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THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Paper No. 26

AN EVALUATION OF THE FARMERS' DECISION-MAKING FOR INVESTMENT IN FARM MACHINERY

By

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ABSTRACT

Results are derived from a survey of eighty-eight tractor owning farmers in Faisalabad, Pakistan. The study highlights decision-making at the farm level in terms of selection and purchase of farm machinery. The majority of the sample farmers were large land-owners. Investment decisions were made predominantly on the basis of economic factors, but non-economic factors such as expected leisure and prestige attached with tractor ownership also played a vital role. No economic analysis or financial justification was formalized and the perception of benefits frequently led to miscalculation of expected gains. The investment decision turned out incorrect for 18 farmers. Joint ownership was rare and mainly confined to close relatives. Priorities for purchase of the tractor implements and attachments were fixed by visualizing round-the-year use, cost and custom services market. Most of the tractor replacements resulted in increased H.P. Choices of farm machinery were most commonly based on the experience and advice of fellow farmers.

INTRODUCTION

The history of farm mechanization in Pakistan is fairly recent. A visible pace was set in late 60s. It is generally believed that the Green Revolution paved the way for mechanized farming (Kaneda, 1969). Tubewell technology came first and was quickly adopted. The enormous gains due to increased cropping intensities was reported to be the strongest factor encouraging the diffusion of tubewells (Clark, 1973). Tractor technology was, in a way, necessary to meet the increased farm power requirements resulting from intensive cultivation. However, the pioneer tractor buyers were mainly big landlords with irrigated tracts, mostly concentrated in central Punjab (Finney, 1972). Tractor adoption further augmented the size of their operated holdings (McInerney and Donaldson, 1975). The magnitude of private and social benefits, labour displacement or savings, marginal rates of productivity and the appropriateness of the imported technology itself are just some of the issues which have been inconclusively discussed (Hamid, 1973; McInerney and Donaldson, 1975; Ministry of Agriculture and Works, 1970). But, what had been generally ignored by the earlier research workers was the farmers' own point of view and perspective to justify investments in farm machinery. This study was initiated to analyze the process of farm mechanization in the context of the factors which influence the farmers in their decisions to make substantial investments in agricultural machinery.

METHOD OF STUDY

The Survey Area

The survey area was conducted during 1978 in District Faisalabad of Pakistan, Punjab. Faisalabad is the sixth largest district of Punjab with respect to cultivated area, third in private tractors ownership and sixth with respect to the cultivated area covered per tractor (Government of Pakistan, 1975). It surrounds the third largest city of Pakistan where the earliest agricultural education and research institutes, and most of the country's textile industry are located. With these particulars, this district was considered most suitable for the purpose of the study.

Sampling

Forty villages, 10 from each of the four sub-divisions and depicting substantial cropping pattern variation, were randomly selected and a pilot survey was carried out to identify the tractor owners in these villages. One hundred and twenty-five farmers owned 129 tractors. Four villages were without tractors and 11 were one-tractor villages. The

maximum number of tractors found in a village was 8 and there were 8 such villages. Eleven tractor owners in one-tractor villages, 4 absentee landlords and 3 landless tractor owners were discorded for the final survey. This left a total of 107 tractor owners since 19 could not be contacted, 88 tractor owners were finally interviewed (Table 1). The data was transferred to 'sorting strips' and the results tabulated. No statistical techniques were involved except for correlation analysis where considered necessary.

RESULTS AND DISCUSSION

Process of farm mechanization in the 25 survey villages.

The first tractor in the study villages was bought as early as 1952, but the adoption process remained slow. By 1965 there were 5 tractors with the sample farmers along with 16 tubewells. Thus the farm mechanization began with investment in tubewells. Sixteen tractors were purchased and 18 tubewells were installed from 1966-70. Subsequently the major investments were in tractors, implements and attachments. Tubewells were given second priority. During the period 1971-75, 41 tractors and only 11 tubewells were funded. The first mechanical thresher was also purchased in 1971 and by 1975 there were 15 with the sample farmers. During the last 3 years, i.e., 1976-78, 50 tractors and 15 tubewells were purchased. However, investment in threshers was more rapid, 38 being bought in last three years. By August, 1978, the sample farmers had purchased 112 tractors and sold 22 (Fig. 1); 90 were owned at the time of survey. In addition, the 88 sample farmers owned 89 cultivators, 60 tubewells, 59 trailers, 59 pullies, 53 wheat threshers, 44 levellers and 20 other implements and attachments (Table 2). The pattern of tractor purchases by sample farmers fairly matched the pattern of tractor imports (Fig. 2).

Tractor ownership and farm size: Most tractor owners in the study villages were medium and large farmers:

28 (32 percent of sample farmers) were farming more than 50 acres

24 (27 percent of sample farmers) were farming 25 - 50 acres

24 (27 percent of sample farmers) were farming 12.5 - 25 acres

12 (14 percent of sample farmers) were farming below 12.5 acres

However, the trend in recent years has been for relatively small farmers to invest in tractors and accessories, mainly to obtain new income streams by providing various types of tractor hire services. This was supported by the fact that the mean farm size of the 11 sample farmers who owned tractors in 1970 was 73 acres against 49 acres of the 32 farmers who bought their tractors between 1971 and 75 and 33 acres of the 45 farmers who

purchased tractors after 1975. Thus mechanized farm technology has not remained the monopoly of big landlords (Fig. 3). The majority of the tractor owners were educated and enjoyed a relatively higher social status in the rural set up.

The tractors. The make of tractor owned by sample farmers were Massey Ferguson (28), Fiat (26), Ford (25), Byelarus (4), IMT (4) and International (3). None of these tractors was less than 41 H.P. About 21 percent were 41 - 45.5 H.P.; 46 percent were 46 - 48 H.P., 23 percent were 55 H.P. and 10 percent were 64 H.P. Tractors of 46 - 55 H.P. were mostly preferred. The tractor H.P. per acre of cultivated land was highest on smaller farms (6.0) and lowest on the larger farms (0.6). Thus, there was evidence that the smaller farmers were making over-investments in bigger tractors, probably without calculating the economies of scale. The surplus tractor power which existed led most of them (68 out of 88) to engage in custom servicing (Table 3/Fig. 4).

Investment in farm machinery.

The sample farmers had invested about 6.8 million rupees in the farm machinery owned by them up to August 1978. Nearly 3 percent of the total investment was made by 1965, about 7 percent between 1966-70, almost 31 percent during 1971-75 and 75 percent from 1976 to 1978. Up to 1965, about 79 percent of all investments in farm machinery were in tubewell alone. In later years, the share of tubewells in total spending on farm machinery gradually declined and tractors and related equipments dominated the financial allocations. According , the share of tubewells in total farm machinery investments fell to [illegible] percent during 1966-70, to 8 percent during 1971-75 and to only 5 percent between 1976-78. By August, 1978, roughly 11 percent of total investments were made in tubewells; 66 percent in tractors and cultivators (usually bought together), 11 percent in threshers and pullies, 10 percent in trailers and the other 2 percent in miscellaneous implements (Table 4).

Levels of investment at different farms. The average investment by the sample farms was around 77.2 thousand rupees. The smaller farmers had lower total investments than the bigger farmers (Table 5) but, in terms of rupees per unit of cultivated land, the smaller farmers had the larger investment. The indivisibility of tractor technology and desire for larger farm machines were the main reasons of this "over investment". On average prices of 1973-78, the 'package investment' in a tractor, cultivator, trailer, thresher and pulley (the most important set) cost the farmer of the order of Rs. 80-90,000. The very high investment levels on small farms, coupled with excessively idle diesel power compel them to use their tractors for custom hire services.

Sources of finance. Of the total investment in farm machinery approximately 48 % had come from farm incomes, 31% from bank loans, 7% from overseas remittances, 8% from private loans and 6% from other non-farm sources (Table 6). Some of the small farmers had sold their family jewelry to buy tractors. Bank loans were restricted almost completely to investments in tractors; they financed 46% of these investments. Almost all funds for purchase of implements and attachments came from the farmers' own sources. Overseas remittances were relatively more important for smaller farmers. Also the larger farmers were more dependent on bank loans.

Decision-making for investment in farm machinery.

The process. The farmers investment decisions are not based on statistical conclusions derived from economic or financial analysis. They are not aware of these types of evaluation. However, they have sound convictions about the profitability of investments in farm machinery. In almost all the cases, such inferences are drawn from the experiences of fellow farmers who were among the earlier tractor buyers and are making attractive earnings, mainly by rental services.

The decision-making process of the sample farmers, for making large investments in tractor technology, was found to be simple but in no way abrupt. A proper sequence of events was identified between the reflections and actions. The process included the use of rental services, perception of benefits from buying own tractor, internal or external inspirations, consultations for choice of a particular tractor and arrangements of funds, and detailed inquiries about the performance of different tractor makes and models. Generally speaking, the whole process was stretched over 2-6 years.

Use of rental services prior to buying own tractor. Of the 88 sample farmers 16 were not practicing farmers before they had their own tractor. Sixty nine of the other 72 growers had been using tractor custom hire services for 4 - 5 years before they decided to buy their own tractors. In fact, the first hand impressions about the superiority of tractors over bullock power were derived from the constant use of hired tractors, mainly for general cultivation, wheat threshing, agricultural and miscellaneous carting, land levelling and/or seeding.

Perceived benefits (the basis of decision-making). Having been convinced by the performance of tractors, the farmers would start seriously thinking about owning one. Many benefits are perceived by different individuals under varying circumstances. In general, the expected benefits are economic, such as the higher incomes believed to be generated from optimum tillage, timeliness of farm operations, custom services, etc. Sixty of the 88 sample farmers based their decisions primarily on economic considerations. But, the prime motives of the other 28 farmers were subjective, or at least visibly non-economic. They included 16 landlords whose entire

holdings were tenant operated and who contended that, without owning tractors, they could not take hold of their farms and afford to eject the tenants. Easy farming, added prestige and more leisure were other important non-economic considerations (Table 8). The pace, sequence and volume of investment in tractors and allied accessories was largely determined by the extent of the perceived benefits.

Inspiring agents: Apart from self conviction of perceived benefits, certain farmers were motivated to purchase tractors by other persons and forces. Forty six such instances were recorded. In 30 cases the sons and younger family members refused to go in farming without a tractor, 8 farmers were inspired by their friends and relatives, 6 by family members in off-farm services, 1 by a tenant's attitude and another one by his neighbour used a tractor but once refused him the rentin services.

Consultations. The majority of sample farmers discussed their tractor buying intentions with various people to obtain advice on the selection of a tractor and mode and sources of funding. Such consultations, in the absence of any proper public advisory agency, were mainly confined to fellow farmers, family members, friends and relatives and, workshop mechanics. Advice other organized services than the government was rarely sought (Table 9).

Financial alternatives. Thirty-six farmers operating less than 25 acres were not eligible for bank credits to fund tractor purchases and accordingly they had no choice except to tap non-institutional sources. They mostly purchased used tractors (16) and 7 farmers obtained deferred payment from the sellers. Two farmers sold their family jewelry to pay for the tractors; the others made use of their accumulated farm incomes (10), overseas remittances of family members (11), off-farm earnings (3) and private loans (3).

The choice between cash or bank credit was required for 52 farmers who held more than 25 acres of land and were virtually entitled to bank credits. Forty-seven of them had bought their tractors through bank's loans. But due to very high procedural costs (5 percent of loan value), high interest rates and the possibility of confiscation of mortaged properties in case of default of repayment, 31 farmers said that they would prefer cash purchases in future.

Choice of tractor size. The general trend was to buy as big a tractor as could be funded. At the time of survey, 22 tractors had been replaced. Twelve of these purchases were of higher HP, 9 were within the previous tractors' H.P. range and one was of lower H.P. Of 90 tractors owned by sample farmers in August 78, 60 were of low H.P. (41-48) and 30 were of high H.P. (55-64). Fifteen farmers among the former group had purchased low H.P. tractors because they either had not enough finance or their first high H.P. tractor choices were not available. Sixty farmers wished

to replace their tractors; 42 with higher H.P. models. The most important reason cited for the trend towards bigger tractor was the farmers intentions of providing custom services. Therefore, heavy duty tractors, suitable for a large number of farm and non-farm operations were most preferred. The general opinion was that more versatile a tractor would be,larger would be its demand for custom hire services.

Sequence of farm machinery purchases. Forty-five sample farmers had installed 60 tubewells and in most of the tubewell plus tractor farms the tractor was a much later investment. Tractors and cultivators were usually purchased together. The real choice was between levellers, trailers and wheat threshers. Other implements were rare and mostly acquired between 3 - 6 years after the tractor. Of the three most important farm machinery components the farmers usually gave first preference to levellers, second to trailers and third to threshers; these were purchased with an average gap of 10 months, 14 months and 19 months respectively after the tractors (Table 10). Priorities were normally fixed keeping in view of the versatility, likelihood of round-the-year use, price and demand of a particular implement/attachment for custom services.

Joint ownership. Sixteen tubewells, 9 tractors, one thresher and one leveller were jointly owned. Five out of 9 joint holders groups of tractors were also farming jointly and in all such cases share holders were close relatives. However, 2 of these farmers were seriously considering single ownership due to disputes and clash of interest among the partners.

Evaluation of farmers' investment decisions.

The majority of the farmers were fully satisfied with their decisions on investment in tractors. Problems were reported by 18 farmers, including 11 (out of 16) who had bought used tractors. The wider gaps between the perceived and experienced benefits gave rise to various levels of dissatisfactions. Answering a question that "what would you do different if you go back in time of purchase of present tractor", 6 farmers wished not to buy the tractors at all; their expectations were totally reversed. Five farmers replied that they would avoid credit fundings because they had faced serious repayment problems. Four respondents regretted second-hand purchases. Three farmers indicated that they would prefer to buy bigger, heavy duty, all round tractors.

Discontent was generated by many factors, the most significant being the frequent breakdowns, diseconomies of scale, lack of technical skill and machinery operating capabilities, and high operating costs. Closer probing, however, revealed that all the above reasons stemmed out from a single missing link in the process of farm mechanization, that is the presence of organized advisory services to guide the farmers in selection and operation of farm machinery according to individual requirements and background. Very low literacy levels, absolute unawareness of the comparative technical efficiency of various tractor-makes and models, non-existence of appropriate training and repair facilities, and the unsuitability of imported technology are major bottlenecks which need to be removed to ensure wiser investments in farm mechanization, both at the micro and macro levels.

REFERENCES

Clark, Edwin H. 1973. The diffusion of private tubewells in the West Pakistan, Punjab. Research Memorandum No. 48. Center for Dev. Econ. Williams College, Williams Town, Massachussetts.

Finney, C. E. 1972. Farm Power in West Pakistan. Department of Agri. Econ. University of Reading, England.

Hamid, Javed. 1973. Agricultural Mechanization: A case for fractional technology. Pakistan Economic and Social Review, reprinted in A/D/C Teaching Forum No. 33.

Kaneda, H. 1969. Economic implications of the Green Revolution and the strategy for agricultural development in West Pakistan. Research Report No. 73. Pakistan Institute of Dev. Econ. Islamabad.

McInnerney, John P., and Graham F. Donaldson. 1975. The consequences of farm tractors in Pakistan. World Bank Staff working paper No. 210.

Ministry of Agri. & Works. 1970. Farm mechanization in Pakistan. Report of Farm Mechanization Committee. Printing Corp. of Pakistan Press. Dacca.

Ministry of Food and Agriculture, 1975. Pakistan Census of Agri. Machinery. Agricultural Census Organization - Lahore.

Table 1. Sampling design

Sub-division	Preliminary survey			Final survey		
	No. of villages	No. of tractors	No. of owners	No. of villages	No. of tractors	No. of owners
1-Faisalabad	10	35	34	6	25	24
2-Jaranwala	10	42	41	9	30	29
3-Samundri	10	26	24	6	17	17
4-Toba Tek Singh	10	26	26	4	18	18
Total	40	129	125	25	90	88

Table 2. Farm machinery purchases by 88 sample farmers

Farm machinery	Up to 1965	1966-70	1970-75	1976-78	Total
Tubewells	16 (27%)	18 (30%)	11 (8%)	15 (25%)	60
Tractors + cultivators	5 (4%)	16 (14%)	41 (37%)	50 (45%)	112
(- tractor sales)	(2)	(4)	(5)	(11)	(22)
Tractors working	3 (3%)	15 (17%)	51 (57%)	90 (100%)	90
Trailers	-	6 (10%)	15 (25%)	38 (65%)	59
Pullies	-	1 (2%)	19 (32%)	39 (66%)	59
Wheat threshers	-	-	15 (28%)	38 (72%)	53
Levellers	-	6 (14%)	17 (39%)	21 (47%)	44
Others	2 (10%)	2 (10%)	8 (40%)	8 (40%)	20

* 9 cane crushers, 5 seed drills, 3 rotators, 2 discs and 1 ridger.

Table 3. Tractors owned by horse-power

Farm Size Acres	No. of farmers	No. of Tr. owned	Percent in various H.P. range				Rated HP	
			41 - 45.5	46 - 48	55	64	Per farm	Per acre
Up to 12.5	12	12	25	50	25	-	48.4	6.0
12.5 - 25	24	24	21	33	29	17	51.4	2.3
25 - 50	24	24	25	38	29	8	50.0	1.3
Above 50	28	30	17	60	13	10	53.0	0.6
All farmers	88	90	21	46	23	10	51.2	1.1

Table 4. Investment in farm machinery ('000 rupees)

Farm machinery	Up to 1965	1966-70	1970-75	1976-78	Total till August, 78
Tubewells	144.0	231.5	157.3	212.6	745.4
	(79)	(45)	(8)	(5)	(11)
Tractors + cultivators	34.2	237.7	1564.8	2658.7	4495.4
	(19)	(47)	(75)	(66)	(66)
Thresher + Pulley	-	0.5	185.8	581.1	767.4
	-	(.)	(9)	(14)	(11)
Trailers	-	33.8	130.7	501.8	666.3
	-	(7)	(6)	(13)	(10)
Others	4.0	7.0	53.0	57.1	121.1
	(2)	(1)	(2)	(2)	(2)
TOTAL	182.2	510.5	2091.6	4011.3	6795.9
Percent by period	2.68	7.51	30.78	59.03	100

NOTE: Figures in parentheses indicate percent share of each machinery group in total investment during the given period.

(10 rupees = 1 U.S. dollar)

Table 5. Levels of investment on different farm size units

Farm size	Cases	Mean operated holdings (acres)	Levels of investment '000' Rs		
			Total	Mean/farm	Mean/acre
Up to 12.5 acres	12	8.0	698.6	58.2	7.3
12.5 - 25 acres	24	22.3	1810.7	75.4	3.4
25 - 50 acres	24	38.4	1687.6	70.3	1.8
Above 50 acres	28	89.0	2599.0	92.8	1.1
Overall	88	46.0	6795.9	77.2	1.7

Table 6. Sources of funds for investment in farm machinery.

Farm machinery	No.	Total investment '000' Rs.	Source of finances (% of total investment)					
			Farm Income	Bank Loans	Private Loans	Over-Seas	Non Farm	Other
Tubewells	60	745.4	83	1	-	-	15	1
Tractor + tillers	90	4495.4	27	46	11	10	1	5
Threshers + pulleys	53	767.6	94	(.)	5	1	-	--
Trailers	59	666.3	93	-	1	-	3	3
Others	64	121.1	98	-	1	(.)	1	-
All machinery	x	6795.9	48	31	8	7	6	(.)

(.) = Less than 1 percent.

Table 7. Sources of funds for'tractor purchases'by 88 sample farmers: to August, 1978.

Operational Farm size (Acres)	No. of farmers	Percent of purchase cost					
		Cash			Loans		
		Farm income	Overseas remittance	Other income	Bank	Private	Seller
Under 25	23	16.8	23.8	13.7	33.7	0.8	11.3
25 - 49	31	17.4	11.2	7.1	51.7	8.6	4.0
50 - 99	23	52.1	2.4	1.7	41.4	2.9	0.0
100 +	11	18.6	0.0	0.0	78.00	3.3	0.0
All farmers	88	24.0	10	6	49	6	5

Table 8. Perceived benefits.

Benefits perceived	Responses/priorities			
	Total responses	First priority	Second priority	Third priority
i. Economic				
- More farm income	66	36	22	8
- Timely farm operations	21	10	8	3
- Income from custom services	16	5	10	1
- Saving bullock expenses	12	4	6	2
- Overcoming labour scarcity	12	3	5	4
- Generating employment for for sons	1	1	-	-
- Facilitating farm carting	2	-	1	-
	131	60	52	19
ii. Non-economic				
- Self cultivation (removing tenants	20	16	4	-
- Easy farming	12	8	3	1
- Adding to prestige	3	2	-	1
- More leisure	3	2	-	1
- Emergent travelling	1	-	1	-
	39	28	8	3

Table 9. Consultations prior to tractor purchases.

To whom consulted	No. of farmers who made consultations	
	For tractor choice	For funding
- Co-villager tractor owners	22	10
- Mechanics	19	-
- Friends/tractor owner relatives	13	8
- Family members	4	16
- Tractor dealers	2	-
- Custom workers	1	-
- Bank officials	1	9
- Revenue department officials	-	2
- Shareholders	1	1
Total farmers making consultations	63 (72%)	46 (52%)
Farmers who consulted more than one person	14 (22%)	4 (9%)

Table 10. Sequence of purchase of different tractor attachments

Farm size	Time lag after the tractor purchase (months)			
	Cultivators	Levellers	Trailers	Threshers
Up to 12.5 acres	0	6	19	24
12.5 - 25 acres	0	7	8	17
25 - 50 acres	0	11	10	18
Above 50 acres	0	14	20	21
Average price (1975) Rs.	3500	970	10300	11200
Average annual use hours	537	75	227	201
% hours hired-out	19.20	2.41	9.92	12.77

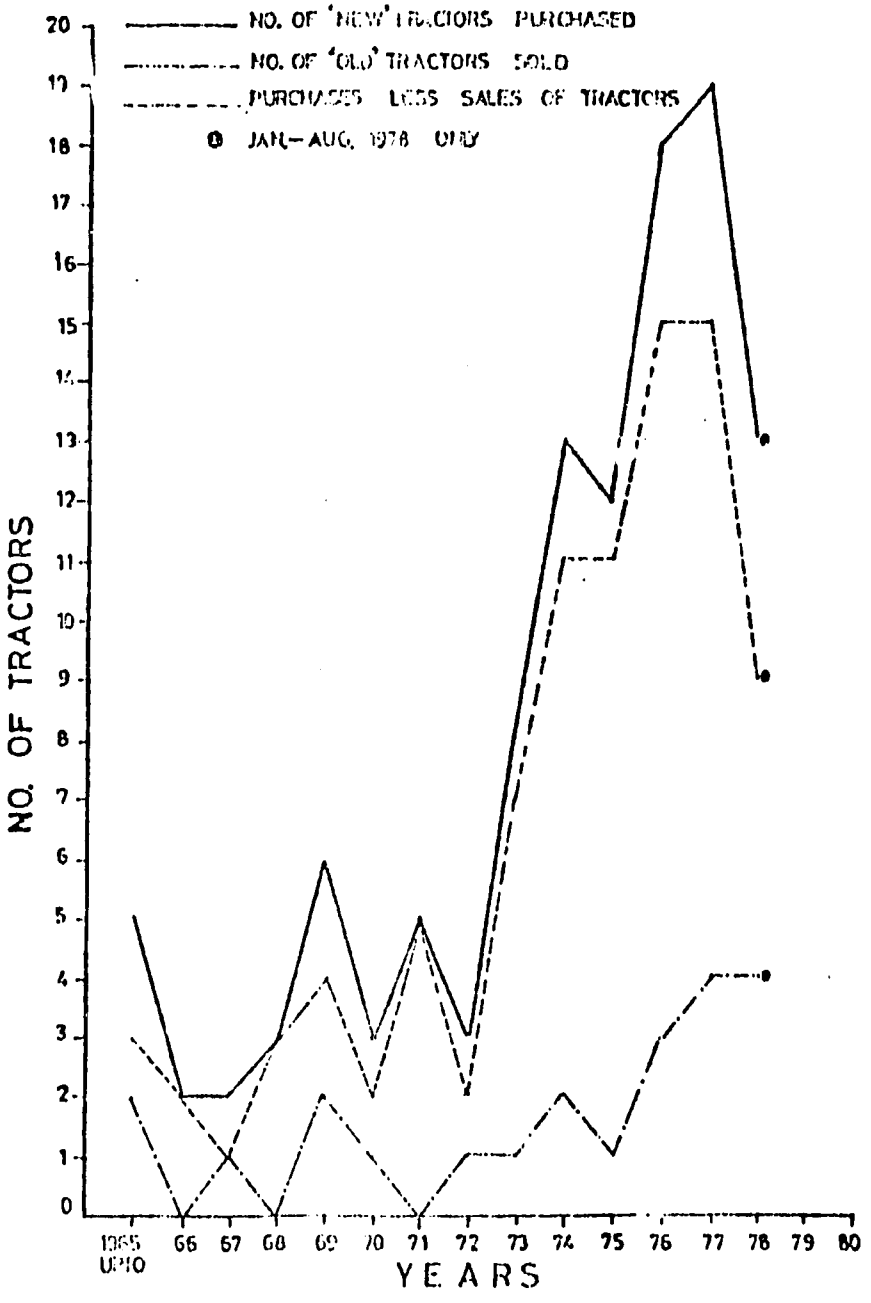


FIG. 1 YEARLY PURCHASES AND SALES OF TRACTORS IN SAMPLE VILLAGES

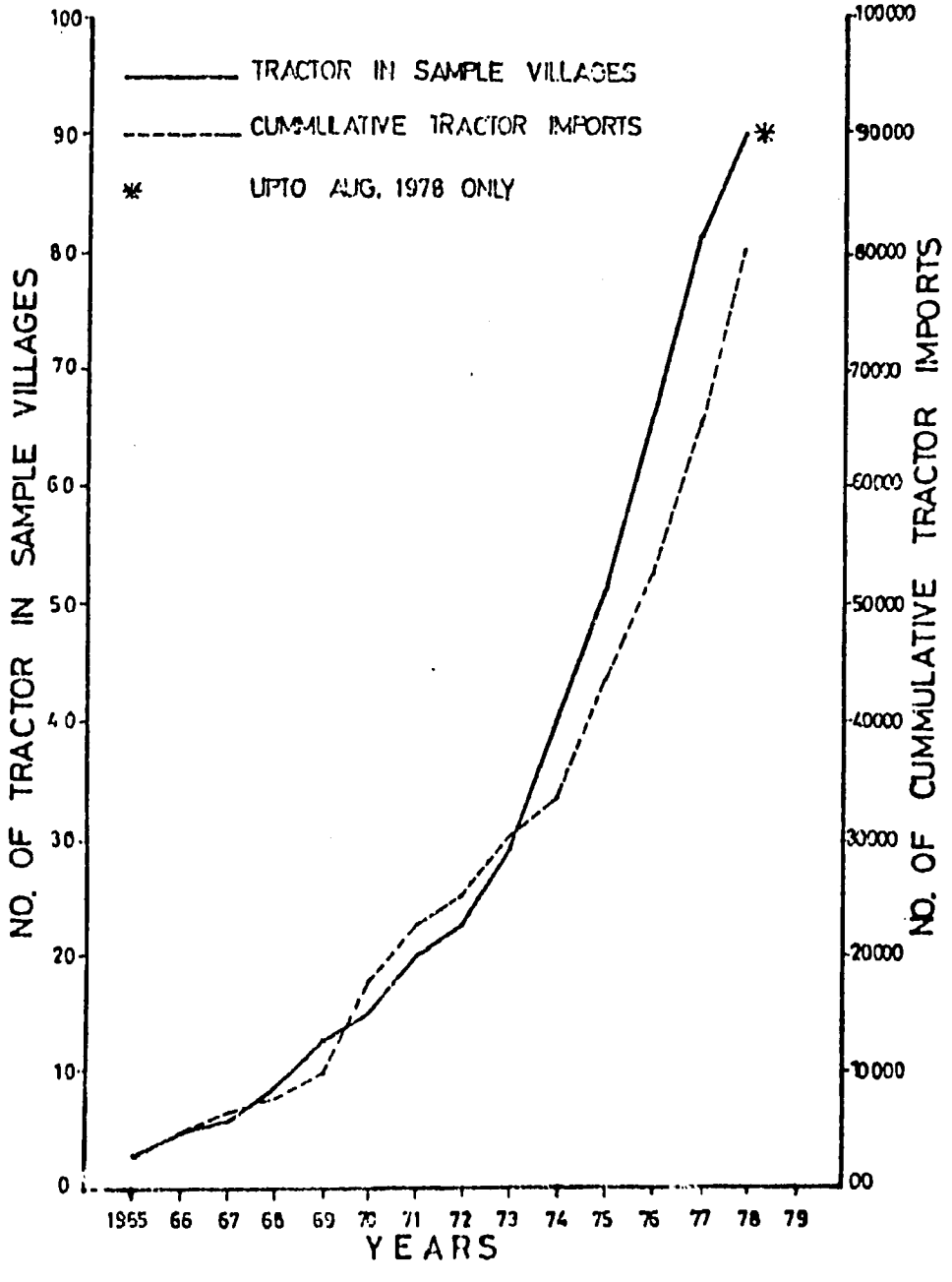


FIG. 2 NO. OF TRACTORS IN SAMPLE VILLAGES AND THE COUNTRY: (YEARLY 1965-78)

PERIOD OF TRACTOR PURCHASE	CASES	AV. FARM SIZE OF NEW BUYERS
UPTO 1970	11	73.4 ACRES
1971—1975	32	49.1 "
1976—1980	45	33.0 "

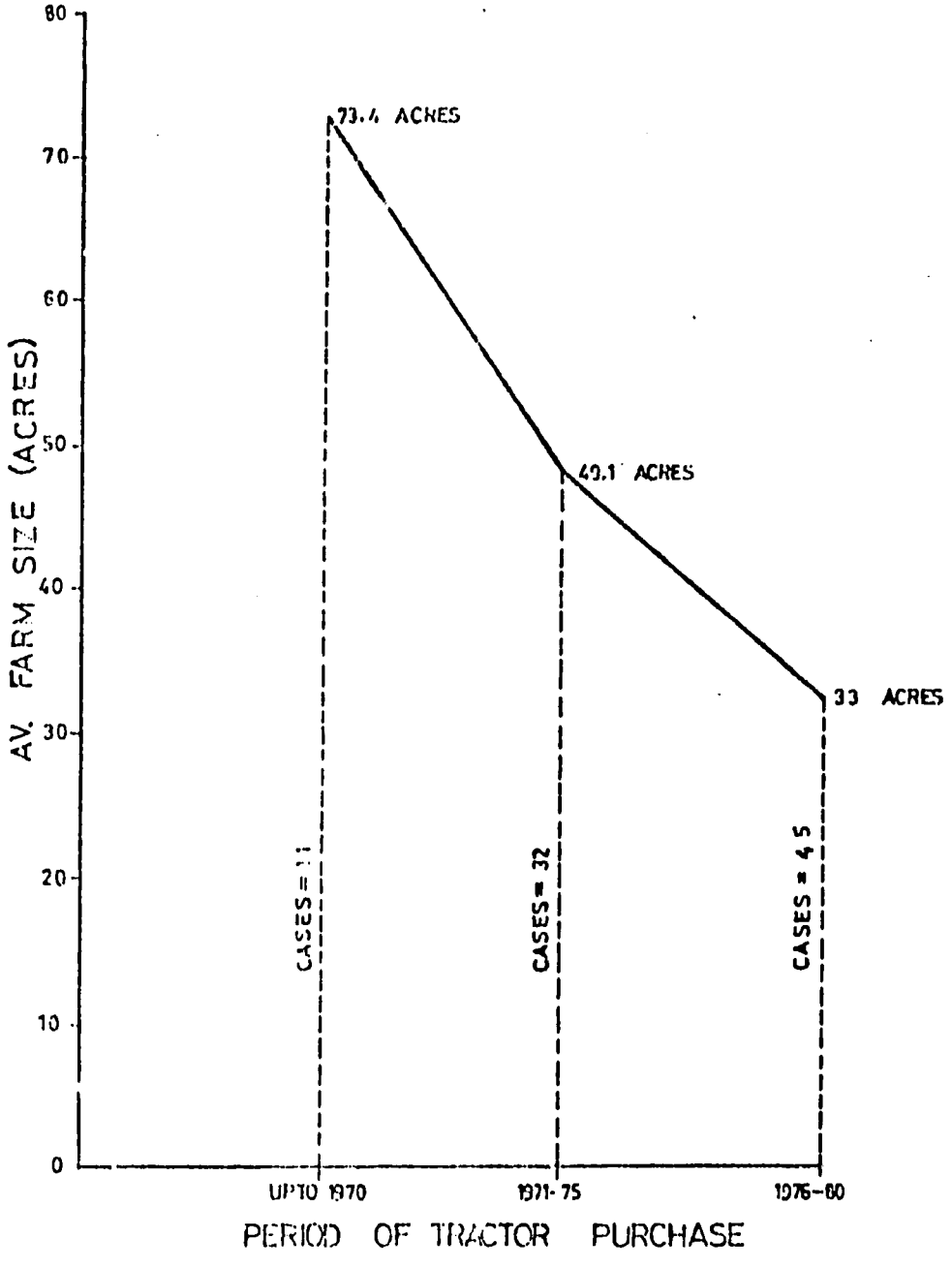


FIG. 3 PERIOD OF TRACTOR PURCHASE AND AVERAGE FARM SIZE

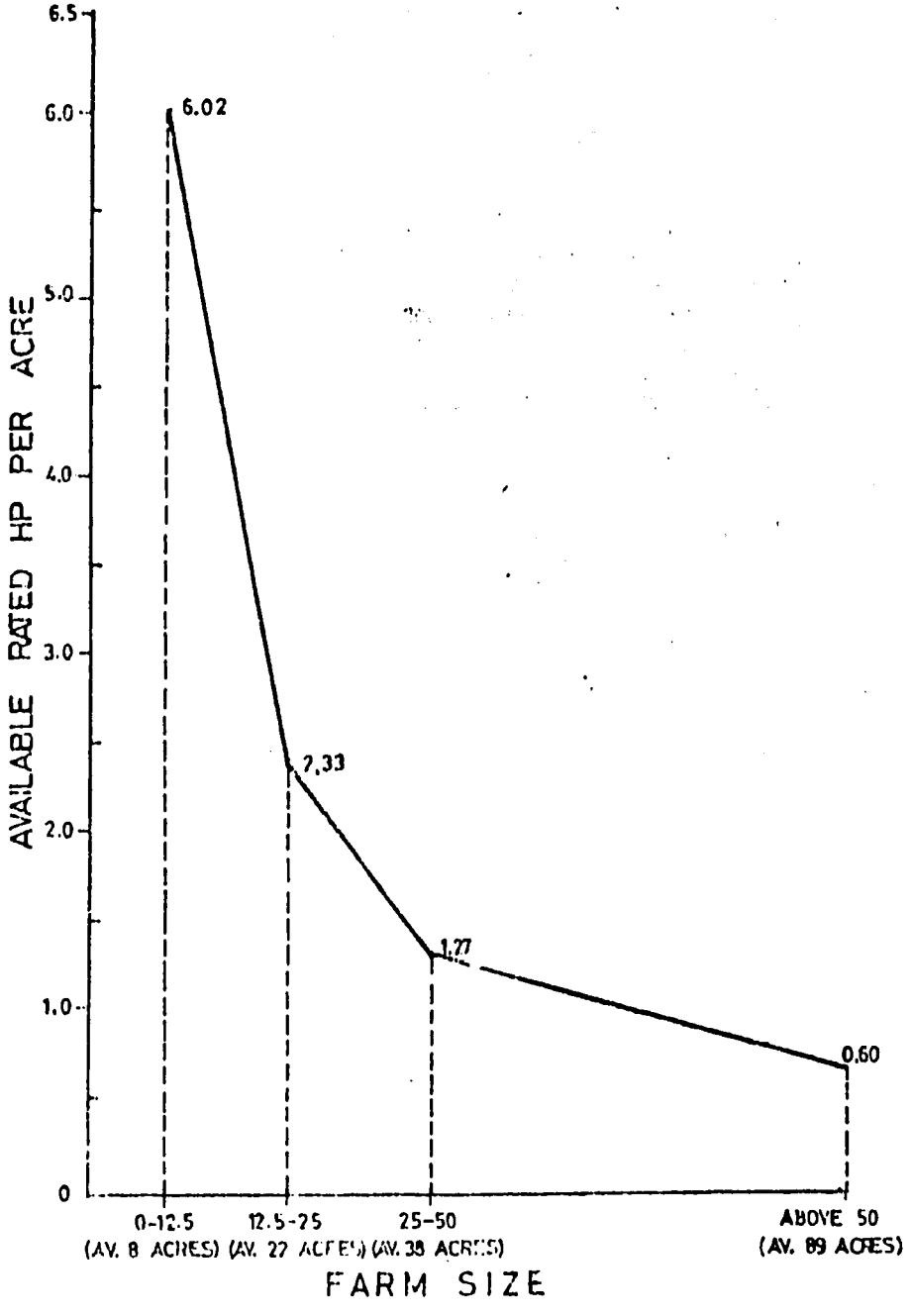
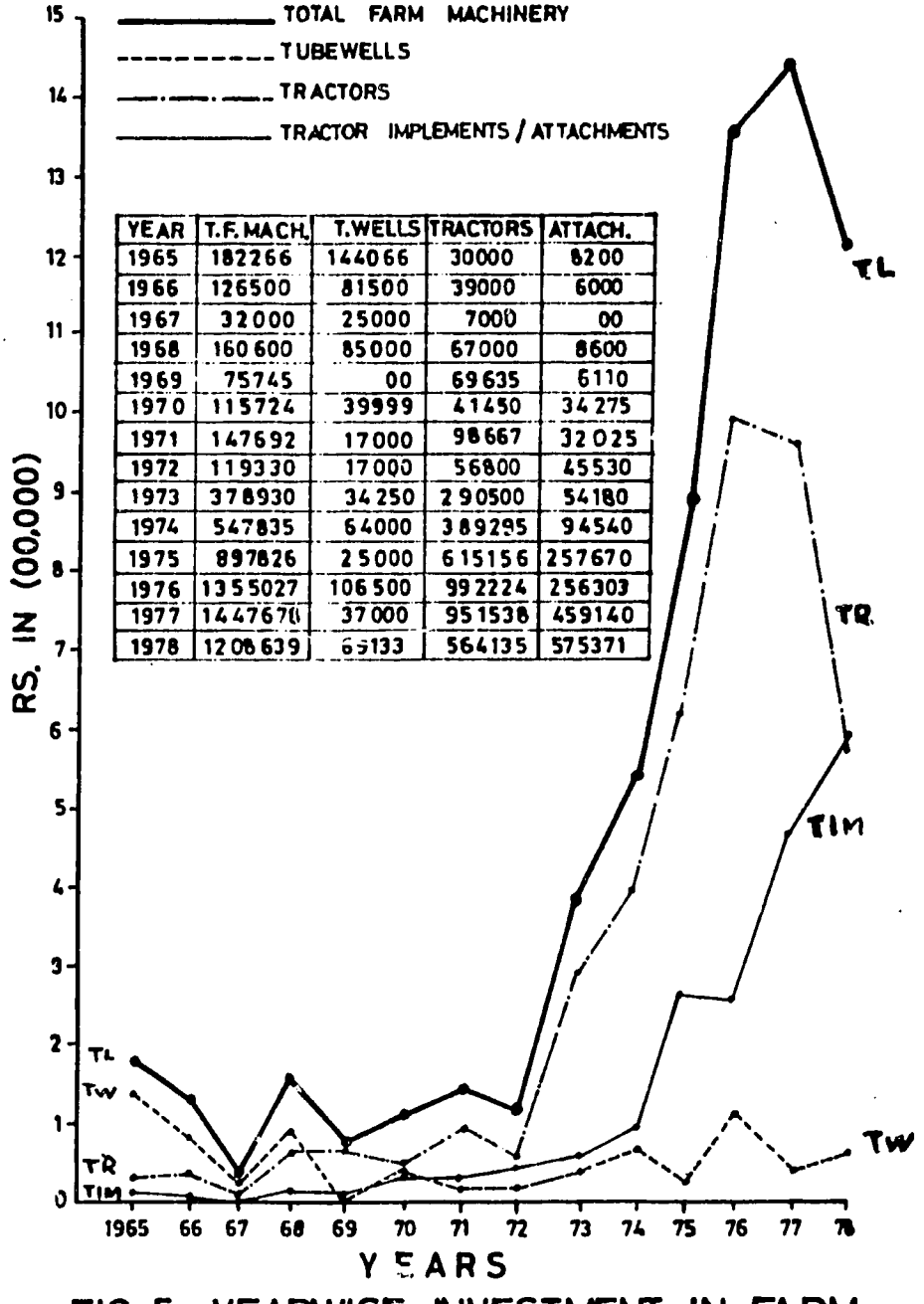


FIG. 4 RATED TRACTOR HORSE POWER PER ACRE ON SAMPLE FARMS



YEAR	T.F. MACH.	T.WELLS	TRACTORS	ATTACH.
1965	182266	144066	30000	8200
1966	126500	81500	39000	6000
1967	32000	25000	7000	00
1968	160600	85000	67000	8600
1969	75745	00	69635	6110
1970	115724	39999	41450	34275
1971	147692	17000	98667	32025
1972	119330	17000	56800	45530
1973	378930	34250	290500	54180
1974	547835	64000	389295	94540
1975	897826	25000	615156	257670
1976	1355027	106500	992224	256303
1977	1447670	37000	951538	459140
1978	1208639	65133	564135	575371

FIG. 5 YEARWISE INVESTMENT IN FARM MACHINERY (BREAK UP)

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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.

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