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THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

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EFFECT OF MECHANIZATION ON INTENSITY OF LAND USE SOUTH SULAWESI, INDONESIA

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ABSTRACT

Increasing cropping intensity is one way to increase production on a fixed land base. Mechanized land preparation may contribute to this objective. During 1979-81 over 250 farmers in Sidrap and Pinrang Districts, South Sulawesi, were surveyed and farm activity records were maintained on 50 respondents, stratified to represent the major non-mechanized and mechanized land preparation techniques used. The data indicated that mechanized rainfed farmers had higher cropping intensities than the non-mechanized, but for irrigated farmers there was no difference. In the wet season, non-mechanized farmers generally prepared their fields more rapidly than those using a mini-tractor. For the districts as a whole, the increase in mini-tractor numbers did not cause an observable increase in cropping intensity.

INTRODUCTION

Total food crop production may be raised by increasing yields, cultivated area and cropping intensity. In South Sulawesi, lowland rice yields average 3.2 t/ha (BPS, 1979) and the food cropping index was only 1.5 in 1973 (Nyberg, 1979). While these data suggest there is a potential for increasing yields and cropping intensity, the population density is only 60 persons/km^2 (BPS, 1979). Consequently, a shortage of labor may act as a constraint to timely land preparation and delay the turn-around-time between crops.

Mini-tractors have been introduced into the Province since 1974 in the expectation that these units will enable the farmers to expand the cultivated area and increase the cropping intensity.

OBJECTIVES

The purpose of this paper is to evaluate the impact of the introduction of mini-tractors on cropping intensity. This issue is evaluated by:

1) comparing the cropping patterns (intensity) of farmers before and after they mechanized land preparation

2) comparing the rate at which land preparation is completed by alternative techniques, and

3) observing the relationship between the increase in the number of mini-tractor and changes in cropping intensity in the districts.

STUDY AREA

Sidrap and Pinrang Districts are located about 200 km north of Ujung Pandang, the capital of South Sulawesi. This area was chosen as the research site because 51% of all the mini-tractors in the Province are found in these districts (Maamun, 1979).

These districts have a population density of about 100 persons/km^2 close to one-third of the agricultural area is irrigated, lowland rice yields average around 3.0 t/ha, and they have a mini-tractor population of nearly 600 units (Table 1).

SURVEY DESIGN

Sampling. Sampling procedures were developed to identify a stratified sample of respondents who represented the existing agricultural diversity. First, a random sample of eight sub-districts (among the two districts) with ten or more tractors was identified. Then, four villages in each district with five or more tractors were randomly selected. Next, a block census of the eight villages was conducted covering over 2000 households. Based on data collected, strata were chosen to represent the typical environments and power sources as shown in Table 2.

Survey

Data was collected with a comprehensive questionnaire developed and used to interview about 250 respondents during the 1979 wet, 1979/1980 dry (second crop), 1979/1980 dry (third crop), 1980 wet and 1980/1981 dry (second crop) seasons. In addition, weekly work records were maintained during the first four seasons (1979 wet through 1980 wet) including all environment/power source strata covered by the survey, but concentrated in 4 out of 8 villages and 70 farmers. Analysis presented in this paper is mainly based on the data collected on the 1979 wet season (March through October) using the survey and record keeping data.

RESULTS

Cropping intensity before and after mechanization. If a lack of power is the prevailing constraint to increasing cropping intensity, it should be possible to observe in cropping intensity among farmers who adopt mechanized land preparation. Table 3 classifies the record keeping cooperators who used custom hire services according to whether their cropping intensity fell, stayed the same or increased after adopting a mini-tractor for land preparation.

Among the 18 rainfed cooperators who adopted custom services 28% increased their cropping intensity - one farmer planted a second rice crop and four grew corn after rice. Consequently, although the sample size is small it appears that in rainfed areas mechanization may contribute to increasing cropping intensity. On the other hand, among the 26 irrigated cooperators who adopted custom services, none increased their cropping intensity after choosing to use mechanized land preparation. These results may be explained in terms of the relative income earned by farmers in the two environments. Almost all the irrigated farmers grew two rice crops, typically producing over 3 t/ha and operated an average of 1.25 ha of land. On the other hand, rainfed farmers typically grew only one rice crop, yielding less than the irrigated crop and operated an average of 1.5 ha. Consequently, there probably exists a greater incentive for rainfed farmers to try for a second crop than for irrigated farmers to attempt to grow a third crop.

Power source and rate of land preparation. If power tillers enable farmers to prepare their land more rapidly, the land preparation time 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 rainfed area in the wet season, the land prepared manually was completed most rapidly, followed by man plus tractor, animal only, man plus animal plus tractor and man plus animal (Figure 1). Yet, the area cultivated by man and man plus tractor was small, so our attention should focus on the reasons animal power users completed land preparation more rapidly than tractor users. This is probably due to the fact that almost all animal users own and control their power source, but almost all tractor users hire custom services. Consequently, each user must wait his turn in order to hire the tractor.

In the irrigated area, the situation is less clear, although land prepared by man and animal or animal only is generally completed most rapidly, followed by mechanized and manual. Non-mechanized farmers probably completed land preparation more rapidly than the mechanized respondents due to the queuing problem noted for rainfed farms. On the other hand, manually cultivated land is probably prepared most slowly because 85% of the labor used by these irrigated farmers is supplied by the family, the average farm size is about 1.25 ha and typically 1-2 adult males characterize a household (Consequences Team, 1981). With these resources, it would take about one month for a farmer to prepare his land with the observed requirement of 29.2 MD/ha (Bernsten, 1981) using mainly family labor. While this does not completly explain the long period over which manual farmers prepared their land, it does point out the potential contribution of tractor and animal power to reduce land preparation time in areas such as Sidrap and Pinrang where there is almost no landless labor to hire.

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 number of mini-tractors has grown rapidly from 1976 to 1980. Yet, in Sidrap and Pinrang there appears to be no correlation between mini-tractor numbers and rice cropping intensity.

Part of the difficulty in identifying the hypothesized relationship is the fact that reported planted area varies considerably from year-to-year. While this may be due to estimation errors, it is also likely the result of real changes in planted area. For example, during the period covered by the field survey, farmers in some of our sample villages could not plant a crop because the irrigation canal was being repaired.

Farmers' reasons for using a mini-tractor. While it may be technically possible to increase cropping intensity thru the introduction of mini-tractors, farmers must be motivated to achieve this objective in order for the benefit to be realized. Survey results showed that the main reasons farmers bought mini-tractors was to enable them to plant on time (30%), improve the quality of land preparation (26%), to increase yield (10%) and to reduce drudgery (8%). For farmers who hired custom services the main reasons given were to improve the quality of land preparation (45%), to enable them to plant on time (31%), to increase yield (22%) and due to a shortage of labor (13%). These results suggest that increasing cropping intensity is not an important reason for tractor purchase of custom service adoption.

Constraints to crop intensification. In the rainfed areas farmers typically grow a single rainfed rice crop followed, in some instances, by secondary crops. Research results from similar environments indicate there are technologies which could enable farmers to grow a second crop (McIntosh, 1980). Yet, in order to achieve this objective, these practices must be demonstrated to the farmers.

On the other hand, in the irrigated areas, two rice crops are normally grown, after which the fields are left fallow. Technologies have been developed for irrigated environments that enable farmers to plant an additional non-rice crop which matures on residual moisture (McIntosh, 1980). Yet, these practices must be first demonstrated before they can be adopted. At the same time, irrigated farms are relatively large in Sidrap & Pinrang and yields are quite high. Consequently, farmers may not be interested in making the additional effort required to grow a third crop unless irrigation water is guaranteed.

Consequently, unless a Government program is initiated to test and demonstrate technologies that can enable farmers to increase cropping intensity, inputs such as fertilizer, pesticides, seed and credit are made available, and large enough areas are planted to spread the risk of rat damage; it is unlikely that cropping intensity will increase.

CONCLUSION

The data collected in Sidrap and Pinrang Districts during 1979-1980, suggests that mini-tractor adoption has contributed towards increasing food cropping intensity in rainfed, but not in irrigated areas. On the other hand, mechanization has not increased the speed of land preparation for rice in the wet season. Based on available secondary data it is not possible to identify a systematic relationship between number of mini-tractors introduced into the districts and changes in the rice cropping intensity - even though about 25% of the area is now prepared by mini-tractors.

Future research needs to focus on testing/transferring new technologies and management practices for increasing cropping intensity and the impact of water availability, pests (rats) and input availability as constraints to crop intensification.

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Table 1. Characteristics of Sidrap and Pinrang Districts, South Sulawesi, Indonesia

	Sidrap	Pinrang
Area (km^2)	2,340	2,508
Population density (persons/km^2)[a]	83	108
Percent irrigated	35	30
Lowland yield (t/ha)[b]	3.5	2.8
Tiller population[c]	303	297

[a]1980

[b]1979 (B.P.S., 1979)

[c]1980 Dinas Pertanian Kabupaten

Table 2. Number of respondents in each sample cell by water and power sources, Sidrap and Pinrang Districts, South Sulawesi, Indonesia, 1979.

Environments	Non-mechanized				Mechanized
	Man only	Animal only	Man + animal[a]	Total	Tractor[b]
Rainfed	13	41	30	84	48
Irrigated	28	31	23	82	38
Total	41	72	53	166	86

[a]Man for first plowing and animal for second plowing (harrowing).

[b]Mini-tractor (12-15 hp.) users include farmers preparing their land by man plus tractor, and man plus animal plus tractor.

Table 3. Change in cropping intensity associated with adoption of mini-tractor land preparation, by environment, Sidrap and Pinrang, South Sulawesi, Indonesia, 1974-80.

Environment	Change in cropping intensity		
	Reduced	Same	Increased
Rainfed (N=18)			
No.	2	11	5
Pct.	11	61	28
Irrigated (N=26)			
No.	1	25	0
Pct.	4	96	0

Table 4. Tiller population and rice cropping intensity by year, Sidrap and Pinrang Districts, South Sulawesi, Indonesia, 1976-79.

Year	Sidrap			Pinrang		
	Mini-tractors		RCI[c]	Mini-tractors		RCI[c]
	No.[a]	Area prepared(%)[b]	(Index)	No.[a]	Area prepared(%)[b]	(Index)
1976	76	6.1	1.68	97	9.9	1.65
1977	148	NA	NA	109	8.9	1.99
1978	151	12.2	1.63	131	10.1	1.69
1979	297	21.5	1.59	208	18.3	1.62
1980	303	23.0[d]	NA	297	24.8[d]	NA

NA = Data not available

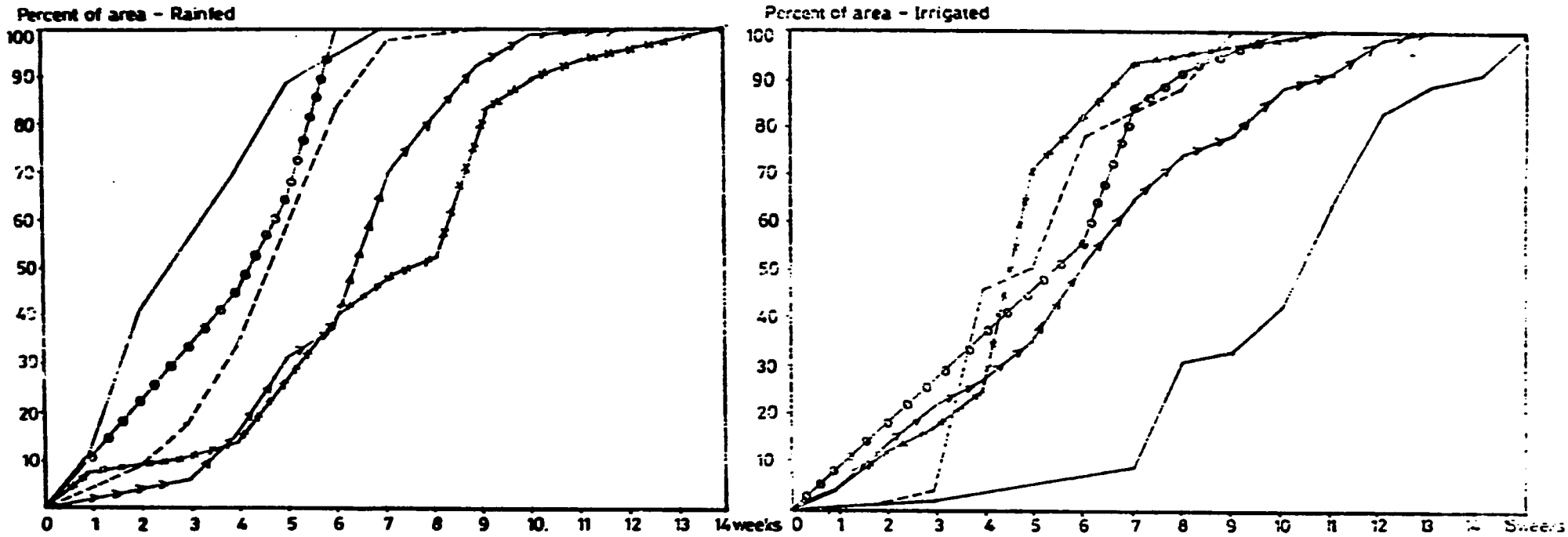
[a]Data from Dinas Pertanian Kabupaten

[b]Assuming all mini-tractors are operating and have an average capacity of 50 ha/year (Consequences Team, 1981).

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

[d]Planted area data not available for 1980, so the calculation is based on the average of hectares planted in 1978 and 1979.

Figure 1. Cummulative frequency distribution of land preparation time for sample cooperators land in Sindrap and Pinrang District. SOUTHSULAWESI, Wet season 1979.



LEGEND

- Man (M)
- Animal (A)
- Man + animal (MA)
- Man + tractor (MT)
- Man + animal + tractor (MAT/AT) or animal + tractor

Rainfed area (ha)	
M	3.37
A	50.93
MA	22.39
MT	2.65
MAT/AT	47.02

Irrigated area (ha)	
M	11.24
A	18.73
MA	21.10
MT	5.34
MAT/AT	61.59

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