PN-AAN-548
ISN 31717

THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Paper No. 49

EVALUATING THE SECTORAL IMPACT OF MECHANIZATION ON EMPLOYMENT AND RICE PRODUCTION IN THE PHILIPPINES: A SIMULATION ANALYSIS

By

L. A. Gonzales and R. W. Herdt
The International Rice Research Institute

J. P. Webster
London University

1981

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.

ABSTRACT

The paper reviewed three existing Philippine mechanization policy instruments, namely, credit subsidy, tax/tariff and fuel subsidy and analyzed their impact on the sales of five types of machines. These policy instruments are presently incorporated in a policy analysis model being developed at IRRI to evaluate their impact on production, employment and income distribution in the rice sector.

INTRODUCTION

Currently the Philippines is in the process of evolving a farm mechanization policy that will spell out guidelines and strategies towards mechanization in the country.[1] In the past, farm mechanization policies took the form of general statements embodied in the development plans.[2]

Even before the formulation of the development plans, however, projects and programs related to farm mechanization already existed in the country. The major problem was that these projects and programs under different agencies were uncoordinated and were not formulated under any overall strategy. This was because there was no central government body directly responsible for agricultural mechanization development.

Because of its socio-economic aspects, farm mechanization is a sensitive issue. The Ministry of Agriculture nevertheless passively encourages mechanization even though research on mechanization is one of the areas which has received little attention in the country. It is not surprising therefore that policy-makers cannot make forward looking decisions on mechanization development -- the needed research to back-up such decisions does not exist. Furthermore, different types of machines have different impacts on the socio-economic well being of people who are located in divergent regions. It takes time to evolve a mechanization policy that takes into account these differences within the framework of national objectives.

This paper is intended to contribute to the policy discussion on mechanization through description of work in progress upon the analysis of the impacts of various policies on employment and production. Three mechanization policy instruments are evaluated for five types of machines: power tillers, four-wheel tractors, manual rice transplanters, irrigation pumps (4" Ø), and portable rice threshers.

The three mechanization policy instruments are:

- interest rates subsidies;
- taxes and tariffs on imported machineries; and
- subsidy on fuel used in farming.

To assess the impact of these policy instruments on production, employment, prices and income distribution in the rice sector, they are combined into 7 policy alternatives and analyzed within the context of a quantified model of the rice sector. A model incorporating other policy instruments affecting irrigation, fertilizer, and population, is used in evaluating the overall impact of the mechanization policies on the rice sector.

IMPACT OF EXISTING MECHANIZATION POLICY INSTRUMENTS ON SALES

The CB:IBRD farm mechanization study (SGV, 1980) classified programs, policies and institutions of farm mechanization into at least four categories relating to: farm machinery supply, farm machinery prices, farmer financing and indirect programs that affect farm mechanziation in one way or the other. Two specific government mechanization policy instruments, namely, the credit subsidy program and the taxes and tariffs on imported machinery directly influence machinery sales. A third, the high specific tax on fuel indirectly affects sales.

A. Subsidized Credit Policy

Since 1966 the Philippines has had a rural credit program for financing farmer purchase of tractors and power tillers known as the CB:IBRD credit project. This was the main source of institutional credit for farm machinery. As of June 1980, the program was in its fourth phase and the Fourth Rural Credit Project had granted total loans amounting to ₱492.2 million to 11,154 borrowers (SGV, 1980).

There seems to be agreement that the CB:IBRD lending program was a major factor affecting the sales of power tillers and tractors (Duff, 1978, Sanvictores 1977, SGV 1980). This is reflected in the graph of sales of power tillers and tractors and number of loans granted over a 14-year period (1966-1979) in Figure 1. Industry sales of tractors and tillers during the 14-year period were growing at an annual average rate of less than 1% and 17%, respectively. We can divide the 14-year period covered by the credit program into 4-sub periods: the initial phase - 1966-1968; the peso devaluation phase - 1969-1971; the recovery phase - 1972-1975, and the high fuel cost phase - 1975-1979.

If we look at trends using these four sub-periods as reference points we can understand better the growth rate of sales. During the period 1966-1968, the beginning of the rural credit program for machineries, sales of tractors and power tillers were averaging 1,100 and 2,200 units per annum, respectively. It was during this period that power tillers sales overtook tractor sales in absolute number because of the introduction of high yielding varieties in rice farming. Before the mid-sixties however tractor sales averaging 800 units a year dominated industry sales because of the export boom in the sugar sector.

The peso devaluation sub-period (1969-1971) adversely affected the sales of tillers and tractors. During the sub-period the exchange rate of the peso relative to the dollar floated to seek its own equilibrium level. During this phase, although sales were positive (annual

average of 1,100 and 700 units of tractors and tillers, respectively), the growth rates of sales for tractors and tillers declined at an annual average of 11% and 15% respectively. Very few loans were made during this period.

During the recovery phase (1971-1975), tractors and power tillers hit their peak sales. Annual sales were 1,644 units for tractors and 5,581 units for tillers. The yearly upward growth rate of sales was 16% for tractors and 70% for tillers. Several factors could account for the upsurge of machine sales during this sub-period. One was the land reform program which parceled out rice landed estates into small units. This resulted in large income gains to former share tenants and increased the demand for power tillers. Another was the incidence of hoof and mouth disease that afflicted thousand of work animals in 1975. This led to the creation of a special financing program for tillers and tractors under the Land Bank of the Philippines and the Development Bank of the Philippines (SGV, 1980). The introduction of IRRI designed power tillers and the availability of financing support for locally built farm equipment also affected the increase of machine sales during this phase. Finally the promulgation of the General Order 47 in 1974 also created an additional market for large machinery like tractors and threshers.

The high fuel cost phase (1975-1979) exhibits annual declines of 15% and 16% in the sales of tractors and tillers respectively. Although annual sales averaged 1,061 tractors and 8,708 tillers, the high cost of fuel (to be discussed later) seems to explain the downward trend in the sales of machinery.

The CB:IBRD credit program assumed that at a 75% recovery rate the cost of capital for short term and medium term loan is 24% per annum (CB, 1976). Of this only 12 percent is charged to farmers implying a net subsidy cost to the economy of 12% per annum per loan made. The subsidy cost per machine is calculated by multiplying the percent subsidy (12%) with the retail price of the machine.

B. Tax/Tariff Policy

The current government tax/tariff policy affects machine availability in two ways: one is through the local manufacturing subsectors and the second through direct import of either completely knocked down (CKD) or completely built up (CBU) machines. The purpose of the tax/tariff policy is to raise government revenues and to protect the industry by discouraging imports.

The Agricultural Machinery Manufacturers and Distributors Association (AMMDA) feels that government policies on imports often discriminate against locally manufactured products in favor of imports (ESCAP 1980). For example, import duties of agricultural implements are 10% whiel steel to manufacture these implements is subject to a 50% import duty.

Under the present Tariff and Customs Code of the Philippines (Pinpin, 1977), agricultural machinery is subjected to ad valorem (CIF) duty rates of 10 to 30% depending on the type of machine. In addition, an advance sales tax of 10% is also enforced. The total effective tax rates are 16% and 12% of the retail prices of tillers and tractors, respectively.

An interesting policy issue which applies most to power tillers, is an the possible impact on machine sales of the removal of the import tax on materials and parts for local manufacturing. Data on the operations of firms engaged in local manufacturing are mostly confidential and hence, it is difficult to quantify the growth rate of power tillers in relation to this policy.

A closer look at the sales of imported power tillers show that imported tillers declined from a share of 76% in 1972 to 30% of total sales in 1978 (Monge, 1979). On the other hand local power tillers' sale exhibited the opposite direction -- a larger share of total sale over the period (Table 1). We believe that the imposition of an effective tax rate of 16% on power tillers sometime in 1972 was the primary factor for the decline in the importation of power tillers.

C. Fuel Tax/Price

The price of fuel indirectly determines the demand for power tillers, four wheel tractors and other farm machines. The government's specific tax on oil determines the price of fuel. Such specific tax comprises more than 50% of the retail price of fuel. Although no specific study estimated the structural relationship between machine sales and price of fuel,[3] a look at price trends of fuel and sales of power tillers and tractors shows that during the 1975 to 1979 period sales of machines declined at approximately 15% per annum while fuel prices increased by 28% yearly (Fig. 2).

Since the price of fuel forms part of the economic environment by which machines become economically viable, we hypothesize that a policy instrument that removed the tax on fuel and fully subsidizing fuel cost used for farming would increase economic incentive to use machines to the level prevailing on the 1972 to 1974 period.

MECHANIZATION POLICY ALTERNATIVES

The three mechanization policy instruments can be combined into several policy alternatives to evaluate their impact on machine sales. We propose to limit the policy alternatives into 7 possible combinations. The seven combinations are:

- o Alternative I : Maintain the current credit subsidy of 12% and the current tax and tariff policies.
- o Alternative II : Increase the credit subsidy to 18% but maintain the current level of taxes and tariffs.
- o Alternative III : Increase the credit subsidy to 18% and remove all taxes and tariffs.
- o Alternative IV : Maintain the current subsidy of 12% and remove all taxes and tariffs.
- o Alternative V : Remove the credit subsidy but maintain current taxes and tariffs.
- o Alternative VI : Remove the credit subsidy and double the current taxes and tariffs.
- o Alternative VII : Increase the credit subsidy to 18% and fully subsidize fuel cost of farm operation.

Each alternative has a given policy cost per machine and different impact on the growth rate of machine sales and utilization in rice production. Likewise each type of machine has its own impact on output of the rice sector, employment and income distribution there.

We hypothesize that there exists a structural relationship between the fiscal cost to government[4] of a given policy alternative and the growth rate of machine sales and utilization. The magnitude of the relationship may vary from one type of machine to another and requires much further research to specify. To illustrate the point, in Figure 3 we have plotted the hypothesized behavior of the growth rate of power tiller sales (vertical axis) and net subsidy cost per machine sold for each alternative (horizontal axis).

For example, the 1971-75 trends show that with a credit subsidy policy of 12% and total taxes plus tariff of 30%[5] on tillers, the annual growth rate of power tillers sales was 20%. This growth rate suggests a negative net subsidy cost of ₱600 (₱1,800 credit subsidy-₱2,400 tariff) per machine sold.

If the tax and tariff are eliminated and the credit subsidy is increased we hypothesize a higher than 20% annual growth rate of sales. Conversely if the taxes and tariff are maintained and the government removes the credit subsidy, we expect that the growth rate of sales will be lower than 20%. Thus, the higher the net subsidy the higher the growth rate of machine sales but also higher fiscal cost to government.

The 20% growth rate in tiller sales was observed during a period when the price of fuel was relatively stable. The situation has changed. Since 1975 fuel prices increased to more than four hundred percent of their mid-60's levels. The growth rate of power tillers sales from 1975 to 1979 with the existing tax, and credit subsidy policies was a negative 16 percent (B in Figure 3) -- some 35 percentage points lower than the growth rate of 20% at the old fuel price (A). In order to get back to the 20% sales growth rate of tillers at the new fuel price (C), perhaps a fuel subsidy large enough to cultivate 10 hectares of rice per year could be given to tiller operators. This subsidy would cost approximately ₱3,225 per machine at the rate of 3 liters of gasoline/hour and at the current price of ₱4.30 per liter of regular fuel. With this assumption, one can join points B and C Figure 3 to form the hypothetical relationship between growth rate of sales and subsidy per machine (Figure 3). Fuel requirements of other machines are shown in Table 2.

DIRECT IMPACT OF MACHINES ON LABOR AND PRODUCTION

Different machines have different impacts on labor utilization and production in the rice sector. The five machines incorporated in this analysis represent a cross section of mechanization activities in rice production. For example tillers and tractors are competitors with the traditional man and animal activities of land preparation. The transplanter and the thresher are displaced hired labor used for transplanting and threshing, while irrigation pumps increase rice yields and may permit intensified cropping.

We have assembled data from several studies to show the impact of the 5 study machines on labor displacement and yield. Table 3 shows the average effect of the five machines on labor requirements of rice production. Tillers and tractors displace approximately 25 and 28 mandays family labor per hectare respectively, each season. On the other hand portable rice threshers and transplanter displace hired labor by approximately 26 and 6 mandays per hectare, respectively while irrigation pumps have no known direct impact on labor.

Yield effects of the machines are shown in Table 4. We have not found empirical evidence showing that tillers and tractors increase yield. According to the Regional Network for Agricultural Machineries (RNAM) the manual transplanter decreases yield by as much as 254 kilograms per hectare. Moya (1981) shows that irrigation pumps can increase yield from 1.5 to 3.4 tons per hectare compared to rainfed rice. Finally, portable thresher can increase the yield relatively by the farmer by approximately 292 kilograms per hectare.[6] This incremental yield is due to the change in threshing technique from the hampas method to machine threshing.

These direct impacts on labor and yield of the five types of machines will be incorporated into the rice policy analysis model in order to estimate the overall sectoral impact on production, employment and income. A discussion of the rice policy model is presented in the following section.

THE POLICY ANALYSIS MODEL

A prototype policy analysis model developed under the aegis of the Rice Policies in Southeast Asia Project will be used in evaluating the impact of the mechanization policies. Since the features of the prototype model have been discussed in Herdt et al (1980), only the main features of the model will be presented in this paper.

The prototype is basically a quantitative accounting model that traces overtime the impact of alternative sets of policies on rice production, input utilization, labor demand, rice income and its distribution, and government costs. The model can provide information on the level and timing of investment needed to maintain a desired rate of growth in rice production and to evaluate the relative efficiencies of a series of combinations of fertilizer, irrigation, machine availability, pricing, trade and stocks policies.

Figure 4 presents a schematic diagram of the prototype model. Rice production resources are controlled by three economic classes: large farmers (LF), small farmers (SF), and landless laborers (LL). Rice OUTPUT is determined by the amount of feritlizer, the area of land of each quality and the environment. The ownership or control over the factors of production (land, labor, machinery and fertilizer) by each of the groups, the rate of payment to each factor and rice price determine the RICE INCOME, which makes up a large part of the income of each group. The income and population of each group determine the demand for rice. Demand, the OUTPUT available from the previous period, and the government decisions reflected in the buffer stock, imports and exports, jointly determine the market price (STPRICE) for rice.

The mechanization policy chosen determines the growth rate of machine use and the net subsidy cost per unit of machine. The model traces the impact on rice production, the effect on family and hired labor requirements for small and large farmers. The simulation model does this by incorporating data on total machinery costs, capacity and running cost of each machine, and capital requirements for the acquisition of the machines.

In addition to the mechanization policy instruments the prototype model includes fertilizer prices, irrigation investment and population control as policy instruments. Rice price control is achieved through trade and will be incorporated later in a trade and buffer stock sub-component.

The cost of fertilizer price control depends upon the difference between world price of fertilizer and the domestic price. The model permits the user to specify the price of fertilizer (urea) to be charged to farmers. It then calculates the subsidy (if any) per bag and the total subsidy for all fertilizer used.

Investment in irrigation by government is one primary factor that operates to change the proportion of land in each category. Total land availability is assumed to be fixed and planted entirely to rice during the wet season. Irrigation investments upgrade land from rainfed to different qualities of irrigated land. Two categories of irrigation investment are included: new irrigation and rehabilitation. Newly irrigated land is of varying qualities, just as existing irrigated land is of varying qualities. Rehabilitation investment on the other hand is assumed to have the impact of upgrading dry season irrigated land. Investment in 4" Ø irrigation pumps increases the amount of irrigated land in a similar way as government irrigation investment.

Change in the rate of population growth is modeled by specifying a target rate of population growth at some future target date. The greater the difference between the current and target rate of growth, the greater is the cost of the population program.

The policy instruments are manipulated by the policy maker within the context of the rice policy objectives to achieve a balance in the rice sector. These objectives are:

1. Providing <u>adequate production incentives</u> so that increases in rice production keep pace with increases in the demand for rice.

2. Insuring <u>adequate farm income</u> by keeping an appropriate balance between rice prices, input prices, and production technology.

3. Preserving a fair consumer rice price so that real incomes in the non-agricultural sector are not reduced by unduly rising prices.

4. Achieving the above three goals at a reasonable financial cost to the government budget.

The four objectives are clear but none except perhaps the rice price objective can be directly achieved through development actions because of the many factors affecting the broad objectives. Government has a number of policy instruments (Table 5) which it can use to influence the actions, markets and inputs which constitute the rice sector. The instruments available to any particular government at any one point in time depend on the socio-political forces operating in the country. Direct government purchases and sales of rice and inputs are commonly used, as are subsidies, credit, educational programs and many others. The table identifies those policy instruments which directly affect particular target variables in the prototype model.

RESEARCH NEEDS

The approach to mechanization policy analysis outlined above assumes that the policy maker seeks to optimize the outcome of policy actions by setting the policy instruments at levels chosen to achieve the desired outcome at a reasonable cost with actions that are acceptable by his main client groups. The rice policy model is being built to permit quantification of those costs and outcomes.

In order to follow through on the mechanization policy analysis for the Philippines, there are at least four basic research needs which should be given special attention. These are:

1. We need to know the impact of each machine on yield, cropping intensity and direct labor used. Hopefully the Consequences of Mechanization Project will provide estimates of these parameters.

2. We also need to quantify the fiscal cost of policy instruments used by the government. Current as well as proposed policy instruments affecting farm mechanization have their corresponding costs which are vital to policy decision making.

3. The structural relationship between policy instruments and machine sales should likewise be estimated. What is the real impact on machine sales of the different policy instruments adopted by the government?

4. Last but not the least, we also need to compare the government expenditures (fiscal cost) for mechanization policy instruments, with the perceived subsidies for fertilizers, irrigation and the likes. This information can provide policy makers a stronger base for decisions that strike a balance among policy alternatives to attain the different rice policy objectives.

FOOTNOTES

[1] The first attempt towards this direction was the First Philippine Agricultural Mechanization Policy Workshop held at the Ministry of Agriculture last December 11-12, 1980.

[2] See for example the Five Year Development Plan, 1978-1982, where farm mechanization was included as a sub-component to food production.

[3] Studies however on demand for tillers and four-wheel tractors were done by Monge (1979) and Almario (1979) but did not directly look into this relationship.

[4] Computed as net difference between taxes and subsidies.

[5] The effective tax rate however including 10% advance sales tax is 16% of the retail price.

[6] However, note that the 292 kg would, on the absence of the mechanized thresher, have been recovered by gleaners. It is therefore not a loss to the whole society, but only to the farmer.

REFERENCES

AHAMMED, C. 1981. An Intersectoral Analysis of the Macroeconomic Effects of Rice Farn Mechanization in the Philippines. Paper presented at the Mechanization Workshop, International Rice Research Institute, Los Baños, Laguna, September 14-18, 1981.

ALMARIO, E. 1979. A Historical Approach to Agricultural Mechanization in the Philippines. A paper presented at the Workshop on the Consequences of Small Rice Farm Mechanization, October 1-14, 1979, IRRI, Los Baños, Laguna.

BERNAS, L. 1975. Profiles of the Agricultural Machinery Manufacturing Industry. - Production and Marketing Strategies: Large Firms. A paper presented at the Workshop on Agricultural Mechanization and Indigenous Production of Agricultural Machines in the LDC, May 6-9, 1975, International Rice Research Institute, Los Baños, Laguna, Philippines.

BINSWANGER, H. 1978. The Economics of Tractors in South Asia: An Analytical Review. Agricultural Development Council, New York and International Crops Research Institute for the Semi-arid Tropics, Hyderabad, India, 1978.

BINSWANGER, H. P., R. D. GHODAKE and G. E. THIERSTEIN. 1979. Observation on the Economics of Tractors, Bullocks and Wheeled Tool Carriers in the Semi-arid Tropics of India. Paper presented during the Workshop on Socioeconomic Constraints to Development of Semi-arid Tropical Agriculture, ICRISAT, February 19-23, 1979.

CENTRAL BANK OF THE PHILIPPINES. 1976. Philippine Fourth Rural Credit Proposal. A proposal for a loan from the International Bank for Rural Development (IBRD) to finance the medium and long term credit requirements of rural enterprises in the Philippines, March, 1976.

DUFF, B. 1978. Output, Employement and Mechanization in Philippine Agriculture. A report presented at an International Symposium on Farm Mechanization in Asia, Institute of Developing Economics, July 3, 1978, Tokyo, Japan.

HERDT, R.W. and L.A. GONZALES. 1980. The Impact of Rapidly Changing Prices on Rice Policy Objectives and Instruments in the Philippines. A paper presented at the National Rice Strategy Seminar, September 22-24, 1980, Los Baños, Laguna.

HERDT, R. W., J. P. WEBSTER., and L.A. GONZALES. 1980. Toward a Framework for Agricultural Development Policy in Rice Producing Countries. Paper presented at the Workshop on Rice Policy and Food Security in the ASEAN, November 9-15, 1980, Singapore.

JUAREZ, F. and B. DUFF. 1977. Changing Supply and Demand Patterns for Power Tillers in the Philippines. A paper presented at the Annual Convention of the Philippine Society of Agricultural Engineers, April 28-29, 1977, Manila, Philippines.

JUAREZ, F. and B. DUFF. 1980. 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, Los Banos, Laguna, August 25-27, 1981.

MARANAN, C., J.A. WICKS and B. DUFF. 1981. The Profitability of Two and Four Wheel Tractor Ownership in Nueva Ecija, Philippines, 1980. Paper presented at the IRRI Saturday Seminar, IRRI, Los Baños, Laguna, May 16, 1981.

MINISTRY OF AGRICULTURE, PCARR and UPLB. 1980. Workshop Paper Series. Papers at the First Philippine Agricultural Mechanization Policy Workshop, Ministry of Agriculture, Diliman, Quezon City, December 11-12, 1980.

MOYA, P. 1981. Benefit Cost Analysis of the Different Types of Irrigation Systems in Central Luzon, Philippines. A paper prepared for the A/D/C Workshop on Investment Decisions to Further Develop and Make Use of Southeast Asia's Irrigation Resources, August 16-21, 1981, Bangkok, Thailand.

PINPIN, F. D. 1978. The Tariff and Customs Code of the Philippines, Revised and Codified, As Amended by P.D. No. 34, Other Executive Orders as of Year End 1977. Fifth Edition, 1978.

REGIONAL NETWORK FOR AGRICULTURAL MACHINERY. 1979. Rice Transplanter, RNAM - Digest No. 1, Los Baños, Laguna, Philippines.

SANVICTORES, H. 1977. Status of Agricultural Mechanization in the Philippines. A paper presented at the International Agricultural Machinery Workshop, November 2-5, 1977, International Rice Research Institute, Los Baños, Laguna, Philippines.

SYCIP, GORRES and VELAYO. 1980. CB:IBRD Mechanization Study Final Report Draft, Volume I. Central Bank of the Philippines, Manila, Philippines.

Table 1. Sales of power tillers by source (1972-1978).

Year	Total No. of Units Sold	Percent by Source	
		Local	Imported
1972	1,409	24	76
1973	3,120	66	34
1974	6,721	35 a/	65
1975	11,077	47 a/	53
1976	9,352	61	39
1977	8,865	70	30
1978	9,313	70	30

a/ There were low percentage sales for local and gasoline type tiller in 1974 and 1975 because of the high number of imported Kubota sales (around 5,000 units) to the Department of Agrarian Reform as part of cash programs during these periods. Without these Kubota sales, however, local tillers accounted for 63% in 1974 and 58% in 1975 while gasoline tillers accounted for 86% in 1974 and 77% in 1975.

Source: Firms sales reports submitted to AMMDA and NFAC, 1975, and IRRI interview of firms, 1976 to 1978.

(From Monge, 1979)

Table 2. Fuel use by machine per hectare/season.

	Amount of fuel used (liter/ha)	Price/liter (₱)	Fuel cost (₱)
Power tiller	75[a/]	4.3	322.50
Tractor	60[b/]	4.3	252.00
Manual transplanter	none	none	none
Irrigation pumps	340[c/]	2.40	816
Portable thresher	12[d/]	4.3	51.60

[a/] Tillers takes 25 hours per hectare of land preparation consuming 3 liters of gasoline/hour.

[b/] Tractor takes 4 hours per hectare of land preparation using 15 liters of fuel per hour

[c/] Pump with a diesel engine operating about 200 hours per hectare consuming 1.7 liters of diesel fuel/hour.

[d/] Average of 8 hours per hectare using 1.5 liters of gasoline per hour.

From: (Herdt, Gonzales, 1980 and IRRI Ag. Engineering Dept.)

Table 3. Different types of machines by effects on labor requirements.

	Wet		Dry	
	Family	Hired	Family	Hired
1. Hand tractor[a/]	-25.00	-3.00	-25.00	-3.00
2. Four whell tractor[a/]	-28.00	-3.00	-28.00	-3.00
3. Manual transplanter[b/]	0	-6.00	0	-6.00
4. Irrigation pump	0	0	0	0
5. Portable thresehr[c/]	-15.00	-26.00	-15.00	-26.00

[a/] Herdt and Gonzales, 1980.

[b/] Rice Transplanter, RNAM, Digest April 1, 1979.

[c/] Kikuchi, Village Level Study, 1980.

Table 4. Different types of machines by effects on yield.

	Wet	Dry
	(kg/ha)	
1. Hand tractor	0	0
2. Four wheel tractor	0	0
3. Manual transplanter[a/]	- 254	- 254
4. Irrigation pump (4" Ø)[b/]	+ 1,520	+ 3,380
5. Portable thresher[c/]	+ 292.0	+ 292.0

[a/] Rice Transplanter, RNAM, Digest April 7, 1979.

[b/] Pie Moya, 1981.

[c/] Equivalent to 7.3% of gross yield of 4,000 kg/ha, represented as incremental harvest recovery gain of farmers due to shift from hampas to machine threshing. (IRRI Ag. Engineering Semi Annual Report Nos. 21-28.)

Table 5. Target variables and policy instruments in the prototype rice policy model.

Instruments	Target variables						
	Rice price	Rice consumption	Rice production	Farm income	Farm employment	Income distribution	Government budget cost
Government rice purchase	x			x			x
Government rice sales	x	x		x		x	x
Imports and exports							x
Fertilizer price			x	x			x
Fertilizer distribution			x	x			x
Credit program			x	x			x
Population program		x					x
Irrigation investment			x	x	x		x
Interest rate subsidies			x	x			x
Tax/tariff on machineries							x
Fuel subsidy			x	x	x		
Non-agricultural policies		x				x	x
Wage policies						x	x

Fuel Use By Machine Per Hectare/Season.

	Amount of fuel used (liter/ha)	Price/liter (₱)	Fuel Cost (₱)
Power tiller	75	4.3	322.50
Tractor	60	4.3	252.00
Manual transplanter	none	none	none
Irrigation pumps	340	2.40	816
Portable thresher	12	4.3	51.60

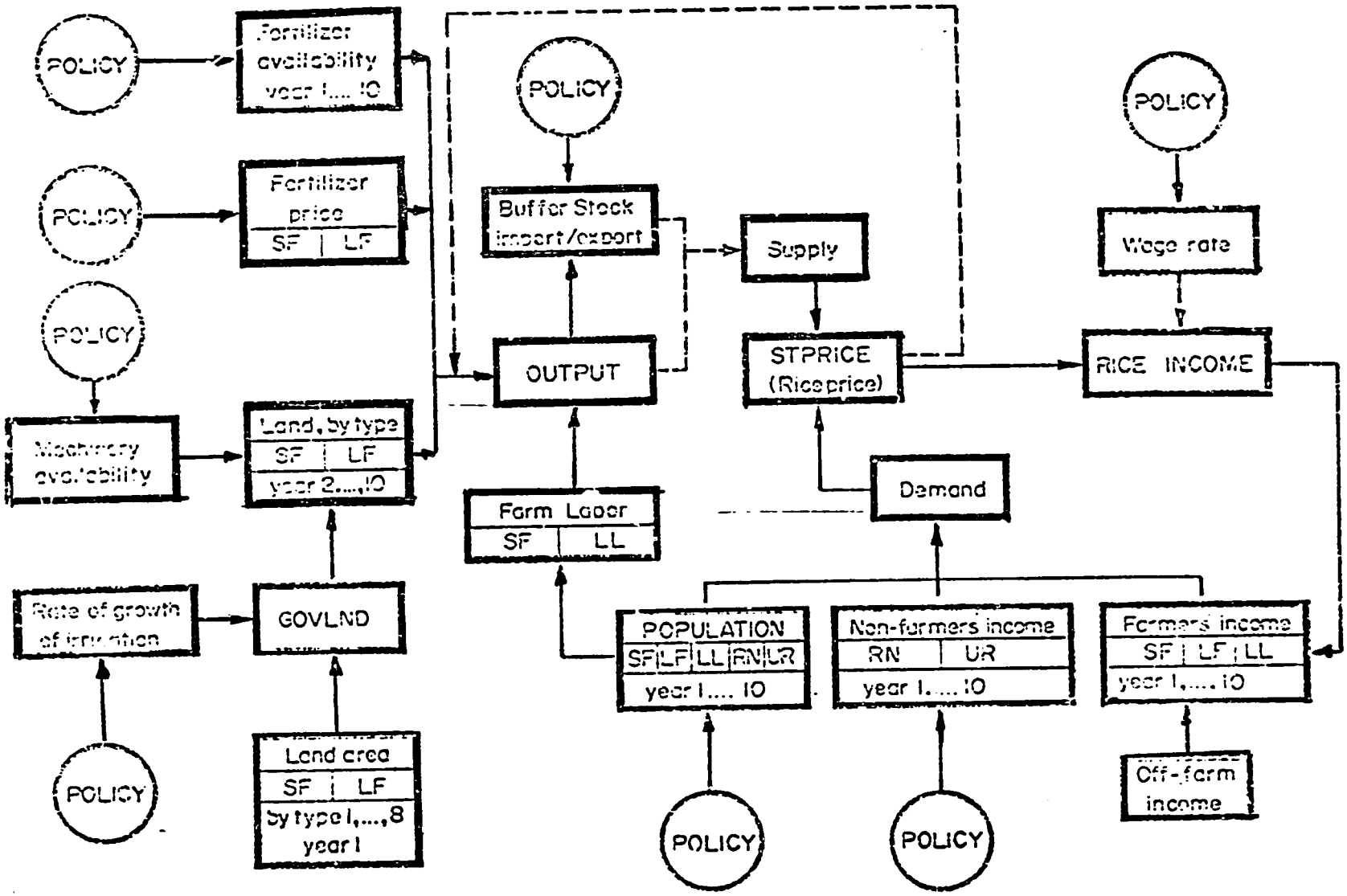


Figure 4. Rice Policy Model

Table A.1 - Sample model results.

I.R.R.I. Rice Policy Model
****

Policy summary:

-Population: present growth rate = 2.50%; growth rate in 10 years = 2.10%;
government cost = 0.11 million pesos per annum
-Fertilizer: starting supplies = 50.00 thou. tonnes; growth rate = 8.00% pa;
government subsidy per tonne of urea = 100.00 pesos
-Land: depreciation rate = 5.00% pa;
rehabilitation rate = 12000 ha pa, costing 2000 pesos per ha.
new irrigated land = 8000 ha pa, costing 8000 pesos per ha.
-Mechanisation policies:
Power tiller
numbers in use = 33,500 projected rate of increase = 20 %, subsidy per machine = -600 pesos.
Four Wheel Tractor
numbers in use = 10,600 projected rate of increase = 5 %, subsidy per machine = 0 pesos.
Manual Transplanter
numbers in use = 60 projected rate of increase = 1 %, subsidy per machine = 239 pesos.
Irrigation Pump 4-pi
numbers in use = 13,000 projected rate of increase = 1 %, subsidy per machine = 0 pesos.
Portable Thresher
numbers in use = 200 projected rate of increase = 10 %, subsidy per machine = 840 pesos.

Results summary:

Yr	Popln m.	Fert '000t	Used '000t	Yield m t	Price p/kg	- Per capita incomes - L/L	S.f.	L.f.	Urb	Rn-f	LabUsed m.manyrs	GovtCost m.pesos
0	-	-	-	-	1.10	250	350	500	1000	500		-
1	42.92	50.00	50.00	6.10	1.17	238	301	362	1007	533		
2	43.97	54.00	54.00	6.11	1.29	261	328	397	1007	536		
3	45.04	58.32	58.32	6.12	1.50	302	378	462	1008	541		
4	46.11	62.99	62.99	6.14	1.78	356	442	546	1008	549		
5	47.19	68.02	68.02	6.16	2.11	422	521	650	1010	557		
6	48.27	73.47	73.47	6.18	2.52	502	615	775	1011	568		
7	49.37	79.34	79.34	6.20	2.99	595	723	923	1012	580		
8	50.46	85.69	85.69	6.22	3.55	706	852	1100	1014	595		
9	51.56	92.55	92.55	6.24	4.16	828	993	1297	1015	611		
10	52.66	99.95	99.95	6.27	4.88	972	1157	1530	1017	629		

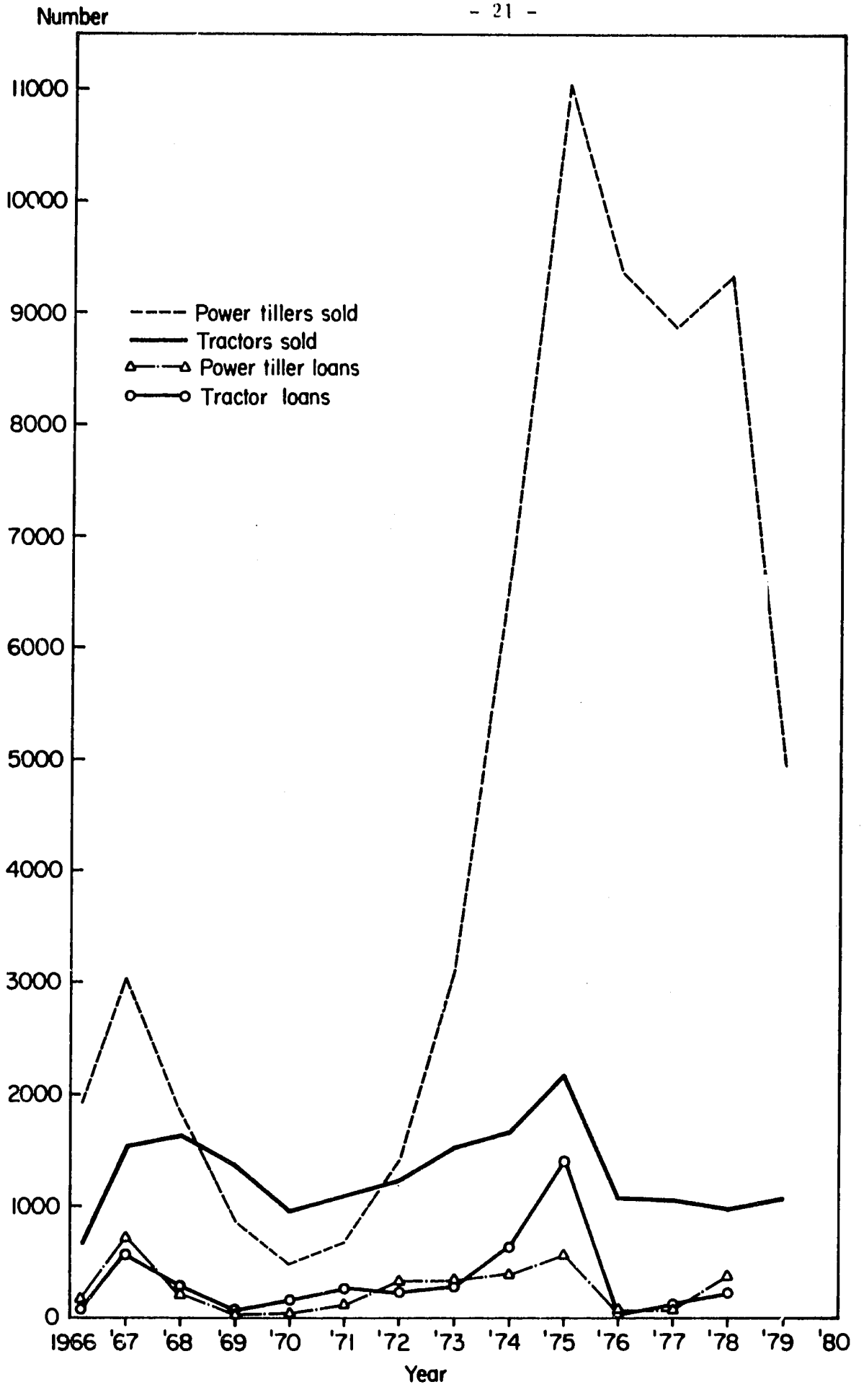


Fig. I. Annual sales of tractors and tillers and number of loans granted under the CB: IBRD rural credit projects, 1966-79.

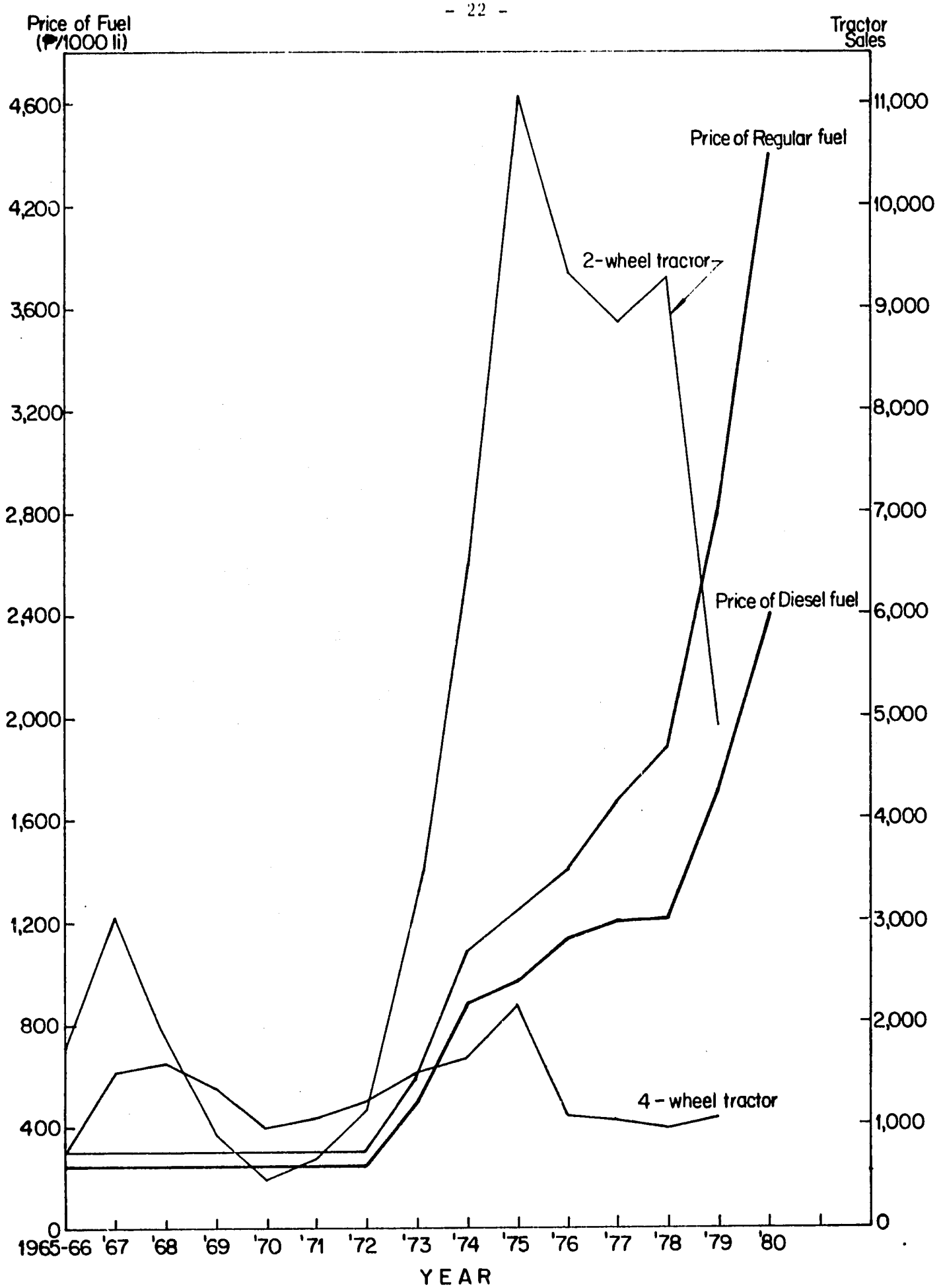


Fig. 2 Sales of Tillers & Tractors and Prices of fuel, 1966 to 1980.

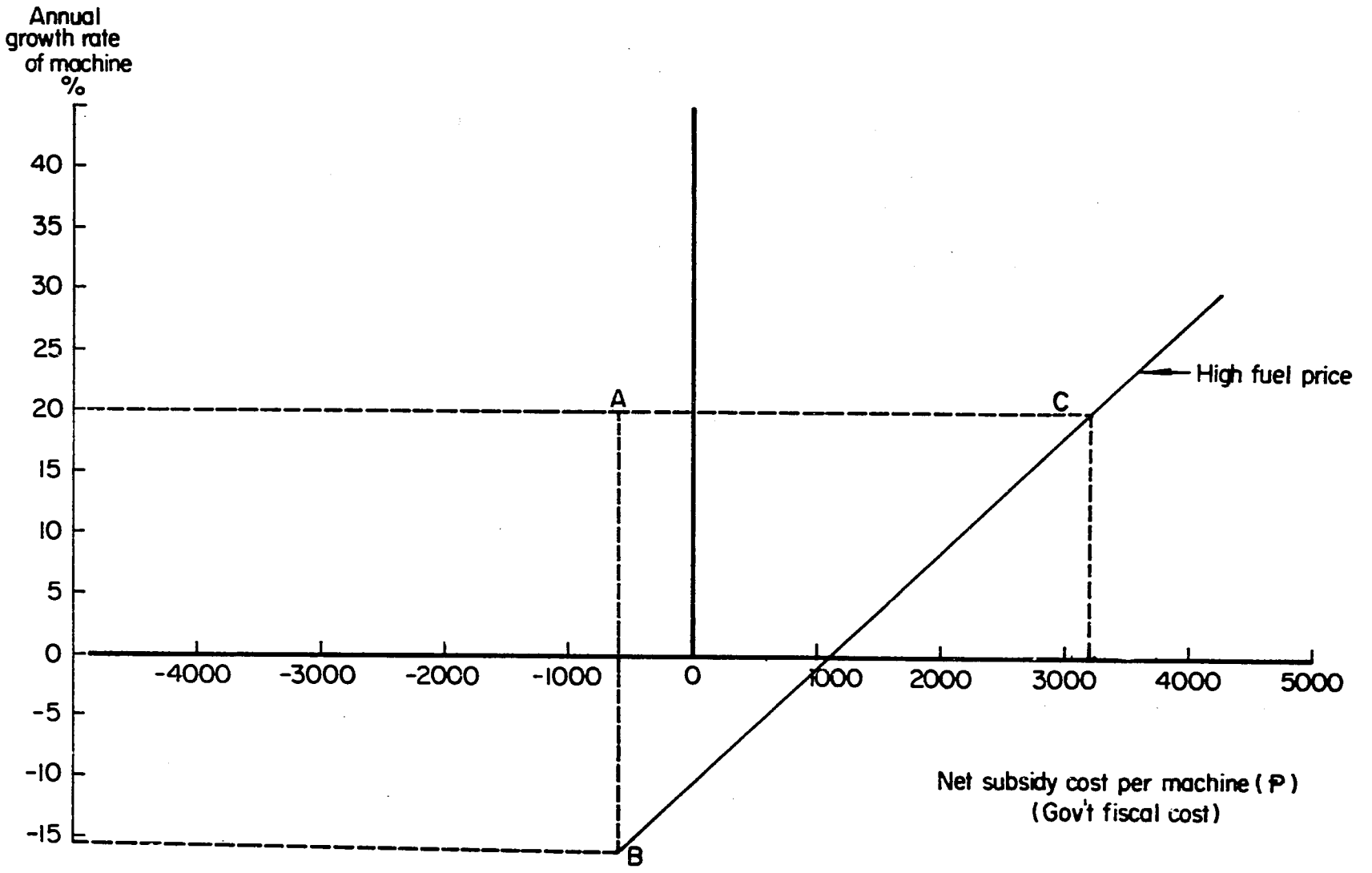


Figure 3. Growth rate of machine influenced by policy instruments.

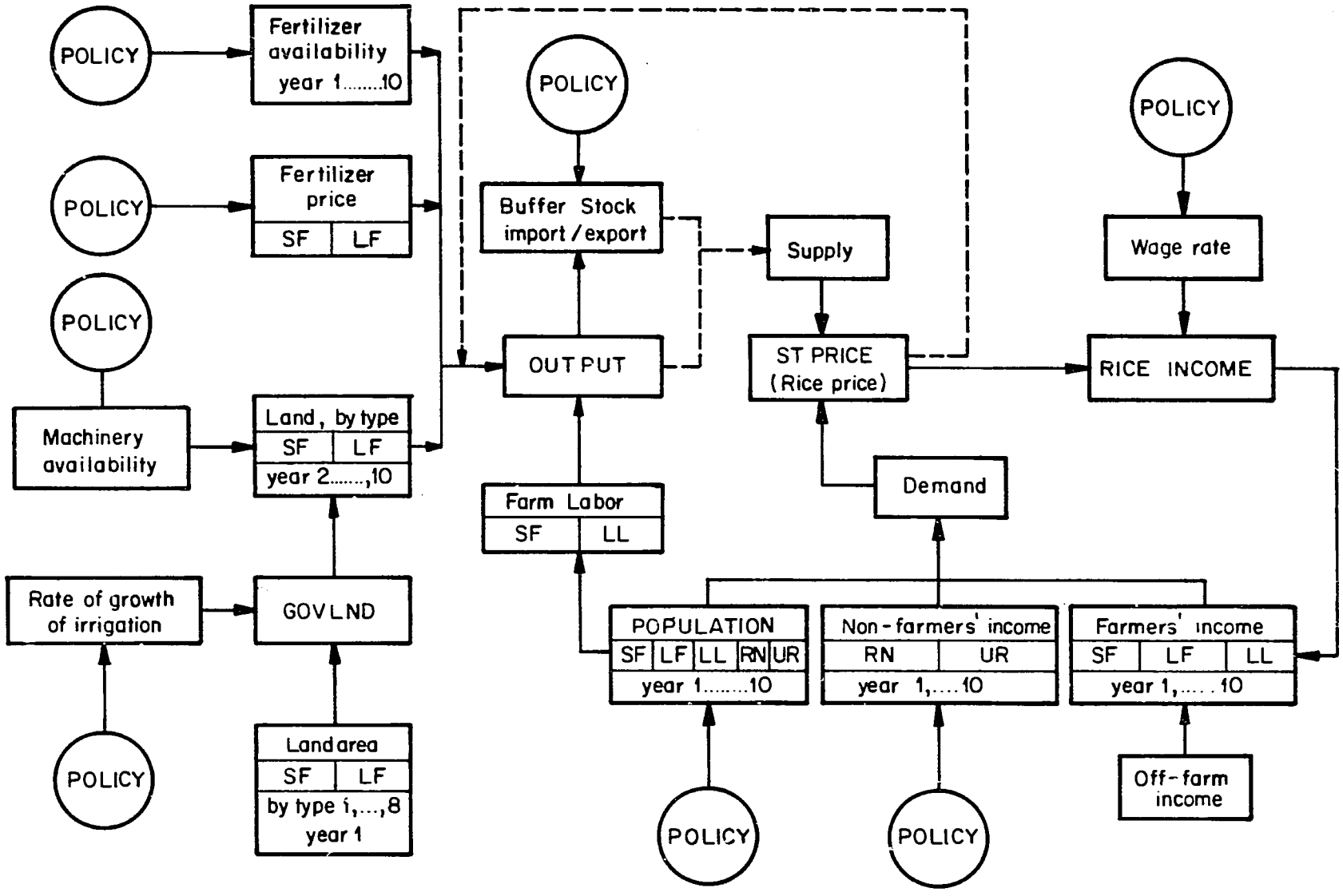


Fig. 4 Rice Policy Model

CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Papers

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

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

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

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

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

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

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

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

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

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

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

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

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

14. Tan, Y. L., J.P.G. Webster and J. A. Wicks. The Decomposition of Differences in Output Between Two Groups of Farms. Revised 1981.

15. Herdt, R. W. Mechanization of Rice Production in Developing Asian Countries: Perspective, Evidence, and Issues. September 1981.

16. Lantin, R. M. Mechanization Policy and the National Agricultural Mechanization Council - Philippines. September 1981.

17. Lockwood, B. Farm Mechanization in Pakistan: Policy and Practice September 1981.

18. Wiboonchutikula, P. The Total Factor Productivity Growth of the Three Digit Manufacturing Industries in Thailand. September 1981.

19. Ahammed, C. S. and R. W. Herdt. A General Equilibrium Analysis of the Effects of Rice Farm Mechanization in the Philippines. September 1981.

20. Mikkelsen, K. and N. Langam. Technology Change in the Philippine Agricultural Machinery Industry. September 1981.

21. Boughton, D. Energy Use in Alternative Rice Production Systems in Nueva Ecija, Central Luzon, Philippines. September 1981.

22. Hurun, A. Financial Analysis of Power Tiller Ownership in Mariuk Village, West Java, Indonesia. September 1981.

23. Hafsah, J. The Economics of Tractor Operation and Use in South Sulawesi, Indonesia. September 1981.

24. Maranan, C. L. A Comparative Analysis of Tractor Contract Operations in Nueva Ecija, Philippines, 1972 and 1980. September 1981.

25. Monge, V. S. and B. Duff. Analysis of the Demand for Farm Power for Small Rice Farm Agriculture in Nueva Ecija, Philippines. September 1981.

26. Munir, M. An Evaluation of the Farmers' Decision-Making for Investment in Farm Machinery. September 1981.

27. Jabbar, M. A., Md.S. R. Bhuiyan and A. K. Maksudul Bari. Causes and Consequences of Power Tiller Utilization in Two Areas of Bangladesh. September 1981.

28. Juarez, F. and R. Pathnopas. A Comparative Analysis of Thresher Adoption and Use in Thailand and the Philippines. September 1981.

29. Ahmed, J. U. Labour Use Pattern & Mechanization of Paddy Postharvest Processing in Bangladesh. September 1981.

30. Colter, J. M. The Impact of Handtractors on Income and Employment Opportunities of Migrant Laborers in Java. September 1981.

31. Santoso, K. The Potential for Agricultural Mechanization and Labor Markets in East Java. September 1981.

32. Bernsten, R. H. Effects of Mini-Tractor Mechanization on Employment and Labour Use Intensity, Sidrap and Pinrang, South Sulawesi, Indonesia. September 1981.

33. Collier, W. Improved Cropping Patterns, Labor Absorption and Small Farm Mechanization in Indonesia. September 1981.

34. Moran, P. B. and E. Camacho. Consequences of Farm Mechanization Project Site Description: Philippines. September 1981.

35. Generalla, A. C. and A. Aguilar. Effects of Mechanization on Intensity of Land Use. September 1981.

36. Tan, Y. and J. A. Wicks. Production Effects of Mechanization. September 1981.

37. Sison, J. F. and P. B. Moran. Farm Labor Utilization and Employment in Two Selected Municipalities in Nueva Ecija - A Preliminary Analysis. September 1981.

38. Saefuddin, Y. Site Description: Mechanization Consequences Project in West Java, Indonesia. September 1981.

39. Handaka, S. Effects of Mechanization on Intensity of Land Use, West Java, Indonesia. September 1981.

40. Handaka, S. A Technical and Economic Evaluation of Rice Mills in West Java, Indonesia. September 1981.

41. Sinaga, R. Effects of Mechanization on Productivity: West Java, Indonesia. September 1981.

42. Sinaga, R. Effects of Mechanization on Productivity: South Sulawesi, Indonesia. September 1981.

43. Sri-Bagyo, A. The Impact of Mechanization on Production and Employment in Rice Areas of West Java, Indonesia. September 1981.

44. Maamun, Y. Site Description: Mechanization Consequences Project in South Sulawesi. September 1981.

45. Sarasutha, I. G. P. and R. Bernsten. Effect of Mechanization on Intensity of Land Use, South Sulawesi, Indonesia. September 1981.

46. Bockhop, C. W. and M. Nafziger. The Impact of Economics upon the Design of Machinery at IRRI. September 1981.

47. Wattanutchariya, S. Economic Analysis of Farm Machinery Industry and Tractor Contractor Business in Thailand. September 1981.

48. Hussain, K. A. An Assessment of Capacity of Workshops and Farmers To Repair and Maintain Farm Machinery in District Faisalabad: Summary of Major Findings and Policy Recommendations. September 1981.

49. Gonzales, L. A. and R. W. Herdt. Evaluating the Sectoral Impact of Mechanization on Employment and Rice Production in the Philippines: A Simulation Analysis. September 1981.

50. Khoju, M. R. The Economics of Pump Irrigation in Eastern Nepal. September 1981.

51. Sudaryanto, T. The Effect of Tubewell on Income and Employment: A Case Study in Three Villages in Kediri, East Java, Indonesia. September 1981.

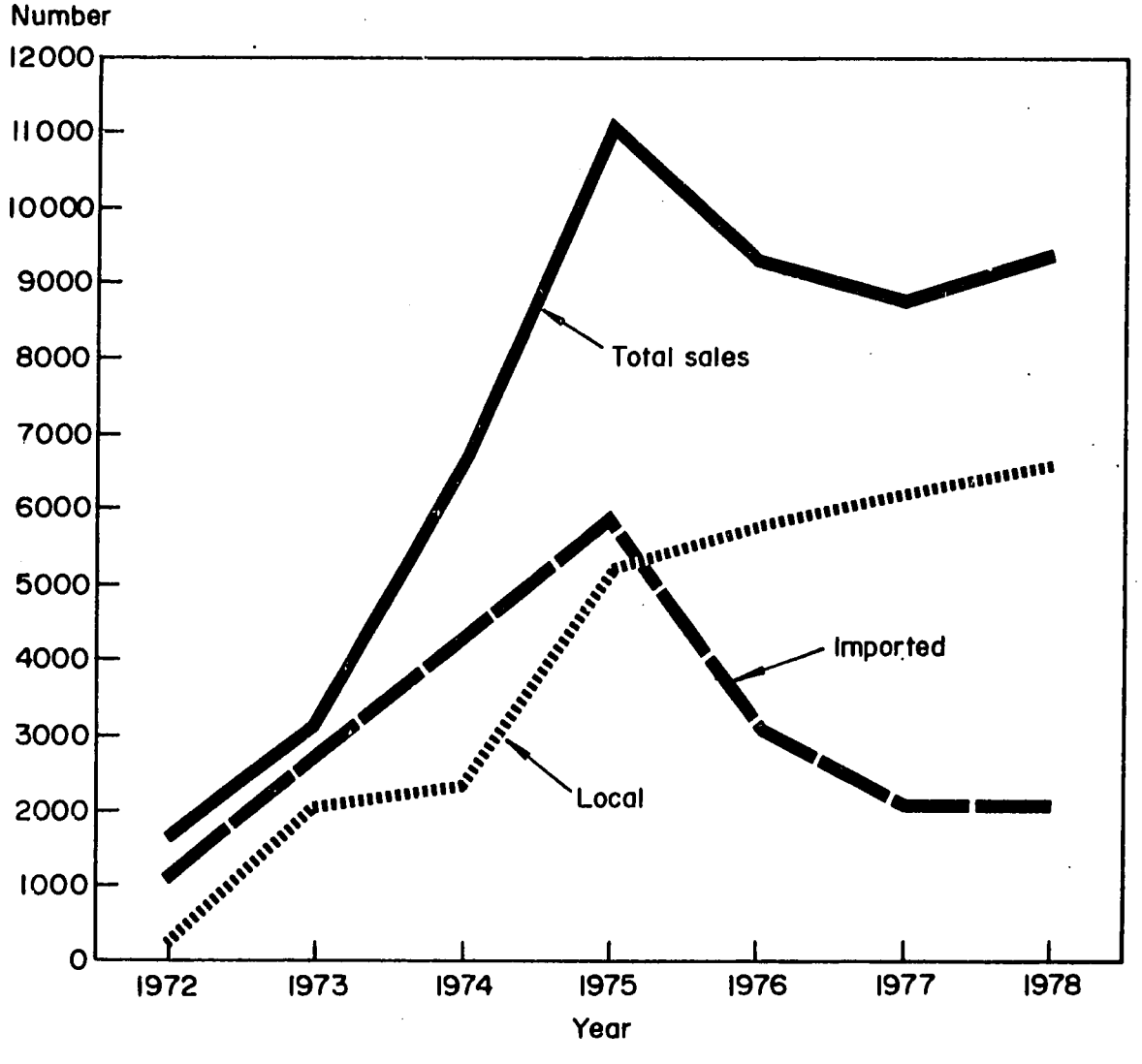
52. Santoso, K. Economics of Pumpsets in East Java. September 1981.

53. Wicks, J. A. and M. A. Sumiran. Data Management for Analyzing the Consequences of Mechanization. September 1981.

54. Webster, J. P. G. An Evaluation of Mechanization Data Using the FAO's Management Data Collection and Analysis System (FMDCAS). September 1981.

55. Lingard, J. Measuring the Impact of Mechanization on Output. September 1981.

JW/hhr



Power tiller sales by source.