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THE NEW RICE TECHNOLOGY AND LABOR ABSORPTION IN PHILIPPINE AGRICULTURE*

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The new rice technology was developed to increase the supply and lower the cost of producing rice throughout Asia. Since rice represents a major source of consumer expenditure, a low rice price is necessary to keep living costs and wage rates low, and thus to promote industrial employment and economic development. This concept of a food-wage policy indicates that the impact of the new rice technology must be viewed in terms of its effect on employment in the entire economy. The fact that our paper focuses on the agricultural sector means that we are dealing with only part of the story, and perhaps not the most important part in terms of total economic development.

Among Asian rice growing countries, the Philippines has been one of the initial beneficiaries of the new seed-fertilizer technology. The high yielding rice varieties were first introduced in 1966 and they are now being grown on over one-third of the more than 3 million hectares of rice in the country.

The first section of this paper presents the historical trends in labor utilization and labor productivity in the Philippines. The second section is concerned with the relationships between new technology, mechanization, and employment in the rice sector. The third section explores the potential for labor absorption through agricultural diversification. In the fourth section we present our observations about employment opportunities in the non-farm sector.

I. HISTORICAL TRENDS IN LABOR UTILIZATION AND LABOR PRODUCTIVITY

Our historical analysis covers the period 1948 to 1968. Trends in agricultural labor use relative to other inputs and in labor productivity are examined using partial productivity indices to measure input efficiency. Labor productivity, although a partial measure, is usually taken as the best indicator of economic

* Portions of this paper are based upon research being conducted as a part of a cooperative study undertaken by the University of the Philippines, School of Economics and the International Rice Research Institute in cooperation with the Organization for Economic Cooperation and Development.

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efficiency.[1] Labor is a major input and increased labor productivity leads to a higher per capita income and standard of living.

Results are compared with a similar analysis in Taiwan for the period 1896 to 1960.[2] Government policy with respect to resource use during the 1948-68 period is also discussed. First, however, we consider the change in labor employed in agriculture and non-agriculture.

AGRICULTURE'S SHARE OF THE TOTAL EMPLOYMENT

The share of labor employed in agriculture has been declining slowly. It was about 62 per cent in 1950, 60 per cent in 1960, and 56 per cent in 1965-68.[3] This change has resulted from a growth of the non-farm labor force of 4.2 per cent per annum while the agricultural labor force has grown at only 2.9 per cent per annum.

The Philippine population and total labor force will continue to grow at 3 per cent per annum or more in the foreseeable future. Past rates of growth in labor absorption in the non-farm sector suggest that for years to come agriculture will have to provide employment for part of this annual increase to the labor force. A move to correct the existing bias of government policies which now favor capital intensive industrialization,[4] would diminish this pressure in the long run but would not remove the immediate need for more jobs in the agriculture sector. The "self-employment" character of the farm sector permits unemployed labor to find partial employment through greater fragmentation of work, but this also sacrifices labor productivity. For sustained and equitable economic development, the agricultural sector must provide productive labor-absorbing activities.

AGRICULTURAL LABOR PRODUCTIVITY

Our analysis of trends in labor use and labor productivity as well as capital and land productivity in the postwar Philippine agriculture (1948-68) is based on the following relationships.[5]

$$Y/L = Y/D \cdot D/L \qquad (1)$$
$$Y/D = Y/K \cdot K/D \qquad (2)$$
$$Y/L = Y/K \cdot K/D \cdot D/L \qquad (3)$$

where:

Y = output
K = capital (both fixed and operating capital)
L = labor
D = land

[1]Sam C. Hsieh and Teng Hui Lee, "Agricultural Development and its Contribution to Economic Growth in Taiwan", *Chinese-American Joint Commission on Rural Reconstruction, Economic Digest Series No 12, (April, 1966).*

[2]Teng Hui Lee, *Intersectoral Capital Flows in Economic Development in Taiwan, 1895-1960* (Unpublished Ph D. Thesis, Cornell University, 1968). Succeeding references to Taiwan are taken from this study.

[3]George Hicks and Geoffrey McNicoll, *Trade and Growth in the Dual Economy, A Study of the Philippines*, (forthcoming book)

[4]See for example, Gerardo Sicat, "Economic Progress in South Korea and Taiwan: Lessons for the Philippines" *IEDR Discussion Paper No. 69-17* (October 27, 1968). See also John Power and Gerardo Sicat, "Industrialization in the Philippines," *IEDR Discussion Paper No. 70-11* (April 24, 1970).

[5]Teng Hui Lee.

Changes in labor productivity (Y/L) depend on relative changes in land productivity (Y/D) and the land/man ratio (D/L) When the land/man ratio declines as a result of population pressure, increased land productivity must offset the decline in the land/man ratio if labor productivity is to increase. Increases in land productivity, on the other hand, may be due to either changes in capital productivity (Y/K) (for example, introduction of high yielding varieties) or the degree of capital intensity (K/D) (for example, shift from rainfed to irrigated or from single to double crop irrigation). However, the complementary relationship between capital productivity and capital intensity means that a technology which increases capital productivity will at the same time raise the profitable level of capital intensity. To summarize, increases in labor productivity depend on relative use of complementary inputs, namely land and capital, and their respective productivities. With limited physical land and abundant labor, growth of agriculture via increases in labor and land productivity ultimately depends on the rate and efficiency of capital investment in agriculture

Development patterns may be identified in terms of changes in the relation between land productivity and land/man ratio A comparison of the historical experience of the Philippines with Taiwan, a country confronted with a similar resource situation (namely, abundant labor and scarce capital and land) is useful in pointing out (a) the time periods at which the two countries were at a similar stage of development, and (b) the pattern of development necessary if labor productivity is to increase in Philippine agriculture

Figures 1a and 1b represent equation (1) for the Philippines and Taiwan agricultural sectors, respectively The growth path for labor productivity (Y/L) is charted by plotting land productivity (Y/D) on the vertical axis and per capita cultivated land area (D/L) on the horizontal axis The Philippine case covers only the postwar period (1948-1968) while the Taiwan case covers more than half a century Each point on the surface represents a combination of 3-year averages for the Philippines and 5-year averages for Taiwan of (Y/D) and (D/L) giving a level of labor productivity (Y/L). Isoquants are drawn through each point representing levels of labor productivity.

The figures show clearly that agricultural development proceeds under changing resource patterns The growth process may be classified into three phases, each phase reflecting different trends in the three variables mentioned earlier, namely. capital intensity and capital productivity which together determine land productivity, and the labor intensity per unit of land. Table 1 summarizes the three phases that have been graphed in Figures 1a and 1b

Phase 1-A is characterized by land-extensive cultivation the cultivated area increased at a higher rate than the growth of agricultural labor Population pressure on land was alleviated by opening up new lands for cultivation. This was accompanied by moderate increases in land productivity, because of increasing capital intensity per unit of cultivated area, despite a deterioration in capital efficiency. Productivity of labor increased at a relatively rapid pace. 3.1 per cent per annum. Productivity gains were attained within the framework of traditional agriculture and with increasing use of relatively limited resources. land and capital. This phase corresponds to the Taiwan experience in the period 1895-1926/

TABLE 1

ANNUAL RATE OF GROWTH OF RESOURCE PRODUCTIVITIES AND RESOURCE INTENSITIES IN THE PHILIPPINES AND TAIWAN

Phase	Period	Direction	Annual rate of increase in				
			Y/L	K/D	D/L	Y/K	Y/D
A. Philippines*							
Phase I-A	1948/50-1954/56	Northeast	3 06	2.90	0 90	—0 98	1 95
Phase II-A	1954/56-1957/59	Southeast	—0.79	4 58	0 81	—5 85	-1.25
Phase III-A	1957/59-1966/68	Northwest	1.33	3 40	-1 34	—0 62	2.69
B. Taiwan†							
Phase I-B	1895-1926/30	Northeast	2.71	5 42	0 1	—3 26	1.87
Phase II-B	1926/30-1936/40	Northwest	2 23	3 18	—0 93	—0.36	3.15
Phase III-B	1946/50-1956/60	North	5.29	9 02	0	—0 30	6 29

Sources:

* Cristina Crisostomo, *Sources of Output Growth in Philippine Agriculture, 1948-1968*, (M.A. Thesis, University of the Philippines, 1971, forthcoming).

† Teng Hui Lee, *Intersectoral Capital Flows in Economic Development in Taiwan, 1895-1960*, (Unpublished Ph D. Thesis, Cornell University, 1968)

30 (Phase I-B). The growth rate in labor productivity in Taiwan, 2.7 per cent per annum, is remarkably similar to that of the Philippines in Phase I-A.

In Phase II-A, the trend in resource use in Phase I-A was pursued further, that is, the cultivated area was expanded more rapidly than the use of labor while growth in capital intensity per unit of land area was at a rate almost 50 per cent higher than that in the previous phase — but with disappointing results. Growth in inputs exceeded growth in output. Partial productivity indices of land, labor, and capital all declined An explanation of this phenomenon may be the extension of cultivation to submarginal land so that capital use per unit of land increased, but at a rate which could not compensate for its low productivity * Capital productivity consequently declined rapidly

There seems to be no comparable phase in the Taiwan experience except during the war period. Apparently, the point of diminishing returns to land was successfully offset by capital investment and technical change initiated in Phase I-B.

In Phase III-A, the unfavorable trends of the previous period were reversed. Population pressure on cultivated land continued as shown by a declining land/man ratio. But labor productivity still managed to improve at a moderate pace because of higher rate of growth in land productivity Capital intensity likewise increased, but capital productivity, although declining, decreased at a relatively slower rate Moreover, the nature of the capital increase seems to have been labor-complementing In this phase an increase in labor intensity per cultivated area

*The upland area planted to rice reached a peak in 1957/59 (See Table 2 and Fig 2) After 1959, the upland rice area declined continuously
However, since only 3 years are averaged, the decline in productivity may be due in part to a drop in yields as a result of poor weather

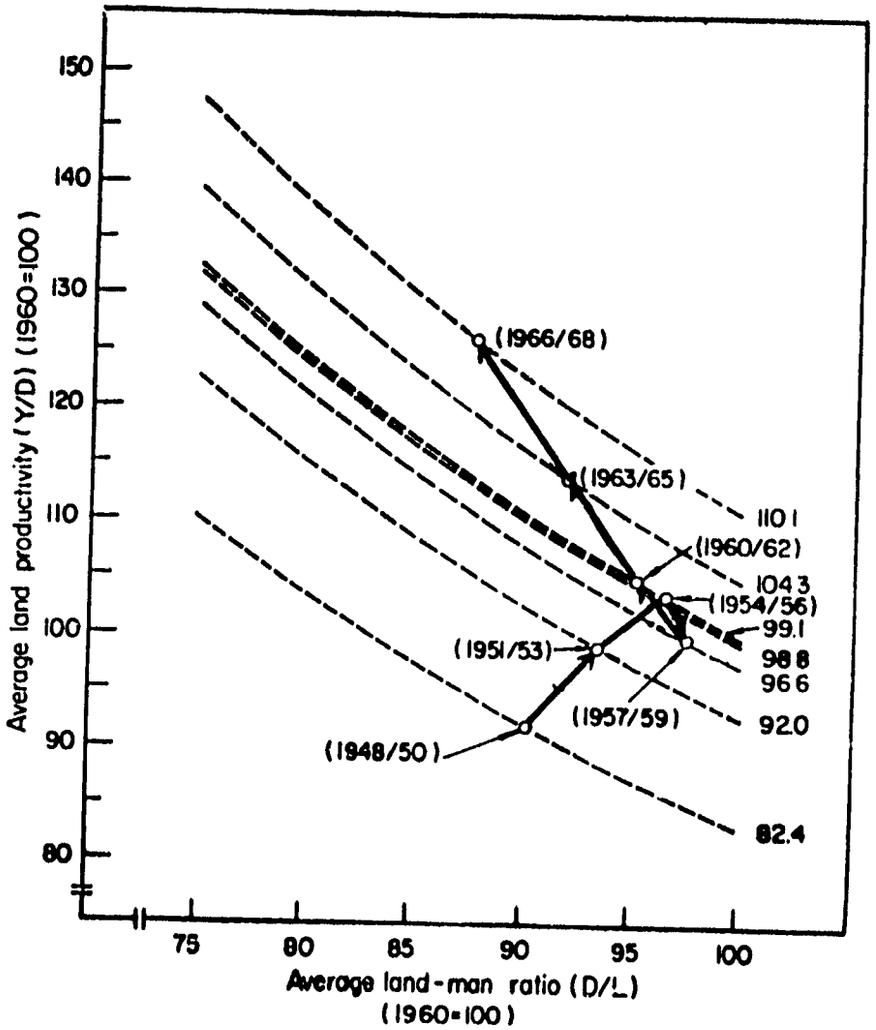

Fig. 1a. Historical growth path of labor productivity of agriculture in the Philippines, 1948-1968.

Source. Cristina Crisostomo, *Sources of Output Growth in Philippine Agriculture, 1948-1968* (M A. Thesis University of the Philippines, 1971, forthcoming).

accompanied the increase in capital intensity In contrast, in the previous phases labor intensity declined as capital intensity increased

The effect of higher capital intensity on land productivity may be associated with increases in the multiple cropping index and increases in unit yield.[7] An

[7]The multiple cropping index, which reflects the ratio of crop area to cultivated land area, is partly a function of capital because irrigation, which makes possible double cropping, is treated as a capital input. Unit yield, on the other hand, is measured by the ratio of output to crop area. Similarly, unit yield is influenced by changes in capital inputs such as irrigation and fertilizer in addition to other technological and non-technological innovations not embodied in the capital.

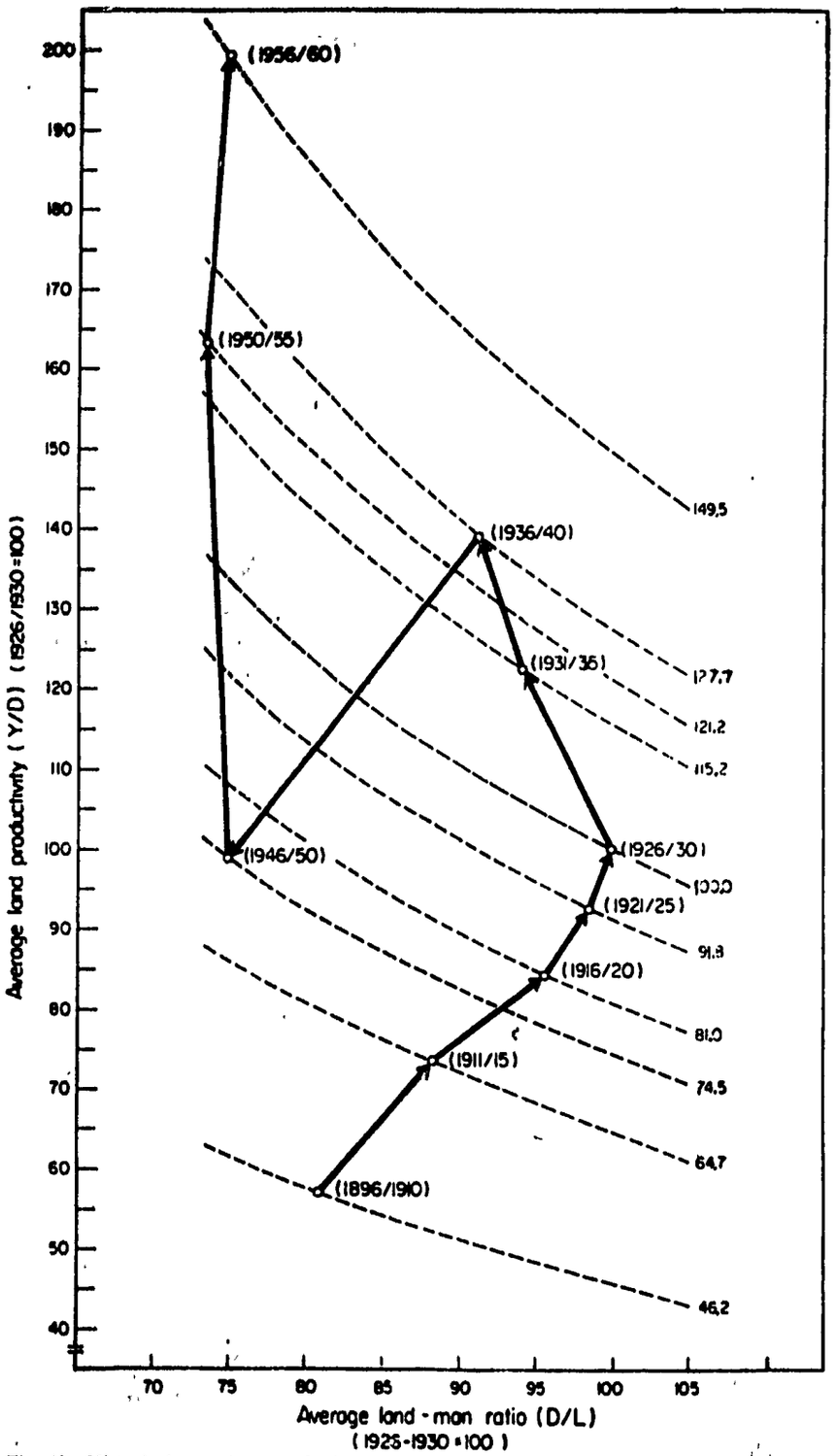

Fig. 1b. Historical growth path of labor productivity of agriculture in Taiwan, 1896-1960.

Source: Teng Hui Lee, *Intersectoral Capital Flows in Economic Development in Taiwan, 1895-1960.* (Unpublished Ph. D. Thesis, Cornell University, 1968).

examination of their trends (see Table 2) in the rice sector, which occupies around 40 per cent of crop area, shows an increase in both the multiple cropping index and unit yield in the third phase. The actual cultivated area devoted to rice declined but production expanded as a result of increases in effective crop area and unit yield. Table 3 indicates the relative contribution of expansion of crop area and increases in unit yield to rice production for the three phases. Although the contribution of expansion of crop area from 1957/59—1966/68 is still positive, we know from Table 2 that expansion of crop area was due to double cropping made possible by expanded irrigation and not to expansion of cultivated area. The increase in rice production in the 1960's can therefore be fully attributed to improvements in land productivity.

TABLE 2

PRODUCTION, LAND USE, AND YIELD FOR THE RICE SECTOR IN THE PHILIPPINES, 1948-1970

Year	Production (thousand m.t. rough rice)	Crop area	Cultivated* land area (thousand hectares)	Upland area	Multiple cropping index	Unit Yield m.t./ha
1948/50	2,446	2,135	1,900	514	112	1.15
1951/53	2,864	2,458	2,268	621	108	1.17
1954/56	3,220	2,681	2,435	687	110	1.20
1957/59	3,411	3,083	2,748	739	112	1.11
1960/62	3,785	3,228	2,757	683	117	1.17
1963/65	3,934	3,150	2,675	653	118	1.25
1966/68	4,242	3,170	a	511	a	1.34
1968/70	4,746	3,250	a	445	a	1.46

* Cultivated area is estimated as the sum of first-crop lowland and upland area. First-crop data not available for 1967 to 1970.

Source: Basic data from Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

TABLE 3

RELATIVE INFLUENCE OF AREA AND YIELD ON RICE PRODUCTION IN THE PHILIPPINES, 1948-1970 (Per Cent)

	Annual rate of growth of production	Change in production due to change in		
		Area	Yield	Total
1) 1948/50-1954/56	4.7	84	16	100
2) 1954/56-1957/59	1.9	100	0	100
3) 1957/59-1966/68	2.4	13	87	100
4) 1957/59-1963/65	2.4	15	85	100
5) 1963/65-1966/68	2.5	8	92	100
6) 1963/65-1968/70	3.8	17	83	100

Source: Basic data from Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

A combination of factors was responsible for this. The annual rate of government investment in irrigation systems accelerated by the end of the 1950's. Irrigation enabled farmers to increase the number of crops planted per year, thus increasing the effective crop area. Likewise, irrigation improved unit yield because of better water supply and control. The increase in average yields was also partially due to the reduction of upland area devoted to rice as indicated by Figure 2. Since yields of upland rice are usually lower than those of lowland rice, a shift in cultivation from upland to lowland areas raises average yields.

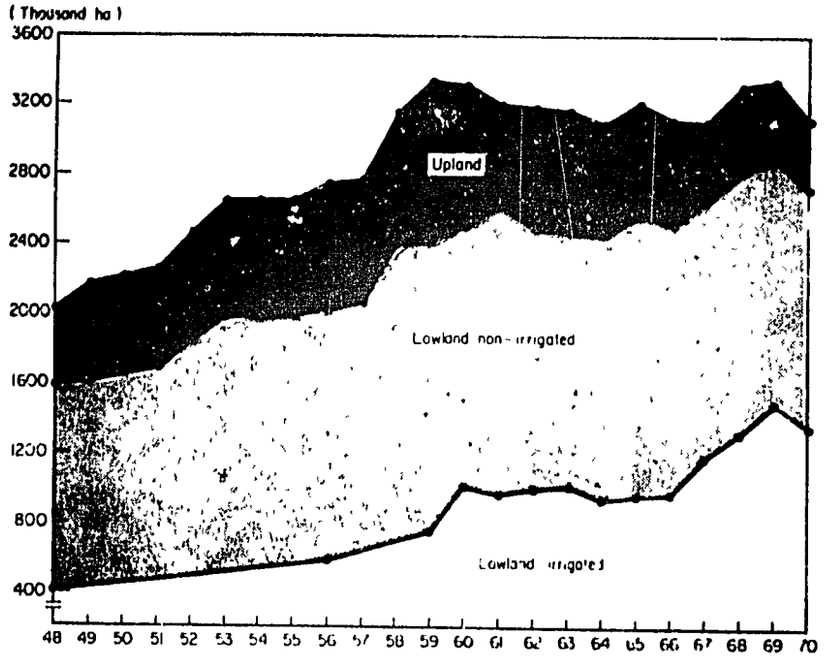

Fig 2 Rice crop area in the Philippines, 1948-1970.*

*No data available for irrigated crop area for 1949-1955, 1957, 1958.

Basic data from Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

Phase III-A may be characterized as the general case of agricultural development comparable to the Taiwan experience after the 1920's (Phase II-B). However, labor productivity in Taiwan was increasing at a much faster rate during the corresponding period, in spite of the greater population pressure exemplified by its relatively smaller farm size. This is not surprising since Taiwan at this time was relatively more advanced in terms of irrigation and use of fertilizer (see Table 4).

A closer examination of each country's experience during this period reveals some common factors which apparently influenced the pattern of agricultural development.

A notable factor was the advent of high yielding varieties (HYV) during this period in Taiwan. The "ponlai" rice, which had a potential yield 40 per cent higher

TABLE 4

SELECTED CHARACTERISTICS OF THE AGRICULTURAL SECTOR IN THE PHILIPPINES IN 1960 AND TAIWAN IN 1930

	Philippines*	Taiwan†
Average size of farm (ha)	3.58	2.00
Cultivated area per agricultural worker (ha/man)	1.08	0.68
Crop area per agricultural worker (ha/man)	1.45	0.83
Proportion of irrigated area to cultivated area (%)	11	53
Chemical fertilizer consumption per crop area (kg/ha)	26	33

Sources:

* *Census of Agriculture, 1960*, Bureau of Census and Statistics, Government of the Philippines; Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines; and Fertilizer Institute of the Philippines.

† Teng Hui Lee, *Intersectoral Capital Flows in Economic Development in Taiwan, 1895-1960* (Unpublished Ph.D Thesis, Cornell University, 1968). Y. Hayami and V. Ruttan, *Resources, Technology and Agricultural Development — An International Perspective*, (Department of Agricultural Economics, University of Minnesota, 1970).

than the traditional varieties available at that time, was introduced in 1922. Within 15 years after its introduction, approximately 50 per cent of the total rice area was planted with ponlai seeds. Together with varietal improvement, application of chemical fertilizers increased, and cultural practices improved. Farmers made greater use of compost manure, they increased application of pesticides and expanded irrigation which also contributed to increases in yields during this period.

High yielding varieties with potential yields approximately 50 per cent higher than traditional varieties were introduced in 1966 in the Philippines. The dissemination and adoption of these improved varieties have been rapid and widespread in those areas where the environment is conducive to their use. This technological breakthrough prompted a general intensification of government efforts on several fronts, particularly extension work and dissemination of HYV's, to achieve self-sufficiency in rice production. Increased application of chemical fertilizer also accompanied the spread of HYV's.

In Figure 3, the yields of rough rice in Taiwan from 1920-1940 are compared with those of the Philippines from 1950-1970. Although only a few years have elapsed since the introduction of HYV's in the Philippines, it is apparent that an upward shift in yields occurred similar to that in Taiwan after the introduction of ponlai seeds in 1922.

This new technology may lead to a new phase in Philippine agriculture similar to the postwar period in Taiwan (Phase III-B). Rapid improvements in land productivity must more than offset the declining land/man ratio to achieve increases in labor productivity and, therefore, a rising per capita income in agriculture.

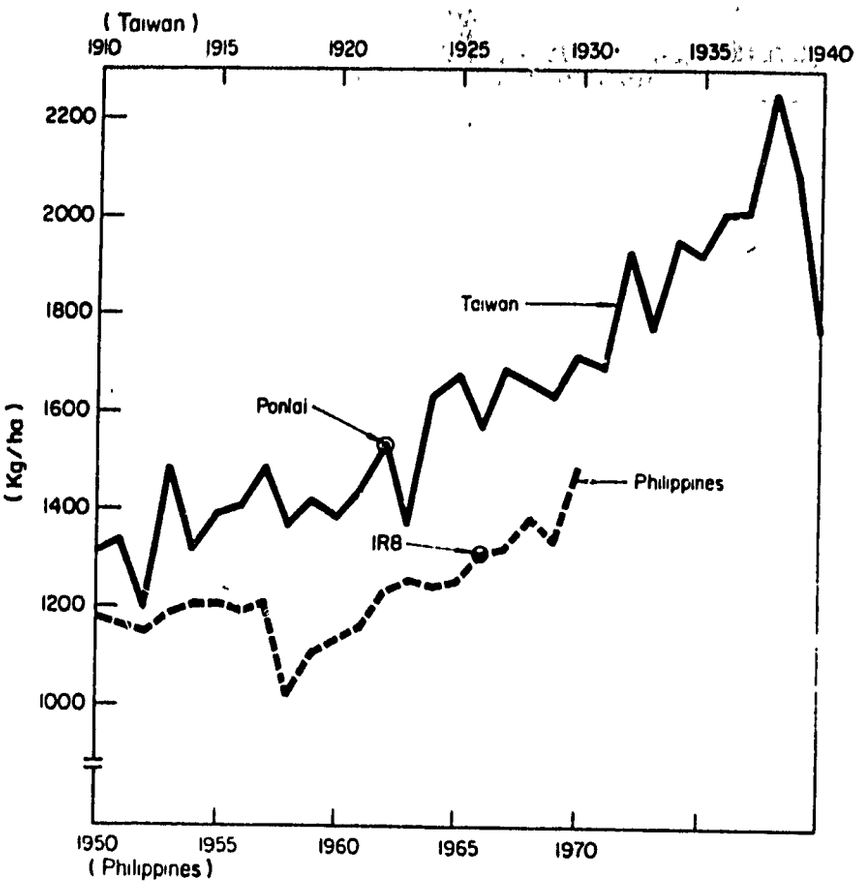

Fig 3. Average yields of rough rice in Taiwan and the Philippines.

Source: *Taiwan Food Statistics Book*, Taiwan Provincial Food Bureau, 1962; and Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

GOVERNMENT POLICIES

The foregoing analysis brings into focus the low intensity of land use and, consequently, low land productivity that has characterized Philippine agriculture. Why has there been such a wide gap between availability and use of technology in the Philippines? The reason cannot be solely the lack of capital because the same problem has beset Taiwan. An examination of government policies during the period sheds some light on the question.

The Philippine government pursued a vigorous program of land settlement until the end of Phase I (1948 to 1960). Taiwan, in the same phase (1895 to 1926-30), was already laying the foundation for a more intensive agriculture. The Japanese government program followed by Taiwan during this

period has been documented by Y. Hayami, T.H. Lee, and other writers.[8] Investment in irrigation development reached a pre-war peak in the 1920's and the high yielding ponlai rice varieties were introduced during the same decade. These developments were the result of Japanese government efforts to increase exports of rice from Taiwan to Japan. Table 4 indicates that Taiwan's agriculture was more intensive in 1930 than Philippine agriculture in 1960. Philippine government policy was redirected toward irrigation development only at the close of the land expansion period; the high yielding rice varieties were not introduced for another decade, and technological development lagged in other crops.[9] As a result of delays in the development of infrastructure and technology, the growth of productivity in Philippine agriculture during the 1960's was well below that of Taiwan's agriculture in the 1930's

Another major contrast in government policies during the period relates to taxation. Both the Japanese and Chinese administrations of Taiwan taxed the agricultural sector to recapture public investments in technology and infrastructure for further economic development.[10] Similar investments in the Philippines are being capitalized into rising land values, with the result that more reliance is being placed on foreign borrowing for public investment [11]

In summary, the Philippines needs new technology that will increase land productivity at this particular point in time In addition, government policies designed to facilitate the shift from a land-extensive to a land-intensive agriculture must be timed to avoid a sharp reduction in labor productivity. This transition seems to have been accomplished successfully in Taiwan (if we ignore the effect of World War II). In the Philippines, this transition is still in process. A major question is what effect the new rice technology will have on labor productivity and labor use in agriculture.

II. LABOR ABSORPTION IN THE RICE SECTOR

In this section, we first discuss the ways in which labor inputs have been affected by the introduction of the new rice technology, and then look ahead at labor requirements assuming that production grows at the same rate as demand.

[8]See Yujiro Hayami, "Rice and Economic Growth, Japan's Rice Policy in Historical Perspective," paper prepared for the Rice Policy Conference, International Rice Research Institute, (May 9-14, 1971), Yujiro Hayami and Vernon W Ruttan, "Korean Rice, Taiwan Rice, and Japanese Agricultural Stagnation The Economic Consequence of Colonialism," *The Quarterly Journal of Economics*, Vol LXXXIV (November 1970), pp 562-589; T. H Lee, *Intersectoral Flows and Economic Development in Taiwan, 1895-1960*, (Unpublished Ph D Thesis, Cornell University, June 1968), Edward L Roda and Teng Hui Lee, "Irrigation Investment in Taiwan" *Chinese-American Joint Commission on Rural Reconstruction, Economic Digest Lines No 15* (Feb, 1963)

[9]See for example Thomas R McHale, "Prospects and Problems of Philippine Sugar in the 1970's", paper presented at the Public Lecture Service on *Prospects and Problems of Development in 1970's*, sponsored by the Institute of Economic Development and Research, University of the Philippines and the Private Development Corporation of the Philippines. Despite the fact that the Philippine sugar industry has been one of the more advanced sectors relative to the use of modern technology, McHale emphasizes the slow rate of growth in yields relative to potential.

[10]See Yujiro Hayami and also Teng Hui Lee.

[11]Amando M. Dalisay, "Financing the Four-Year Development Plan; FY 1971-1974", paper presented at seminar given at Agricultural Economics Department, U.P. College of Agriculture (March, 1970).

EFFECT OF THE NEW RICE TECHNOLOGY ON LABOR REQUIREMENTS

As previously mentioned, the traditional procedure of expanding production by expanding the rice area came to an end in 1960. Although some land was shifted between rice and other crops, particularly sugar-cane, this substitution was relatively small. As a consequence, labor use in the rice sector has been principally affected by: (1) the change in labor requirement due to the increase in the amount of land under irrigation and the decrease in the amount of land under rainfed and upland conditions, (in the context of the previous section, K/D increases and D/L decreases), (2) the increase in labor requirement per hectare due to the introduction of the new rice technology (Y/K increases and D/L decreases), and (3) the change in labor requirement due to mechanization, or capital-labor substitution (K/D increases and D/L increases).

K/D increases, D/L decreases. During the five years an important shift has occurred in the land-use pattern in the rice sector, largely as a result of expanded irrigation. The total crop area increased by only 3.2 per cent, but the irrigated area increased by almost 43 per cent while the lowland rainfed and the upland areas declined (Table 5). Since the labor intensity on irrigated land tends to be

TABLE 5

HYPOTHETICAL RATES OF LABOR ABSORPTION ASSUMING THAT LABOR INPUT PER HECTARE PREVAILING IN 1956 REMAINS CONSTANT OVER TIME FOR EACH LAND TYPE

Years	Total crop area	Lowland area		Upland area	Calculated average labor* (man-days/ha)	Calculated total labor* (million man-days)
		Irrigated	Non-irrigated			
	(thousand hectares)					
1956†	2,742	596	1,425	721	71.2	195
1963/65	3,150	967	1,530	653	72.0	227
1968/70	3,250	1,379	1,426	445	73.1	238
Rate of change due to change in crop area and land use pattern (per cent per annum)						
1956 to 1963/65	1.7				0.2	1.9
1963/65 to 1968/70	0.6				0.3	0.9

* Calculated by assuming that labor input per hectare for each land type remains constant at the 1956 level. These labor input coefficients are listed below and are based on a nationwide survey conducted by the Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

Lowland irrigated crop	78 man-days/ha
Lowland non-irrigated crop	70 man-days/ha
Upland crop	68 man-days/ha

† Area irrigated and not irrigated are not available for 1955 and 1957.

Source: Basic data from Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

higher — even on a per crop basis — than on rainfed and upland areas, this shift in the land-use pattern would necessarily increase the average labor employed per crop hectare.[12]

Assuming that the per-hectare labor coefficients prevailing in 1956 remain constant over time for each land type, the calculations in Table 5 show that changes in the relative levels of irrigated, rainfed, and upland area alone would cause a perceptible growth in the average labor requirement per hectare. From 1956 to 1963/65 the annual growth rate in labor inputs per hectare would be 0.2 per cent and from 1963/65 to 1968/70 it would be 0.3 per cent.

Under our assumptions, the labor absorption due to the expansion in crop area (principally through double cropping of rice) would be at an annual rate of only 0.6 per cent during the last five years compared to 1.7 per cent in the earlier period. These two factors in labor absorption taken together approximate the effect of new irrigation on employment. Our calculations in Table 5 therefore indicate that during the last five years the labor absorption rate due to new irrigation (and consequent shifts in land-use patterns and total crop area) would be about 0.9 per cent per annum compared to 1.9 per cent in the earlier period.

Y/K increases, D/L decreases. Contrary to the assumption in the previous section, the per-hectare labor requirements for each land type have not been constant, particularly since the introduction of the new seed fertilizer technology in 1966. Increases in yield per hectare presented in Table 6 indicate that there has been some improvement in technology on every land type, but that the greatest impact has been on irrigated land as a result of planting high yielding varieties. Therefore, we would also expect that the effect of the new technology on labor use in rainfed lowland and upland areas has been relatively small compared to that

TABLE 6

YIELD PER HECTARE BEFORE AND AFTER THE INTRODUCTION OF HYV'S BY LAND TYPE WITH CORRESPONDING CROP AREA FOR 1968/70
(metric tons/ha)

	Total	Lowland				Upland
		Irrigated		Non-irrigated		
		Local	HYV	Local	HYV	
1963/65	1.25	1.65	—	1.19	—	0.79
1968/70 (Crop area in thousand ha.)	1.46 (3250)	1.69 (693)	1.97 (686)	1.27 (1035)	1.33 (390)	0.88 (445)

Source: Basic data from Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines.

[12] Likewise, this shift influenced the average yield per hectare. In fact, 37.5 per cent of the growth in yield per hectare over the last 5 years was due to this change in land-use pattern. Another 37.5 per cent was due to the increase in yield per hectare on irrigated area, while 18.8 and 6.2 per cent were due to increases in yield per hectare on rainfed low-land and upland areas, respectively.

in irrigated areas. Unfortunately, there is no comprehensive evidence available to establish a basis for comparing present labor-use pattern with the 1956 findings. We rely instead on a few surveys conducted in Luzon.

Two conflicting forces have been affecting the change in labor use. The first is the economic incentives embodied in the new technology, which have caused an increase in the use of labor as well as other inputs. The second is the mechanization of farm operations, which has increased at an accelerated rate since the new technology was introduced, and has diminished the potential for further increases in labor use.

According to the survey results presented in Appendix Tables A-1 to A-4, if mechanization levels were constant, the introduction of the new technology would imply substantial increases in per-hectare labor inputs, mainly for land preparation, weeding, and harvest-threshing operations. These survey results also show that a large portion of the total increase in per-hectare labor inputs would be supplied by hired labor, which in turn would imply a wider distribution of the increased farm income

Tables A-3 and A-4 show an absolute decline in the family labor input while the total labor input is increasing. An explanation of this phenomenon by Takahashi, however, indicates that this may merely be an increase in tenants working for each other:

> "In principle, paying more wages to hire labor means an increase in expenses and therefore a decrease in returns. But in the landlord-tenant relations in Central Luzon ... Landlords ruthlessly collect debts out of the tenants' share of crops, but usually do not touch peasants' and family members' income from side work. What is more important for the peasants then, is not their incomes from farms under their operation, but their incomes from wage work and businesses other than tenant farms ... It is clearly to their advantage that peasants seek to minimize the wage expenses which are borne by themselves alone and to maximize the wage expenses which are divided between landlords and tenants."[13]

K/D increases, D/L increases. It is clear from Appendix Tables A-2 to A-4 that mechanization levels in the survey areas were increasing and that the wider use of tractors and threshers diminished the potential gains in labor use for land preparation and threshing operations. Mechanization levels are higher in later years and higher on HYV areas than on areas using local varieties.[14] Appendix Table A-5 shows the effect of tractor use on the labor requirement for land preparation in one survey area. Full tractor use reduces the labor requirement by more than 50 per cent.

Unfortunately, we do not have time-series data on tractor and thresher purchases or use in the rice sector as a whole, but a recent survey of all tractor owners

[13] A. Takahashi, *Land and Peasants in Central Luzon* (Honolulu: East-West Center Press, 1969), pp. 141-142.

[14] Central Luzon and Laguna have higher mechanization levels than other rice areas. In a 1967 survey of mechanization in the Philippines, Central Luzon region accounted for about 40 per cent of the tractors used and about 85 per cent of the mechanical threshers. The Southern Tagalog region, which includes Laguna, is the next largest tractor user with 20 per cent of the total.

in one municipality of Central Luzon shows a dramatic increase in tractor purchases in recent years. Forty-four per cent of all four-wheel tractors and 77 per cent of all hand tractors in the survey area were purchased within the last four years (Appendix Table A-6). No particular trend is clear in the case of mechanical threshers.

If this trend in tractor purchases were paralleled in other areas where the new technology has been successful, much of the pre-harvest labor increase brought about by the new technology would be offset. The use of tractors for land preparation in rice, however, is far more common in Central Luzon and Southern Tagalog than in other regions. One study in the Bicol region indicates very little change in mechanization or in labor use immediately following the introduction of the high yielding varieties.[15] The interesting question is whether increased mechanization in tasks such as land preparation is normally accompanied by increased labor use in other tasks such as weeding.

In a recent study in Malaysia and Thailand, Chancellor found that of the total labor released through hiring tractors for village work, 65 per cent or more was utilized in "agricultural intensification which would not lead to labor displacement from agriculture."[16] Most of the labor was employed for production of additional field, fruit, or vegetable crops or for livestock production. However it was unclear to the author whether the additional opportunities for labor had provided the incentive for hiring the tractor, or conversely, whether the hiring of the tractor pushed the labor to find new opportunities. In both cases, however, government irrigation and extension programs played a major role in the reallocation of labor.

The use of mechanical weeders appears to have a different relationship to labor input. Experimental station tests indicate that single row rotary weeders require less than half the labor required for the same amount of hand weeding, while using herbicides practically eliminates the labor input (Appendix Table A-7). The survey results in Appendix Tables A-2 and A-3 indicate, however, that weeding time and the use of mechanical weeders are increasing simultaneously. This suggests that (1) the HYV's make it profitable to increase weeding, and (2) the rotary weeder makes the weeding more efficient. One other point can be made in favor of this machine. Unlike tractors, it is produced locally in small, labor-intensive shops and thus its use has an indirect effect on non-farm employment. Herbicides, on the other hand, displace both manpower and mechanical weeders and are produced either abroad or in capital-intensive local plants.

Our data therefore indicate that for the rice sector as a whole — in the period since the new technology was introduced — there has probably been little change in the labor input for land preparation, while the per-hectare input for weeding and harvest-threshing operations has increased, particularly in the irrigated areas. If this is true, the average labor input per hectare would have increased by some

[15] Moises L. Sardido, *Analysis of Income and Resource Productivity of Alternative Rice Farm Cropping Patterns in Bicol*, (M.S. Thesis, University of the Philippines, 1971, forthcoming).

[16] William J. Chancellor, "A Survey of Tractor Contractor Operations in Thailand and Malaysia" (Agricultural Engineering Department, University of California, Davis, 1970), p. 45.

amount in addition to that caused by shifts in the land-use pattern, but the magnitude of the increase is still in question.

New technology inevitably increases labor productivity, and the new seed-fertilizer technology is no exception. One approach to the question of whether the new technology increased the rate of labor absorption in the rice sector is to look at the relative changes in output and labor productivity. Over the last five years, growth rate of rice production has risen to 3.8 per cent per annum as compared to 2.4 per cent for the previous 6-year period (Table 3). Since the growth rate of labor productivity probably did not experience the same quantum jump, this would imply a higher rate of labor absorption in the sector. Therefore, although it is difficult to pinpoint the rate of labor absorption, we are reasonably confident that it has been higher in the later period partly because of the new rice technology.

LABOR REQUIREMENTS IN THE 1970'S

Two important factors will have a significant influence on labor absorption in the rice sector over the next five years. First, the de facto devaluation of the Philippine peso in February 1970 affected the relative factor prices and may diminish, at least temporarily, the rate of mechanization in the sector and have positive effect on labor absorption. Second, since self-sufficiency appears to have been achieved by 1970 and the export market is not strong, a choice must be made between (1) a rapid growth in output, which would have a positive effect on labor absorption but would threaten a sharp decline in farm rice prices, and (2) a growth rate of about 3.5 per cent per annum,[17] which would maintain self-sufficiency with present price levels and have a negative effect on labor absorption in the rice sector.

Alternative self-sufficiency paths, assuming an annual growth rate in output of 3.5 per cent, have been studied by means of a simple linear programming model of the Central Luzon rice sector.[18] Although the study was based on conditions found in Central Luzon, the results can help us understand the interaction of factors which will affect labor absorption in the whole rice sector as well.

In the model, land area is held constant but effective crop area is allowed to increase through the expansion of irrigation facilities and double cropping. The mechanization level is also held constant, so that all productivity gains are due to other factors — principally fertilizer and irrigation. Increases in total labor use are associated primarily with the extension of crop area, higher levels of inputs such as fertilizer, and higher yields. The growth rates in Table 7 result from solutions of the model with different objective functions while holding capital and output levels constant. The capital available for new irrigation investment is not exhausted except in Case III, and this accounts for the differences in the growth of crop area.

[17] This would be the approximate growth in demand if we assumed a population growth rate of 3.2 per cent per annum, income growth r[illegible] f 2.0 per cent per annum and income elasticity of 0.14.

[18] William H. Meyers, "*Alternative Patterns of Resource Use for Achieving Self-Sufficiency in Rice in the 1970's": A Linear Programming Analysis* (M.S. Thesis, University of the Philippines, 1971, forthcoming).

TABLE 7

GROWTH RATES RESULTING FROM SOLUTIONS OF LP MODEL COMPARED TO ACTUAL EXPERIENCE DURING THE LAST FIVE YEARS

(Per cent per annum)

	Central Luzon Model* 1970-1975			Actual experience † 1963/65 to 1968/70	
	I	II	III	Philippines	Central Luzon
Output	3.5	3.5	3.5	3.8	5.8
Labor productivity	1.9	0.9	0.3		
Labor absorption	1.6	2.6	3.2		
Man days per ha	1.3	0.4	0.7		
Effective crop area	0.3	2.2	2.5	0.6	4.2
Yield	3.2	1.3	1.0	3.2	1.6
Irrigated area	0.7	5.4	5.8	7.0	9.0
Nitrogen demand	21.0	5.8	15.0		
Net farm income	3.1	3.6	2.9		
Govt. irrigation subsidy	0	20.0	20.0		

Sources:

* Growth rate resulting when (Case I) maximizing net farm income without government irrigation subsidy, (Case II) maximizing net farm income assuming that current subsidy levels continue and (Case III) maximizing total man-days employed. Adapted from William H. Meyers *Alternative Patterns of Resource Use for Achieving Self-Sufficiency in Rice in the 1970's. A Linear Program Analysis* (M S Thesis, University of the Philippines, 1971, forthcoming).

† Basic data from the Bureau of Agricultural Economics, Department of Agriculture and Natural Resources, Government of the Philippines

Case I. Maximize farm income (unsubsidized irrigation). Considering growth in crop area and yield per hectare, Case I appears to be the most realistic of the three for the rice sector as a whole. Irrigated area, however, will probably grow at a rate closer to 7 0 per cent than to the 0.7 per cent in the model.[19] The former would permit a somewhat lower and more realistic growth rate for nitrogen demand. This trade-off would probably have a positive effect on labor absorption, but the change could be quite small as long as total crop area is not affected.

Case II. Maximize farm income (subsidized irrigation). Case II is similar to what has been experienced in Central Luzon over the last five years — effective crop area expanded rapidly and average yield, which is about 35 per cent above the national average, increased at a slower rate. Based on the distribution of new irrigation in the Four-Year Development Plan, it is probable that crop area and labor demand will continue to grow in Central Luzon at a rate faster than the national average. Thus, as in the past five years, the outlook for labor absorption is more promising in Central Luzon than in the rice sector as a whole.

[19]The Four-Year Development Plan for 1971 to 1974 has programmed 287,900 hectares of newly-irrigated land which may mean 400,000 to 500,000 crop hectares irrigated.

Case III. Maximize total labor employed. The highest rate of labor absorption is found in Case III; this is achieved in the model by choosing the maximum fertilizer application of 120 kg/ha N on about 13 per cent of the crop area and using the remaining area at zero fertilizer input, where labor productivity is lowest. Though much more drastic, this approach has some similarity to priority programs, which push the new technology in the most productive areas in order to achieve output targets. As a method of increasing employment, this approach is highly questionable since the inefficient use of resources cuts deeply into net income growth; and the concentration of the new technology in a small area results in greater income disparities within the sector.

Of course, this model assumes a constant level of mechanization. The labor absorption rates in Table 7 would decline if the level of mechanization increased above the present level. Therefore, factors which affect the rate of mechanization should be examined. Mechanization in the Philippine rice sector means primarily use of tractors for land preparation and to a lesser extent use of mechanical threshers.

Farmers' reasons for buying tractors were recorded in a 1965 survey of 150 farmers owning hand tractors in Laguna province:[20]

Number of farmers responding	Reasons
90	Difficulty in the care of carabao, carabaos are stolen, poisoned, need care and feeding
66	Saves time in land preparation: works faster, easier, cheaper, can work continuously
36	Affects the depth of paddy The paddy becomes shallower with use of hand tractor over time
32	Purchased primarily for own use
28	Purchased as a source of income by renting out
6	Suggested and financed by landlord
2	To ease the work of the carabao

Whether or not a tractor is purchased, however, depends primarily upon credit availability and the loan repayment capacity of the farmers One conclusion of the Laguna study was that "farm size, yield per hectare and rice price are critical factors in establishing repayment capacity "[21] We do not anticipate any significant changes in farm size in the near future, but increases in yields are expected to continue Therefore if there is no surplus on the local rice market and prices remain stable, the repayment ability of farmers should continue to improve for the rice sector as a whole.

[20] R. Barker, S. S Johnson, N Alviar, N Orcino, "Comparative Economic Analysis of Farm Data on the Use of Carabao and Tractors in Lowland Rice Farming", paper prepared for Farm Management Seminar with Focus on Mechanization, Manila (Feb 24 to March 1, 1969)

[21] R. Barker, S. S. Johnson, N. Alviar, N. Orcino

On the credit side, a major new source of financing mechanization was injected into the rural economy by the joint Central Bank: International Bank for Reconstruction and Development (CB:IBRD) Farm Mechanization Program beginning in April 1966. The initial credit line of US$5 million from the IBRD was for medium and long-term loans for the acquisition of farm machinery and irrigation pumps This credit carries an interest rate of 12 per cent per annum for farm borrowers and is administered by the rural banks with the aid of a Central Bank farm technician who determines eligibility and repayment capacity and provides technical supervision.[22] The initial $5 million was fully utilized by May 1968, and 88 per cent of the total amount was used to finance tractor and tiller purchases.[23] A second credit line of US$12.5 million was obtained from the IBRD in June 1969 with the stipulation that it be fully utilized by March 31, 1973.

This large loan program was made available through all rural banks[24] in the Philippines. It undoubtedly increased the rate of mechanization in the rice sector However, the number of loans granted has been decreasing with time and only about 6 per cent of the second credit line has been utilized (Appendix Table A-8) The de facto devaluation of the Philippine peso in February 1970 probably accentuated this trend [25] Interviews with hand tractor dealers in Manila also indicated a sharp decline in sales in 1970 (Appendix Table A-9), which they attributed to both the devaluation and the more stringent loan requirements instituted by the CB IBRD program for the new $12 5 million loan agreement in 1969

The land reform program may also be having a negative effect on loans granted for mechanization We would expect the number of loans guaranteed by landlords for their tenants for tractor purchases to decline as tenants change to leasehold The land reform program may also help to prevent the establishment of large-scale mechanized farms

These factors which dampen the growth of mechanization will probably be present for some time to come and should be considered advantageous from the point of view of labor absorption They tend to compensate for other government policies, especially interest rate, foreign exchange, and minimum wage policies, which have distorted relative factor prices in favor of capital Even though the effect of the peso devaluation which increased the cost of imported goods by about 60 per cent -- was partially offset by domestic inflation and a higher minimum wage rate, it appears that the influence of these factors taken together will lower the rate of mechanization over the next five years. However, our analysis suggests that the future rate of labor absorption in the rice sector will still be lower than it was in the 1963/65 to 1968/70 period, unless the output growth rate is well over 3.5 per cent per annum

[22]An appraisal of the CB IBRD loan program was made covering 18 rural banks and 179 borrowers, see Eugenio P Ladrido, "The CB-IBRD Credit Program", *Seminar on Economics of Rice Production in the Philippines*, IRRI (December 1969)

[23]1968 Annual Report, Department of Rural Banks, Central Bank of the Philippines.

[24]As of February 1969, there were 2,510 loans granted by 143 rural banks, although there were over 400 rural banks in operation

[25]In addition to the effect of devaluation, the eligibility requirements under the second credit line are more stringent Many rural banks also are reluctant to continue promoting CB:IBRD loans, because collections on many loans granted from the first $5 million are already behind schedule

III. THE POTENTIAL FOR LABOR ABSORPTION THROUGH MULTIPLE CROPPING AND DIVERSIFICATION

Our conclusion from the previous section is that the rice sector may absorb less labor in the future than it has in the past, due principally to the increased labor efficiency of the new technology and the very limited export potential which exists for Philippine rice. Given these limitations on the labor absorptive capacity of the rice sector, we now turn to an examination of the potential for increased labor utilization through a program of agricultural diversification.

Much of the information that we present concerns the diversification of individual farms, or more specifically, multiple cropping. Multiple cropping will be defined as a regular sequence of more than one annual food or feed crop both planted and harvested in the course of one year.[26] There are other forms of farm diversification which include livestock production and intercropping perennial with annual crops.

As opposed to the diversification of individual farms, one can consider the diversification of the entire agricultural sector. In this context Philippine agriculture in 1968 was highly specialized with four crops — rice, corn, coconuts, and sugar-cane which accounted for 87 per cent of the total crop area. A change in the relative price of rice has frequently resulted in a shift in land area between rice and these crops.[27]

In this section we review the experience of the Philippines with multiple cropping, examine its potential for labor absorption, and identify the factors that may hasten or constrain the spread of multiple cropping and diversification.

THE EXTENT AND PATTERNS OF MULTIPLE CROPPING IN THE PHILIPPINES

Multiple cropping has not been widespread in Philippine agriculture. Multiple cropping indices computed for the census year 1938, 1948, and 1960 are presented in Table 8. In 1948 the multiple cropping index, reflecting the ratio of the crop area to cultivated area, was 126 which was almost the same as the 1938 level. This can be attributed to the devastation of the agricultural sector caused by World War II. In 1960, the index was 136, which means the annual rate of increase was less than 1 per cent since 1948.

In contrast, the multiple cropping index for Taiwan reached an average level of 180 for 1960. The multiple cropping index for the Philippines in 1960 is roughly equivalent to that which was attained in Taiwan in 1938.

Some of the reasons for the wide difference in cropping intensities have been discussed in the first section of this paper. It was noted that the absence of population pressure on the land in the Philippines allowed continued extensive cultivation of land up to 1960.

Unfortunately, no recent studies on a ntaional scale have been conducted in the Philippines to determine the extent and patterns of multiple cropping. A study

[26]This is essentially the definition used by Dalrymple in his text. See Dana G. Dalrymple "A Survey of Multiple Cropping in Less Developed Nations", Foreign Economic Development Service, U.S. Department of Agriculture (mimeographed, March 1971), p. 7.

[27]See Mahar Mangahas, A. E. Recto, and V. W. Ruttan, "Price and Market Relationships of Rice and Corn in the Philippines", *Technical Bulletin 9*, IRRI, p. 107.

TABLE 8

MULTIPLE CROPPING INDEX AND THE RATIO OF LAND TO POPULATION IN THE PHILIPPINES AND TAIWAN IN 1938, 1948, AND 1960

	Philippines*	Taiwan†
Crop area (thousand ha)		
1938	5,009	1,147
1948	4,666	1,317
1960	7,596	1,562
Cultivated area (thousand ha)		
1938	3,954	858
1948	3,712	863
1960	5,580	869
Multiple cropping index		
1938	127	134
1948	126	153
1960	136	180
Total population (thousand persons)		
1938	16,000	5,896
1948	19,234	6,806
1960	27,088	10,792
Cultivated area per person (ha/person)		
1938	0.25	0.15
1948	0.19	0.13
1960	0.21	0.08

Sources:

* *Census of Agriculture, 1938, 1948, 1960*, Bureau of Census and Statistics, Government of the Philippines.

† "Taiwan Agricultural Statistics 1901-1965", *Chinese-American Joint Commission on Rural Reconstruction, Economic Digest Series: No. 18* (December, 1966).

done in 1954-55 involving more than 5,000 farms of various types throughout the country contains information on the patterns of cropping and the intensity of land use in the Philippines.[28]

Appendix Tables A-10 and A-11 show that the extent of double-cropping and intercropping in the Philippines depends upon the level of irrigation, the type of crop, and the location in which the crop is grown. For example, double-cropping is obviously high in those rice areas which are assured of year-round water supplies. It is also high for corn, much of which is grown in Mindanoa, where the rainfall pattern facilitates double-cropping. But sugar-cane is a 12-month crop and very little is intercropped. The highest intensity of land use is

[28]Horst and Judith von Oppenfeld, J. C. Sta. Iglesia, P. R. Sandoval, "Farm Management, Land Use and Tenancy in the Philippines," *Central Experiment Bulletin 1*, University of the Philippines, (August 1957).

Bicol, where two-thirds of the land area is either double-cropped or inter-cropped.

As shown in Appendix Table A-12, out of 3,801 lowland rice farms surveyed in 1954-55, 67 per cent planted only one crop of rice with no secondary crops. On the other hand, 19 per cent planted two crops in the wet and dry seasons, and only 14 per cent planted wet season rice followed by secondary crops. The most common secondary crops are mungo, onions, and tobacco.

Several surveys have recently been completed on some lowland and upland farms in Luzon. On the whole, these surveys present a picture which is not too different from past observations. For example, a study of 292 lowland farms growing secondary crops in Central Luzon in 1962-63 showed a multiple cropping index of about 148 (Appendix Table A-13). All farms raised rice during the wet season, but the second or dry season crop was variable. Twenty per cent of the farmers raised rice while the rest planted one of the following crops: onions, mungo, peanuts, tomatoes, pole beans, watermelons, cabbage, and tobacco (Virginia and native).[29]

In another survey of 50 diversified farms in the Bicol region in 1968-69 the multiple cropping index varied from 100 to 213 depending upon the type and size of farm (Appendix Table A-14). The common patterns observed were: double-cropping of lowland rice; crop rotation of lowland rice with other crops such as vegetables and root crops; diversified crop farms (lowland rice and other crops in separate fields); crop rotation of upland rice and other field crops; and inter-cropping of upland rice and other field crops.[30]

Some upland farms give a somewhat different picture. Multiple cropping indices for upland farms have been reported to be higher than on lowland farms in Batangas, largely because the rainfall pattern allows crop rotation.[31] In general, upland rice is planted in the rainy season and crops that do not require large amounts of water like corn, vegetables and minor field crops are planted after the rice harvest to take advantage of residual moisture.

Other forms of farm diversification which have been observed in the Philippines are worth mentioning, though they do not fall within our definition of multiple cropping. Some are described by Lawas as follows:[32]

> "In the province of Negros Occidental where sugar-cane is the main crop, inter-cropping with mungo, peanuts or soybeans has been getting more

[29]E. A. Bernal, N. M. Fortuna, R. G. Corcolon, I. P. Belandres and N. G. Alviar, "Unit Requirements, Costs and Returns for Producing Palay and Secondary Crops in Central Luzon, 1962-1963", *The Philippine Agriculturist*, Vol. XLVIII, No. 4-5, (September-October 1964), pp. 203-232.

[30]Moises L. Sardido, *Analysis of Income and Resource Productivity of Alternative Rice Farming Patterns in Bicol*, (M.S. Thesis, University of the Philippines, 1971, forthcoming).

[31]See N. R. Deomampo, B. V. Gaon and E. M. Albano, "The Effects of Cropping Patterns on Farm Earning Capacity", *The Philippine Agriculturist* Vol. LIII No. 1 (June 1969), pp. 17-27. Also Engracia M. Gonzales, "The Economics of Crop Diversification on Upland Farms in Balete, Tanauan, Batangas", (Unpublished undergraduate thesis, U.P. College of Agriculture 1969).

[32]Jose M. Lawas, "Agricultural Diversification and Development: The Philippine View Point," paper presented in SEADAG Conference (Jan 6-8, 1971).

attention....It is common in the provinces of Batangas and Cavite to see wide patches of vegetables laid out between rows of pineapples that are growing under papaya trees interplanted with coconut trees."

Although multiple-cropping and other forms of farm diversification have been practiced, a general conclusion which emerges from the foregoing analysis is that the extent of multiple-cropping on Philippine farms has been low. A major reason is the lack of water control facilities and irrigation development that are required to grow more than a single crop of rice. Also, until recently, low population pressure has permitted perpetuation of a system of production relying on the extensive use of land.

THE POTENTIAL FOR LABOR ABSORPTION

Evidence from other countries shows that an increase in agricultural employment seems to be roughly proportional to the increase in intensity of cropping. In Taiwan, for example, increased labor inputs have been closely related to the increase in multiple-cropping.[33]

One recent study in the Philippines shows the relationship between the intensity of cropping and the amount of labor input. The study was conducted in the Bicol region in 1968-69. The relevant results are summarized in Appendix Tables A-14 and A-15. In general, the labor input increases as the multiple-cropping index increases on both lowland and upland rice-diversified farms. The labor input level varies widely, depending on the cropping system; the highest labor absorption is found on multiple-cropped lowland farms, and the lowest is observed on upland farms. Another important observation is that small farms have higher cropping intensities and higher labor input per hectare than large farms.

Although the labor input increases as the multiple-cropping index increases, Appendix Table A-16 illustrates that the choice of crop combination can also have a considerable impact on the amount of labor used. In practice, those crops with a very heavy labor requirement are seldom planted over the entire farm. Where water is the key limiting factor, part of the land may be left idle. There are thus situations where the multiple-cropping index may be very low but the labor requirement per effective crop area quite high. Conversely, the multiple-cropping index may be high and the labor input per effective area relatively low (see Appendix Table A-13). Obviously, a farmer can arrange his cropping pattern to fit his labor and other resource restrictions in many ways.

Another important consideration is the relationship between labor and capital requirements. The previously mentioned Bicol study shows that more

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Period	Index of	
	Multiple cropping	Labor input
1911-1915	100	100
1921-1935	113	114
1956-1960	136	155

Adapted from: Dana G. Dalrymple, "A Survey of Multiple Cropping in Less Developed Nations", Foreign Economic Development Service, USDA (mimeographed, March 1971), p. 84.

intensive use of land absorbs more labor but at the same time requires more capital (Appendix Table A-15).

Thus several factors interact to determine cropping patterns and, hence, levels of labor use. More labor can be absorbed through multiple-cropping, but the key to expansion of multiple-cropping is the development of appropriate irrigation facilities. At the same time, the most profitable employment of labor in multiple-cropping will require greater inputs of both fixed and operating capital on the farm.

POTENTIALS FOR MULTIPLE CROPPING AND DIVERSIFICATION

Several factors must be considered in a program of farm diversification: the demand for alternative crops (both domestic and foreign), the availability of the technology at the experimental station, the adequacy of irrigation facilities and water control, the ability to shift farmers to a new pattern of production, and the organization needed to market the products. Any one of these factors can prove to be a major bottleneck.

We believe that current levels of domestic and export demand and the production technology already available at experimental stations could support a substantial increase in the production of feed grains, fruits, vegetables, and livestock products. In our view, the major obstacles to diversification involve technological and resource rigidities in the production and marketing of potentially profitable alternative crops. As mentioned previously, Philippine farming tends to be organized around four major crops grown in a monoculture. The irrigation systems are designed primarily for the production of rice, and they lack the water control necessary for the production of most alternative crops. Government policies and institutions have for years been directed at the problem achieving rice self-sufficiency. Even where farmers can be convinced to grow alternative crops, they frequently complain that no markets are available.

Thus, it would require a major effort to create an environment for farm production and marketing (such as practiced in Taiwan) which permits rapid adjustment in response to changing demands.

The Philippine government policy toward diversification is reflected in a recent statement by Lawas and Korzan:[34]

> "Dealing with an abundance of rice is a new experience for decision-makers in this country. Even so, the present plan is at least to push rice production and its related activities during the four-year period, 1971-1974, even if a sizeable surplus may result. Philippine farmers know how to produce rice. We are not going to encourage farmers to change from rice to other crops until there is conclusive evidence that it is in their best interest to do so. A Land Classification and Soil and Water Management Project, now in process, should give important information as to the best and most profitable use of land in the Philippines It is hoped, of course, that the pace of diversification in the next four years can be accelerated but any acceleration has to be based

[34]Jose M. Lawas and Gerald E. Korzan, "Rice Policy in the Philippines", paper presented at Rice Policy Conference, IRRI (May 9-14, 1971).

on attractive alternatives. The opportunity cost to farmers will be minimized under a policy of *greater intensity* of cropping with different enterprises... More can be produced on the same land area. Of course, this clearly implies that this form of diversification is profitable. In any case, there will be an increase in capital, labor inputs and, of course, output."

Clearly, the government has begun to adopt a diversification program as a conscious policy. At this time, however, multiple-cropping of lowland irrigated rice farms is not a major focus of that policy. Current research on land classification suggests that there is perhaps no single best form of diversification. Plans for the development of Philippine agriculture and agricultural policy should take into account the diverse agro-climatic zones of the country and the resource endowments and restrictions in each of these regions.

In conclusion, Philippine agriculture today is not highly diversified. One of the major questions is not whether to diversify but what form this diversification should take. While multiple-cropping offers considerable potential for labor absorption, many factors exist which inhibit its rapid development Diversification of the agricultural sector without reference to farm diversification may or may not create a greater potential for labor absorption, but may prove to be the less costly and more practical course of action for the immediate future. Further development of multiple-cropping will require considerably more time and investment.

IV. EMPLOYMENT OPPORTUNITIES IN THE NON-FARM SECTOR

The new technology can have both a direct and an indirect effect on employment in the non-farm sector. The direct effect occurs through the creation of more jobs in the industrial and service sectors. These jobs are created as farmers spend their increased incomes for inputs in farm production, for farm processing and marketing, and for consumption goods These expenditures also have a multiplier effect, especially in the rural areas Very little evidence, however, is available that can quantify this impact, although studies have clearly shown that spending increased for inputs,[35] for processing facilities,[36] and for consumer goods[37] following the introduction of the high yielding varieties

The degree to which these expenditures affect the employemnt level depends upon the direct and indirect domestic value-added content of the goods and services demanded. Agricultural chemicals, tractors, and pumps are imported. Most rice-processing facilities, farm implements, and building materials are manufactured locally. Sixty per cent of the fertilizer supply is locally manufactured.

[35]Sheng Hui Liao and Randolph Barker, "An Analysis of the Spread of New High Yielding Varieties on Philippine Farms", *Economic Research Journal*, Vol. XVI, No. 1 (June 1969).

[36]Randolph Barker and Geronimo Dozina, Jr., "Second Generation Problems in the Rice Industry in the Philippines", paper presented at the Seminar Workshop in Grain Processing, University of the Philippines, College of Agriculture, Los Banos, Philippines (December 7-10, 1970)

[37]G. T. Castillo, A. M. de Guzman, S. L. Pahud and L Paje, "The Green Revolution at the Village Level: A Philippine Case Study (1963-1970)," paper presented at the 28th International Congress of Orientalists, Canberra, Australia (Jan 6-12, 1971).

but this is a highly capital-intensive industry. On the other hand, goods consumed by farm households consist mostly of food, clothing, and housing which are usually domestically produced under relatively simple, labor-intensive techniques.

The indirect effect of the new technology on non-farm employment is felt through the change in the price of rice relative to wages. Expenditures for rice constituted about 15 per cent of the consumption of an average household in 1965. A low rice price may, therefore, be used as an indirect policy instrument for encouraging labor-intensive industrialization, since it helps to diminish the pressure for wage increases. Figure 4 shows the changes occurring over time in the rice price, the money wage, and the consumer price index. The price of rice was

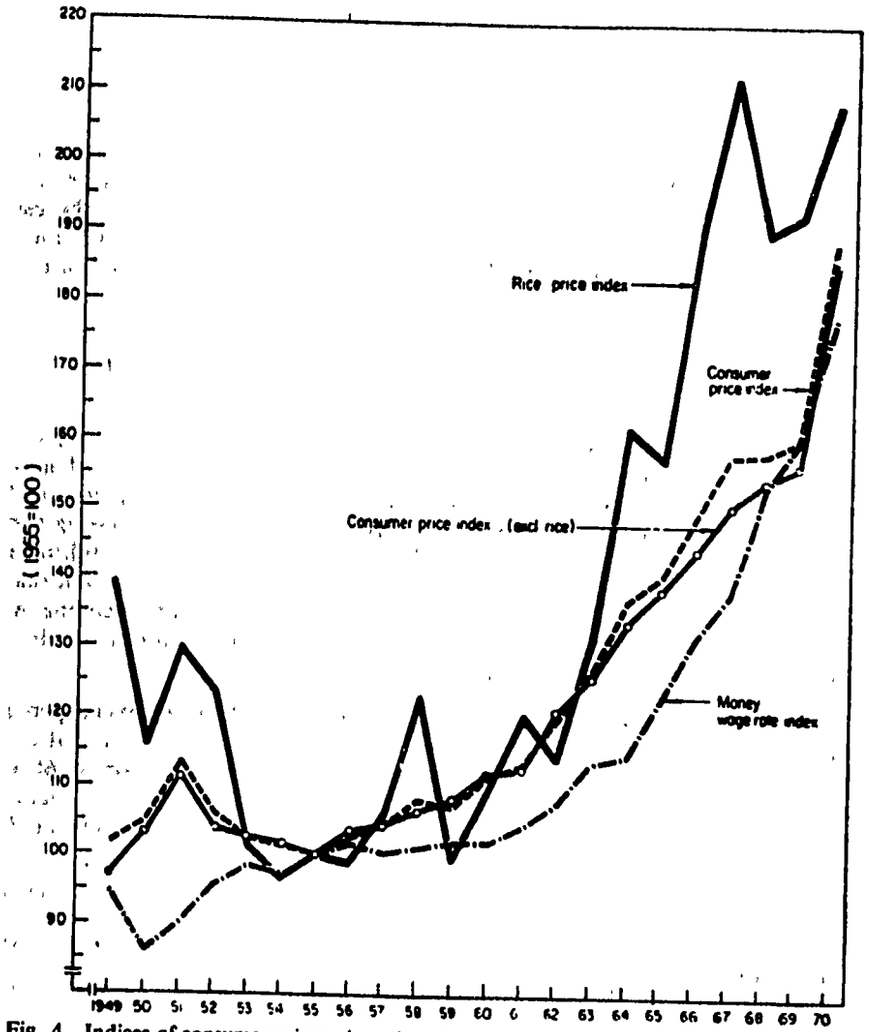

Fig. 4. Indices of consumer prices, rice prices (Macan first class), consumer prices excluding rice, and money wage rates (unskilled) for Manila and suburbs, 1949-1970.

Source: Department of Economics Research, Central Bank of the Philippines.

rising sharply in the mid-1960's relative to the price of other goods. Money wages increased at a slower rate except in 1965 when the minimum wage was raised. Figure 5 shows the money wage index for unskilled workers deflated by the consumer price index and the price of rice. Real wage rates declined steadily between 1955 and 1964, but rose between 1964 and 1969. Rising rice prices contributed to the decline in the real wage. However, between 1967 and 1970, the money wage has risen sharply relative to the rice price. Figure 6 shows the ratio of rice price to the domestic wholesale and consumer price index. This figure suggests that the relative rice price reached a peak in 1967 and has been declining since then. Of course, on many farms this decline in the relative rice price has been offset by rising productivity as a result of the new technology.

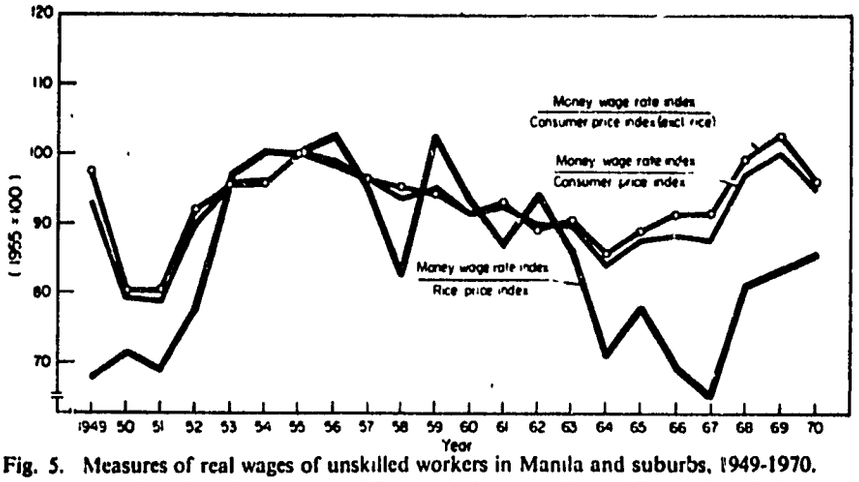

Fig. 5. Measures of real wages of unskilled workers in Manila and suburbs, 1949-1970.
Source: Basic data from Department of Economic Research, Central Bank of the Philippines.

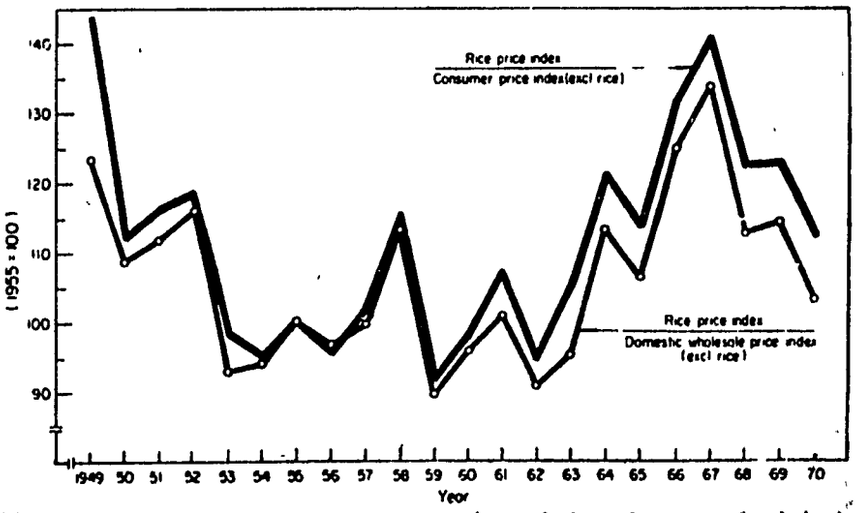

Fig. 6. Indices of rice price relative to consumer prices excl. rice and to domestic wholesale prices excl. rice, 1949-1970.
Source: Basic data from the Department of Economic Research, Central Bank of the Philippines.

In summary, it appears that the introduction of the new rice technology in 1966 helped to arrest an upward trend in the rice price relative to wages and the prices of other goods. Prior to 1967, the rising rice price was in the vanguard of the inflation, but since that date inflationary pressures have continued as a result of rising prices of goods other than rice.

V. CONCLUSION

We have attempted to assess the overall effect of the new rice technology on labor absorption in Philippine agriculture. The cultivated land area in the Philippines has not increased significantly since 1960. Thus, the introduction of the high yielding varieties in 1966 came at a time when growth in labor productivity had become dependent upon growth in land productivity and when labor absorption had become dependent upon growth in labor input per hectare

The immediate effect of the new rice technology was to increase labor use per hectare on many farms and to move the Philippines toward self-sufficiency. In our judgment, however, the rate of labor absorption in the rice sector in the long run may be somewhat lower than it has been in the past because the new rice technology requires less labor per unit of output, and there is little prospect for an export market for Philippine rice. It is thus important to consider alternative measures for employing labor in the agricultural sector.

In distinguishing between diversification of the agricultural sector and diversification of individual farms, there is evidence that multiple-cropping such as practiced in Taiwan offers more potential for labor absorption. However, rapid expansion of multiple-cropping in the Philippines is limited by poor water control, lack of farm know-how, and inadequate market organization. It is our view that considerable attention needs to be given to diversification in Philippine agriculture. We also feel that programs of diversification should recognize their effects on labor absorption.

Finally, we examined briefly the impact of the new rice technology on labor absorption in the non-farm sector. A significant increase in labor demand for supplying agricultural goods and services and consumer goods seems to have occurred particularly in the rural areas where the new technology is being adopted. The new technology seems also to have had a positive effect on non-farm employment by reducing the price of rice relative to other consumption items and to wage rates.

APPENDIX A

Tables presenting supporting data on rice production, mechanization, mechanization credit and cropping patterns in the Philippines.

TABLE A - 1

MAN, ANIMAL AND TRACTOR UTILIZATION PER HECTARE OF 100 LOWLAND RICE FARMS IN RIZAL PROVINCE BY VARIETY AND SEASON 1967-68 (days per hectare)*

	LOCAL			HYV		
	M	A	T	M	A	T
WET SEASON						
Land preparation	28.45	19.73	0.53	27.60	15.89	1.35
Transplanting	12.95			17.37		
Weeding & replanting	13.65			29.38		
Other pre-harvest	2.95			5.83		
Harvest, thresh, haul	25.86			30.72		
TOTAL	83.86	19.73	0.53	110.90	15.89	1.35
(Hired)	(45.38)			(70.79)		
(O-F-E)†	(38.48)			(40.11)		
DRY SEASON						
Land preparation	28.84	28.08	1.13	24.48	11.24	3.0
Transplanting	18.49			18.76		
Weeding & replanting	22.71			46.28		
Other pre-harvest	5.52			6.67		
Harvest, thresh, haul	25.10			35.97		
TOTAL	100.66	28.08	1.13	132.16	11.24	3.02
(Hired)	(49.65)			(96.34)		
(O-F-E)†	(51.01)			(35.82)		

* Average farm size was 1.39 ha with 23% double cropped and 42% of the farmers were owners or part-owners.

† Operator, family and exchange labor.

Source: P. C. Manuel and M. P. Lopez, "Productivity of Farms Using Traditional and Improved Rice Varieties in Rizal and Laguna", *Seminar on Economics of Rice Production in the Philippines*, IRRI, (December 1969).

TABLE A - 2

LABOR AND MECHANIZATION INPUTS PER HECTARE ON 92 CENTRAL LUZON AND LAGUNA FARMS, 1966 AND 1968 WET SEASONS

	Rainfed		Low quality irrigation†		High quality irrigation†		All Farms	
	1966	1968	1966	1968	1966	1968	1966	1968
Number of farms*	32	38	39	32	21	22	92	92
Average of area (ha.)	1.9	3.0	2.6	3.7	2.2	3.0	2.3	3.2
			Man-days by operation					
Land preparation	17	11	20	11	16	9	18	11
Transplanting	16	16	15	17	12	13	15	16
Weeding	5	6	6	8	5	12	5	8
Other pre-harvest	9	7	8	9	8	12	8	9
Harvest-threshing	17	13	17	15	22	22	18	16
Total	64	53	66	60	63	68	64	60
(Average of rainfed)	(56.8)							
(Average of irrigated)			(62.8)		(65.9)			
			Per cent using machine					
User of tractor	9	32	5	22	43	50	15	33
User of mech. weeder	3	3	10	19	10	41	8	17
User of mech. thresher	84	92	95	81	0	50	69	78
Yield (m.t./ha)	2.1	1.9	1.9	2.1	1.9	2.4	2.0	2.1
Kg. per man day	33	36	29	35	30	35	31	35

* Note shift in number of irrigated and rainfed farms due to drought in 1968.

† Farms with a sufficient irrigation water supply for a dry season crop are termed "high quality"; others are "low quality".

Source: R. Barker, and M. Mangahas, "The Impact of New Technology on Labor Use in Rice Production", progress report on a cooperative study undertaken by the University of the Philippines, School of Economics and the International Rice Research Institute in cooperation with the Organization for Economic Cooperation and Development, March 1971 (unpublished).

TABLE A - 3

TOTAL AND HIRED LABOR INPUTS PER HECTARE AND PERCENT MECHANIZATION FOR 118 FARMS GROWING LOCAL AND HIGH YIELDING VARIETIES, CENTRAL LUZON AND LAGUNA, WET SEASON 1968

	Local		HYV	
Number of farms	102		45	
Average area (ha.)	2.5		2.6	
	Man days by operation			
	Total	*(Hired)*	*Total*	*(Hired)*
Land preparation	11	(2.7)	9	(3.2)
Transplanting	16	(15.2)	16	(15.2)
Weeding	6	(0.8)	11	(4.[illegible])
Other pre-harvest	9	(0.5)	10	([illegible])
Harvesting and threshing	15	(12.8)	18	([illegible])
Total	57	(30.0)	64	([illegible])
	Per cent using machine			
Tractor used	27		36	
Mechanical weeder used	12		31	
Mechanical thresher used	68		69	
Yield (m.t./ha)	2.3		2.5	
Kg. per man day	40		[illegible]	

Source: R. Barker and M. Mangahas, "The Impact of New Technology on Labor Use in Rice Production", progress report on a cooperative study undertaken by the University of the Philippines, School of Economics and the International Rice Research Institute in cooperation with the Organization for Economic Cooperation and Development, March 1971 (unpublished).

TABLE A - 4

LABOR INPUTS PER HECTARE FOR SPECIFIC TASKS ON 42 LAGUNA FARMS PLANTING HYV'S IN 1969 AND LOCAL VARIETIES IN 1966 (WET SEASONS)

	1966-local		1969-HYV	
Number of farms	42		42	
Average area (ha.)	2.4		2.3	
	Man-days by operation			
	Total	*(Hired)*	*Total*	*(Hired)*
Land preparation	22	(1)	16	(6)
Transplanting	10		10	(10)
Weeding	14	(12)*	14	(11)
Other pre-harvest	10		11	(6)
Harvesting and threshing	23	(23)	34	(34)
Total	79	(36)	85	(67)
Percent using tractors (%)	31		62	
Yield — (m.t./ha)	2.5		4.3	
Kg. per man day	32		51	

* Transplanting, weeding and other pre-harvest operations are combined in the 1966 records.

Source: R. Barker and V. Cordova, "The Impact of New Technology on Rice Production — A Study of Change in Three Philippine Municipalities from 1966 to 1969", paper presented at IRRI Saturday Seminar, December 12, 1970.

TABLE A - 5

COMPARATIVE LABOR REQUIREMENT FOR LAND PREPARATION USING HAND TRACTOR AND CARABAO, BY TYPE OF FARM ON 115 FARMS, CENTRAL LUZON AND LAGUNA, CROP YEAR 1967-68

	Type of farm								
	Rainfed		Irrigated — 1 crop			Irrigated — 2 crops			All farms
	Carabao	Carabao and tractor	Carabao	Carabao and tractor	Tractor	Carabao	Carabao and tractor	Tractor	
Number of farms owning tractors (carabaos)	(24)	[illegible]	(4)	2	2	(17)	14	15	115
Average size of farm (ha)	2.4	7.2	3.5	2.2	2.1	4.1	4.9	5.4	4.4
Labor input (man-days/ha)									
Plowing	5.8	[illegible]	12.9	5.6	4.8	6.5	3.5	3.1	4.8
Harrowing	9.4	[illegible]	13.8	8.4	6.4	11.2	6.4	4.8	[illegible]
Total land preparation	15.2	[illegible]	26.7	14.0	11.2	17.7	9.9	[illegible]	[illegible]

Source. R. Barker, S. S. Johnson, N. Alviar, N. Orcino, "Comparative Economic Analysis of Farm Data on the Use of C[illegible] [illegible]ators in Lowland Rice Farming," paper prepared for Farm Manag[illegible] [illegible] on Mechanization, Manila [illegible] March 1, 1969).

TABLE A - 6

NUMBER OF TRACTORS AND MECHANICAL THRESHERS PURCHASED BY YEAR, GAPAN, NUEVA ECIJA

Year	Total tractor	Four-wheel tractor		Hand tractor		Thresher	
		Number	Cumulative	Number	Cumulative	Number	Cumulative
1936-45	1	1	1	0	0	2	2
1946-51	0	0	1	0	0	2	4
1952	1	1	2	0	0	1	5
1953-56	0	0	2	0	0	0	5
1957	1	1	3	0	0	1	6
1958	1	1	4	0	0	0	6
1959	1	1	5	0	0	0	6
1960	2	0	5	2	2	2	8
1961	1	1	6	0	2	0	8
1962	0	0	6	0	2	0	8
1963	2	2	8	0	2	0	8
1964	1	0	8	1	3	0	8
1965	3	1	9	2	5	1	9
1966	2	0	9	2	7	0	9
1967	8	1	10	7	14	0	9
1968	10	2	12	8	22	1	10
1969	10	2	15	7	29	1	11
1970	4	3	18	1	30	0	11
Total	48	18	18	30	30	11	11

Source: Preliminary results of survey entitled "Diffusion of Farm Practices and Inputs, and Growth in Rice Production in Gapan, Nueva Ecija", conducted by Liu Fu-Shan, IRRI Research Fellow, 1971 (unpublished).

TABLE A - 7

COMPARATIVE EVALUATION OF WEEDING METHODS IN FLOODED RICE, IRRI, 1968 WET SEASON

Weeding method	Labor*	Total cost†
	man-days/ha	(pesos)
1. Hand, two times	62.5	250
2. Rotary followed by hand	38.8	155
3. Rotary, two times	25.0	100
4. Hand, one time	30.0	120
5. Rotary, one time	11.2	45
6. MCPA, followed by hand	32.5	140
7. MCPA, followed by rotary	13.0	62
8. Power weeder, one time	3.1	24
9. EPTC + MCPA (granular)	1.0	80

* 8 hour days

† Labor at P4.00 per day; gasoline at P12/ha; chemicals at 1968 prices.

Source: Adapted from Stanley S. Johnson, "Terminal Report on the General Engineering and Economic Research Portion of Contract No. AID/csd-834" (IRRI 1969) Table 22.

TABLE A - 8

NUMBER AND AMOUNT OF LOANS GRANTED BY YEAR UNDER THE CB : IBRD FARM MECHANIZATION PROGRAM

	Loans granted		Average size of loan (Pesos)	Loans outstanding (Pesos)
	Number	Amount (Pesos)		
1967	1,545	12,947,000	8,380	-
1968	832	7,724,000	9,284	18,754,000
1969	235	2,586,000	11,004	17,828,000
1970*	188	2,337,000	12,431	17,510,000
Total	2,800	25,594,000		

* As of September 1970

Source. Adapted from Jose M. Lawas and Gerald E. Korzan, "Rice Policy in the Philippines", paper presented at Rice Policy Conference, IRRI, (May 9-14, 1971).

TABLE A - 9

HAND TRACTORS AND FOUR-WHEEL TRACTORS SOLD IN THE PHILIPPINES 1967 TO 1970, (NUMBER OF UNITS)*

Type	1967	1968	1969	1970
Hand tractor	n.a.	n.a.	860	457
Four-wheel tractor	1531	1630	1358	978

* While most hand tractors are used for rice cultivation, many of the four-wheel tractors are purchased for use in other sectors; but we have no breakdown by sector.

Source: Agricultural Engineering Department, IRRI (unpublished data).

TABLE A - 10

EXTENT OF DOUBLE AND/OR INTERCROPPING BY TYPE OF FARMING, PHILIPPINES, 1954-55

Type of Farming	Number of farms	Per cent (of land) double and/or intercropping
All farms	5179	34
Lowland palay: (rice)		
one crop	2245	10
two crops	750	96
Upland palay (rice)	403	39
Coconut*	261	32
Sugarcane†	105	10
Corn	105	72
Abaca†	30	12
Tobacco	33	48
Livestock	49	15
Vegetables and/or fruits	89	26
Combination of two crops	375	35
No specialization	734	38

* Coconuts are frequently intercropped with palay and corn.

† Sugarcane and abaca farmers had some other land on which double or intercropping was practised.

Source: Horst and Judith con Oppenfeld, J. C. Sta. Iglesia, P. R. Sandoval, "Farm Management, Land Use and Tenancy in the Philippines", *Central Experiment Bulletin* / University of the Philippines, (August 1957), Table 14, p. 37.

TABLE A-11

EXTENT OF DOUBLE- AND/OR INTERCROPPING BY REGIONS, PHILIPPINES, 1954-55

Region	Number of farms	Percent (of land) double and/or intercropping
Ilocos	418	29
Cagayan	103	30
Central Luzon	1819	21
Southern Luzon	1653	36
Bicol	539	67
Visayas	328	52
Mindanao	319	30
All Regions	5179	34

Source: Horst and Judith von Oppenfeld, J.C. Sta. Iglesia, P.R. Sandoval, "Farm Management, Land Use and Tenancy in the Philippines", *Central Experiment Bulletin 1*, University of the Philippines (August 1957) Table 15, p. 17

TABLE A-12

CROPPING PATTERN AND ROTATION OF 3,801 LOWLAND RICE FARMS PHILIPPINES, 1954-55

Cropping pattern	Lowland palay farms	
	Number	Percent
Single palay, no secondary crops	2523	67
Double crops:		
Palay, wet and dry season	744	19
Wet season palay, followed by		
Mungo	221	6
Onions	82	2
Tobacco	77	2
Other single crops	79	2
Combination of crops	72	2
Total	3801	100

Source: Horst and Judith von Oppenfeld, J.C. Sta. Iglesia, P.R. Sandoval, "Farm Management, Land Use and Tenancy in the Philippines", *Central Experiment Bulletin 1*, University of the Philippines (August 1957) Table 87, p. 117

TABLE A-13

MULTIPLE CROPPING INDICES AND LABOR UTILIZATION OF 292 LOWLAND FARMS WITH VARIOUS CROPPING COMBINATIONS, CENTRAL LUZON, 1962-63

Cropping combination	Number of farms	Cultivated land area per farm (ha)	Effective crop area per farm (ha)	Multiple cropping index	Labor per farm (man-days)	Labor per cultivated area (man-days/ha)	Labor per crop area (man-days/ha)
Rice-rice	60	2.48	4.62	187	299.5	120.8	64.8
Rice-peanut	21	1.26	2.33	185	150.4	119.4	64.5
Rice-taro	16	3.09	5.08	165	353.7	114.5	69.6
Rice-corn	22	2.71	4.37	161	188.7	69.6	43.2
Rice-virginia tobacco	18	2.02	3.17	157	282.3	139.8	89.1
Rice-mungo	22	2.57	4.02	157	161.4	62.8	40.1
Rice-watermelon	19	2.39	3.39	142	256.8	107.4	75.7
Rice-native tobacco	17	2.15	2.77	129	211.0	98.1	76.2
Rice-tomato	20	2.74	3.53	129	240.2	87.7	68.0
Rice-cabbage	19	2.76	3.32	120	271.9	98.5	81.9
Rice-pole beans	19	2.44	2.91	119	321.0	131.6	110.3
Rice-onion	39	2.97	3.32	112	299.5	100.8	90.2
All farms	292	2.49	3.69	148	259.5	104.2	70.3

Source: Adapted from F. A. Bernal, N.M. Fortuna, R. G. Corcolon, I.P. Belandres and N.G. Alviar, "Unit Requirement, Costs, and Returns for Producing Palay and Secondary Crops in Central Luzon, 1962-1963". *The Philippine Agriculturist*, Vol. XLVIII, No. 4-5 (September-October 1964), pp. 203-232.

TABLE A-14

RELATION OF MULTIPLE CROPPING INDEX TO LABOR INPUT, UPLAND DIVERSIFIED AND LOWLAND DIVERSIFIED RICE FARMS, BICOL REGION, 1968-69

Per cent of farms	Average cultivated area (hectares)	Work units (man-days per hectare)	Multiple cropping index
23 upland diversified rice farms			
48	2.5	85	100
22	2.0	67	125
13	3.7	70	155
17	0.9	167	200
27 lowland diversified rice farms			
33	7.4	79	102
22	3.0	123	137
19	2.2	113	166
19	1.6	125	187
7	1.4	378	213

Source: Moises L. Sardido, "Income Distribution Patterns of Rice Farms in Bicol" IRRI Saturday Seminar, (December 13, 1969), Tables 9 and 12.

TABLE A-15

LABOR INPUT AND COST AND RETURNS PER HECTARE UNDER FOUR CROPPING SYSTEMS, BY SIZE OF FARM, BICOL REGION, PHILIPPINES, 1968-69

Cropping System	Small Farms[1]		Large Farms		All Farms		Operating[2] Capital	Fixed[3] Capital	Net Returns[4]
	No.	Man-days	No.	Man-days	No.	Man-days			
Lowland rice-lowland rice	28	284	18	172	46	240	95	1002	823
Lowland rice-other corps[5]	18	373	14	236	32	313	157	1850	1206
Lowland rice-diversified	12	250	12	184	24	217	84	745	687
Upland rice-diversified	12	120	11	64	23	94	14	706	145

[1]Lowland farms with 1.0 hectare or less were classified as "small", and upland farms with 1.5 hectares or less were classified as "small".

[2]Includes all variable costs except wages for hired labor and values of shares for harvesting and threshing services.

[3]Value of buildings, tools, and equipment, work-animals and supplies inventory.

[4]Return above variable costs (which includes expenses for fertilizers, insecticides, wages for hired labor and value of shares for harvesting and threshing)

[5]Include vegetables such as cabbage and tomatoes.

Source: Moises L. Sardido, *Analysis of Income and Resources Productivity of Alternative Rice Farming Patterns in Bicol* (M.S. Thesis, University of the Philippines, 1971, forthcoming).

TABLE A-16

LABOR REQUIREMENTS OF SELECTED CROPS PER HECTARE OF CROP AREA, PHILIPPINES†

Crop	Man-days ††
Rice	
lowland-irrigated	77.7
lowland-non-irrigated	70.2
upland	67.9
Onion	417.1*
Pole beans	382.5*
Pineapple	219.5**
Native tobacco	194.8*
Cabbage	185.2*
Watermelon	171.0*
Virginia tobacco	158.1*
Sugarcane	147.8***
Taro	141.9*
Chinese cabbage	11.5
Tomato	108.7*
Garlic	84.0
Cassava	73.0
Peanut	61.1*
Soybeans	47.0
Sweet potatoes	45.0
Cowpea	39.5
Corn	37.0
Mungo	31.5
Coconut	24.2

†Since these come from different sources and different time periods, their reliability and comparability vary; but their relative magnitudes are still useful. Those without asterisk are from the first mentioned source.

††Man-day is equivalent to eight hours.

Sources: Agricultural Economics Division, Department of Agriculture and Natural Resources, *Handbook of Agriculture*, 1955, and Cost of Production surveys, 1956.

*E.A. Bernal, N.M. Fortuna, R.G. Corcolon, I.P. Belmadres and N.G. Alviar, "Unit Requirement, Costs, and Returns for Producing Palay and Secondary Crops in Central Luzon, 1962-1963." *The Philippine Agriculturist*, Vol. XLVIII, No. 4-5, (September-October 1964), pp. 203-232.

**Farm Record Keeping Project, Department of Agricultural Economics, University of the Philippines, College of Agriculture, 1966-67.

***Crisogono U. Caintic, "The Economics of Irrigating Sugarcane Farms in San Carlos Milling District, 1967-68," (M.S. Thesis, University of the Philippines, 1969).