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THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

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EFFECTS OF MECHANIZATION ON INTENSITY OF LAND USE, WEST JAVA, INDONESIA

By

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ABSTRACT

Increasing cropping intensity makes it possible to raise total production on a fixed land base. The mechanization of land preparation is often suggested as a means by which this goal can be achieved. Over 250 farmers who prepared their fields using men, animals and power tillers were interviewed in Subang and Indramayu District, West Java, Indonesia in 1979-80 to evaluate the relationship between power source and cropping intensity. Analysis of the data showed that mechanized farmers had only slightly higher cropping indices than non-mechanized and that non-mechanized farmers prepared their fields more rapidly in the wet season, but slower in the dry season than mechanized farmers.

INTRODUCTION

Total food crop production may be raised by increasing yields, area under cultivation and cropping intensity. In West Java, lowland rice yields already average 3.3 t/ha (1979) and with a population density of 561/km^2 (BPS, 1979), almost all suitable agricultural land is in production. On the other hand, the food cropping intensity was estimated to be only 1.25 in 1973 (Nyberg, 1979). In much of the irrigated area double cropped to rice, a third rice or non-rice crop is seldom grown. Consequently, agricultural scientists believe food crop production can be increased by raising cropping intensity, especially in irrigated environments.

Recently it has been suggested that a shortage of land preparation labor delays land preparation and as a result, constututes a constraint to crop intensification. Consequently, this operation should be mechanized in order to break the perceived bottleneck.

OBJECTIVES

The purpose of this paper is to evaluate the contribution of power tillers that have been introduced into West Java to increasing cropping intensity. This issue is evaluated by

1) comparing a sample of mechanized and non-mechanized farms to determine if mechanized farms have higher cropping intensities than non-mechanized.

2) comparing the time required for non-mechanized and mechanized farms to prepare their land, and

3) examining the relationship between changes in aggregate cropping intensity in the District and the number of tillers/tractors introduced.

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 the 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 (Table 1).

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 2.

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 1980 dry season (April through September) and the 1979 dry season (third crop).

RESULTS

Cropping intensity on non-mechanized and mechanized farms. If a shortage of labor is responsible for delays in land preparation and power tillers enable farmers to prepare their land more rapidly, farms prepared by tillers should show higher cropping intensities than those prepared with human or animal labor. Table 2 shows there was a small difference in cropping intensity associated with power source. In the sample of 300 respondents, manual farmers had a cropping intensity of 2.07 compared to animal users (2.14) and tractor users (2.17). In interpreting these results, we must keep in mind that the planting of a third crop in the research area was the result of the Government's INPRES program to stimulate secondary crop production. Since tiller owners tend to be large land owners and community leaders, they may be more responsive to Government demonstration programs.

Power source and rate of land preparation. If power tillers enable farmers to prepare their land more rapidly, the land preparation period should be shorter for mechanized than non-mechanized farmers. This hypothesis was tested by estimating the area prepared each week after water became available, as a percent of the area prepared by each type of power user.

In the wet season, the area prepared manually was completed most rapidly, followed by animal, tractor owners, and tractor hire (Figure 1). This relationship is logical for two reasons. First, farmers preparing their land manually had the smallest farms (1.01 ha), followed by those using animals (1.64 ha), tiller hire (2.23 ha), and tiller owners (5.50 ha) (Consequences Team, 1981). When a farm is small, farmers typically hire enough labor to complete the work in a short time with the hired labor moving on to the next farmer. In contrast, a single tiller typically plows about 0.5 ha/day, returning to the field in two weeks to harrow at a rate of 0.5 ha/day. Consequently, the elapse time required to prepare a 5.5 ha field is about 35 days. Second, tractor owners normally prepare their own land before offering contract services. Consequently, individuals waiting for contract services will necessarily complete land preparation later than tractor owners.

In the dry season, tractor owners and contract users completed land preparation more rapidly than farmers using manual methods (Figure 1). Yet, the main difference is due to the fact that land preparation was initiated 1-2 weeks later on manual farms. Typically, harvesting the first rice crop and land preparation for the second crop occur almost simultaneously in the same area. As harvesting pays substantially more than land preparation, the observed delay in initiating manual land preparation may be due to a shortage of labor until the harvest is completed. On the other hand, it is not clear why farmers hiring tillers prepare their land more rapidly than tiller owners.

District cropping intensity and the introduction of mechanization. If mechanization contributes to increasing rice cropping intensity, it should be possible to observe higher aggregate (district wide) cropping indices as the number of units grows. Table 4 shows that the tiller/mini-tractor population has increased rapidly from 1976 to 1979. Yet, in Subang there appears to be no relationship between tiller number and rice cropping intensity. On the other hand, in Indramayu, the rice cropping intensity has increased as tractor numbers grew.

While the above analysis is indicative, it is important to note that in terms of the total area cropped to rice, tillers and mini-tractor appear to have prepared a maximum of only 2% and 5% of the land in Subang and Indramayu Districts in 1978 (Table 4). Given the relatively small area prepared, it is impossible to draw any firm conclusions about the relationship between the introduction of mechanized land preparation and cropping intensity at the aggregate level.

Farmers reasons for using a tractor. Although researchers and policy makers may perceive of the tiller as a means by which cropping intensity can be increased, this is not true for the tiller users. In fact, none of the 68 tiller owners interviewed (W.S. 1979/80) expressed an interest in growing a third crop as a reason for purchasing a tiller. On the contrary, the most important advantages expressed were to reduce costs of land preparation (51%), to plant the crop on time (24%) and to plow deeper/more thoroughly (22%).

Constraints to crop intensification. Farmers in the Jatiluhur Irrigation area where the project is located typically plant two rice crops in a year. When asked why they did not grow a third crop, 39% of the 263 farmers reporting cited "risk" (especially rat damage), 20% "no time after the second rice crop", 16% "poor drainage", (especially for the areas there near the canals), 15% that "it is not a common practice in the area" and 9% "a shortage of water". It is important to note that rat damage is frequently heavy on the third cropping because few farmer grow a third crop. Consequently, there are many places for rats to hide and propagate. It seems that the cropping intensity could be significantly raised if all the farmers were strongly motivated to plant large areas in a third crop in order to reduce rat damage and if seed, fertilizer, pesticide, water and credit were available when needed.

CONCLUSION

Based on the data collected in Subang and Indramayu during 1979-80 there appears to be only a weak relationship between cropping intensity and mechanized land preparation. The sample of respondents who prepared their land manually had cropping indices of 2.07, with animals 2.14 and with tillers 2.17. In terms of time required to prepare the land, manual and animal users completed land preparation more rapidly in the wet, but less rapidly in the dry season. Although over 500 tillers/mini-tractors have been introduced into the study area, it is not possible to identify a consistent relationship over time between changes in cropping intensity and number of units -- probably because about 95% or more of the area is still prepared manually or with animals.

Future research needs to focus on the impact of water availability, pests(rats) and input availability as constraints to growing a third non-rice crop.

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Table 1. Characteristics of Subang and Indramayu Districts, West Java, Indonesia.

Characteristic	Subang	Indramayu
Area $(km)^2$	2,052	1,964
Population density (persons/km^2)[a]	474	557
Percent irrigated	85.6	68.3
Wet season yield (t/ha)	5.8[b]	4.8[c]
Tiller population	197[d]	260[e]

a) 1979

b) 1978/79, lowland rice

c) 1977/78, lowland rice

d) 1979

e) 1978

Sources: Consequences Team, 1981

Table 2. Number of respondents in each cell, by power source, Consequences Survey, Subang and Indramayu Districts, Indonesia, 1979-80.

Season	Non-mechanized		Mechanized[a]	
	Manual	Animal[c]	Hire[b]	Owner
Wet 1979/80	56	100	61	68
Dry 1980	161	0	61	64

a) Two wheel power tiller

b) Including tractor plus manual and tractor plus animal

c) Including manual plus animal

Source: Consequences Team

Table 3. Sample characteristics, cropping pattern and cropping intensity, by power source, Consequences survey, Subang and Indramayu Districts, West Java, Indonesia, 1978-79.

	Manual used in:	Animal used in:		Tiller used in:		
	WS and DS	WS only	WS and DS	WS only	DS only	WS and DS
Sample size	58	112	2	47	8	73
Total area (ha)	64.7	185.6	5.8	123.5	15.6	297.7
Cropping pattern (%)						
Rice-rice	93.0	85.7	100	80.9	62.5	86.3
Rice-rice-secondary	7.0	14.3	0	19.1	37.5	13.7
Cropping intensity	2.07	2.14	2.00	2.19	2.38	2.14
		2.14			2.17	

Source: Consequences Survey

Table 4. Tiller population and rice cropping intensity, by year, Subang and Indramayu Districts, West Java, Indonesia, 1976-79.

	Subang			Indramayu			
	Tillers[a]		RCI[c]	Tractors[a]			RCI[c]
	No.	Area prepared (%)[b]	(index)	Tillers (no.)	Mini-tractors (no.)	Area prepared (%)[b]	(index)
1976	72	1.3	2.09	29	0	0.4	1.61
1977	86	1.4	1.95	98	60	3.0	1.65
1978	118	2.0	1.89	260	77	5.2	1.72
1979	197	3.7	2.07	N.A.	N.A.	N.A.	1.75

N.A. = Data not available

a) Data from Dinas Pertanian Kabupaten.

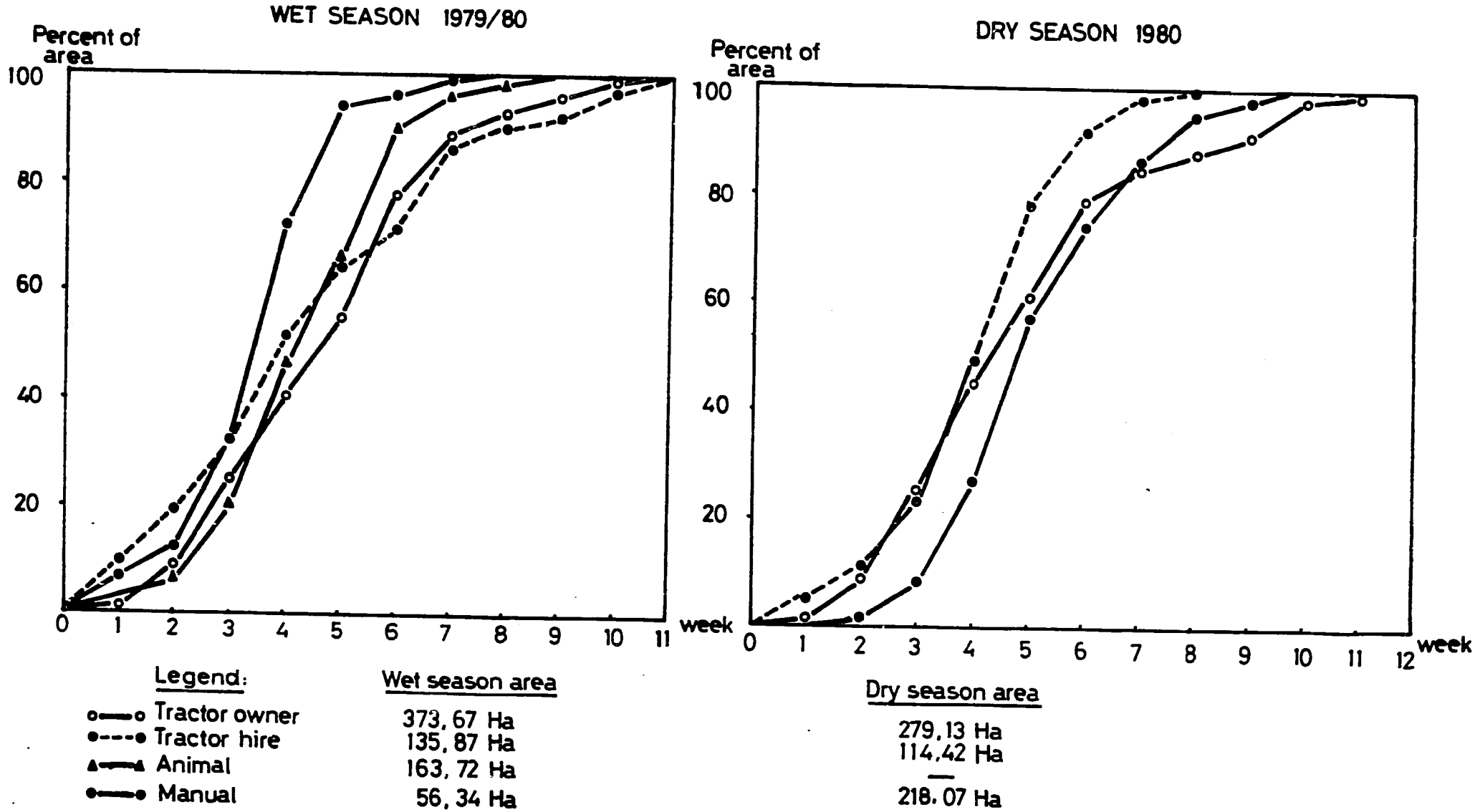
b) Assuming all tillers are operating and have an average capacity utilization of 25 ha/year (Hurun, 1981). Assuming all mini-tractors are operating and have a capacity utilization of 50 ha/year (Consequences Team, 1981). Total area planted each year from (Direktorat Pembinaan Mutu Benih, respective years).

c) Rice cropping intensity calculated as wet season lowland rice area divided by dry season lowland rice area (Direktorat Pembinaan Mutu Benih, respective years).

Figure 1. Workplan for analyses: August 1981 - August 1982

Site	Survey: Staff	Survey: Students	Survey: Decomposition	FRK
Philippines	P. Lim P. Moran	J. Sison H. Ur-Rahman B. Reyes	Y. Tan	A Generalla
Thailand	A. Aguilar G. O'G. Sharrock (ODA fellow		Y. Tan A. Wongsangaroonsri	--
Indonesia W. Java	M. Sumiran Post-doc	Bunasor Sri Bagyo Siregar Y. Saefudin Sugianto K. Nehen	Y. Tan	--
S. Sulawesi	"	Y. Maamun Sultoni J. Hafsah		

Figure. 1. Cumulative frequency distribution of land preparation time for sample cooperations land, Subang and Indramayu Districts, West Java 1979-80.



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