PN-AAQ-950
ISN 36469

THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Paper No. 95

GOVERNMENT POLICIES AND FARM MECHANIZATION IN THE PHILIPPINES

AAOO
G732

by

Cristina C. David
The International Rice Research Institute
Los Baños, Laguna

December 1983

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

GOVERNMENT POLICIES AND FARM MECHANIZATION IN THE PHILIPPINES*

Cristina C. David**

Countries with abundant land have relied primarily on mechanical technology to overcome limited labor supply in developing agriculture. In Japan, Taiwan, and South Korea, where land is scarce, adoption of modern biological technology has historically played a more important role (Hayami and Ruttan). As agricultural labor declined and farm wages increased relative to rental rates of capital in these countries, a wide range of farm tasks have been mechanized with machines especially developed for small farms.

In the Philippines, average farm size is about 3 hectares, still higher than the one-hectare farms in East Asian countries. The decline in cultivated land area per worker since 1960, however, suggests the closing of the land frontier (David and Barker). The agricultural labor force continues to increase at about 1 percent per year because population grows at 2.5 percent and labor demand in the non-agricultural sector has been limited by the capital intensive bias of industrialization policies (International Labor Organization). The proportion of landless households in the rural areas has risen over the

---

*Paper prepared for workshop on the Consequences of Small Farm Mechanization in the Philippines, December 1 - 2, 1983, Tagaytay, Philippines. An earlier version of this paper was presented at the International Seminar on Small Farm Mechanization sponsored by the Agricultural Development Council, the Chinese Academy of Agricultural Mechanization Sciences, the Japan Center for International Exchange and the National Institute of Research Advancement (Japan), held at Hangzhou, China, June 21--27, 1982.

**Agricultural Economist, Agricultural Economics Department, International Rice Research Institute, Los Banos, Laguna.

past two decades and farm wages have at best remained relatively constant (David and Barker). Thus, the impact of mechanization on agricultural employment and income distribution is a critical issue in the choice of technology for Philippine agricultural development.

The purpose of this paper is two-fold: to describe the pattern and growth of farm mechanization and to examine how government policies have affected the economic incentives for mechanization in Philippine agriculture.

Pattern and Growth of Farm Mechanization

Until 1971, inventories of farm machineries and equipment based on the agricultural censuses indicate that farm mechanization was generally limited to tractors and power tillers for land preparation and mechanical threshers for threshing rice (Table 1)[1]. Water pumps have not been covered by the censuses but are estimated to be used in about 10 percent of irrigated areas. The other machines are essentially for transport and agricultural processing of sugar and abaca.[2]

At the national level, there were fewer than two units of tractors and tillers per thousand hectares of cultivated area in 1971. This is very low by East Asian standards where the numbers range from 20 in South Korea to as many as 650 in Japan (Herdt). Mechanical land preparation and threshing was practiced by only about 5 percent of farms. It should be stressed, however, that mechanization has been unevenly adopted across regions and crops, being much more prevalent in sugar and rice.

Mechanization of land preparation in rice accelerated towards the late 1960's coinciding with the introduction of the new seed-fertilizer technology and the start or the series of World Bank financed credit programs to promote mechanization (Barker, et.al.). Rice farms are typically small, from 2 to 3 hectares. Rice is the most important crop, contributing 25 percent of crop output and employing about 40 percent of the agricultural labor force. By the late 1970's, 47 percent of tractors were purchased for rice farms.[3] Sugar accounted for 41 percent of tractor sales; the remainder is for corn (5 percent), the second most widely planted crop, and for plantation crops of banana and pineapple (4 percent). Power tillers which began to be sold in the market in 1960 are being used almost exclusively for preparing rice land.

Two separate nationwide surveys of tractors and power tillers conducted in 1976 allow us to describe the pattern of tractor and power tiller availability by region and by crop for a recent period (Table 2).[4] By 1976, about one million horsepower was available from existing tractors and power tillers. Total horsepower provided by draft animals was twice as much.[5] The water buffalo is the main beast of burden especially in the lowlands while cattle are more adapted to the upland areas.

In terms of horsepower, the sugar sector, historically the most mechanized farms, accounted for about one-third of total available mechanical horsepower. Since crop area in sugar was only about one-sixth of rice, horsepower per hectare in sugar was 0.56 compared to 0.20 in rice. In the same sugar survey of tractors, it was reported

that about 50 percent of the sugar area were cultivated by tractors. There were no comparable data for rice; the best educated guess to date is about 10 percent (Herdt).

Eighty percent of mechanical horsepower was supplied by four-wheel tractors and these were found mostly in Western Visayas, Central Luzon and Southern Mindanao. Half of these large tractors were located on sugar farms. Power tillers, which were more evenly distributed across the regions, constituted the remaining 20 percent and at least 30 percent of mechanical horsepower available in rice.

Farm Mechanization in Rice.

Although the level of mechanization remains low at the national level, mechanization of rice appears to be growing rapidly, particularly in the more progressive areas. Sales of power tillers rose much faster than tractors between 1970 and 1979 (Fig. 1). There is no annual breakdown of tractor sales by crop and also no information on the changes in mechanization taking place in the sugar sector. In rice, however, a number of farm-level studies documenting the changing structure of rice farming provides a more adequate impression of the level and growth of mechanization.

In Table 3, trends in mechanization rates, labor use and farm wages are shown for sample rice farmers in Central Luzon and Laguna which are regularly surveyed by the Agricultural Economics Department of the International Rice Research Institute. Central Luzon and Laguna are

major rice producing areas and since the sample farms in the surveys were located along the main highways, these data represent the best rice growing conditions. Among the Central Luzon farms, 72 percent of crop area are irrigated, while all of the Laguna sample farms were irrigated. Adoption of modern varieties was virtually complete by 1970 in Laguna and by 1979 in Central Luzon.

The number of farms using mechanical horsepower for land preparation has risen from about 20 percent in 1966 to almost 80 percent in Central Luzon and almost 100 percent in Laguna by the beginning of the 1980's. In Laguna, only power tillers are used primarily for harrowing after plowing with water buffaloes. In Central Luzon, on the other hand, four-wheel tractors were adopted first but by 1982, power tillers have become more popular. Water buffaloes continue to be used for a portion of the land preparation job, including final harrowing before transplanting in both locations.

Unlike sugar farms where tractors are typically owned, custom renting, especially of four-wheel tractors, is a more common arrangement in the rice sector. Most of four-wheel tractors are owned by large landowners and are rented out to small private owners, lessees, or share tenants. A recent survey of machine owners in Central Luzon showed that 83 percent of four-wheel tractors were being rented out compared to 36 percent of power tillers (Maranan).

The relatively high rate of mechanical thresher use (77 percent) observed in 1966 is unique to the Central Luzon region. Rice has been generally threshed by hand or feet in most other parts of the country at that time. Prior to 1975, mechanical threshers were large and of the

stationary type, typically pulled around by tractors during the dry part of the year when the harvested rice could be left to dry in stacks and the heavy machines easily moved across the rice fields. Adoption of large mechanical threshers declined as farmers shifted to hand threshing and since the mid seventies to portable threshers as expansion of double cropped area due to improvements in irrigation and introduction of early maturing varieties made it difficult for the large machines to move across rice fields. Since the early use of threshers has been encouraged in part by landlords to control crop sharing at harvest time, the advent of land reform in 1972 may also have diminished the incentive to thresh mechanically (Cordova).

The small farm size and continuous cropping in Laguna did not make the use of large threshers feasible. After 1975, small mechanical threshers, most of which were designed at the International Rice Research Institute, began to replace the large mechanical threshers and hand threshing in the Philippines. The proportion of farms using portable mechanical thresher rose to 92 percent in Central Luzon and 82 percent in Laguna.

In land preparation, higher rates of mechanization are associated with lower use of labor (Table 3). The decline in labor use with mechanical threshing is not shown by the data because harvesting labor which has increased with rising yields is combined with the data in threshing labor. In terms of land preparation, IRRI experimental and farm level evidence do not indicate significant output gains as a result

of mechanization. Mechanical threshing, however, show some increase in recovery rate. With the limited labor demand in the manufacturing sector and the currently high population growth, adoption of technologies that substitute capital for labor in Philippine agriculture will reduce the share of output received by labor and worsen income distribution. It is therefore not surprising to observe positive real growth rates in agricultural production being accompanied by stagnant or even declining real wages as indicated by the trends in real wages based on farm level surveys as well as at the national level (Fig. 2).

Though farm mechanization may not be the leading cause of the decline in real wages, it may have contributed to this trend.

The fact that farmers are adopting mechanical technology, however, suggests that at least from the private viewpoint, it is profitable to do so. The question I want to answer is to what extent government policies make mechanization artificially profitable. Aside from the Central Bank-World Bank Credit Mechanization Program and other smaller credit mechanization projects, the government does not appear to have an explicit policy with respect to farm mechanization. But there are broad economic policies which indirectly and perhaps unintentionally tend to promote mechanization.

Government Policies and Incentives for Mechanization

For farmers allocating resources more or less rationally, the rate of capital use relative to labor (K/L) depends on the relative price of capital (or the user cost of capital) to wages (c/w), technology (T), farm size (S), relative output price (P_i/P_j), and so forth as in equation (1).

$$(1) \quad K/L = f\ (c/w,\ T,\ S,\ P_i/P_j \ldots\ldots,)$$

This discussion focuses on the impact of government policies on c, the use cost of capital. There are modern wage policies but these tend to raise wages in non-agriculture and in plantation agriculture where minimum wages are higher and the ability to enforce the law is stronger. For the rice and other small farm agriculture, it is generally believed that wage policies do not significantly influence the labor market.

The annual user cost of operating a farm implement consists of the annual fixed and variable costs. The fixed cost is composed of depreciation and the opportunity cost of the total investment. In formula,

$$(2) \quad c = P\ (d + r) + Q^f\ p^f$$

where P and p^f are the prices of the machine and fuels, respectively, d, is the rate of depreciation, r is the interest rate, and Q^f is quantity of fuels.

The government does not directly intervene in the farmer's decision to use farm machinery. It does affect farmer's decision indirectly by changing the profitability of using capital versus labor, i.e., by changing the price of farm machinery, fuels, and the interest rate. If there is no government intervention, the domestic price of machinery and fuel will be equal to the world price valued at our border and converted into domestic currency by the free trade exchange rate. The interest rate, on the other hand, will be equal to the social opportunity cost of capital. The government intervenes in both the product and capital markets, however, and the effects can be measured by comparing the actual users cost of capital to that occuring in a free market situation.

Government policies create a gap between domestic and border prices of farm machinery and fuel in two ways. First, tariffs and the compensating sales tax raise domestic price (P_d) over border price converted at official exchange rates (P_b) as measured by implicit tariffs,

$$(3) \qquad T = \frac{P_d}{P_b} - 1$$

A positive T means that government policies increase the cost of capital, i.e., penalizes use of capital, and a negative number lowers it, i.e., subsidizes use of capital.

Second, the total protection system through trade and foreign exchange policies tends to cheapen imports (such as machinery and fuel) by defending an official exchange rate that overvalues the domestic currency. To include this effect, the net implicit tariff is estimated:

$$(4) \quad NT = \frac{P_d}{P'_b} - 1$$

which converts the border price by the free trade exchange rate, P'_b. The overvaluation of the peso was approximately 60 percent in the late 1960s. Power estimated a 10 percent overvaluation due to the protection system, the other 50 percent was due to the substantial disequilibrium in the balance of payments permitted during this period (Bautista and Tecson). With the floating of exchange rates in 1970, Medalla estimated a lower degree of overvaluation, for the mid-1970s from 16 to 30 percent depending on the assumption about the trade regime. For this analysis, a 20 percent domestic currency overevaluation was assumed.

The opportunity cost of capital is at least as important as the price of farm machineries in determining the user cost of capital. Government regulations on interest rates under the general umbrella of

the Anti-Usury Law as well as special credit mechanization programs have lowered the real market interest rate compared to the social opportunity cost of capital. During the late sixties, the real lending rate was about 3 percent as compared to a free market interest rate of 15 percent in real terms (International Labor Organization). With inflation rates of about 20 percent in the 1970's and nominal interest rates (including implicit charges) ranging from 14-20 percent, interest rates in real terms have been negative or at best zero, providing an important source of subsidy to users of capital.

To include the effect of the low interest rate policy on the annual user fixed cost of capital, the implicit panalty is estimated as in equation (5).[8]

$$(5) \qquad IP = \frac{P_d\,(d + R)}{P'_b\,(d + r)} - 1$$

where R is the actual market interest rate in real terms and r is the shadow interest rate. Depreciation rate, d, is assumed to be .10 for four-wheel tractors and .12 for power tillers.

It may be argued that interest rate subsidy applies only to credit from the formal financial institutions where interest rate ceiling can be effectively controlled. This is not entirely valid because credit

supplied by producers or dealers of farm machineries is most likely obtained also from the formal financial sector including government lending institutions. For self-financed purchases, the low interest rate policy may also have an impact on the farmers opportunity cost of capital to the extent that financial assets which are also subject to interest rate regulation are the alternative forms of investment.

It should be noted that an indirect effect on mechanization of a low interest rate policy is not included in (5). Since low interest rates cause excess demand for credit, lenders inevitably ration scarce loanable funds in favor of larger farmers as a means of minimizing risk and transactions costs. Bigger farms expected to have a higher productivity for large than for small machines would have greater access to low cost credit. On the other hand, small farms where small machines or draft animals will likely be more efficient, are usually confronted by higher cost of borrowing from informal sources. Thus, a low interest rate policy favors the use not only of machines over labor but also of large over small machines. This expected bias is borne out by the distribution of the four Central Bank-World Bank (CB-IBRD) Credit Mechanization Programs from 1966 to the present. These loans have financed a higher proportion of sales of tractors (30 percent) than of power tillers (7 percent) over the whole period (Table 4).

To include the effect of policy on fuel prices, the total implicit penalty (TIP) is estimated rather crudely by the weighted average of the

implicit penalty on the annual user fixed cost of capital and net implicit tariff on fuel prices. In equation form,

$$(6) \qquad TIP = w^{1} (IP) + w^{f} (NT^{f})$$

where w^{i} and w^{f} are the proportions of annual user fixed cost of capital and cost of fuels to total user cost of capital. It is assumed that annual cost of fuels is 14 percent and 18 percent of total user cost of capital for four-wheel tractors and power tillers, respectively. Net implicit tariffs are based on implicit tariff estimates of Medalla and Power of 32 percent and 61 percent for the 1960's and 1970's respectively.

In Table 5, the results of our calculations for the late 1960's and mid-1970's are presented. The choice of these two time periods is based on the availability of estimates of the degree of over-valuation of the domestic currency. The farm machineries are grouped into two based on the difference in the rates of tariffs.

Implicit tariffs have raised the price of machines by 19 percent in the 1960's. Implicit tariff on power tillers and water pumps increased to 43 percent in the 1970's due to both an increase in tariffs from 10 to 30 percent and compensating sales tax from 7 to 10 percent. The increase in tariffs was aimed at promoting their domestic production but

had the unintended effect of increasing their price relative to four-wheel tractors and mechanical threshers which are clearly more labor displacing.

If the effect of the over-valuation of domestic currency is considered, government policies appear to have reduced the price of machines by about 26 percent in the 1960s. In the 1970's, the net implicit tariff on the price of power tillers and water pumps was positive at about 19 percent. The price of large scale machines, on the other hand, was approximately equal to its social opportunity cost.

The overall impact of tariffs and taxes specific to farm machineries, of the over-valuation of the peso, and of the interest rate subsidy has been to reduce the annual capita cost by about 60 percent during the late 1960's. In the 1970's, this implicit subsidy on annual capital cost has persisted at a somewhat lower rate of 47 to 60 percent and the interest rate became a more powerful instrument for lowering users cost of capital than the general protection system. Even if we account for the higher fuel tax in the 1970's, the total implicit subsidy on the user's cost of operating farm machinery remains significant at 32 to 47 percent.

Concluding Remarks

Some have argued that mechanization has been encouraged by public expenditures for irrigation and introduction of short-maturing modern varieties because these have been frequently associated with adoption of

mechanical technology. It should be emphasized, however, that at least for land preparation in rice, there is no evidence of a higher productivity of tractors and power tillers with these technologies (Duff). Rice farmers do complain of the increasing lack of fallow land for draft animal grazing suggesting a higher cost of maintaining draft animals as double cropped area expanded. Perhaps more important, the higher income due to irrigation and modern varieties increased farmers' investible funds and/or desire to reduce drudgery of farm work and increase leisure over work time. Note, however, that mechanization of land preparation was made profitable mainly by factor price distortions and not by irrigation or modern varieties.[9] Any source of higher income would likely result in a similar pattern of resource use.

The capital intensive bias of general economic policies in the Philippines has been well-documented in relation to the manufacturing sector. This paper simply emphasizes the presence of a similar bias in the factor price structure in agriculture and also illustrates the importance of looking at the impact of broad economic policies on the economic environment in agriculture. Well-meaning agricultural production programs all too often fail because of the failure to consider the structure of economic incentives existing at the country-side.

There may be some types of mechanization that increases social profitability and these are likely to be the simple and smaller type of

machineries - water pumps and machines for deep placement of fertilizer are obvious. Even small threshers and power tillers may even be socially profitable if we consider the occurrence of labor shortages during peak seson, the cost of drudgery, and cost of management. However, the government should not artificially encourage its use, i.e., the government should not make the user cost machineries artificially cheap. The government should also remove the penalty imposed on domestic manufacturing of farm machineries by the over-valuation of the domestic currency - making imports artificially cheap and by the higher tariff on raw materials than on finished product. The government should encourage the development of new technology which will lower the unit social cost of agricultural products through research and extension. And clearly mechanical technology is one potential area. Furthermore the subsidy required for doing this should not be fully paid by farmers because the benefits of new technology in agriculture particularly for food production largely accrues to food consumers not farmers. When the relative price of machinery to labor reflect the true scarcity value of our resources, i.e., when we have correct price signals, farm machinery engineers and manufacturers will produce the appropriate type of mechanical technology.

REFERENCES

Barker, R. , Meyers, W.H., Crisostomo, C. and Duff, B. "Employment and Technological Change in Philippine Agriculture," International Labor Review 106 (1972)

Bautista, R. M. and Tecson, J. R. "Domestic Resource Costs in Philippine Manufacturing: 1969 and 1974," In Industrial Promotion Policies in the Philippines by Bautista, R. M. et. al, Philippine Institute for Developoment Studies. 1979.

Cordova, V. "Changes in Practices of Rice Farmers in Central Luzon; 1966-1979." Paper presented at the Crop Science Society of the Philippines, La Union, April 1981.

David, C. and Barker, R. "Agricultural Growth in the Philippines, 1948-1971," in Agricultural Growth in Japan, Taiwan, and the Philippines, eds. Hayami, Y., Ruttan, V. and Southunth, H., Honolulu: University of Hawaii Press, 1979.

David, C. and Barker, R. "Labor Demand in the Philippine Agriculture". Paper presented at the Technical Meeting on Labor Absorption in Asian Agriculture, Bogor, Indonesia, June 11-13, 1981.

Duff, B. "Output Employment and Mechanization in Philippine Agriculture." Paper presented for the International Symposium on Farm Mechanization in Asia, Tokyo, July 1978.

Duff, B. "Mechanization and Use of Modern Rice Varieties," in Economic Consequences of the New Rice Technology, Laguna: International Rice Research Institute, 1978.

Hayami, Y. and Ruttan, V. W. Agricultural Development: An International Perspective, Maryland: Johns Hopkins University Press, 1971.

Herdt, R.W. "Perspective, Issues and Evidence on Rice Farm Mechanization in Developing Asian Countries." Paper presented at the ADC/IRRI Workshop on the Consequences of Small Rice Farm Mechanization, September 1981.

International Labor Organization. Sharing in Development: A Programme of Employment, Equity, and Growth, Geneva, 1974.

Jayasuriya, S. K., Herdt, R.W. and Roxas, N. M. "The Economics of Machinery Use in Crop Intensification." Paper presented at the International Rice Research Conference, International Rice Research Institute, Laguna, April 19-23, 1982.

Juarez, F. and Duff, B. "The Economic and Institutional Impact of Mechanical Threshing in Iloilo and Laguna." Paper presented at the Workshop on Village Economy and Institutions, International Rice Research Institute, Laguna, August 1980.

Maranan, C. "A Comparatrive Analysis of Tractor Contract Operations in Nueva Ecija, Philippines, 1972 and 1980." Paper presented in the Consequences of Small Rice Farm Mechanization in Asia, International Rice Research Institute, Laguna, September 1981.

Medalla, E. M. and J. H. Power, "Estimating Implicit Tariff and Nominal Rates of Protection," in Industrial Promotion Policies in the Philippines, by Bautista, R. M. et. al. Manila: Philippine Institute for Development Studies, 1979.

Medalla, E. M. "Shadow Price of Labor" and "Estimating the Shadow Exchange Rate", in Industrial Promotion Policies in the Philippines, by Bautista, R. M., et. al. Manila: Philippine Institute for Development Studies, 1979.

Power, J., "The Structure of Protection in the Philippines" in Structure of Protection in Developing Countries, by Belassa, B. and Associates, Maryland: Johns Hopkins University Press, 1971.

FOOTNOTES

[1] Throughout this paper, tractor means four-wheel and crawler tractors while power tillers refer to walking tractors.

[2] Among other farm equipment is a locally produced Japanese type of rotary weeder introduced in the early 1960's. This has not gained wide acceptance because of it requires straight row planting requirement which is practiced only in a few areas (Barker, et. al.).

[3] Based on data of tractor sales for 1978 reported by the Agricultural Machinery Manufacturers and Dealers Association.

[4] The number of machines for the Philippines and for sugar have been taken directly from these surveys. Tractors for rice were derived from the difference between the total number of tractors and those for sugar. Most of the tractors found in Mindanao are probably being used in corn, pineapple, and banana plantations. All power tillers were assumed to be used in rice.

[5] This is based on the assumption that 90 percent and 40 percent of total number of water buffaloes and cattle, respectively, are draft animals. A water buffalo is assumed to be equal to 0.5 horsepower while cattle to 0.6 horsepower. Data on animal inventories are from the annual survey of livestock and poultry of the Bureau of Agricultural Economics.

[6] Timeliness apparently can be achieved only by ownership of machines or by higher tractor densities for custom renting in the area. Given the small farm size and the price structure in rice, ownership of machines is usually economically viable only with custom renting.

[7] Only cost of fuels is considered.

[8] While users of labor also benefit from this subsidy when borrowing for working capital, the opportunity cost of working capital usually represents a much smaller proportion of total labor cost.

[9] In the case of threshing as pointed out earlier, the complementarity double cropping and adoption of small mechanical threshers may be stronger.

Table 1. Inventories of farm machineries and equipment, agricultural censuses, 1948, 1960, and 1971.

	1948	1960	1971
1. Number of machines and equipment			
Tractors and power tillers[a]	1,577	5,127	15,476
Threshers and harvesting machines[b]	-	3,602	25,867
Motor vehicles	-	8,041	19,085
Stripping machines, crushers, shellers and shredders	1,674	6,173	19,395
Power producing machines	-	-	6,638
Plows	1,217,693	1,753,234	1,511,194
Harrows	918,161	1,214,501	1,069,201
Carts	164,227	418,406	292,233
Sprayers		35,507	89,509
Incubators		2,758	-
Other farm equipment			3,679,358
2. Tractors and power tillers per 1000 has of cultivated area			1.6
3. Percent of farms using tractors			4
4. Percent of farms using threshers			6

[a] The introduction of power tillers started only in 1960.

[b] The bulk of these are threshers.

SOURCE: Agriculture Censuses, 1948, 1960, and 1971, National Census and Statistics Office.

Table 2. Inventories of tractors and power tillers in the Philippines, by region and by crop, 1976.

	PHILIPPINES				SUGAR				RICE				
	Tractors[a]	Tiller Tillers	Total HP[a]	HP per Hectare[b]	Number of Tractors	Total HP	Crop area (000 has)	HP per Hectare	Number Tractors	Number Tillers	Total HP	Crop area (000 has)	HP per Hectare
Philippines	14,539	25,939	1,007,157	.25	5,862	322,410	573	.56	8,677	23,939	684,747	3,548	.20
Iloilo	508	977	35,756	.11	-	-	-	-	508	977	35,756	311	.11
Cagayan Valley	1,043	7,945	96,925	.22	563	30,965	78	.40	1,043	4,945	96,925	433	.22
Central Luzon	2,650	6,747	199,726	.41									
Southern Tagalog	850	2,910	80,030	.16	572	31,460	74	.43	605	6,150	82,475	790	.10
Bicol	327	3,240	43,905	.13									
Western Visayas	5,449	1,981	315,543	.40	4,604	253,220	399	.63	1,942	3,626	135,818	743	.18
Central Visayas	706	258	40,894	.27									
Eastern Visayas	391	1,387	32,601	.16									
Western Mindanao	151	345	11,065	.08	123	6,765	22	.31	2,492	3,494	165,012	855	.20
Northern Mindanao	247	872	33,046	.10									
Southern Mindanao	1,321	1,004	80,687	.31									
Central Mindanao	669	1,273	46,979										

[a] Each tractor is assumed to provide 55 horsepower and power tiller 8 horsepower.

[b] Total Horsepower is divided by the total crop area in rice and sugarcane.

SOURCES: Philippines - Unpublished data from the Bureau of Agricultural Economics.
Sugar - Adopted from the Central Bank-World Bank Credit Mechanized-Program Evaluation Report conducted by the Sycip, Gorres, Velayo & Co., Makati, Rizal. Original source of data is the Philippine Sugar Commission.

Table 3. Trends in rate of mechanization, labor use, and farm wages in Central Luzon and Laguna, 1966-1982 wet seasons.

	CENTRAL LUZON					LAGUNA				
	1966	1970	1974	1979	1982	1965	1970	1974	1978	1981
Percent of farms using or power tillers	0	6	17	45	56	37	78	88	99	98
Percent of farms 4-wheel tractor	20	40	38	26	23	0	0	0	0	0
Percent of farms using large threshers	77	68	48	28	16	0	0	0	0	0
Percent of farms using portable threshers	0	0	7	21	76	0	0	0	67	82
Total labor (man days/ha.)	66	65	85	83	86	92	89	102	102	101
Land preparation	16	10	10	10	10	20	12	9	10	10
Care of crop	29	34	46	47	47	38	41	59	58	55
Harvesting and post harvest	21	21	29	26	29	34	36	33.3	34	36
Index of nominal wage[1]	100	131	236	393	553	100	153	254	319	481
Index of real wage[2]	100	105	90	94	94	100	117	87	84	83
Number of farms	92	62	58	149	136	156	152	67	96	100

[1] Refers to transplanting wage.

[2] Deflated by consumer price index outside Manila (1965-1981) and consumer price index, Philippines (1982).

Source: Department of Agricultural Economics, International Rice Research Institute.

Table 4. Trends in total sales and percent of sales with CB-IBRD financing of tractors and power tillers, 1960-1977[a]

	TRACTORS		POWER TILLER	
	Number sold	% with CB-IBRD financing	Number sold	% with CB-IBRD financing
1960	588	-	-	-
1961	813	-	-	-
1962	994	-	-	-
1963	863	-	-	-
1964	950	-	-	-
1965	607	-	1,505[b]	-
1966	664	11	1,932	7
1967	1,531	37	3,058	24
1968	1,630	16	1,873	12
1969	1,358	4	910	4
1970	978	15	475	9
1971	1,086	23	680	16
1972	1,216	39	1,908	23
1983	1,517	35	3,120	10
1974	1,666	38	6,721	6
1975	2,176	64	11,077	7
1976	1,074	4	9,352	5
1977	1,318	9	8,865	1
1978	1,266	47	9,313	6
1979	1,241	na	5,379	na

[a] The importance of the public sector in extending credit is greater than these figures indicated, especially during the outbreak of the hoof and mouth disease among draft animals around 1975 when other government agencies such as the Land Bank, Development Bank of the Philippines, and the Philippine National Bank financed significant purchases of power tillers.

[b] Estimated cumulative total of power tillers sold between 1960 and 1965.

SOURCE: Unpublished data from the Agricultural Machinery Dealers Association.

Table 5. Impact of government policies on users cost of farm machineries (percent).

	Late 1960's	Mid-1970's
Power tillers and water pumps		
Effect on price of machines		
Implicit tariff (T)	19	43
Net implicit tariff (NT)	-26	19
Effect on user cost of capital (IP)	-59	-47
Effect on total user cost of capital, i.e. including cost of fuels (TIP)	-52	-32
Four-wheel tractors, threshers and others		
Effect on price of machines		
Implicit tariff (T)	19	21
Net implicit tariff (NT)	-26	1
Effect on user cost of capital (IP)	-62	-60
Effect on total user cost of capital, i.e., including cost of fuels (TIP)	-56	-47

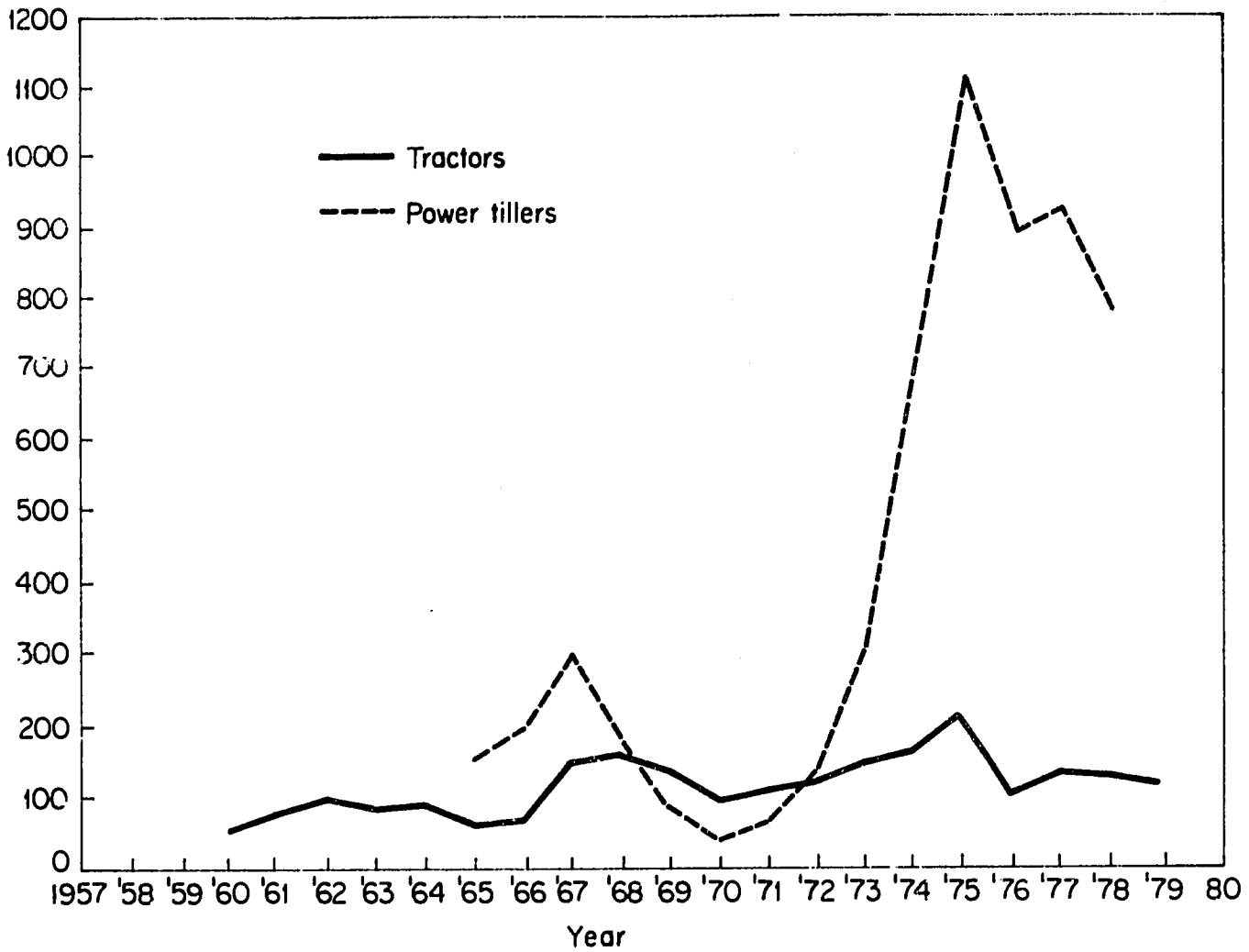

Fig. 1. Trends in sales of power tillers and tractors in the Philippines, 1960-1979.

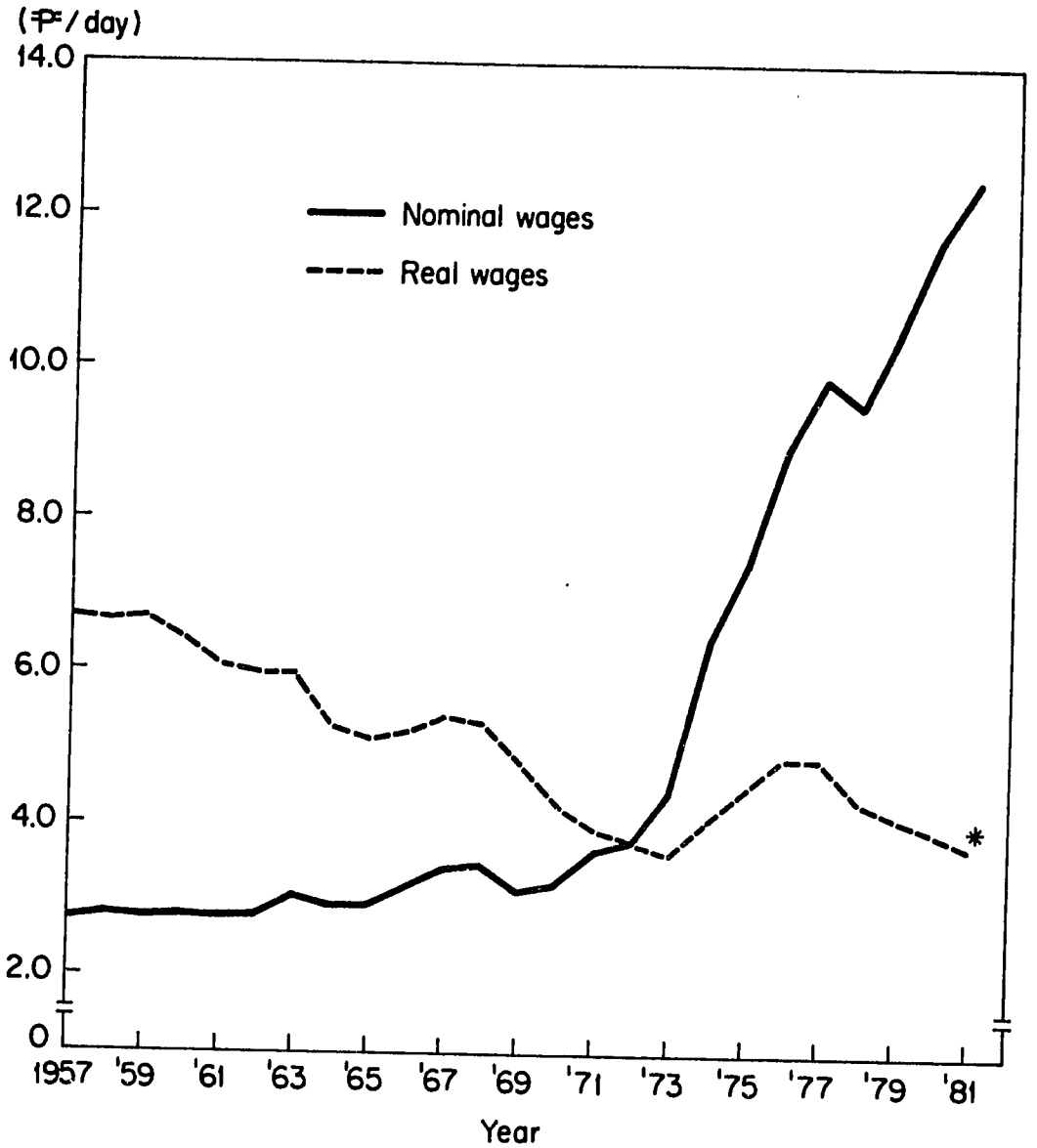

Fig. 2. Trends in nominal and real wages in Philippine Agriculture, 1957-1981.

* Deflated by consumer price index outside Manila, 1972 = 100.
Source of data: Bureau of Agricultural Economics and NCSO.
CPI = 1972 = 100