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THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

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AN EX ANTE EVALUATION OF NATIONAL MECHANIZATION POLICIES IN THE PHILIPPINES

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by

Paul Webster
Wye College, University of London
England

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An Ex Ante Evaluation of National Mechanization Policies in the Philippines*

Paul Webster**

ABSTRACT

The paper reviewed three existing Philippine mechanization policy instruments, namely, credit subsidies, 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.

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**Senior Lecturer, Wye College, and former Visiting Scientist, IRRI.

INTRODUCTION

Currently the Philippines is in the process of evolving a farm mechanization policy that will spell out guidelines and strategies for 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.

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 mechanization 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 programs 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-subperiods: 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 machinery, 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 thousands 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 sub-sectors 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% while 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 the possible impact on machine sales of the removal of 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 in 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 to 7 possible combinations. The seven combinations are:

- Alternative I : Maintain the current credit subsidy of 12% and the current tax and tariff policies.
- Alternative II : Increase the credit subsidy to 18% but maintain the current level of taxes and tariffs.
- 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 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 the higher the 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 more than four hundred percent compared with mid-60's levels. The growth rate of power tiller 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 transplanters 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 manual 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 IFPRI/IRRI 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 fertilizer, 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 stocks, 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, and 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 adequate production incentives so that increases in rice production keep pace with increases in the demand for rice.

2. Insuring adequate farm income 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 these policy instruments which directly affect particular target variables in the prototype model.

EXAMPLE RESULTS

Two of the mechanization policies outlined earlier were investigated using the policy simulation model. Table 6 shows the baseline policy (1) plus two extremes (VI and VII, page 5) listed in terms of their government, cost or subsidy and their resulting expected

growth rate for each machine. Policy 6 is a "low mechanization" alternative in which taxes and tariffs are levied on machinery and which effectively halts their adoption. Policy 7 is a "high mechanization" alternative which subsidizes machines heavily and which expects very rapid uptake of machines.

Table 7 shows some results which are presented as indices comparing the annual position after ten years simulation of the policy as compared with ten years simulation of the base policy. A sample of the output is given in Table 8.

The results suggest that under the "low mechanization" policy, production would be slightly less than base, but that production would increase under the "high" policy. This would be primarily because of yield increases from the irrigation pumps, and some threshing losses foregone when the portable threshers were used.

The effect of the policies upon incomes would be that landless income would decline relative to base under the "low" policy, but would increase if the "high" policy were followed. This is explained by noting that mechanization often results in displacement of family labor whilst increasing hired labor as is seen here. The increase of hired labor under the "high" policy results in some improvement of the position of the landless.

However, the incomes of the small farmers and to a lesser extent those of the large farmers are hit relatively by the move from the "low" to the "high" policy. This effect results from the fact that particular growth rates of the machines are hypothesized, irrespective of the economics of the machines on the individual farms. In fact the model is suggesting that at the particular level of machinery costs expected here, incomes of the adopting farmers would decline slightly under the "high" policy.

Finally it is interesting to note that whilst under the "low" policy, government costs are very similar to base, the "high" policy results in more than doubling the base level of costs. Obviously this figure is important when considering the type of production gains which the model has suggested.

The foregoing results demonstrate the type of analysis which the policy model facilitates. The main focus has currently been with mechanization policies but many other areas could be investigated. Likewise an 'aggregate' approach has been taken to the mechanization issue. It would be possible to look very much more precisely at the impacts of particular machines. Indeed it was seen that the major contributor to output referred to above was the irrigation pump. It may be that further analysis would be required which omitted the pumpsets from consideration since policy towards the remaining machines should not be determined on such a simplistic basis.

Again, a primary focus has been to trace the income effects of the various policies. If, as could readily be envisaged, the major purpose of the analysis is to trace the effect of alternative government investments, it would be necessary to use social accounting prices rather than market prices.

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 complete 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 like. This information can provide policy makers a stronger base for decisions that strike a balance among policy alternatives to attain different rice policy objectives.

FOOTNOTES

[1]The first attempt of this type was the First Philippine Agricultural Mechanization Policy Workshop held at the Ministry of Agriculture in 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 partially recovered by gleaners. It is therefore not a loss to the whole society, but only to the farmer.

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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 sales for local and gasoline type tillers in 1974 and 1975 because of the large number of imported Kubota sales (around 5,000 units) to the Department of Agrarian Reform as part of crash 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.

(Source: 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.

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

Table 3. Coefficients for labor and yield impact of agricultural machinery 1980.

Item	Impact on labor (md/ha)				Impact on yield (kg/ha)	
	Wet season		Dry season		Wet Season	Dry Season
	Family	Hired	Family	Hired		
2-wheel tractor[a]	-11.1	+14.1	-11.1	+14.1	0	0
4-wheel tractor[a]	-11.7	+ 2.6	-11.7	+ 2.6	0	0
Manual transplanter[b]	0	- 6.5	0	- 6.5	0	0
Irrigation pump (4")[c]	+ 4.8	+ 7.2	+11.0	+17.0	+1520	+3380
Portable thrsher[d]	0	- 6.0	0	- 6.0	+40	+40
Axial flow thresher[d]	0	-10.0	0	-10.0	+40	+40

[a]Monge, V. S. 1980. Analysis of factors affecting the demand for tractor and power tiller services in Nueva Ecija, Philippines. (Unpublished M. S. thesis University of the Philippines at Los Banos); Maranan C., J. Wicks and B. Duff, 1981. The profitability of two and four-wheel tractor ownership in Nueva Ecija, Philippines, 1980. (IRRI Saturday Seminar Paper, Ag. Engineering Dept.).

[b]Kim, U. K. 1977. Field tests on three transplanting systems. (IRRI Agricultural Engineering Dept. Paper No. 77-07).

[c]Yield increments from Herdt, R., L. Gonzales and P. Webster. 1981. "Evaluating the Sectoral Impact of Mechanization on Employment and Rice Production in the Philippines: A Simulation Analysis, Working Paper No. 49. Consequences of Small Rice Farm Mechanization Project (IRRI Ag. Engineering Dept.); Impact on labor computed as propotional to increase in yield for harvesting, handling and threshing operations only.

[d]Toquero, Z., C. Maranan, L. Ebron and B. Duff. 1977. Assessing Quantitative and Qualitative Losses in Rice Postproduction Systems. Agricultural Mechanization in Asia. Vol. VIII. No. 3

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

	Wet (kg/ha)	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 manual 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

Table 6. Net subsidy and growth rates by type of machine for example policy alternatives (see page 5).

Policy	I (BASE)	VI "Low"	VII "High"
Power tillers			
Net subsidy ₱	-600	-4800	3345
Growth rate %	20	0	30
4W Tractors			
Net subsidy ₱	0	-30240	23196
Growth rate %	5	0	13
Manual transplanter			
Net subsidy ₱	239	0	358
Growth rate %	1	0.5	2
Irrigation pump			
Net subsidy ₱	0	-3744	0
Growth rate %	1	0	5
Portable thresher			
Net subsidy ₱	840	0	1363
Growth rate %	10	5	15

Table 7. Simulated impact of two mechanization policies

Policy	VI "Low"	VII "High"
	Base run 1 = 100[a]	
Total rice production (qty)	99	109
Total hired labor (qty)	96	106
Per caput incomes (value)		
- landless	97	105
- small farmer	127	95
- large farmer	109	100
Government cost	98	203

[a]Indices calculated at year 10.

Table 8. Sample model results.

I.R.R.I. Rice Policy Model
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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 = %-225.00 pesos

-Land: depreciation rate = 5.00% pa;
rehabilitation rate = 12000 ha pa, costing 401 pesos per ha.
new irrigated land = 8000 ha pa, costing 40000 pesos per ha.

-Mechanisation policies:

Power tiller
numbers in use = 35,000 projected rate of increase = 20 %, subsidy per machine = -600 pesos.

Four Wheel Tractor
numbers in use = 2,000 projected rate of increase = 5 %, subsidy per machine = 0 pesos.

Manual Transplanter
numbers in use = 200 projected rate of increase = 1 %, subsidy per machine = 239 pesos.

Irrigation Pump 4pi
numbers in use = 15,000 projected rate of increase = 1 %, subsidy per machine = 0 pesos.

Portable Thresher
numbers in use = 10,000 projected rate of increase = 10 %, subsidy per machine = 840 pesos.

Axial fl thresher
numbers in use = 5,000 projected rate of increase = 1 %, subsidy per machine = 0 pesos.

Results summary:

Yr	Popln m.	Fert '000t	Yield m t	Export m t	- Per Capita incomes - L/L	S.f.	L.f.	Urb	Rn-f	Totlab million mandays	HireLab million mandays	GovtCost m.pesos
0	-	-	-	-	250	350	500	1000	500			-
1	47.92	50.00	7.26	0.46	250	334	464	1000	500	349.3	231.21	313.67
2	49.09	54.00	7.28	0.35	250	329	456	1000	500	346.2	230.06	308.48
3	50.28	58.32	7.30	0.22	249	323	447	999	499	342.8	229.01	306.39
4	51.48	62.99	7.32	0.10	249	317	438	999	499	339.3	228.07	303.98
5	52.68	68.02	7.34	-0.02	248	311	427	999	499	335.5	227.26	301.19
6	53.89	73.47	7.37	-0.13	248	303	416	999	499	331.3	226.61	297.94
7	55.11	79.34	7.40	-0.25	247	295	403	999	499	326.7	226.15	294.16
8	56.34	85.69	7.43	-0.35	247	285	388	998	499	321.7	225.92	289.74
9	57.56	92.55	7.46	-0.46	246	275	370	998	498	316.1	225.97	284.57
10	58.80	99.95	7.50	-0.56	246	262	350	998	498	309.9	226.34	278.50

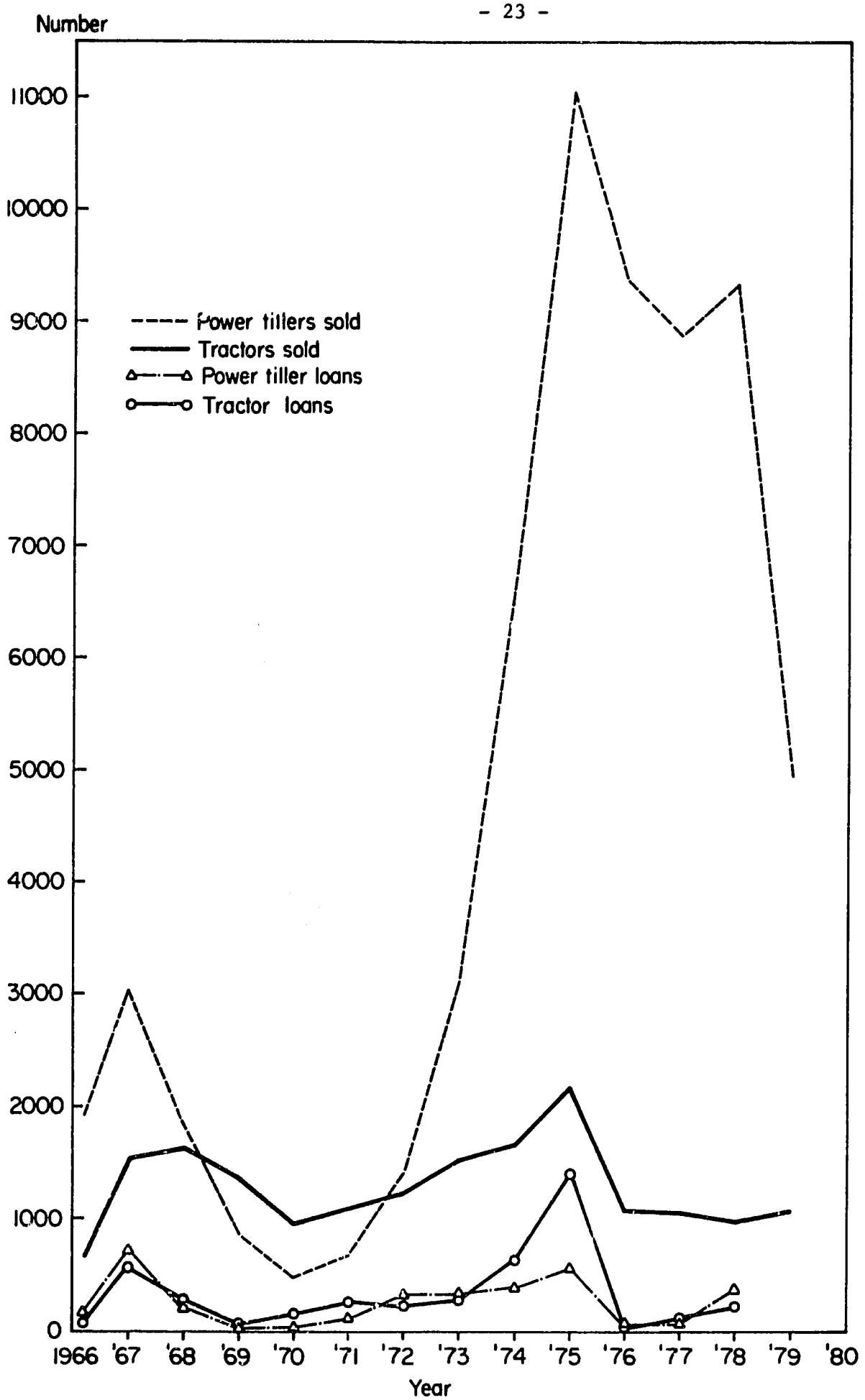


Fig.1. Annual sales of tractors and tillers and number of loans granted under the CB: IBRD rural credit projects, 1966-79.

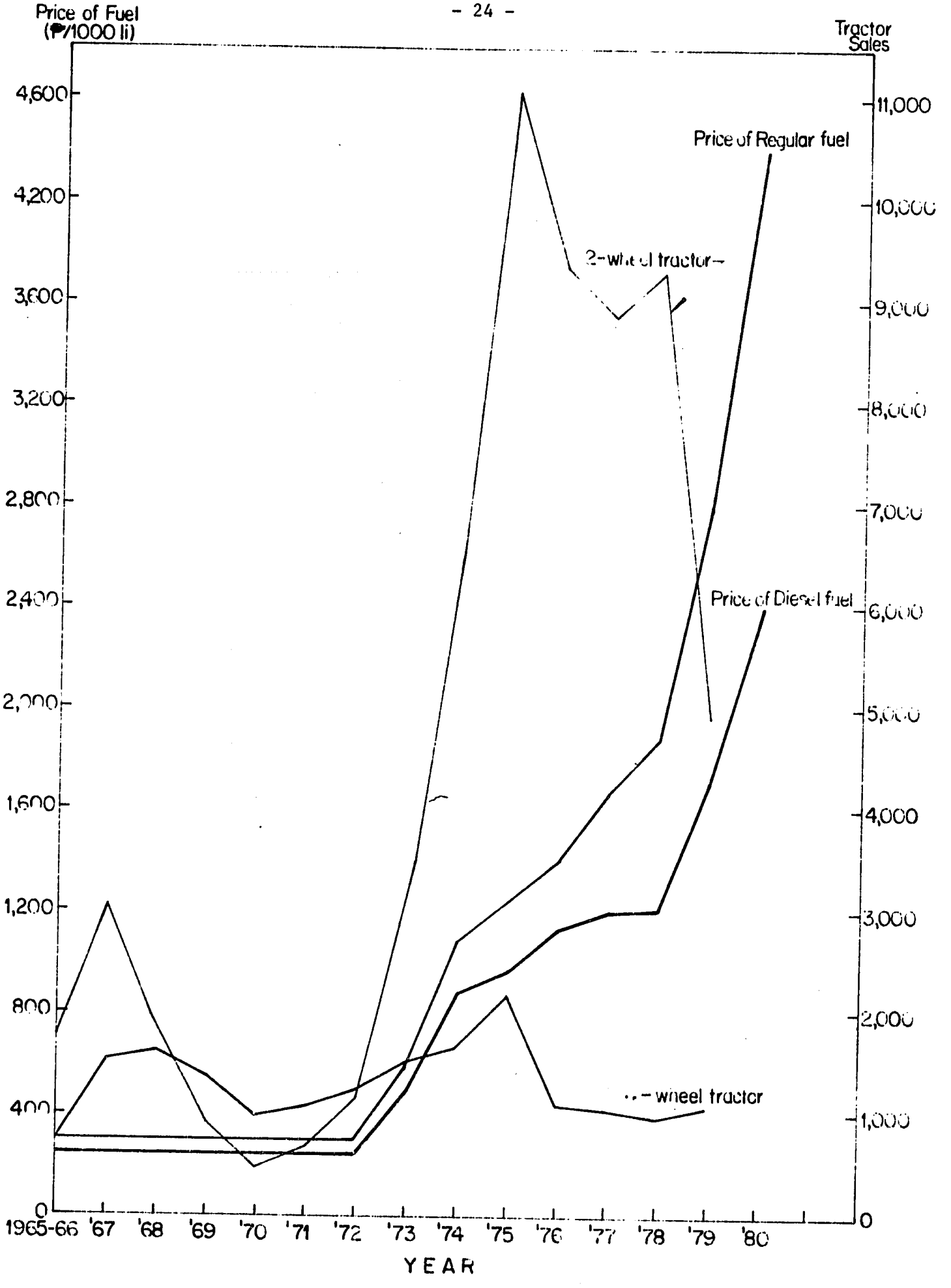


Fig. 2 Sales of Tillers & Tractors and Prices of fuel, 1966 to 1980.

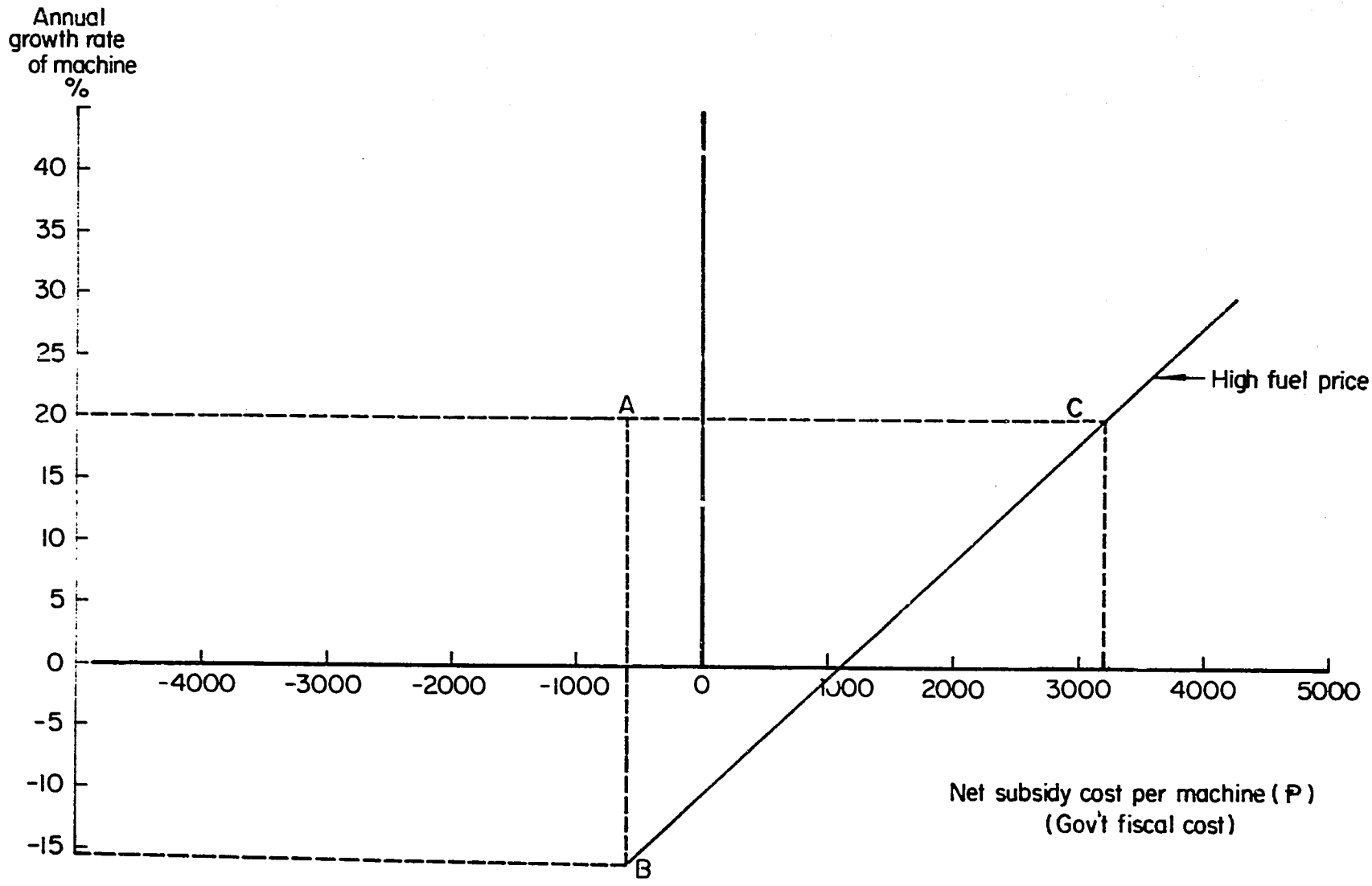


Figure 3. Growth rate of machine influenced by policy instruments.

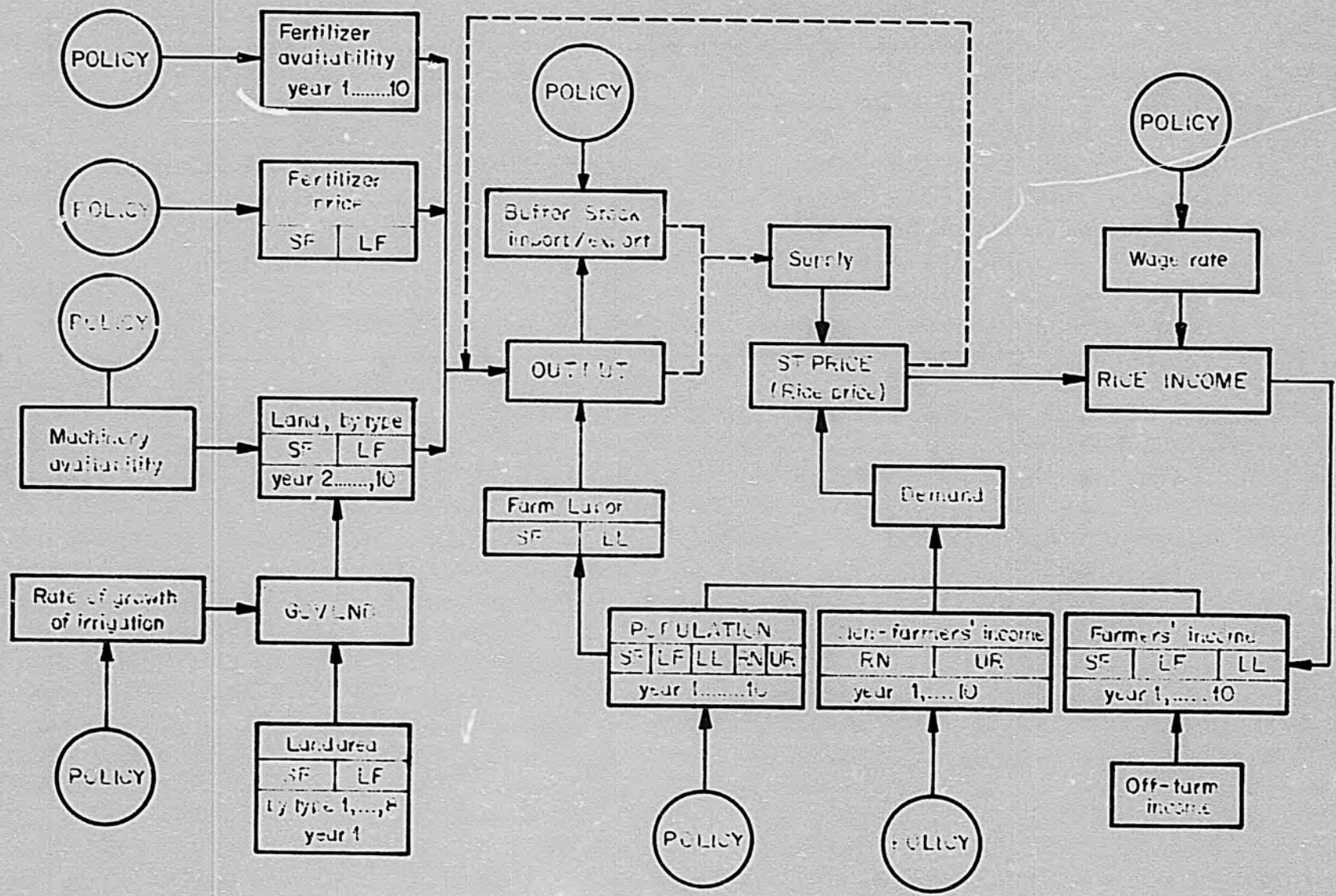
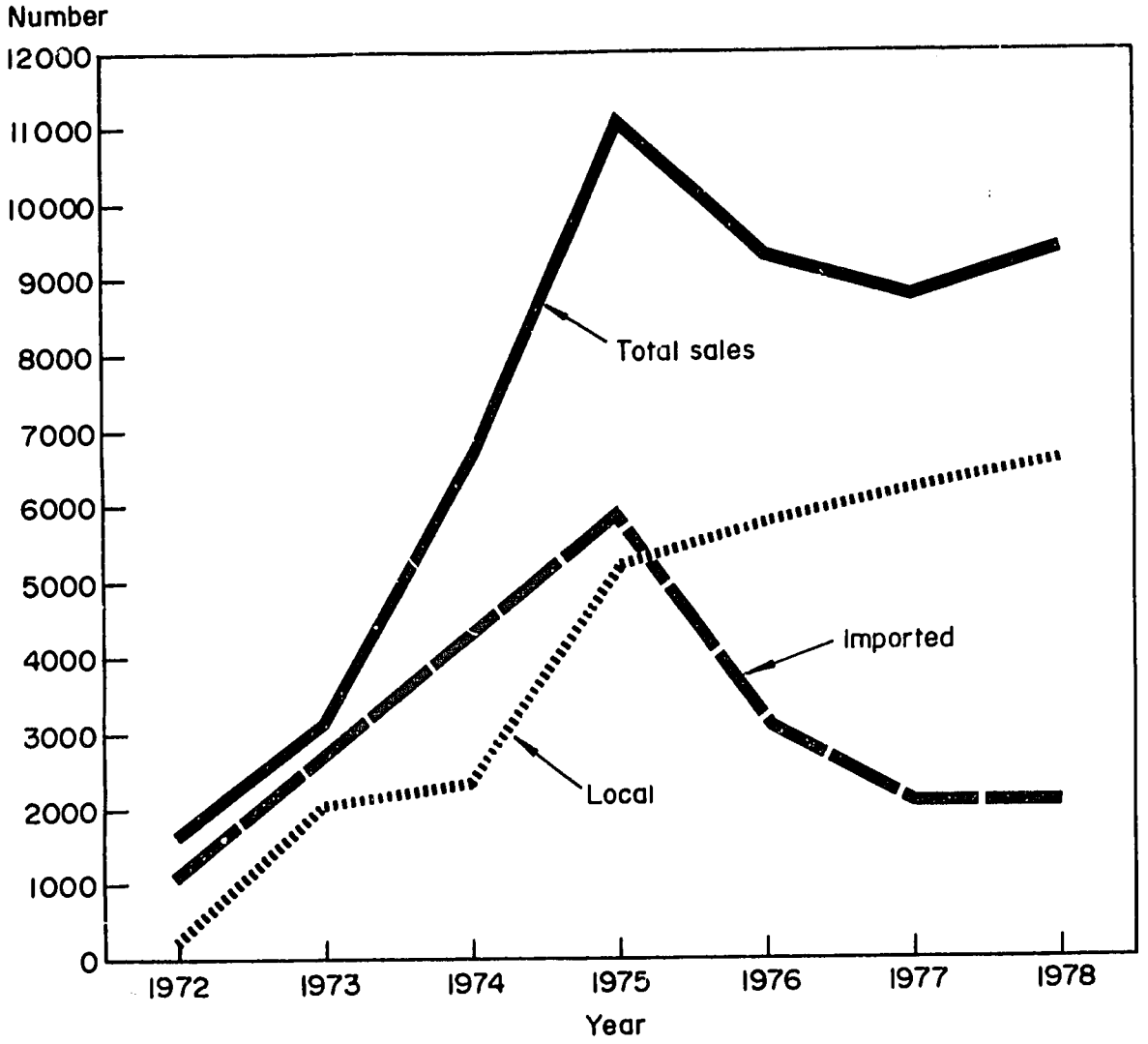


Fig. 4 Rice Policy Model



Power tiller sales by source.