THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

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EFFECTS OF MECHANIZATION ON PRODUCTIVITY: WEST JAVA, INDONESIA

By

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ABSTRACT

The mechanization of land preparation has been expected to increase rice yield/ha. A study was undertaken in West Java in 1979-81 to evaluate the impact of mechanization on yields. Results of this research showed that after adjusting for crop failure and differences in fertilizer application there was no evidence to support the expection that mechanization increases yield.

I. INTRODUCTION

Agricultural extension agents and various Government officials have contended that due to a lack of power, rice land preparation is done by men and animals. It is contended that because power tillers and tractors can plow the land deeper and more completely, yield/ha can be increased if mechanized land preparation is adopted. Based on these assumptions, mechanization of land preparation has been promoted to encourage farmers to purchase mini tractors/power tillers in both densely populated Java-Bali and in the sparsely inhabited outer islands of Sulawesi and Sumatra.

II. OBJECTIVES

The purpose of this paper is to evaluate the impact of mechanization on rice yields. This issue will be evaluated by :

(1) comparing yields achieved on non-mechanized and mechanized farms.

(2) comparing yields achieved on non-mechanized and mechanized farms, adjusted for differences in crop failure.

(3) comparing yields achieved on mechanized and non-mechanized farms adjusted for crop failure and differences in fertilizer use.

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III. STUDY AREA

Indramayu and Subang Districts, located 161 and 205 km. East of Jakarta on the North coastal plain of Java, were chosen as the research site because 34% of all tillers in the 20 Districts of Java are found here.

These districts have a population density of about 500 persons/km^2 are largely irrigated, achieve rice yields of about 5 t/ha, and have a tiller population of approximately 457 units. (Siswosumarto, 1981).

IV. SURVEY DESIGN

Sampling. Sampling procedures were developed to identify a stratified sample of respondent that represented the agricultural diversity. A random sample of eight sub-districts (within the two districts) with the greatest number of hand tractors were selected. Then, four villages with four or more tractors were randomly selected in each district, and a block census of the eight villages was conducted covering over 1600 households. Census results were used to select a random sample of respondents who used human labor, animals and power tillers to complete land preparation. The sample size in each cell is noted in Table 1.

Survey. Data was collected using a standard questionnaire, during the 1979 dry (second crop), 1979 dry (third crop) 1979/1980 wet, 1980 dry (second crop). and 1980 dry (third crop) seasons. Analysis in this paper is primarily based on the survey data collected during the 1979 dry season (April through September), the 1979/80 wet season, and the 1980 dry season.

V. RESULTS

Data on yield, fertilizer use and crop failure is presented in Table 1 for non-mechanized and mechanized farms.

Yield differences. Data in Tabel 2 (col. 1) suggests that mechanized farms have higher yields than non-mechanized farms. Over the three seasons, the difference ranged from 62 kg/ha (W.S. 1979/80) to 586 kg/ha (D.S. 1980).

Yield differences, adjusted for crop failure. As shown in Table 1, crop failure was severe in the 1980 D.S. and this affected both mechanized and non-mechanized farms, much greater damage occurred in the non-mechanized area (24% vs. 2.6%). After adjusting yields to compensate for this exogenous effect (Table 2, col. 2), the yield on non-irrigated farms was 263 kg/ha greater than on mechanized farms.

Yield differences, adjusted for crop failure and fertilizer use. Data in Table 2 (col. 3) shows the difference in level of fertilizer applied by mechanized compared to non-mechanized farms. In all seasons, more fertilizer was applied by the mechanized farmers - ranging from 11 kg/ha in 1979/80 W.S. to 24 kg/ha in the 1979 D.S.

By assuming various values for the average in yield resulting from one kg of additional fertilizer, the contribution of fertilizer to mechanized yields can be netted out. In Table 2, using yields adjusted for crop failure, it is assumed the average productivity of one kg of fertilizer is 10 kg (col. 6), 9 kg (col.9) and 8 kg (col. 12) of yield increase/kg of fertilizer applied. For all seasons, these adjustments result in a negative yield difference - i.e. non-mechanized yields are greater than mechanized yields.

Alternatively, these results can be presented in terms of breakeven analysis. In Table 2, the value in parentheses after column 1 is the average fertilizer productivity that would have to be assumed to equalize mechanized and non-mechanized yields - before adjusting for crop losses. The value in parentheses after column 2 is the average productivity that must be assumed to equalize yields - after adjusting for crop losses. This data shows that an average fertilizer productivity assumption of 5.8 kg yield increase per kg of fertilizer is required to net out the yield differences between mechanized and non-mechanized farms in the 1979 D.S. and 1979/80 W.S. No fertilizer productivity assumption is required in the 1980 D.S. since crop loss adjusted yields are already higher on non-mechanized farms.

VI. CONCLUSION

After comparing yields on mechanized and non-mechanized farms, it is often concluded that mechanization increases yields because yields are higher on mechanized farms. Yet, because farmers who choose to mechanize also typically use higher input levels, such conclusions may be unjustified. After adjusting yield differences to take into consideration differences in crop lossed and input use, it was found that in all three seasons, higher yields were observed on non-mechanized farms.

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Table 1. Yield and Fertilizer Use per Ha, Consequences Cooperator, Indramayu and Subang Districts, West Java 1979 - 1980.

	Non Mechanized			Mechanized		
	Manual	Animal	Aggre-gate	Hire	Owner	Aggre-gate
Dry Season 1979						
- No.of Reporting	217	-	217	-	-	81
- Fertilizer :						
- Urea (Kg)	213	-	213	-	-	219
- TSP (Kg)	63	-	63	-	-	81
- Total (Kg)	276	-	276	-	-	300
- Yield (Kg)	2,835	-	2,835	-	-	2,975
- Crop Failure (%)	0	-	0	-	-	0
- Yield if CF = 0% a/	2,835	-	2,835	-	-	2,975
Wet Season 1979/80						
- No.of Reporting	56	100	156	61	68	129
- Fertilizer :						
- Urea (Kg)	226	250	241	238	242	240
- TSP (Kg)	74	70	71	81	84	83
- Total (Kg)	300	320	313	319	326	323
- Yield (Kg)	4,613	4,966	4,939	5,116	4,709	4,901
- Crop Failure (%)	0	0	0	0	0	0
- Yield if CF = 0% a/	4,613	4,966	4,939	5,116	4,709	4,901
Dry Season 1980						
- No.of Reporting	161	-	161	61	64	125
- Fertilizer :						
- Urea (Kg)	207	-	207	220	230	225
- TSP (Kg)	72	-	72	84	71	77
- Total (Kg)	279	-	279	304	301	302
- Yield (Kg)	2,993	-	2,993	3,632	3,528	3,579
- Crop Failure (%)	24.0	-	24.0	2.6	2.6	2.6
- Yield if CF = 0% a/	3,938	-	3,938	-	-	3,675

a/ Yield after adjusting for area affected by crop failure (harvested area yield).

Sources : Consequences of land preparation Mechanization in Indonesia : South Sulawesi and West Java.

Table 2. Yields on Non-Mechanized and Mechanized Farms, Adjusted for Crop Failure and Differences in Fertilizer Application, Indramayu and Subang Districts, West Java, 1979 - 1981.

Season	Yield diff. (unadjusted a/ (Kg/Ha)	Yield diff. (adjusted a/ (Kg/Ha)	Diff. in c/ fert. app. (Kg/Ha)	1 kg. fertilizer = 10 kg. rice			1 kg. fertilizer 9 kg. rice			1 kg. fertilizer 8 kg. rice		
				Expected yield d/ diff. due to diff. level of fert. app. (Kg/Ha)	(1-4) (Kg/Ha)	(2-4) (Kg/Ha)	Expected yield d/ diff. due to diff. level of fert. app. (Kg/Ha)	(1-7) (Kg/Ha)	(2-7) (Kg/Ha)	Expected yield d/ diff. due to diff. level of fert. app. (Kg/Ha)	(1-10) (Kg/Ha)	(2-10) (Kg/Ha)
	1	2	3	4	5	6	7	8	9	10	11	12
Dry Season 1979												
Agg. mech Vs. agg. non mech.	+140(5,8)	+140(5,8)	+24	+240	-100	-100	+216	- 76	- 76	+192	- 52	- 52
Wet Season 1979/1980												
Agg. mech. Vs. agg. non mech.	+ 62(5,6)	+ 62(5,6)	+11	+110	- 48	-48	+ 99	- 37	- 37	+ 88	- 26	- 26
Dry Season 1980												
Agg. mech. Vs. agg. non mech.	+586(25,5)	-263(N.A)	+23	+230	+356	-493	-207	+379	-470	+184	+402	-447

a/ Mechanized yields minus non-mechanized yields.
b/ Mechanized yields minus non-mechanized yields, after adjusting for crop failure.
c/ Mechanized fertilizer application rate minus non-mechanized fertilizer application rate.
d/ Expected yield difference between mechanized and non-mechanized after adjusting for various levels of yield response to fertilizer application.

N.A = Not Applicable.

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