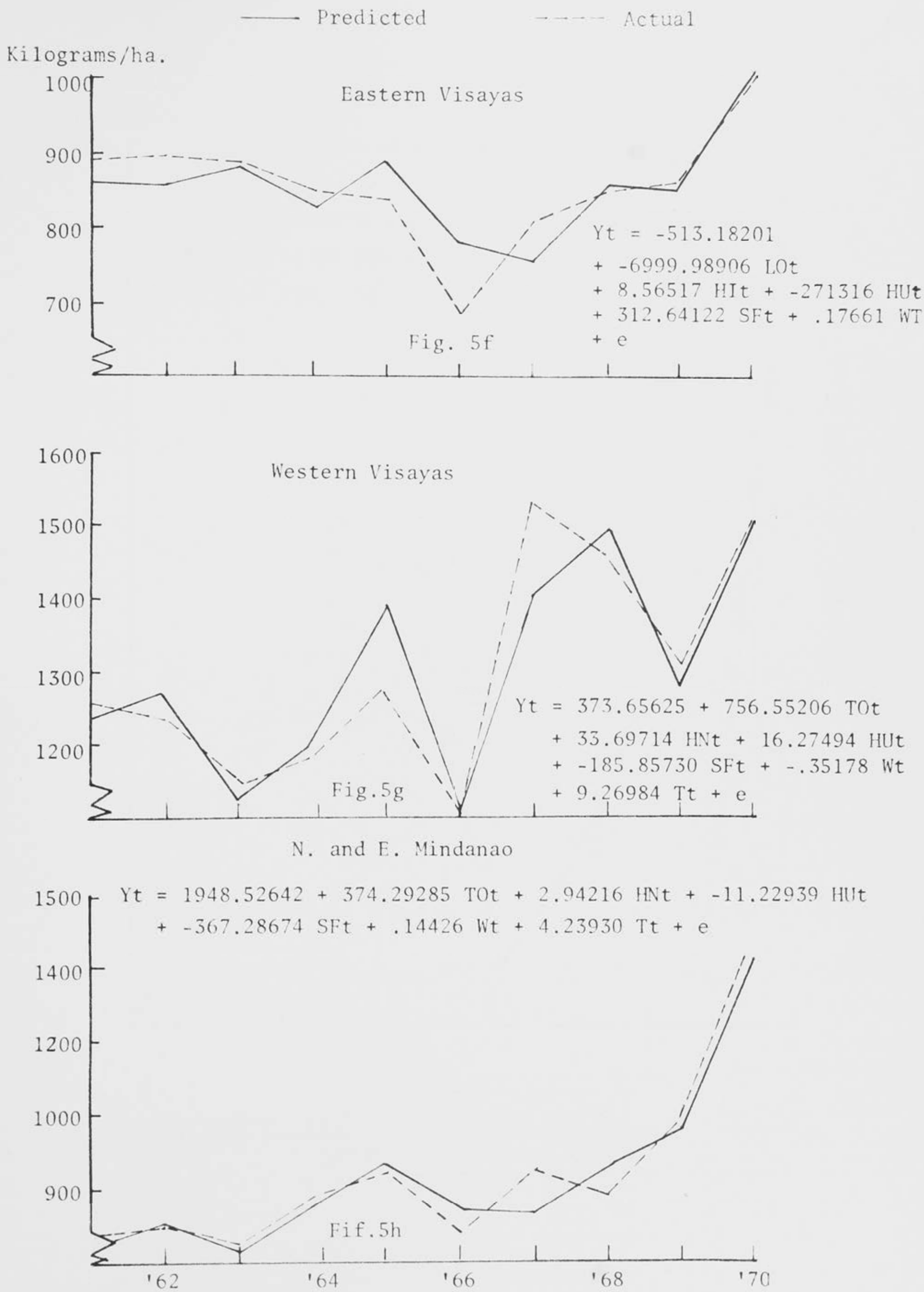


FIGURE 5

COMPARISON BETWEEN ACTUAL AND PREDICTED PALAY YIELD IN VARIOUS REGION, PHILIPPINES 1961 TO 1970

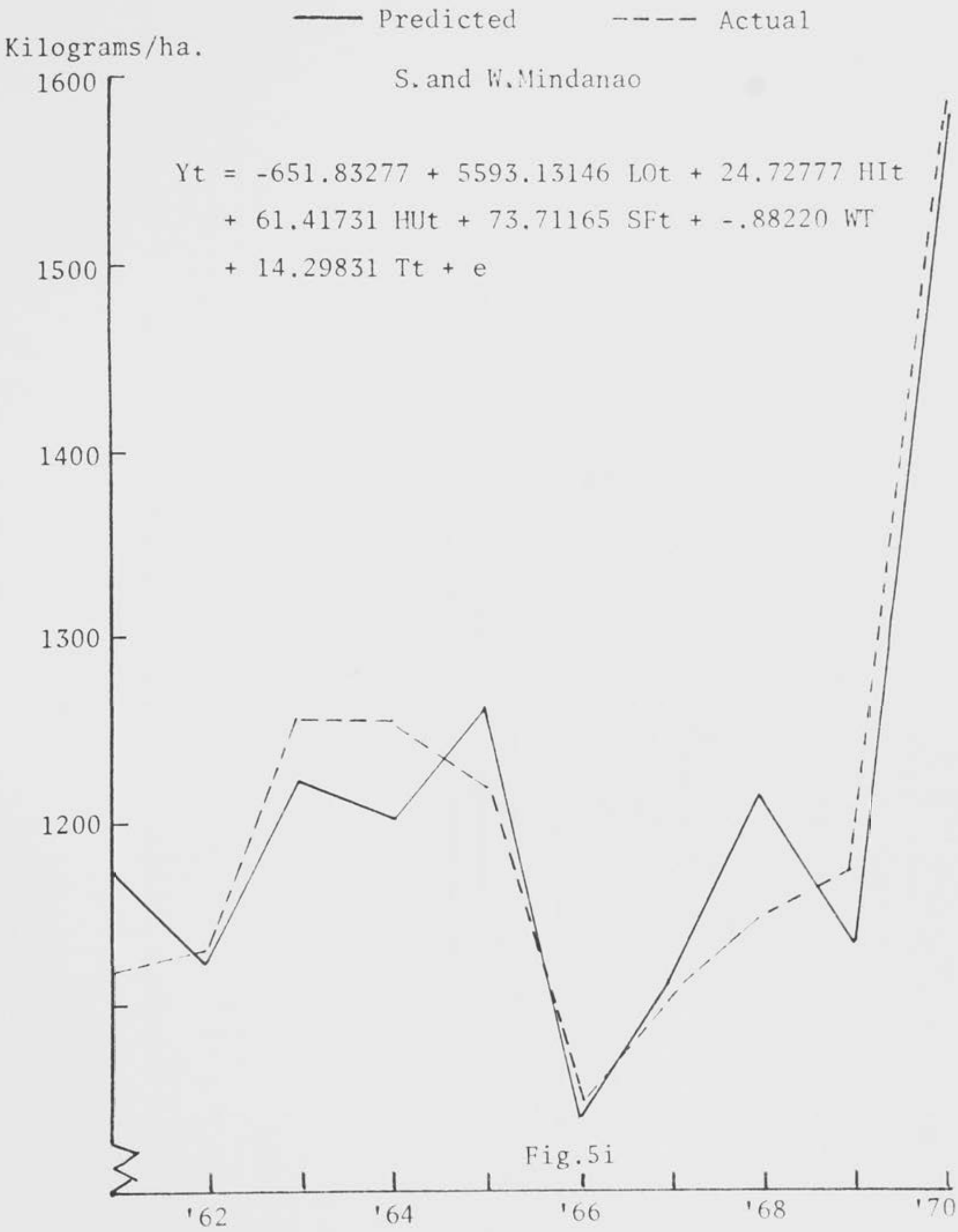


FIGURE 5 (cont)

COMPARISON BETWEEN ACTUAL AND PREDICTED YIELD IN VARIOUS REGION, PHILIPPINES 1961 TO 1970

TABLE 4.2

ESTIMATED YIELD RESPONSE FUNCTION FOR PHILIPPINES, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	Ilocos	Cagayan Valley	Southern Tagalog	Bicol	Eastern Visayas	Western Visayas	N. & E. Mindanao	S. & W. Mindanao	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	1482.51017	-438.24507*	-433.47544*	-447.80437*	-525.37890*	-925.70409*	-296.25482*	-670.57232*	-364.65851*		25.08434	3.70949***		-4.00130	-33.29121	.10146*	4.02449*	.84274	138.88527
		(-4.89256)	(-6.00425)	(-4.11168)	(-5.86129)	(-10.61740)	(-2.86741)	(-4.51787)	(-3.28784)		(.07847)	(1.50327)		(-1.21752)	(-.95713)	(3.11426)	(3.78597)		
(2)	1433.09020	-389.69458*	-390.83401*	-418.73911*	-483.96495*	-882.84631*	-260.01872*	-632.95598*	-324.51708*	20.93056		3.64419***		-3.84391	-31.51729	.09943*	4.20464*	.84325	138.65630
		(-3.06520)	(-3.49609)	(-3.42656)	(-3.99148)	(-7.21202)	(-2.05976)	(-3.84366)	(-2.37992)	(.50407)		(1.48918)		(-1.19293)	(-.91120)	(3.04641)	(3.76004)		
(3)	1835.39511	-383.27960*	-387.19153*	-424.83626*	-495.11284*	-878.21153*	-251.40056*	-637.14972*	-329.33595*	19.96182			-4.20593**		-33.99595	.10009*	4.03917*	.84516	137.81194
		(-3.03046)	(-3.49780)	(-3.53711)	(-4.10034)	(-7.31569)	(-2.04967)	(-3.97920)	(-2.45229)	(.48354)			(-1.77954)		(-.99015)	(3.08872)	(3.64754)		

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2a

ESTIMATED YIELD RESPONSE FUNCTION FOR ILOCOS REGION, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	-1562.06457	831.58880 (.88791)		34.32200*** (1.50370)	14.68351 (.75389)		453.18846 (.91881)			.46832	249.25931
(2)	467.80137	592.56704 (.70838)		18.33027** (1.87586)		-13.71583 (-1.08148)	139.37893 (.34979)			.52014	236.80249
(3)	-487.69679	824.24224 (.55034)		22.55790** (1.95827)		-3.66172 (-.14554)	103.62205 (.33676)	.30162** (1.68174)		.72919	198.89187
(4)	1646.99048		1250.34795*** (1.61538)		-20.40175* (-2.23756)		-90.86830 (-.25444)	.31578* (2.01365)		.59026	218.81755
(5)	-654.25382		1021.37630** (1.78237)	23.71476* (3.17181)			117.45854 (.44756)	.31787* (2.52593)		.72775	178.36467
(6)	1090.90162	-556.81800 (-.57549)				-17.57724 (-1.21134)	42.54394 (.09358)	.23041 (1.26635)		.38096	268.95840
(7)	2126.34007	-294.75107 (-.37013)			-14.92842** (-1.89983)	-22.62106** (-1.87606)	-190.05777 (-.48942)	.24442** (1.65511)		.67459	218.01994
Second (1)	1297.09079		-641.04958 (-.27228)	+8.89301 (+.22392)		-5.65272 (-.21489)	282.08123 (.73130)	.04768 (.13309)	10.61665 (.83069)	.77983	207.07680
(2)	3170.44783	-2371.01855* (-2.69904)		55.91564* (2.37221)		-38.79497* (-2.13036)	282.98642*** (1.40159)	.04597 (.48483)	29.71903* (3.20257)	.93419	113.21250
(3)	-879.17125	-858.27316*** (-1.34872)			-21.01950 (-1.18281)	-24.55979 (-1.03356)	573.65167 (1.25918)	.09462 (.73778)	17.11527* (2.13631)	.87094	158.54605

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2b

ESTIMATED YIELD RESPONSE FUNCTION FOR CAGAYAN VALLEY, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	I_t	R^2	Standard Error of Estimate
First (1)	1910.82181	972.82609***		.47552	-12.39387		-41.88665			.78759	121.51192
		(1.26895)		(.02367)	(-.60657)		(-.24408)				
(2)	698.25138	1064.67306***		12.81802*		8.68384	-52.39762			.77747	124.37422
		(1.39512)		(3.12660)		(.35172)	(-.27756)				
(3)	531.39265		8691.94380	7.48265***		32.06983	110.92858	-.01313		.74149	149.87340
			(.88404)	(1.46235)		(.80182)	(.36791)	(-.12217)			
(4)	1895.35127		4395.07779		-8.39589**		-20.72641	-.02937		.73393	135.99776
			(.64853)		(-1.81774)		(.10990)	(-.31129)			
(5)	1276.15417		4012.58113	7.57846***			-68.27814	-.03573			
			(.52624)	(1.53740)			(-.35012)	(-.35766)			
(6)	2649.55148	80.78796				-20.36786	-401.54427***	-.06706		.36339	210.36405
		(.06442)				(-.44824)	(-1.46918)	(-.40611)			
(7)	2235.78008	1271.44486***			-12.87086*	-14.75531	-85.46263	-.07502		.81596	126.45976
		(1.50632)			(-3.13623)	(-.53902)	(-.44339)	(-.75540)			
Second (1)	598.11675		9998.75329	7.88873		27.72587	104.04376	-.03064	-.90448	.74235	172.77133
			(.57792)	(1.10149)		(.43763)	(.29364)	(-.14281)	(-.09997)		
(2)	1572.95710	2018.79827***		18.45451**		-45.48193	-257.66274	-.18835	-4.75828	.82260	143.36329
		(1.35724)		(1.82414)		(-.57554)	(-.71037)	(-.84965)	(-.62887)		
(3)	3416.20148	1897.18501***			-17.90933*	-62.83549	-260.24857	-.18864	-4.39709	.83813	136.94357
		(1.41875)			(-1.98360)	(-.77918)	(-.75794)	(-.90994)	(-.64109)		

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2c

ESTIMATED YIELD RESPONSE FUNCTION FOR CENTRAL LUZON, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	-3642.58861	-39.69648 (-.45298)		49.95399*** (1.34366)	62.69362*** (1.36117)		44.42236 (.26799)			.33749	183.73524
(2)	2616.98991	-39.29664 (-.44798)		-12.60551 (.65189)		-62.36775*** (-1.35353)	44.88859 (.27046)			.33548	184.01409
(3)	4508.24061		2075.22614* (2.53195)	-30.42680* (-2.56612)		-109.83021* (-3.25894)	108.54702 (1.13066)	-.58280* (-2.65714)		.78287	117.57422
(4)	1898.75344		1166.93661 (.92287)		9.72614 (.60072)		84.04922 (.55046)	-.37976 (-1.09850)		.26001	194.18124
(5)	2085.48687		829.01349 (.66874)	-.32809 (-.02580)			104.90072 (.63903)	-.25907 (-.77475)		.20671	201.05319
(6)	2166.90417	30.81000 (.43229)				-47.11276*** (-1.31522)	99.94472 (.72603)	-.22321 (-.76080)		.35380	181.45883
(7)	1801.34642	-14.90296 (-.15747)			15.74132 (.77896)	-55.41404*** (-1.42781)	26.07777 (.15168)	-.26619 (.85704)		.43892	189.04470
Second (1)	5916.84915		1611.13816* (26.49435)	-55.96700* (-44.94924)		-105.48376* (-43.75940)	-82.61090* (-8.53527)	-.45385* (-27.80890)	7.47849* (27.96626)	.99917	8.39221
(2)	5880.21006	-43.06521 (-.71224)		-58.09414* (-2.85342)		-79.16659* (-2.58516)	-232.02034*** (-1.59749)	-.15688 (-.78532)	9.87612* (2.66556)	.83331	118.97890
(3)	73.26235	-43.27916 (-.71432)			58.02261* (2.84845)	-21.15102 (-.76515)	-231.50703*** (-1.59302)	-.15658 (-.78282)	9.84903* (2.65945)	.83289	119.13039

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2d

ESTIMATED YIELD RESPONSE FUNCTION FOR SOUTHERN TAGALOG, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	2487.49885	-227.29397 (-.22439)		7.19325 (.94001)	-22.46457 (-.72774)		-172.32990 (-.64950)			.38710	219.39942
(2)	248.67364	-224.37343 (-.22131)		29.51844 (1.04012)		22.29297 (.72304)	-172.22330 (-.64869)			.38634	219.53488
(3)	-447.21765		-1558.74888 (-.87841)	22.45646 (1.16828)		9.57672 (.39371)	23.99653 (.10761)	.25648*** (1.63930)		.74231	159.05443
(4)	2719.97983		-3063.70725** (-1.76292)		-38.85198* (-2.06190)		-65.17963 (-.26264)	.08365 (.63698)		.57544	182.60444
(5)	-105.33221		-1092.55399 (-.90684)	15.18849* (3.11025)			52.34531 (.27207)	.29650* (2.73467)		.73232	144.99284
(6)	385.50506	466.53334 (1.00040)				-18.27104* (-2.96953)	80.81381 (.39911)	.34908* (2.80677)		.71019	150.86830
(7)	523.10591	412.42367 (.49403)			-2.10727 (-.08295)	-17.96943* (-2.31097)	75.48573 (.32103)	.34220* (2.11436)		.71069	168.53100
Second (1)	-465.18395		-842.43682 (-.40606)	12.49127 (.52412)		3.98226 (.15009)	136.16794 (.49660)	.30062** (1.73055)	3.71192 (.78816)	.78651	167.16681
(2)	241.62371	1057.95746*** (1.42701)		-22.96794 (-.95612)		-31.74287 (-1.27474)	285.48699*** (1.31929)	.42195* (3.14436)	7.05972** (1.86314)	.86584	132.51676
(3)	-2055.50934	1057.29102*** (1.42325)			22.97442 (.95265)	-8.77389 (-1.11524)	285.73681*** (1.31769)	.42186* (3.13937)	7.06874** (1.85974)	.86562	132.62918

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2e

ESTIMATED YIELD RESPONSE FUNCTION FOR BICOL REGION, 1961 TO 1970

(dependent variable in kilgrams per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	2463.13667	-962.36145		-1.42199	4.49184		-347.74371*			.72939	123.97891
		(-1.17882)		(-.16295)	(.42801)		(-3.18480)				
(2)	2912.87997	-962.85350		-5.92282		-4.50653	-347.66118*			.72943	123.96415
		(-1.17938)		(.46406)		(-.42945)	(-3.18368)				
(3)	2682.01187		-4252.26680	-6.84013		-15.67430	-325.88363**	.08657		.73699	136.64720
			(-.58576)	(-.47357)		(-.93700)	(-1.80154)	(1.01745)			
(4)	1937.83577		-4203.90358		8.46656		-354.38514*	.04627		.69139	132.39205
			(-.59812)		(.61023)		(-2.05954)	(.68232)			
(5)	1977.78669		-2056.41592	3.68732			-332.11613**	.03118		.67926	134.96938
			(-.30302)	(.41129)			(-1.86008)	(.51589)			
(6)	2307.20979	-548.54444				-5.29981	-309.90742*	.04218		.73092	123.62274
		(-.63263)				(-.46727)	(-2.39314)	(.49417)			
(7)	2063.15943	-716.22837			7.06607	-3.26810	-307.42170*	.04960		.74707	134.00225
		(-.71858)			(.50539)	(-.25266)	(-2.18872)	(.52943)			
Second (1)	1659.80450		586.71785	-.67505		7.27713	-218.11068	.00618	4.54090***	.83753	124.01487
			(.07839)	(-.04867)		(.32090)	(-1.19689)	(.06359)	(1.36250)		
(2)	645.16929	1018.94650		5.06357		14.14497	-129.33396	.01180	6.97874***	.86192	114.32557
		(.73300)		(.35711)		(.68817)	(-.78606)	(.14146)	(1.57920)		
(3)	1152.13775	1017.23175			-5.05308	9.07460	-120.41297	.01180	6.97444***	.86189	114,33684
		(.73260)			(-.35624)	(.67103)	(-.78661)	(.14141)	(1.57933)		

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2f

ESTIMATED YIELD RESPONSE FUNCTION FOR EASTERN VISAYAS, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	885.91649	-330.07565		.98100	-1.68971		71.34522			.19764	117.56772
		(-.25358)		(.06917)	(-.12540)		(.27822)				
(2)	717.91625	-330.76710		2.66897		1.67412	71.14343			.19758	117.57184
		(-.25399)		(.31823)		(.12399)	(.27722)				
(3)	-599.46183		-7496.67769*	8.72466*		-2.83768	355.34174*	.17475*		.82739	60.96579
			(-3.31940)	(2.20070)		(-.44349)	(3.34874)	(3.39547)			
(4)	-93.57047		-6661.36263*			-5.27429***	391.14409*	.14601*		.73454	67.62418
			(-2.74781)			(-1.48990)	(3.41581)	(2.76571)			
(5)	-643.92384		-7329.56802*	8.52887*			368.46816*	.16872*		.81891	55.85400
			(-3.59279)	(2.36290)			(3.94689)	(3.70995)			
(6)	730.74467	-602.61076				-1.70356	57.44200	.07215		.30515	109.40805
		(-.57859)				(-.13623)	(.25027)	(.94391)			
(7)	800.73517	-221.18901			-4.91021	-5.25886	100.88986	.08461		.35652	117.71301
		(-.16909)			(-.56512)	(-.35407)	(.39009)	(.99371)			
Second (1)	-513.18201		-6999.98906*	8.56517**		-2.71316	312.64122**	.17661*	.99420	.83288	69.27007
			(-2.32160)	(1.88947)		(-.37264)	(1.71944)	(3.00482)	(.31373)		
(2)	-635.03571	1158.13942		9.96752		5.36537	103.72386	.15052**	7.47674***	.60606	106.35117
		(.74784)		(1.14972)		(.41194)	(.44377)	(1.66184)	(1.37857)		
(3)	363.12183	1153.86204			-9.93992	-4.60512	103.37163	.15030**	7.46474***	.60555	106.41973
		(.74530)			(-1.14729)	(-.34274)	(.44209)	(1.65941)	(1.37623)		

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2g

ESTIMATED YIELD RESPONSE FUNCTION FOR WESTERN VISAYAS, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	655.28005	-697.78339*** (-1.29685)		12.60490 (.35006)	18.28429 (.71536)		-146.20324 (-.90218)			.47649	147.23167
(2)	2482.78314	-698.52943*** (-1.29673)		-5.69889 (-.37348)		-18.20565 (-.71058)	-146.12302 (-.90095)			.47585	147.32285
(3)	2999.68930		359.84129 (.70939)	-3.80218 (-.28526)		-47.66152*** (-1.57434)	-53.84030 (-.26987)	-.37561*** (-1.27873)		.60819	142.40768
(4)	288.81346		7053.08243*** (1.59719)		13.10761 (1.14158)		135.47117 (1.02439)	-.20628 (-.75944)		.46159	149.31347
(5)	900.36919		7669.90224*** (1.54521)	-8.70165 (-.58984)			183.70870 (1.23651)	-.08310 (-.32087)		.36541	162.10162
(6)	3971.61048	-528.44634** (-1.64721)				-50.09273* (-2.44106)	-246.78252** (-1.91441)	-.41911* (-2.10149)		.71391	108.84066
(7)	2927.86593	-854.13203* (-2.36109)			16.07876*** (1.48659)	-24.12585 (-1.06749)	-268.52702* (-2.30314)	-.51913* (-2.71532)		.81572	97.66369
Second (1)	2101.68351		2838.72557 (.54634)	-32.23007 -.98123		-10.02686 (-.20008)	29.48293 (.13385)	-.15256 (-.40250)	13.91501 (.94931)	.69870	144.19978
(2)	3745.74349	-755.81169** (-1.94495)		-33.70216*** (-1.47061)		-17.48639 (-.50902)	-186.09168 (-1.22145)	-.35228*** (-1.28791)	9.28164 (.88054)	.85348	100.55811
(3)	373.65625	-756.55206** (-1.94739)			33.69714*** (1.47172)	16.27494 (.29949)	-185.85730 (-1.21980)	-.35178*** (-1.28585)	9.26984 (.88059)	.85357	100.52628

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2h

ESTIMATED YIELD RESPONSE FUNCTION FOR NORTHERN & EASTERN MINDANAO, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	514.87865	220.39600 (.92914)		22.33338* (3.37871)	17.89013* (4.19355)		-227.45965*** (-1.57319)			.87172	87.22496
(2)	2306.95682	221.57401 (.93192)		4.41300 (.77557)		-17.87962* (-4.18247)	-228.43997*** (-1.57623)			.87119	87.40474
(3)	1454.50658		1763.37903 (.83923)	7.20090* (2.10080)		-13.60709* (-.60865)	-127.40678** (-1.69869)	.10408** (1.86737)		.93294	70.51078
(4)	797.79016		5227.65358*** (1.41183)		2.31430 (.49766)		-133.16924 (-.91180)	.13198 (1.22583)		.68193	137.34579
(5)	655.98168		4260.72714 (1.16393)	5.78718 (.92108)			-106.38039 (-.77104)	.15087*** (1.50836)		.71460	130.10099
(6)	2464.82164	399.39202* (4.16272)				-15.65741* (-6.27474)	-416.53784* (-7.38775)	.13713* (3.56817)		.95931	49.12591
(7)	2519.53394	317.76170 (2.24957)			-2.71999 (-.81313)	-18.18734* (-4.49658)	-357.79049* (-3.85147)	.13215* (3.28179)		.96508	50.88007
Second (1)	1450.95884		1456.41932 (.54413)	5.97860 (.97477)		-13.36673* (-3.03433)	-127.72587*** (-1.49102)	.10829** (1.64834)	1.23773 (.25886)	.93440	80.52447
(2)	2243.03112	374.37615* (3.38189)		-2.93888 (-.77262)		-14.17158* (-6.85700)	-367.41833* (-5.20626)	.14429* (4.64506)	4.23523* (1.99815)	.98502	38.47563
(3)	1948.52642	374.29285* (3.38939)			2.94216 (.77533)	-11.22939* (-2.42528)	-367.28674* (-5.21948)	.14426* (4.64909)	4.23930* (2.0008	.98504	38.45329

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2i

ESTIMATED YIELD RESPONSE FUNCTION FOR SOUTHERN AND WESTERN MINDANAO, 1961 TO 1970

(dependent variable in kilograms per hectare)

Trial	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
First (1)	2667.89560	-1468.97695*** (-1.36695)		-2.22178 (-.14227)	-21.41239 (-1.0818)		-118.70716 (-1.11314)			.50875	142.96208
(2)	526.77536	-1470.11240*** (-1.36746)		19.19726* (1.98413)		21.40452 (1.08216)	-118.70979 (-1.11133)			.50881	142.95388
(3)	1897.54435		1408.34659 (.24201)		-13.89932 (-1.05368)		-57.29724 (-.61453)	.00877 (.01855)		.30670	169.83722
(4)	584.96661		2847.80220 (.50230)		11.70515 (1.25108)		3.24068 (.03301)	.12050 (.30496)		.35474	163.84672
(5)	572.48840		2760.60771 (.40936)		12.09067 (.82802)	1.0370 (.03783)	-.32121 (-.00222)	.10866 (.20078)		.35500	183.15343
(6)	1141.94593	-810.83165 (-.66176)				-6.38340 (.33531)	-57.59478 (-.46799)	.39922 (.98206)		.26403	174.98531
(7)	2458.49249	-1471.64148 (-1.21312)			-19.31640*** (-1.41177)	2.31259 (.12536)	-118.98668 (-.98722)	.00700 (-.01490)		.50888	159.83107
Second (1)	-651.83277		5593.13146* (2.15384)	24.72777* (4.09630)		61.41731* (3.88257)	73.71165*** (1.30903)	-.88220* (-3.11534)	14.29831* (5.03052)	.93164	68.85008
(2)	-347.96002	-194.03670 (-.19599)		25.44460* (2.62298)		62.88790* (2.50519)	-15.59507 (-.16725)	-.83304** (-1.75477)	12.40740* (2.36074)	.82813	109.16911
(3)	2196.00448	-192.37715 (-.19448)			-25.44986* (-2.62572)	37.48904** (1.92307)	-15.58092 (-.16722)	-.83369** (-1.75707)	12.41471* (2.363564)	.82838	109.08997

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.2.1

SUMMARY OF YIELD RESPONSE ESTIMATED FOR PHILIPPINES AND ITS REGIONS, 1961 TO 1970

(dependent variable in kilograms per hectare

Variable / Region	Constant	TO_t	LO_t	HI_t	HN_t	HU_t	SF_t	W_t	T_t	R^2	Standard Error of Estimate
Philippines	1433.09020	20.93056		+3.64419***		-3.84391*	-31.51729*	.09943*	4.20464*	.84	138.656
Ilocos	3170.44783	-2371.01855*		55.91564*		-38.79497*	282.98642***	.04597	29.71906*	.93	113.212
Cagayan Valley	1572.95710	2018.79827***		18.45451**		-45.48193	-257.66274	-.18835	-4.75828	.82	143.363
Central Luzon	5916.84915		1611.13816*	-55.96700*		-105.48376*	-82.61090*	-.45385*	7.47849*	.99	8.392
Southern Tagalog	241.62371	1057.95746***		-22.96794		-31.74287	285.48699***	.42195*	7.05972**	.87	132.517
Bicol	645.16929	1018.94650	5.06357			14.14497	-129.33396	.01180	6.97874***	.86	144.326
Eastern Visayas	-513.18201		-6999.98906*	8.56517**		-2.71316	312.64122**	.17661*	.99420	.83	69.270
Western Visayas	373.65625	-756.55206**			33.69714***	16.27494	-185.85730	-.35178*	9.26984	.85	100.526
N. & E. Mindanao	1948.52642	374.29285*			2.94216	-11.22939	-367.28674*	.14426*	4.28930*	.99	38.453
S. & W. Mindanao	-651.83277		5593.13146*	24.72777*		61.41731*	73.71165*	-.88220*	14.29831*	.93	68.850

* Significant at 5% significant level
** " " 10% " "
*** " " 20% " "

TABLE 4.3

ESTIMATED IRRIGATED YIELD RESPONSE FUNCTION FOR PHILIPPINES 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	Ilocos	Cagayan Valley	Southern Tagalog	Bicol	Eastern Visayas	Western Visayas	N. & E. Mindanao	S. & W. Mindanao	TO_t	LO_t	SF_t	W_t	R_t	Standard Error
(1)	32.33708	3.00351 (.52312)	6.48433 (1.28104)	.06697 (.01556)	3.58709 (.72284)	-9.04208** (-1.79863)	2.66339 (.55577)	-7.41087 (-1.46982)	-2.52868 (-.48210)	3.62926** (1.90585)		.03814 (.02381)		.54529	6.44540
(2)	42.56638	-5.13213 (-1.28188)	-1.47353 (-.48040)	-5.95606* (-1.97155)	-4.13159*** (-1.36353)	-16.82715* (-5.45083)	-4.57041*** (-1.49401)	-15.18557* (-4.91820)	-10.77835* (-3.47929)		-.84274 (-.05766)	-.33756 (-.20559)		.5243	6.59362
							Unirrigated Yield								
(1)	24.97712	1.57982 (.23744)	-7.29631 (-1.11191)	-6.48628 (-1.13886)	-11.58333** (-1.69933)	-18.61918* (-2.73427)	-1.43804 (-.23338)	-16.49206* (-2.38627)	-1.86019 (-.27149)	.59550 (.24254)			.00378** (1.89816)	.35619	8.81651
(2)	33.38842	2.14729 (.41197)	-11.55067 (-2.93117)	-8.25144 (-2.14614)	-15.25706 (-3.72303)	-22.01283 (-5.21197)	-3.51620 (-.89123)	-18.57036 (-4.45300)	-4.18848 (-.96360)		-52.95620* (-2.83278)	-1.81753 (-.86979)	.00300* (2.02142)	.43152	8.39156
							Upland Yield								
(1)	32.40669	-12.77379* (-4.26147)	-15.53264* (-5.96715)	-12.07288* (-5.34362)	-16.17662* (-5.97847)	-18.08163* (-6.64121)	-16.67121* (-6.82256)	-13.57513* (-4.94957)	-10.82636* (3.96702)	-3.97448* (-4.09318)		-.45497 (-.53826)	.00103*** (1.30611)	.50147	3.48257
(2)	19.55001	-3.06584 (-1.37797)	-6.84840* (-4.07132)	-5.55470* (-3.38455)	-7.75652* (-4.43411)	-9.25765* (-5.13498)	-8.53310* (-5.06682)	-5.03401* (-2.82786)	-1.78147 (-.96013)		-1.90802 (-.23911)	.28200 (.31615)	.00111* (1.3501	.47934	3.58204

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.3a

ESTIMATED IRRIGATED YIELD RESPONSE FOR ILOCOS REGION 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	24.64386	2.44253		7.97372		.47100	6.80464
		(.11060)		(.71738)			
(2)	3.57712		9.98776	9.44893	.00696**	.67648	5.82931
			(.57387)	(1.12385)	(1.77342)		
			Unirrigated Yield				
(1)	-29.53994	87.58541**			.01482***	.56575	15.79604
		(1.75428)			(1.40312)		
(2)	66.05047		-24.90568	-54.74245*	.01699*	.76260	12.61505
			(-.67202)	(-3.00984)	(2.02138)		
			Upland Yield				
(1)	6.34069	-1.42345		8.38715***	.00140	.30846	3.77053
				(1.35892)	(.55795)		
(2)	8.90899		-8.59771	8.85221***	.00039	.39059	3.87739
			(-.74268)	(1.58291)	(.14844)		

* Significant at 5% level

** " "10% "

*** " "20% "

TABLE 4.3b

ESTIMATED IRRIGATED YIELD RESPONSE FOR CAGAYAN VALLEY 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	32.17836	46.49876* (2.27903)		-.40887 (-.09130)		.48244	3.81294
(2)	38.35113		-143.83785 (-.27088)	-.64242 (-.08101)	.00317 (.16720)	.113931	5.46518
			Unirrigated Yield				
(1)	30.71994	2.55749 (.09634)			.00308 (+.87409)	.10461	5.06997
(2)	35.92486		243.12590*** (1.47425)	-2.42718 (-.45191)	.00310 (1.15217)	.51645	4.02433
			Upland Yield				
(1)	15.42025	-5.03862 (-.32206)		.18774 (.05962)	.00102 (.50442)	.04495	2.90303
(2)	11.96375		345.48182*** (1.28748)	2.60465 (.64992)	.00153 (+.60637)	.27968	2.76181

* Significant at 5% level

*** " " 20% "

TABLE 4.3c

ESTIMATED IRRIGATED YIELD RESPONSE FOR CENTRAL LUZON 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	-13.23324	8.25848** (1.83266)		11.05557*** (1.35890)		.47682	11.08722
(2)	11.66711		12.71755 (.13153)	9.53777 (.75506)	.00105 (.03992)	.18892	15.122537
			Unirrigated Yield				
(1)	52.24623	1.88369 (.36695)			-.01006 (-.43086)	.02900	14.59940
(2)	-14.28192		5.61723 (.07528)	16.86266*** (1.63720)	.00023 (.01229)	.35014	12.90063
			Upland Yield				
(1)	27.75910	-4.94772* (-2.27214)		-2.70089 (-.60208)	.00714 (.72949)	.47852	6.10119
(2)	10.86785		-17.55322 (-.49202)	-3.32785 (-.71397)	.00888 (.91760)	.63650	5.58009

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.3d

ESTIMATED IRRIGATED YIELD RESPONSE FOR SOUTHERN TAGALOG 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	54.16995	4.67277 (.27157)		-6.28843 (-.93596)		.13297	5.58878
(2)	12.95809		-18.43855 (-.60547)	+1.72005 (+.34821)	.00830* (3.09888)	.71247	3.52549
				Unirrigated Yield			
(1)	13.86281	7.33004 (.73914)			.00368** (1.84604)	.37157	3.23104
(2)	9.13773		-13.18168 (-.45751)	2.72605 (.59155)	.00443** (1.85714)	.37760	3.47314
				Upland Yield			
(1)	7.59264	10.74415 (.61229)		-1.06949 (-.14120)	.00285 (.72860)	.17069	5.67949
(2)	-17.91216		-1.39077 (-.05817)	+5.30909*** (1.36910)	.00729* (3.46446)	.83589	2.76763

* Significant at 5% level

** " " 10% "

*** " " 20% "

TABLE 4.3e

ESTIMATED IRRIGATED YIELD RESPONSE FOR BICOL REGION 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	42.77170	23.44735 (.52190)		-4.78138 (-.72637)		.60993	5.46501
(2)	46.57695		64.16276 (.22076)	-5.92612 (-.73288)	.00194 (.78446)	.63775	5.76915
			Unirrigated Yield				
(1)	7.81115	26.79446* (2.05841)			.00297* (2.56989)	.55928	2.68931
(2)	28.92049		14.48230 (.13088)	-4.44714*** (-1.52802)	.00257* (2.72325)	.73670	2.24519
			Upland Yield				
(1)	11.92825	14.65225 (1.21458)		-.11331 (-.06798)	.00025 (.28451)	.27861	2.05505
(2)	33.90938		-93.68587 (-1.54211)	-4.81406* (-2.84821)	.00042 (.81567)	.79300	1.20590

* Significant at 5% level
** " " 10% "
*** " " 20% "

TABLE 4.3f

ESTIMATED IRRIGATED YIELD RESPONSE FOR EASTERN VISAYAS 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	4.05066	36.63931 (.82127)		2.75300 (.34115)		.34309	4.63804
(2)	-35.49175		-409.70206* (-6.19072)	19.35312* (4.70866)	.00675* (5.42345)	.93570	1.58961
			Unirrigated Yield				
(1)	15.93703	-8.45444 (-.73932)			.00170*** (1.33723)	.22600	1.90195
(2)	1.60042		-75.37984 (-1.12938)	4.09922*** (1.31018)	.00255** (1.75901)	.35706	1.87234
			Upland Yield				
(1)	44.30667	-44.33186* (-2.19360)		-5.17922*** (-1.33195)	+.00025 (.15279)	.45251	2.35163
(2)	26.74201		106.77756 (.79112)	-5.21509 (-.62215)	.00052 (.20600)	.13291	3.24193

* Significant at 5% level

** " " 10% "

*** " " 20% "

TABLE 4.3g

ESTIMATED IRRIGATED YIELD RESPONSE FOR WESTERN VISAYAS 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	50.00783	-11.33244		-2.83958		.49937	4.86122
		(-.66969)		(-.54478)			
(2)	26.67573		96.40507	-.93844	.00221	.49795	5.33276
			(.52639)	(-.17404)	(.27050)		
			Unirrigated Yield				
(1)	38.14540	-6.82282			+.00202	.14359	3.21643
		(-.99909)			(.44275)		
(2)	25.32461		108.69134	1.81829	.00094	.18536	3.38836
			(1.08509)	(.61268)	(.19131)		
			Upland Yield				
(1)	29.64603	-16.02698***		-2.05424	.00074	.31973	3.65340
		(-1.53925)		(-.53216)	(.14051)		
(2)	-2.35709		126.77698	3.02882	.00233	.31650	4.01158
			(.92020)	(.74672)	(.37901)		

*** Significant at 20% level

TABLE 4.3h

ESTIMATED IRRIGATED YIELD FOR NORTHERN & EASTERN MINDANAO 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	11.13693	-6.72448 (-.41735)		4.42999 (.42650)		.33617	7.70067
(2)	9.51058		-50.66492 (-.49794)	-7.33954* (-2.17342)	.01339* (5.35546)	.90443	3.20084
			Unirrigated Yield				
(1)	24.33148	-5.25450 (-1.11806)			.00098 (.37857)	.23036	4.01399
(2)	19.69641		133.93247*** (1.38533)	.08315 (.02204)	.00085 (.30826)	.47346	3.58611
			Upland Yield				
(1)	26.84010	3.13487 (1.12673)		-5.37396* (-3.27060)	.00320* (2.99348)	.74041	1.43324
(2)	17.56048		18.88403 (.46027)	-2.30152** (-1.69018)	.00285* (2.82256)	.82457	1.29069

* Significant at 5% level

** " " 10% "

*** " " 20% "

TABLE 4.3i

ESTIMATED IRRIGATED YIELD FOR SOUTHERN & WESTERN MINDANAO 1961 TO 1970

(dependent variable in cavans per hectare)

Equation	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
(1)	35.29885	-13.21710 (-.63719)		-1.09128*** (-1.58325)		.74541	2.76470
(2)	27.24924		39.88296 (.34492)	-1.08865** (-1.63627)	.00169 (.23044)	.75864	2.07019
			Unirrigated Yield				
(1)	+16.58580	-9.94499 (-.33417)			.00968 (.91015)	.11140	4.88825
(2)	7.91543		153.59629 (.90317)	1.87416 (.69020)	.00877 (.78799)	.21199	4.67211
			Upland Yield				
(1)	19.56024	3.26405 (.16415)		.23879 (.15901)	.00017 (.02453)	.00792	3.07371
(2)	11.60556		117.26595 (1.12806)	2.96462*** (1.34955)	.00280 (.42663)	.33389	2.75901

** Significant at 10% level

*** " " 20% "

Three sets of regression equations were tried. Rice yield responded positively to increases in the amount of rainfall and adoption of the new rice variety, as indicated by their significant coefficients. Increase in the proportion of irrigated areas also contributed positively to the rice yield. Also as expected, the yield responds negatively to expanded proportion of unirrigated and upland ricelands. The total explained variations estimate is stable in all three regression equations. The coefficient of the parameters, however, varies slightly among the estimating equations.

Analysis by land condition (Table 4.3): The regression equations used to estimate the yield response of the different land conditions failed to obtain good R^2. Analysis for irrigated yield response showed only TO_t factor input to have a significant relation (positive) to yield. It was further observed that there was a change in the sign of the SF_t coefficient that is, from positive to negative in the two equations.

As predicted, rainfall is a major factor that relatively influences yield in both unirrigated and upland areas. Increase in tenant/leasehold cultivated farms, as expected, contributes negatively to yield in both land conditions.

4.2.3 Summary and conclusions

The relative importance of the variables employed to estimate the yield response varies among regions (Table 4.2.1). For instance, rainfall favourably influences increased production/yield for Southern Tagalog, Eastern Visayas and Northern and Eastern Mindanao, but could reduce yield for Central Luzon, Western Visayas and Southern and Western Mindanao. The rest of the regions did not indicate a significant responsiveness. Similarly, while it is expected that a greater proportion of tenancy cultivated area (leasehold or tenant) will negatively affect yield, a reverse relation was observed in the following regions: Cagayan Valley, Bicol, Southern Tagalog and Northern and Eastern Mindanao. It was further noted that a greater proportion of irrigated riceland does not always indicate positive effect on yield. In some regions like Central Luzon and Southern Tagalog, per cent of irrigated area variable inferred negative effect on yield.

Adoption of the new rice variety proved a crucial factor in increasing yield for all regions, except in Cagayan Valley, which indicated a negative sign attached to the T_t coefficient, although not significant.

Increased size of farm for palay can assist in higher yield for regions such as Ilocos, Southern Tagalog, Eastern Visayas and Southern and Western Mindanao as the obtained coefficient for this parameter in the regions were all positive and significant. Meanwhile, SF_t variable can reduce the expected yield for Central Luzon, and Northern and Eastern Mindanao regions as the yield response estimates tried for these regions showed negative significant coefficientsfor the parameter.

The yield response estimate for the Philippines revealed that rice yield responded to increases in rainfall and the adoption of the new rice variety. The presence of an irrigated area also contributed positively to yield. A greater proportion of unirrigated and upland ricelands will reduce the yield per hectare indicated by the negative coefficients.

The trials performed to estimate yield responses in various land conditions failed to show a better estimate of R^2. Besides, only rainfall variable was able to indicate significant and consistent positive coefficients in most trials done for each land condition (Table 4.3.1).

TABLE 4.3.1

SUMMARY OF YIELD RESPONSE ESTIMATE FOR THE DIFFERENT LAND CONDITIONS, PHILIPPINES AND ITS REGIONS, 1961 TO 1970

(dependent variable in cavans per hectare)

Philippines Region	Constant	TO_t	LO_t	SF_t	W_t	R^2	Standard Error of Estimate
			Irrigated Land				
Philippines	32.33708	3.62926**		.03814		.54	6.445
Ilocos	3.57712		9.98776	9.44893	.00696*	.68	5.829
Cagayan Valley	38.35113		-143.83785	-.64242	.00317	.11	5.465
Central Luzon	-13.23324	8.25848**		11.05557***		.48	11.087
Southern Tagalog	12.95809		-18.43855	1.72002	.00830*	.71	3.525
Bicol	46.57695		64.16276	-5.92612	.00194	.64	5.769
Eastern Visayas	-35.49175		-409.70206*	19.35312*	.00675*	.94	1.589
Western Visayas	26.67573		96.40507	-.93844	.00221	.50	5.333
N. & E. Mindanao	9.51058		-50.66492	-7.33954*	.01339*	.90	3.200
S. & W. Mindanao	27.24924		39.88296	-1.08865*	.00169	.76	2.070
			Unirrigated Land				
Philippines	33.38842		-52.95620*	-1.81753	.00300*	.43	8.392
Ilocos	66.05047		-24.90568	-54.74245*	.01699*	.76	12.615
Cagayan Valley	35.92486		243.12590***	-2.42718	.00310	.52	4.024
Central Luzon	-14.28192		5.61723	16.86266*	.00023	.35	12.901
Southern Tagalog	9.13773		-13.18168	2.72605	.00443**	.38	3.473
Bicol	28.92049		14.48230	-4.44714***	.00257*	.74	2.245
Eastern Visayas	1.60042		-75.37984	4.09922***	.00255**	.36	1.872
Western Visayas	25.32461		108.69134	1.81829	.00094	.19	3.388
N. & E. Mindanao	19.69641		133.93207***	.08315	.00085	.47	3.586
S. & W. Mindanao	7.91543		153.59629	1.87416	.00877	.21	4.67
			Upland Land				
Philippines	32.40669	-3.97448*		-.45497	.00103***	.50	3.483
Ilocos	8.90899		-8.59771	8.85221***	.00039	.39	3.877
Cagayan Valley	11.96375		345.48182***	2.60465	.00153	.30	2.762
Central Luzon	10.86785		-17.55322	-3.32785	.00888	.64	5.580
Southern Tagalog	-17.91216		-1.39077	5.30909***	.00729***	.84	2.767
Bicol	33.90938		-93.68587	-4.81406*	.00042	.79	1.206
Eastern Visayas	44.30667	-44.33186*		-5.17922***	.00025	.45	2.352
Western Visayas	29.64603	-16.02698***		-2.05428	.00074	.32	3.653
N. & E. Mindanao	17.56048		18.88403	-2.30152**	.00285*	.82	1.290
S. & W. Mindanao	11.60556		117.26595	2.96462*	.00280	.33	2.759

* Significant at 5% significant level
** " " 10% " "
*** " " 20% " "

CHAPTER 5

RICE SUPPLY RELATION: IMPLICATION IN POLICY ANALYSIS

The reader may now ask how the data presented in the previous chapters can be used to provide information on policy issues and assistance to policy makers. This chapter, therefore, will attempt to synthesize the results and present an illustration of how the obtained estimates, specifically the hectarage and yield responses, could be used to analyse response of the Philippines rice industry to changes in agricultural policy.

There may be weaknesses in the hectarage and yield response estimates obtained from the study if evaluated in terms of significance, signs and stability of the coefficients. The available time series data utilised in the analysis are relatively short and known to contain imprecisions which may partly explain the poorness of some estimates. The analysis, however, can provide basis for further investigation along these lines which may lead to a quantitative and qualitative adjustment of the estimates.

Statistical supply response functions were estimated for the Philippines as a whole for the period 1961 to 1970. Regional estimates were also constructed in an attempt to avoid aggregation problems implicit in the use of national data and to permit more precise estimates of responses for specific geographic regions.

The supply or output response function was approached indirectly in terms of hectarage (H) and yield (Y) response estimates. Estimated rice supply is the product of hectarage and yield for a specific area.

To illustrate the implications of some agricultural legislation on rice production, the response estimates obtained from the analysis were used to predict changes in total production for some regions and the Philippines as well.

5.1 Hectarage response

Over the past 20 years, the government through the National Rice and Corn Office (NARIC) and the Rice and Corn Administration (RCA) has been actively engaged in programs to support a floor and control a ceiling price for palay and corn. Under the most recent law (Republic Act No. 4634) passed on March 8, 1966, the Philippine Government in effect raised the prices for rice and corn by approximately 20 per cent over the current prices existing during the period. The new law was one of a number of measures designed to encourage increased production for both crops with the ultimate goal of achieving self-sufficiency in these two staples.

The support price policy has two general objectives namely:

(1) to support farm prices at reasonable levels, and
(2) to keep consumer prices at levels which are in line with the incomes of the bulk of consumers.

As an illustration of how these results might be used regions which indicated positive coefficient of palay price parameter (and negative for corn) were selected from the results and utilised for the analysis of the effect of, say, 10 and 20 per cent rises in price of palay on their regional production.

Table 5.1 presents the estimated changes in hectarage and total production for some regions as a consequence of two different levels of price change. Columns (2) to (4) are the

TABLE 5.1

ESTIMATED CHANGES IN PALAY HECTARAGE AND PRODUCTION AT A 10 AND 20 PER CENT CHANGE IN PALAY PRICE, PHILIPPINES AND SELECTED REGION a/

Region	Actual			10 - Per cent Increase					20 - Per cent Increase			
	Area ('000 has)	Yield (m.t.)	Production ('000 m.t.)	Area ('000 has)	Yield (m.t.)	Production ('000 m.t.)	%		Area	Yield	Production	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)	(11)	(12)
Central Luzon	634.70	2.224	1,411.57	692.32	2.224	1,548.62	9.71	(3)	730.91	2.224	1,625.54	15.16
Southern Tagalog	345.40	1.781	615.16	352.83	1.781	629.39	2.31	(3)	358.10	1.781	637.78	3.68
Bicol	358.00	1.551	555.26	364.14	1.551	564.78	1.72	(3)	371.30	1.551	575.89	3.72
Eastern Visayas	256.60	1.090	279.69	291.65	1.090	317.90	13.66	(3)	297.60	1.090	324.38	15.98
N. & E. Mindanao	194.30	1.436	279.02	215.90	1.436	310.00	11.11	(3)	222.37	1.436	319.32	14.44
S. & W. Mindanao	467.80	1.599	748.01	554.56	1.599	886.74	18.55	(3)	565.15	1.599	903.65	20.81
Philippines	3,113.44	1.680	5,230.58	3,675.02	1.680	6,174.03	8.04	(3)	3,726.32	1.680	6,260.18	19.68

a/ Based on 1970 reported data on Area, Yield and Production; assuming yield and other factors are equal.

( ) Denotes equation used in the estimate.

actual figures reported for the regions and the Philippines for the period 1970. Columns (5) and (7) are the estimated changes in area and total production for a 10 per cent increase in price and columns (9) and (11) are the estimated changes for a 20 per cent rise in price. Yield per hectare reported for the regions in 1970 was assumed to prevail.

Central Luzon, for instance, at 10 per cent rise in price will increase hectarage devoted for rice by around 57 thousand hectares (from 635,000 to 692,000). The predicted production for the region will, therefore, increase by almost 10 per cent over the 1970 production. On the other hand, if price support of 20 per cent prevails the change in hectarage and production is estimated to reach roughly 15 per cent above the 1970 figure. Similarly, in Southern Tagalog, the response to a 10 per cent rise in price will be 2.3 per cent (7,000 hectares) and for a 20 per cent rise the change in hectarage will be 4 per cent. For the Philippines the estimated change in area and production for a 10 per cent rise in price was about 8 per cent and for a 20 per cent support price it would be 20 per cent too. The same procedure was repeated for other regions using their respective hectarage estimating equation presented in Chapter 4.0.

Therefore, it can be generalised that frontier regions like the Mindanao areas where substantial new lands were brought into rice production in recent years, were slightly more responsive to price change than older, more intensively cultivated areas as in Southern Tagalog, Bicol and Central Luzon.

5.2 Yield response

Another recommended area that will solve permanently the problem of rice supply in the Philippines is to increase yield per hectare. Various member agencies of the National Food and Agriculture Council (NFAC) unanimously feel that potential surplus of rice can be attained to meet any increase in international requirement if the government will concentrate on a program of intensive rice cultivation rather than expansion of hectarage devoted to rice.

Increasing the yield per hectare means expansion in adoption of modern farm technology like fertiliser application, use of a new rice strain, change in cultural practices, etc. These new lines of farm inputs necessary to increase yield certainly need huge financial assistance from the government. Therefore, priority has been set out in the present Annual Self-sufficiency Program of the Philippines for rice.

The current program on rice self-sufficiency manifests priority on[a]: (1) expansion of irrigation in potential rice producing regions, (2) production of certified high-yielding varieties for adoption in various parts of the country, (3) conversion of tenancy to owner-cultivators (Land Reform Act) and (4) assistance in the marketing of food grains, which include rice and corn.

An attempt to measure the effect on yield of the possible changes in factor input is illustrated in this section. Table 5.2 demonstrates the effect on yield and total production resulting from

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[a] 'Four-year Program on Agriculture', prepared by the Department of Agriculture and Natural Resources for the year 1971.

TABLE 5.2

ESTIMATED CHANGES IN PALAY YIELD PER HECTARE AND PRODUCTION FOR A 10 PER CENT CHANGE IN VARIOUS INPUT FACTOR

PHILIPPINES AND SELECTED REGION [a]/

Region	Actual			New Rice Variety Adoption				Proportion of Irrigated Areas				Proportion of Leasehold			
	Area	Yield	Production	Area	Yield	Production	%	Area	Yield	Production	%	Area	Yield	Production	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Ilocos	144.80	1.585	229.51	144.80	1.850	267.88	16.72 (2)	144.80	2.203	318.99	38.99 (2)				
Cagayan Valley	314.00	1.635	513.39					314.00	1.859	583.73	13.70 (2)				
Central Luzon	634.70	2.224	1,411.57	634.70	3.078	1,953.60	38.40 (1)					634.70	2.385	1,513.76	7.24 (1)
Southern Tagalog	345.40	1.781	615.16	345.40	2.228	769.77	25.13 (2)								
Bicol	358.00	1.551	555.26	358.00	1.651	591.06	6.45 (2)								
Eastern Visayas	256.60	1.090	279.69					256.60	1.115	286.11	2.29 (1)				
N. & E. Mindanao	194.30	1.436	279.02	194.30	1.773	344.49	23.47 (2)								
S. & W. Mindanao	467.80	1.599	748.01	467.80	1.964	918.76	22.83 (1)	467.80	2.254	1,054.42	40.96 (1)	467.80	2.158	1,009.51	34.96 (1)
Philippines	3,113.44	1.680	5,230.58	3,113.44	1.901	5,918.65	13.15 (3)	3,113.44	1.710	5,232.98	1.78 (2)	3113.44	1.550	4,825.83	-7.74 (1)

[a]/ Based on 1970 reported data on Yield, Area and Production; assuming area and other factors are equal.

( ) Denotes equation of the second trial used in the estimate.

changes in rice variety adoption, the proportion of irrigated areas and leasehold-owner ratio in some regions which indicated a positive significant coefficient for the above variables. Columns (2) and (4) state the actual value reported for the regions in 1970 regarding area, yield and total production. Columns (5) to (16) specify the changes in production attributed to a 10 per cent change in the input factors.

Adoption of new rice variety

The government's drive towards saturating potential rice producing regions with high yielding varieties started in 1968. The area devoted to these new lines of rice strain for the period amounts to 21 per cent of the total area planted to rice. In 1970, the total area devoted increased to 43.5 per cent. If the government can program a 10 per cent increase in adoption of new rice variety the Philippines is expected to increase the overall production by 13 per cent above the 1970 figure, that is considering no change in hectarage will occur and other factors affecting yield will remain constant. Similar analysis was done for each region. In Southern Tagalog, for example, if the 1970 area planted to high yielding varieties can be expanded by 10 per cent, the resulting production will increase by 25 per cent. Meanwhile, in the Bicol region the estimated response to 10 per cent change will amount to only 6 per cent above the 1970 reported production. Central Luzon showed the highest response rate in total production for a 10 per cent increase in area planted to a new rice variety.

It is felt important to mention again that adoption of a new rice variety is only a transformed variable in this study (definition and calculation discussed in Chapter 4).

Therefore, the change in total production brought about by the 10 per cent change in this variable is really attributed to a 10 per cent change in the proportion of irrigated area for each region. The difference in yield obtained from the estimate, however, is explained by the different coefficient of the two parameters.

Proportion of irrigated areas

One of the main conclusions at the executive meeting of the National Food and Agriculture Council (NFAC) held on January 17, 1970, was that 'self-sufficiency in rice supply from domestic production for the next ten years is now feasible through expansion of irrigated ricelands all over the country'.[a]

The attained conclusion on the benefit to be derived from the expansion of irrigated ricelands made this a priority project for financial assistance. If a 10 per cent target rate of increase is set for expansion of irrigated areas all over the country, the expected increase in total production amounts to only 2 per cent, using the response estimate equation for yield for the Philippines. The low estimate can be explained by the negative coefficient of this variable obtained from some regions like Central Luzon and Western Visayas.

Similar approximations were done for selected regions to measure the probable effect of a 10 per cent increase in proportion of irrigated areas to their respective total production considering 1970 data as the base.

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[a] Planas, G. (1970). 'Food Council Aims to Permanent Stabilization of Rice Supply in 1970'. International Rice Research Institute (IRRI) special publication, 1970.

Proportion of leasehold

Only two regions, Central Luzon and Southern and Western Mindanao, indicated a positive and significant coefficient of leasehold parameter in their yield response estimates. The positive relationship of yield to leasehold contradicted the expectation that a greater proportion of leasehold cultivated area will result in reduced yield per hectare for the region.

Inasmuch as the majority of the regions failed to show positive significant coefficients of this parameter, regional estimates were pooled in an attempt to secure a more precise estimate of the relationship.

If the Philippines, for example, adopts an increase of 10 per cent leasehold conversion relative to owner-cultivated area, production is expected to decline by almost 8 per cent from the 1970 production data. This confirms our previous hypothesis of the negative effect to yield of leasehold cultivated farm.

Analysis for the two regions, depicting positive responsiveness of yield to leasehold variable, was as follows. In Central Luzon, a 10 per cent increase in proportion to leasehold cultivated ricelands will ultimately gain 7 per cent production for the region. Meanwhile, Southern and Western Mindanao predicted an increase of 35 per cent for a 10 per cent increase in leasehold area.

The results of the estimates presented above, assuming that the assumptions are feasible, can provide a guideline to policy makers with less use of intuitive judgment on what legislation concerning rice production should be given emphasis in order to attain the goal of increased production for the country.

For example, what will be the support price for palay that will generate incentive to farmers to plant and produce more for the consuming population? Moreover, a choice could be made on what input factor will have to be subsidised so that rice producers will adopt it, in an attempt to increase the overall production.

It is felt important to mention, however, that the estimates being presented on the effect of some agricultural policy on rice production, do not represent the final step in policy analysis. These are merely the first approximation and need to be further examined to consider the appropriateness of the assumptions upon which the estimates are based. For example, what is the trend in the terms of trade between rice and corn? It is also necessary to study the current economic environment or climate to decide whether estimating coefficients based upon historical time series are likely to be relevant for the immediate future.

DEFINITIONS AND EXPLANATIONS OF TERMS

<u>Palay</u> - 'Palay' is the local term for unhulled rice or paddy rice. Being the main staple food of the Filipino people, palay, among all crops, ranks first in importance. For this reason, farms growing this crop are widely distributed throughout the country notwithstanding the differences in geographic characteristics and climatic conditions which account for the specialisation of certain major crops in the different regions and provinces. This distribution is made possible by the numerous varieties of palay, each type of which is suited to a specific climatic and environmental condition.

<u>Palay Irrigated</u> -This refers to a type of palay grown on irrigated lands. The area of land irrigated refers to the specific part of the farm (physical area) artifically watered at any time during the specified crop year, regardless of the number of times it is irrigated.

<u>Unirrigated Palay</u> - The growing of a type of palay on land watered solely by direct rainfall.

<u>Upland Palay</u> - Sometimes referred to as 'Kaingin'. This type does not require standing water during its growth. It is grown on soil usually dry on the surface.

<u>Corn</u> - Statistics on corn are confined to harvested grain on maturity. Data for young green corn are not included in the report for production or area harvested; instead they are reported in the category of vegetables. Corn is considered as a substitute for rice in the Visayas regions and some provinces in the Mindanao islands. Almost 20 per cent of the Filipinos are highly dependent on corn as their staple food.

<u>Production</u> - All data on production refer to the gross harvests of the crop during the whole crop year, i.e., from July of the previous year to June of the current year. Production includes the share of the land-owner, the tenant or manager, farm labourers and harvesters. If the home lot is reported as part of the farm, all its crop production is reported regardless of whether sold or used for home consumption. Data are reported in terms of cavans or sacks of 44 kilograms of palay each.

<u>Area planted</u> - Area is classified into two categories: physical area and crop area. Physical area refers to the actual measurement of the land; hence, 2 has. is the physical area of a two-hectare piece of land.

If the whole of this two-hectare parcel is planted in succession to the first and second crops of palay within the same crop year, the physical area would be counted twice resulting in the crop area 'doubling' to 4 hectares. If instead of palay, the first, second and third crops of corn were planted (that is, in succession) during the crop year, the crop area would be 6 hectares.

In general, the crop area is the product of the physical area multiplied by the number of times a crop was planted on it. This area is expressed in terms of hectarage (a hectare is equal to 2.47 acres).

Area Harvested - refers to the actual physical area where production has been realised. If the land is planted twice, the count may be twice if there is a standing crop to be reaped. Area harvested is less than area planted by the amount of land abandoned owing to pest or diseases and/or bad weather. Thus, in the price, response analysis, area harvested is a poorer indicator of intended area than area planted.

Yield - indicates the average production per hectare harvested. For palay, this is measured in terms of cavans of 44 kilograms each, while for other crops, it is in kilograms per hectare harvested.

Average Palay Farm-size - refers to size of landholdings that each farm operator manages to cultivate. This is an aggregate of all parcels comprising the farm, regardless of ownership and/or location.

Tenure of Farm Operators - refers to the proprietory relationships between the person actually operating the farm and the farm he is operating.

Accordingly, tenure classification of farm operators is categorised as follows:

(a) Full owners are those who own all of the land on which they work.

(b) Tenants are farm operators who rent from others the land they operate. More often the term of payment is on a percentage sharing system.

(c) Leaseholders are farm operators who pay a fixed amount of cash or the equivalent value in farm produce for the use of the land they are working on. Usually, there is a contract of agreement between the land owners and the leaseholders on the terms of payment which obliges them to pay the stipulated rental regardless of harvest yield.

(d) Farm operators under other conditions are those who operate farms under conditions other than those already mentioned.

Farm Prices - are actual value in pesos received by farmers for palay of 44 kilograms.

Agricultural Wages - daily compensation paid to a hired farm labourer. This excludes meals which are generally provided by employers in some regions.

Annual Rainfall - yearly amount of rain, expressed in terms of millimetres. This is a summation of the monthly recorded drops in every weather station situated in relevant regions of the country.

Rice Variety - high yielding varieties recommended by the different rice research agencies. This is commonly referred to as IR varieties (IRRI), BPI strains (BPI certified variety), C-series (College of Agriculture HY series).

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APPENDIX A

SUPPLEMENTARY TABLES

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TABLE A1.0: Rice Production, Area and Yield Philippines, 1961 to 1970

	Production (cavan)	Area (Hectare)	Yield (cav./ha.)
1961	84,199,000	3,197,750	26.33
1962	88,864,900	3,179,190	27.95
1963	90,158,700	3,161,320	28.51
1964	87,337,700	3,087,450	28.28
1965	90,737,800	3,199,670	28.35
1966	92,559,900	3,109,180	29.76
1967	93,045,900	3,096,120	30.05
1968	103,652,200	3,303,660	31.37
1969	101,014,900	3,332,150	30.31
1970	118,941,100	3,113,440	38.20

* A cavan is equal to 44 kilograms.

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A1.1: Rice production in various regions, Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					cavan					
Philippines	84,199,000	88,864,900	90,158,700	87,337,700	90,737,800	92,559,900	93,045,900	103,652,200	101,014,900	118,941,100
Ilocos	3,212,750	3,172,100	3,419,400	3,306,400	3,716,900	4,767,600	4,622,500	5,715,000	5,980,900	5,217,200
Cagayan Valley	11,217,900	10,197,100	9,139,300	7,462,500	9,439,500	12,214,300	8,499,800	10,931,100	7,881,100	11,671,500
Central Luzon	19,517,570	20,967,500	21,579,600	20,979,900	21,086,700	23,422,100	23,624,200	26,367,000	25,666,700	32,085,100
Southern Tagalog	8,677,790	11,008,000	10,258,100	10,420,800	10,817,200	12,574,200	13,691,800	15,232,900	14,094,400	13,981,400
Bicol	7,402,040	7,245,000	8,688,000	8,397,000	8,315,700	12,515,300	9,072,100	9,861,200	10,216,500	12,618,800
Eastern Visayas	7,650,920	5,765,200	5,865,500	5,315,100	5,737,100	5,098,100	6,394,800	6,755,800	7,542,700	6,358,100
Western Visayas	11,895,710	11,341,300	10,949,600	10,712,500	11,159,600	9,374,900	11,612,100	12,525,300	11,481,100	13,657,100
N. & E. Mindanao	3,318,840	4,860,800	4,544,600	4,582,600	4,575,400	2,783,900	3,758,100	4,222,500	5,628,900	6,344,800
S. & W. Mindanao	11,305,480	14,307,900	15,714,600	16,160,900	15,889,700	9,809,500	11,770,500	12,041,400	12,522,600	17,007,100

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A1.2: Rice Area in various regions, Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					Rectare					
Philippines	3,197,750	3,179,190	3,161,320	3,087,450	3,199,670	3,109,180	3,096,120	3,303,660	3,332,150	3,113,440
Ilocos	110,630	104,620	119,920	120,080	139,220	144,710	132,290	140,950	136,160	144,820
Cagayan Valley	453,890	370,620	313,250	289,710	344,180	354,390	265,520	296,760	265,010	314,040
Central Luzon	545,730	513,550	520,760	495,700	510,240	519,310	602,060	628,010	608,840	634,750
Southern Tagalog	363,850	406,860	398,410	414,080	433,280	467,290	466,990	529,740	538,080	345,370
Bicol	317,800	290,540	310,530	305,370	299,260	366,910	300,980	314,560	300,320	357,960
Eastern Visayas	377,940	283,770	289,760	274,600	299,470	323,480	346,850	349,780	382,940	256,580
Western Visayas	414,310	400,960	415,950	396,310	383,680	377,870	333,200	376,210	384,900	397,810
N. & E. Mindanao	172,380	254,490	243,350	226,100	218,600	145,090	180,850	207,630	248,680	194,330
S. & W. Mindanao	441,200	553,780	549,390	565,500	571,740	410,130	467,380	460,020	467,250	467,780

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A1.3 : Distribution of Harvested Area by Land Condition, by Region, Philippines, 1961 to 1970.

IRRIGATED AREAS

Region										
Philippines	959,790	987,370	1,013,570	929,880	958,380	960,460	1,170,640	1,309,020	1,482,820	1,345,730
Ilocos	35,650	47,110	43,340	38,680	44,550	65,480	39,060	75,790	57,720	76,540
Cagayan Valley	91,780	121,600	127,990	58,580	68,840	135,270	120,050	130,880	128,220	211,860
Central Luzon	245,250	215,690	249,550	222,770	224,510	230,420	325,860	360,290	371,560	327,320
Southern Tagalog	87,690	98,260	145,100	99,790	103,980	142,380	216,300	238,520	276,440	153,490
Bicol	142,920	129,810	136,850	137,320	134,670	134,950	151,110	134,600	174,040	164,020
Eastern Visayas	116,820	60,530	71,860	84,880	92,830	58,060	52,790	101,780	105,290	63,960
Western Visayas	61,480	56,090	85,940	58,810	57,550	65,300	45,110	80,690	105,180	72,390
N. & E. Mindanao	21,300	63,520	20,860	27,950	25,630	21,230	29,140	41,140	86,530	56,080
S. & W. Mindanao	156,900	194,760	132,080	201,090	205,820	107,370	191,220	145,330	177,840	220,070

NON-IRRIGATED AREAS (RAINFED)

Region										
Philippines	1,660,120	1,510,000	1,450,890	1,530,500	1,607,030	1,542,880	1,480,130	1,514,020	1,406,790	1,355,630
Ilocos	72,030	42,370	58,880	78,180	90,490	60,390	88,670	60,420	66,940	63,200
Cagayan Valley	340,600	232,790	158,010	217,400	258,130	197,680	122,720	141,740	130,750	94,130
Central Luzon	273,080	273,000	255,950	248,050	260,220	285,880	268,560	260,150	229,760	296,350
Southern Tagalog	141,210	147,080	112,630	160,710	168,980	166,120	170,090	207,800	179,630	103,700
Bicol	89,710	89,550	82,690	86,210	83,790	119,870	101,200	133,040	87,990	109,390
Eastern Visayas	223,970	187,570	155,510	162,730	176,690	230,130	261,030	214,800	243,350	173,200
Western Visayas	280,370	286,490	252,100	268,180	260,900	244,930	233,030	228,510	212,170	288,570
N. & E. Mindanao	84,280	67,620	123,230	110,540	107,720	66,650	64,170	58,900	53,020	85,330
S. & W. Mindanao	154,870	183,530	251,890	198,500	200,110	171,230	170,660	208,660	203,180	141,760

UPLAND AREAS

Region										
Philippines	577,840	681,820	696,860	627,070	634,260	605,840	445,350	480,620	442,540	412,080
Ilocos	2,950	15,140	17,700	3,210	4,180	18,840	4,560	4,740	4,530	5,080
Cagayan Valley	21,510	16,230	27,250	13,730	17,210	21,440	22,750	24,140	13,010	8,050
Central Luzon	27,400	24,860	15,260	24,880	25,510	3,010	7,690	7,570	7,520	11,080
Southern Tagalog	134,950	161,520	140,680	153,580	160,320	158,790	80,600	83,420	82,010	88,180
Bicol	85,170	71,180	90,990	81,840	80,800	112,090	48,670	46,920	38,290	84,550
Eastern Visayas	37,150	35,670	62,390	26,990	29,950	35,290	33,030	33,200	34,300	19,420
Western Visayas	72,460	58,380	77,910	69,320	65,230	67,640	55,060	67,010	67,550	36,850
N. & E. Mindanao	66,800	123,350	99,260	87,610	85,250	57,210	87,540	107,590	109,100	52,920
S. & W. Mindanao	129,450	175,490	165,420	165,910	165,810	131,530	105,500	106,030	86,230	105,950

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A1.4: Distribution of Production (Rough Rice) by land condition, by region, Philippines 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Irrigated Areas										
Philippines	32,949.49	34,302.70	36,111.00	34,669.50	35,358.90	39,415.10	42,364.10	51,602.30	57,849.70	62,750.30
Ilocos	1,224.38	1,588.90	1,330.10	1,260.10	1,412.50	2,521.10	1,779.30	3,623.30	3,085.70	2,918.80
Cagayan Valley	3,984.60	4,324.60	4,783.50	2.650.70	3,398.20	6,458.90	4,837.60	5,417.90	5,177.10	8,756.90
Central Luzon	10,763.94	9,085.20	10,776.90	11,570.40	11,597.70	10,664.10	13,355.10	16,174.50	17,608.50	18,152.70
Southern Tagalog	3,273.26	3,683.30	4,940.30	3,929.70	4,121.30	5,302.50	7,540.00	7,973.80	8,499.00	7,487.50
Bicol	4,159.21	4,490.50	4,801.80	4,718.20	4,656.80	6,797.10	5,807.60	5,818.60	7,738.70	8,114.40
Eastern Visayas	2,625.80	1,770.50	1,918.60	1,824.10	1,951.36	1,480.50	1,233.00	2,481.60	2,972.50	2,343.30
Western Visayas	2,175.73	1,967.70	2.510.70	1,959.30	2,008.60	2,254.70	1,984.10	3,698.40	4,272.70	3,228.60
N. & E Mindanao	462.31	1,777.60	669.50	638.40	617.70	423.40	695.70	1,088.80	2,342.60	2,630.70
S. & W. Mindanao	4,280.26	5,614.40	4,379.70	6,118.50	6,038.00	3,512.80	5,131.70	5,325.40	6,152.90	9,117.40
Non-irrigated Areas (Rainfed)										
Philippines	41,807.44	42,649.80	41,177.50	41,444.60	43,517.80	43,208.30	42,216.80	43.037.00	35,192.50	46,577.90
Ilocas	1,928.29	1,288.20	1,622.20	1,984.50	2,230.10	1,842.20	2,741.40	1,966.30	2,571.00	2,211.70
Cagayan Valley	6,904.62	5,543.10	3,971.00	4,593.10	5,758.10	5,351.10	3,250.60	5,063.30	2,775.60	2,773.30
Central Luzon	8,326.19	11,362.30	10,543.80	8,950.00	9,067.30	12,678.40	10,038.00	9,939.70	7,819.00	13,619.10
Southern Tagalog	3,471.12	4,578.20	3,022.00	4,169.40	4,294.40	4,492.80	4,730.10	5,649.70	4,043.90	3,669.90
Bicol	1,977.82	1,641.70	2,091.20	2,243.70	2,245.30	3,485.50	2,409.10	3,274.40	1,897.00	3,311.20
Eastern Visayas	4,375.56	3,583.70	2,888.20	3,039.70	3,270.10	3,287.80	4,643.80	3,719.40	4,056.50	3,727.70
Western Visayas	8,779.03	8,771.40	7,238.80	7,905.80	8,258.10	6,386.20	8,643.00	7,749.30	6,302.60	9,602.20
N. & E. Mindanao	1,695.60	819.00	1,976.00	2,341.20	2,356.30	1,373.00	1,314.90	1,110.10	1,098.80	2,374.30
S. & W. Mindanao	4,349.21	5,062.20	7,824.30	6,217.20	6,038.10	4,311.30	4,445.90	4,564.80	4,628.10	5,288.50
Upland Areas										
Philippines	9,442.07	11,912.40	12,870.20	11,223.60	11,361.10	9,936.50	8,465.00	9,012.40	7,972.70	9,612.90
Ilocas	60.08	295.00	467.10	61.80	74.30	404.30	101.80	125.40	93.00	86.70
Cagayan Valley	328.68	329.40	384.80	218.70	283.20	404.30	411.60	449.90	159.60	141.30
Central Luzon	427.44	520.00	258.90	459.50	421.70	79.60	231.10	252.80	239.20	313.30
Southern Tagalog	1,933.41	2,746.50	2,295.80	2,321.70	2,401.50	2,778.90	1,421.70	1,609.40	1,551.50	2,824.00
Bicol	1,265.01	1,112.80	1,795.00	1,435.00	1,413.60	2,232.70	855.40	768.20	580.80	1,193.20
Eastern Visayas	649.56	411.00	1,058.70	451.30	459.00	329.80	518.00	554.80	513.70	287.10
Western Visayas	940.95	602.20	1,200.10	847.40	892.80	734.00	985.00	1,077.60	905.80	826.30
N. & E. Mindanao	1,160.93	2,264.20	1,899.20	1,603.00	1,601.40	987.50	1,747.50	2,023.60	2,187.50	1,339.80
S. & W. Mindanao	2,676.01	3,631.30	3,510.60	3,825.20	3,813.60	1,985.40	2,192.90	2,151.20	1,741.60	2,601.20

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A2.0: Palay prices (Macan Ordinario) by region, Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					peso per cavan					
Philippines	10.92	10.33	12.54	14.56	13.34	15.06	15.12	14.57	14.95	15.67
Ilocos	11.50	10.44	11.12	13.89	16.04	15.23	18.56	16.55	15.76	11.43
Cagayan Valley	10.67	9.44	11.35	13.33	12.89	14.21	14.70	13.29	14.48	15.15
Central Luzon	11.82	11.09	13.27	16.13	14.77	17.28	16.25	16.47	16.71	17.98
Southern Tagalog	11.55	10.86	13.68	15.97	13.42	14.36	14.36	15.66	16.98	17.20
Bicol	10.15	9.95	11.66	13.18	11.79	14.42	14.55	13.10	14.63	15.70
Eastern Visayas	10.64	10.31	12.58	13.93	12.81	14.89	16.00	15.24	15.54	13.53
Western Visayas	11.17	10.53	13.14	15.23	14.22	15.11	14.59	13.64	13.02	14.96
N. & E. Mindanao	10.84	10.32	12.66	14.06	13.12	14.30	13.67	13.28	13.64	16.38
S. & W. Mindanao	10.10	9.99	12.01	13.37	12.18	13.59	14.72	14.30	12.18	14.00

TABLE A2.1: Corn prices (White, shelled corn) by region, Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
				peso/cavan of 57 kilogram						
Philippines	10.96	10.22	13.56	13.52	14.64	16.06	14.73	14.17	15.02	16.98
Ilocos	11.72	13.28	16.35	16.15	20.11	18.24	19.69	16.03	19.20	20.00
Cagayan Valley	10.18	9.22	11.28	12.13	14.26	15.96	12.01	11.83	15.12	16.47
Central Luzon	12.27	11.46	14.28	16.56	17.56	18.58	15.84	19.77	17.57	18.39
Southern Tagalog	12.42	11.11	16.73	16.41	12.64	14.86	13.04	14.06	15.53	14.95
Bicol	10.59	10.03	12.56	12.45	14.05	15.49	16.00	15.70	14.48	14.87
Eastern Visayas	11.33	11.47	15.26	14.27	15.70	16.63	16.05	15.19	15.97	18.05
Western Visayas	11.09	9.78	13.57	13.64	14.67	16.62	14.16	13.10	14.52	17.69
N. & E. Mindanao	10.44	10.25	13.94	12.10	15.49	14.54	16.11	11.70	12.26	16.45
S. & W. Mindanao	9.64	9.42	12.97	11.41	12.72	12.74	10.62	12.56	11.90	15.42

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A2.2: Agricultural Wages in various regions, Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					peso per day					
Philippines	1.98	1.99	1.98	2.09	2.14	2.23	2.30	2.35	2.47	2.68
Ilocos	2.21	2.19	2.26	2.29	2.32	2.36	2.37	2.42	2.58	3.00
Cagayan Valley	2.05	2.05	2.25	2.32	2.35	2.37	2.42	2.58	2.67	2.89
Central Luzon	2.14	2.11	2.12	2.31	2.38	2.57	2.62	2.63	2.73	2.75
Southern Tagalog	2.48	2.45	2.37	2.45	2.49	2.62	2.73	2.75	3.01	3.13
Bicol	1.65	1.74	1.86	1.87	1.93	2.05	2.12	2.14	2.30	2.50
Eastern Visayas	1.66	1.66	1.74	1.82	1.85	1.93	1.98	2.07	2.20	2.32
Western Visayas	1.64	1.71	1.59	1.63	1.67	1.72	1.79	1.83	1.89	2.25
N. & E. Mindanao	1.91	2.02	1.98	2.03	2.12	2.23	2.35	2.38	2.43	2.65
S. & W. Mindanao	2.13	2.21	2.02	2.06	2.17	2.22	2.32	2.35	2.43	2.62

Source of basic data: Journal of Philippine Statistics. 16(3) 1970., Bureau of Census and Statistics and Central Bank's Annual Reports.

TABLE A2.3: Annual rainfall in various regions of the Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					In millimeters					
Philippines	1,313.7	1,370.3	1,252.5	1,490.1	1,229.2	1,355.6	1,270.0	1,002.6	1,020.8	1,506.4
Ilocos	3,573.3	2,661.7	2,448.9	2.629.2	1,973.4	2.080.9	3,236.6	3,253.7	2,956.1	2,062.2
Cagayan Valley	2,399.2	1,782.4	1,429.4	2,701.2	1,624.5	2,246.4	2,440.8	1,228.1	1,488.1	2,330.4
Central Luzon	2,307.8	2,120.7	2,075.9	2,568.6	2,039.6	2,546.7	2,230.8	2,306.4	1,920.2	1,799.0
Southern Tagalog	2,281.1	2,401.1	2,118.3	2,872.7	1,954.8	2,728.9	1,986.2	1,415.1	1,557.1	3,055.5
Bicol	2,666.1	3,057.3	2,897.7	3,985.1	3,336.4	3,313.9	2,772.8	1,805.9	2,336.2	4,235.7
Eastern Visayas	2,669.2	3,265.4	3.532.1	2,815.2	3,798.7	2,861.7	3,520.2	2,422.4	2,379.8	3,482.1
Western Visayas	1,615.3	2.200.9	1,862.2	2,152.4	1,952.3	2,133.6	2,066.6	1,557.9	1,798.5	2,169.5
N. & E. Mindanao	3,186.4	3,736.1	3,734.6	3,137.2	3,117.6	2,316.4	2,653.8	2,650.2	2,059.6	3,371.9
S. & W. Mindanao	1,360.6	1,542.0	1,101.8	1,301.6	1,384.1	1,408.7	1,073.2	1,173.3	1,290.7	1,466.8

Source of Basic data: Weather Bureau Annual Report series, Weather Bureau.

TABLE A2.4: Average Size of palay farm by region, Philippines, 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
					hectare					
Philippines	3.11	3.28	2.93	2.64	2.78	2.67	2.50	2.66	2.64	2.69
Ilocos	0.82	1.64	1.34	1.13	1.45	1.25	1.43	1.46	1.39	1.09
Cagayan Valley	3.06	3.06	2.80	2.80	2.78	2.90	2.09	2.30	2.48	2.58
Central Luzon	2.02	3.61	2.80	2.39	2.69	2.81	2.21	3.36	2.35	3.31
Southern Tagalog	2.73	3.32	3.33	2.81	3.58	3.37	3.45	3.20	3.27	2.95
Bicol	3.70	3.50	2.76	2.73	2.43	2.39	2.33	2.30	2.50	2.40
Eastern Visayas	2.13	2.30	2.22	2.86	2.46	2.35	2.42	2.65	2.95	2.92
Western Visayas	3.43	3.79	3.35	2.36	3.03	2.97	2.93	3.14	3.40	3.72
N. & E. Mindanao	4.47	3.93	3.86	3.52	3.32	3.13	2.89	2.85	2.75	2.65
S. & W. Mindanao	4.63	4.41	3.92	3.60	3.28	2.91	2.73	2.71	2.70	2.63

Source of Basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.

TABLE A2.5: Palay Area cultivated by tenure of farm operator, by region, Philippines 1961 to 1970

Region	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Owner - cultivator										
					hectore					
Ilocos	72,518	90,486	81,342	81,306	79,063	124,306	87,920	102,597	87,333	94,930
Cagayan Valley	342,052	327,146	254,234	219,687	271,627	276,849	219,904	231,176	230,135	257,356
Central Luzon	132,722	220,878	138,158	114,804	99,293	107,965	198,318	220,934	317,084	286,209
Southern Tagalog	205,866	242,733	189,962	211,471	255,722	269,813	267,165	313,129	321,395	189,850
Bicol	253,795	231,648	248,610	233,700	213,013	256,874	207,917	230,321	239,745	278,779
Eastern Visayas	272,722	195,205	215,929	199,277	217,176	226,954	246,645	262,405	297,928	195,360
Western Visayas	250,492	294,786	291,872	227,006	266,697	239,494	231,241	266,996	295,988	318,288
N. & E. Mindanao	157,231	237,057	211,471	195,418	185,810	127,549	159,257	181,739	221,597	173,789
S. & W. Mindanao	409,673	511,527	455,994	471,118	456,706	355,008	407,556	404,220	419,731	424,744
Leasehold - cultivator										
Ilocos	-	-	6,631	16,475	30,712	6,382	19,539	7,696	18,422	22,939
Cagayan Valley	-	-	-	2,926	103	674	2,097	5,846	3,180	8,510
Central Luzon	-	-	6,613	25,231	1,939	-	20,049	21,352	20,031	14,599
Southern Tagalog	-	4,353	25,578	14,078	6,109	701	5,697	4,185	6,780	2,452
Bicol	-	116	125	5,710	6,524	8,182	5,089	6,857	4,835	6,945
Eastern Visayas	-	2,838	2,753	7,277	9,762	2,329	7,388	4,967	8,003	2,951
Western Visayas	-	441	3,328	5,033	10,819	1,663	4,831	8,503	5,658	6,524
N. & E. Mindanao	-	-	-	2,306	7,542	-	3,490	4,547	7,857	8,434
S. & W. Mindanao	-	830	10,438	7,578	20,297	5,455	7,805	5,796	9,111	9,028
Tenant - cultivator										
Ilocos	38,112	14,134	31,947	22,299	29,445	14,022	24,831	30,657	30,405	26,951
Cagayan Valley	111,838	43,474	59,016	67,097	72,450	76,867	43,519	59,738	31,095	48,174
Central Luzon	413,008	292,672	375,989	355,665	409,008	411,345	383,693	385,724	271,725	333,942
Southern Tagalog	157,984	159,774	182,870	118,531	171,449	196,776	194,128	212,426	209,905	153,068
Bicol	64,005	58,776	61,795	65,960	79,723	101,854	87,374	77,382	55,739	72,236
Eastern Visayas	105,218	85,727	71,078	68,046	72,532	94,197	92,817	82,408	77,009	58,269
Western Visayas	163,818	105,733	120,750	164,270	106,164	136,713	97,128	100,711	83,254	72,998
N. & E. Mindanao	15,149	17,433	31,879	28,376	25,248	17,541	18,103	21,344	19,196	12,107
S. & W. Mindanao	31,547	41,423	82,958	86,804	94,737	49,667	52,019	50,004	38,408	34,008

Source of basic data: Crop and Livestock Survey series, Bureau of Agricultural Economics, D.A.N.R.