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THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

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THE POTENTIAL FOR AGRICULTURAL MECHANIZATION AND LABOR MARKETS IN EAST JAVA

By

Kabul Santoso
Jember University

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ABSTRACT

Primary and secondary data were collected from 120 Kampungs in 24 villages in 3 Kabupatens of East Java in order to estimate the need for mechanization. This need was quantified on the basis of a ranking between villages for each of 13 variables. The amount of power currently available for land cultivation and of land to be cultivated was also compared. Results indicated potential for mechanization in most areas. The cost of land preparation by hand tractors was often cheaper than by traditional methods and the time required was less. Finally it was concluded the development of agricultural mechanization will cause little unemployment because of opportunities outside the agricultural sector.

INTRODUCTION

The land area in East Java is 47,922 sq km and there is a population of 30,398,780 persons. The population density is 634/sq km. The cultivable agricultural land is 3,138,846 ha. The estimated ratio between man-power and agricultural land is 9.68 men per hectare. In East Java there are 19,911,200 farmers which is 3,982,240 households, and in general a farmer owns an average of 0.16 hectare.

The small average size of land ownership however does not mean that there are extra labourers in the agricultural sector. The marginal farmers and landless laborers find employment because:

1. The government has carried out a programme of "Padat Karya" (public works programs) in the rural areas as well as urban areas to create employment opportunities.

2. The planting times in the rural areas are staggered so that the farm labourers and farmers with small operations are still able to work in others' rice fields.

3. The rural young men, especially the educated ones, seem to be reluctant to work in rice fields.

Besides this, new land-cultivating tools have been introduced in areas of East Java. They are two-wheel and four-wheel tractors. In the areas where irrigation is not satisfactory, several kinds of pumpsets are utilized. These pumps are used to raise water from the river to the rice fields in order to increase the planting and harvesting frequency. Duff (IRRI) has emphasized that three steps in technology transfer deserve emphasis. These are the transfer of materials, transfer of knowledge, and transfer of capacity. Any of these changes may occur through multinationals, national agencies, and private agencies.

The development of agricultural machinery especially the tractors creates various problems:

1. A dilemma arises over the need to use machinery in the land-cultivating process to improve the planting system and on the need to lower expenses. On the other hand, use of the "tractor" will reduce the amount of manpower in the agricultural sector. As a matter of fact, the "labour intensive" system in Java has not been able to absorb the available manpower. Such a situation happens when the tractor really replaces the laborers and animals in cultivating the land.

2. A clash of objectives arises in society. Some people want to use mechanization because of efficiency (even though they seem to be unable to repair the machine in case it is damaged). On the other hand the idea of maintaining the traditional land cultivation system still governs some other people. It means they want to increase the number of draft animals and beef-cattle at the same time. By doing so they will increase their income. Based on these ideas of the author, this study will examine the following:

   a. The potential for mechanization,

   b. The economic value of two-wheel and four-wheel tractors,

   c. The condition of labour-markets and the influence of mechanization on the labour-markets.

Selection of Sample Villages

This study is concerned with the population of farmers in East Java. Consequently, this statistical population is very large, and because of limited funds, researchers, and time, it was narrowed to include only those farmers who plant rice. Since this is still too large a population for sampling purposes, the size has been further narrowed in the following manner:

1. This study was restricted to those regions where some farmers are using agricultural machinery.

2. East Java is subdivided into Kabupatens which are administrative units. Three Kabupatens were selected:

   a. Jember Kabupaten
   b. Bondowoso Kabupaten
   c. Probolinggo Kabupaten

   These three Kabupatens were chosen because some farmers are using hand tractors to plow their fields. Other farmers in these three Kabupatens are also using animal power and man-power to prepare the fields.

3. Each Kabupaten is sibdivided into Kecamatans, and four Kecamatans were randomly selected in each one to give a total of 12 Kecamatans.

4. Within each Kecamatan, there is a further subdivision into Desa which are villages and are the lowest administrative unit. Two villages were selected randomly in each Kecamatan, yielding 24 villages for the study.

5. Although not an administrative unit, villages are composed of a number of pedukuhans which are Kampungs. In each of the selected villages, the researchers in the project then randomly choose 5 kampungs in each village to give a total of 120. In each Kampung, 5 to 10 respondents were randomly selected. These respondents were farmers who owned irrigated fields (sawah), progressive farmers (petani maju), and farm laborers.

Data Collected.

To satisfy the requirements of the methodology in this study, two types of data were collected:

1. Primary data obtained by interviewing the respondents using a questionnaire.

2. Secondary data collected from each administrative unit.

The data collected were as follows:

1. Total population
2. Total number of draft animals
3. Total number of tractors
4. Total number of "power tillers" that are operating and total that are broken down.
5. Number of work days for humans, animals, and tractors in the sawah one month
6. Total number of work hours in agriculture per day for humans, animals, and tractors
7. Area of agricultural land
8. Area of agricultural land cultivated
9. Time required to prepare the soil by people, animals, and tractors
10. Wage rates of agricultural laborers
11. Rental payment for draft animals (Kerbau and cattle)
12. Cost of soil preparation by humans, animals, and tractors
13. Yields of rice in 1970, 1975, 1979
14. Labor requirements in 1975, 1976, 1977, 1978, and 1979
15. Additional laborers from outside the village needed to prepare the fields for rice production
16. Total amount of human and animal power needed to prepare the rice fields.

17. Possibilities of finding work outside of agriculture in the wet season of 1975 to 1979

METHODOLOGY

In order to estimate the demand for mechanization this study has used the methodology developed by Bernsten and Sinaga (1979).

The monthly demand for lowland rice land preparation labor may be approximated as the area that was planted the previous year during that month. The area that can be prepared by the available supply of labor, carabao, power tillers and mini-tractors may be approximated by:

1. $S_{ha} = M_{ha} + A_{ha} + P_{ha} + MT_{ha}$

2. $M_{ha} = \{ Ma\{ (MpAgWf)\} - \{2(AaApAw + PaPpPw + MTaMTpMTw)\}\} / MD$

3. $A_{ha} = Aa(ApAw)/AD$

4. $P_{ha} = Pa(PpPw)/PD$

5. $MT_{ha} = MTaMTpMtw/MTD$

where:

S_{ha} = estimated hectares/months that is prepared by existing supply of human labor, animals, and machinery

M_{ha} = estimated hectares/month prepared by existing human labor

A_{ha} = estimated hectares/month prepared by existing animal labor

P_{ha} = estimated hectares/month prepared by existing power tillers

MT_{ha} = estimated hectares/month prepared by existing mini-tractors

Ma = days/month a man normally works

Aa = days/month a draft animal is normally used

Pa = days/month a power tiller is normally used

MTa = days/month a mini-tractor is normally used

Mp = male population

Ap = draft animal population

Pp = power tiller population

MTp = mini-tractor population

Ag = percent of male population in agriculture

Wf = percent of males in labor force (15-54 years old)

Aw = percent of draft animal of working age

Pw = percent of power tiller operating

MTw = percent of mini-tractors operating

MD = mandays required to cultivate 1 hectare

AD = animal days required to cultivate 1 hectare

PD = power tiller days required to cultivate 1 hectare

MTD = mini-tractor days required to cultivate 1 hectare

According to Bernsten and Sinaga, the methodology suffers from at least three weaknesses. First, we know that labor is mobile with residents of a village migrating to other areas for seasonal employment and vice versa. Yet, by assuming mobility of labor, this model can be expanded to include several villages, irrigation blocks, sub-districts, or districts and the effect of this expansion of the labor supply-demand balance can be observed in each level of aggregation. Second, the area planted in a given month may have been prepared over the previous several months, but not transplanted at that time. Farmers generally plant during a common short period to avoid excessive rat damage which would occur if the field was planted out of phase with others in the community. Hence, while this methodology is indicative, it will not provide a conclusive answer to whether or not a power constraint exists which delays land preparation. Third, the methodology does not provide any insights into the related potential benefits from mechanization such as its impact on yield, area expansion, reducing turn-around time and reducing costs of land preparation.

It may be possible to evaluate the probable impact of the mechanization of land preparation by using a set of indirect or proxy variables. Of course, the validity of this approach, according to Bernsten and Sinaga, rests on our ability to identify a relevant set of proxies that can be easily estimated for each village. Table 1 presents a hypothesized set of variables selected to measure the impact of mechanization on yield, area, cropping intensification, net returns, and labor displacement.

The data can be used as described below. First, once collected for a set of villages, the data may be entered into a matrix. For each village, the value for each variable can be compared to the mean, maximum, and minimum values for the data set. Examination of the values for each variable will identify those for which the variability is greatest and as a consequence, may have the greatest predictive power. Also, it is probable that some of the variables will be highly related. By using correlation analysis, it is possible to identify a subset of those variables that are independent. In future data collection efforts, this reduced set of data could be collected, thereby reducing the time required to assemble and evaluate the data.

Second, once the set of "best" variables is identified an indicator index could be developed by ranking each village in terms of each of the variables. For example, if there were 30 villages surveyed, the one with the greatest percentage increase in real land preparation wages (indicator TLS) would be assigned a score of one and the village with the smallest change the value 30. After all villages are ranked in this manner, the scores for all variables for each village, can then be summed (Table 2). The village with the lowest score would be the one with the greatest potential need for the mechanization of land preparation. Alternatively, the researcher may choose to assign weights to the various indicator variables to reflect preferences regarding the trade off, for example, between increasing yield through better weed control at the cost of displacing labor.

Third, according to Bernsten and Sinaga having identified villages where mechanization seems to be needed most, validation surveys, could be undertaken in these villages to determine the social, economic, and institutional factors responsible for each villages' low score on the indicator index. For example, in one village indicator R may suggest that land preparation is extended over several weeks, but from the survey we learn that this is because irrigation water is not available. In another village, indicator CX may show that the cropping index is very low, but from the survey we learn that 50 percent of the farmers rotate lowland rice with sugarcane. In a third village indicator variable A tell us that the uncultivated area/farmer is large, but the survey shows that this rainfed land is owned by a few families who use it to graze cattle. Consequently, the on-site validation survey is necessary to identify the primary constraints and permit us to differentiate between villages with a real need for mechanization from those with other problems.

In addition, such studies would make it possible to recommend alternative technological solutions for breaking observed labor bottlenecks. For example, where transplanting is extended over a long period of time it may be possible to introduce dry seeded rice and thereby reduce the demand for labor during the peak land preparation period.

Mechanization Potential

The values of the various indexes for each of the 24 villages are shown in Tables 3, 4 and 5. Summarized results of the analysis for the 24 villages are shown in Table 6.

To determine if the land preparation capacity in the villages is adequate or if there is a potential for mechanization, one must compare the dependent variable S_{ha} (estimated hectares/month prepared by existing supply of human labor, animals, and machinery) with the area of agricultural land for each village as shown in Table 6. The villages where the S_{ha} is lower than the total amount of agricultural land were Pancaran, Bataan, Koncer, Sukokerto, Krankingan, Wirowongso, Kemuning Sari Kidul, Arjasa, Biting, Baratan, Kebun Agung, Asem Bagus, Taman Sari, Sumber Kleding, Pajurangan, Jatiadi, Karang Geger, and Karang Pranti, Or, in other words, according to this analysis, 17 out of the 24 villages still need additional power for land preparation. Using the total value of the indicator variables a priority for additional power can be assigned to each village. The first priority is given to the village with the lowest total value. The lowest value is 72 which is Bataan village in Bondowoso Kabupaten. It is interesting to note that the indicator does not always agree with the difference between S_{ha} and total agricultural area. If this formulation is valid, then one must conclude that in most of these villages there is a shortage of power for land preparation, though it does not necessarily hold that the shortage has to be filled with tractors.

Tables 7 and 8 show how the results of the analysis for the Kecamatan and Kabupaten. Nine of the 12 Kecamatans have a shortage of land preparation power and all three Kabupatens have a shortage, though Bondowoso Kabupaten is only slightly so.

Obviously, mechanization is one possible way of solving this shortage.

In the areas of this study apparently there has not been very much out migration, partly because there has not yet been mechanization of land preparation, and thus there is not yet unempllyment due to tractors. The average number of hand tractors was only one per village. Beside this, several of the villages do not have adequate irrigation facilities. Thus, these villages need water pumps, though there were no pumps in

these selected villages which had poor irrigation. Therefore, the agricultural land for rice fields that needs to be cultivated is reduced.

In this analysis both the S_{ha} and the indicator variable need to be considered together. For example in Prajekan Lor (Bondowoso) village the estimated power (S_{ha}) is much higher than the total agricultural areas (216 and 106 ha), thus indicating mechanization is not necessary. Yet if examined by using the indicator variable it states that there is a high priority for additional power. Perhaps, this is because Prajekan Lor village has a substantial amount of sawah which is very muddy, thus causing problems if land preparation is by tractor but the use of human labor and animal power would be useful. Thus, according to the value of the indicator variable NET, the use of tractors would not be of value.

To avoid misinterpretation of the data for these villages and wrong recommendations on agricultural mechanization, both the comparison between S_{ha} and agricultural area as well as the total values of the indicator variables need to be used in this analysis. If these are taken into consideration, the areas that have a potential for agricultural mechanization, at least for land preparation can be determined. In Bataan the values of the variables indicate the following:

1. The CX (Cropping Index) variable is 2.88 and the score is 3. This indicates that the agricultural land cultivated during the year is more than what can be cultivated in the wet season. Thus, there is still land in this village that could be cultivated in the dry season if irrigation facilities were better.

2. The TLS (Trend Labor Shortage) is 2.4 and has a value of 4. This is based on the wage rates of the agricultural laborers in 1975 and 1979. Apparently, the wage in 1979 was 2.4 times the wage in 1975.

3. The SLS (Intra Seasonal Labor Shortages) variable is 2.4 and the indicator has a value of 4. This means that the wage for laborers to prepare the land was 2.4 times higher than the wage for weeding which may be caused by a greater demand for laborers in the land preparation season. Of course, this does not include the fact that women weed and men prepare the soil.

4. The R (Rate of Land Preparation Work) variable is 0.5 and the value is 15 which indicates that there is a lack of labor and/or power of 50% at the time of land preparation.

5. ILS (Inter Seasonal Labor Shortage) variable is 1 and had a value of 12 which means that the wage rates for farm laborers in the wet season and dry season for land preparation was the same.

6. The NET (Increased Net Returns) was estimated to be 1.66 and is given a value of 5. Thus, the land preparation with farm laborers or animals is 166% higher than if a hand tractor is used.

7. The OFF (Off Farm Jobs) variable and the NON (Non-Farm Jobs) variables each are calculated to be 3 and the indicators have values of 3.5 and 1. Thus, farm laborers in Bataan village have no difficulty in finding work outside of agriculture.

8. The TM (Timeliness) variable is .758 and the indicator has a value of 16. This indicates that the rice yields have increased from 1970 to 1975.

Based on these indicator variables, Bataan village has a good potential for agricultural mechanization (based on the low total value of the 72 for the indicators, and the CX shows cultivation can be increased in the dry season to overcome the increased farm labor wage (TLS), to overcome the cost of land preparation, to overcome a shortage of laborers because of the ease in finding non-farm work (OFF).

CONCLUSIONS

Based on the analysis of the data from 24 villages in the three Kabupaten, the conclusions reached in this study are:

1. Most of the agricultural areas in East Java have good potential for agricultural mechanization, especially land preparation (if the formulation of the relationships and the indicators are valid).

2. In some of the villages there is an imbalance between the labor power and agricultural land area caused by:

   a. The work days in a month and the work hours for the laborers are not yet at a maximum

   b. There is a tendency for the farm laborers to move from agricultural employment to other jobs outside of agriculture.

3. The cost of land preparation with hand tractors in several of the areas was cheaper than land preparation by traditional methods.

4. The time required to prepare a field with a hand tractor was much shorter than the time necessary using traditional methods.

5. In the future the development of agricultural mechanization will cause very little unemployment because there still is work available in other fields outside of the agricultural sector.

REFERENCES

Anon. Perencanaan, Pembanguanan Regional Jawa Timur, Buku II (Bidang Ekonomi), Pemda Propinsi Jawa Timur.

Anon. 1979, Pedoman Pelaksanaan Inpres Penghijauan Propinsi Daerah Tingkat I Jawa Timur, Badan Pembina Pengawetan Tanah dan Air Propinsi Daerah Tingkat I Jawa Timur.

Bernsten, R.H. and R.S. Sinaga, 1979, A Methodology for Identifying Benefits from the Mechanization of Land Preparation, International Rice Research Institute, Los Baños, Philippines.

Made Sedhana and M. Dasoeli, 1972, Meteorologi Pertanian, Fakultas Pertanian, UNED, Jember.

Hamilton, J.E. and Bryont, W.R. 1975, Farm Management, Eanglewood Cliffs, N.J. Prentice Hall, Inc.

Harri Hardi, 1970, Pengarahan Kebijaksanaan Pembagunan yand sesuai dengan keadaan daerah-daerah, Y.B.F.E. U.I.

Harri Hardi, 1970, "Problems of Regional Differences," in Development Planning Indonesian Case.

Iih Abdurrahman, 1973, Pengantar masalah penduduk, Penerbit Alumni, Bandung.

Southworth, H. and M. Barnet, 1974, Experience in Farm Mechanization in South East Asia, The Agricultural Development Council, Inc., New York and Singapore.

Table 1 - Indicators of the Impact of Mechanizing on Land Preparation

Yield		
	Weed control (WC)	$\frac{\text{Normal yield}}{\text{Yield with good weed control}}$
	Timeliness (TM)	$\frac{\text{Yield of early harvest}}{\text{Yield of mid-season harvest}}$
Area (A)		$\frac{\text{Total cultivatable area minus Total planted area}}{\text{farmer population}}$
Cropping intensity		
	Cropping index (CX)	$\frac{\text{Total cropped lowland}}{\text{Total lowland area}}$
	Rate of land preparation work (R)	$\frac{\text{Area transplanted, 1st and 2nd month}}{\text{Total WS area}}$
	Trend labor shortage (TLS)	$\frac{\text{Real daily wage rate for LP, WS 79}}{\text{Real daily wage rate for LP, WS 74}}$
	Intra-seasonal labor shortage (SLS)	$\frac{\text{Real daily wage rate for LP}}{\text{Real daily male wage rate for weeding}}$
	General labor shortage (GLS)	$\frac{\text{MD of hired labor used for LP, WS}}{\text{MD of total labor used for LP, WS}}$
	Inter-seasonal labor shortage (ILS)	$\frac{\text{Daily hired wage rate for LP, DS}}{\text{Daily hired wage rate for LP, WS}}$
Increase net returns (NET)		$\frac{\text{LP cost/ha with man}}{\text{LP cost/ha with mechanical power}}$

Cont. - Table 1

Labor displacement		
	Off-farm jobs (OFF)	Off-farm job index
	Non-farm jobs (NON)	Non-farm job index
	Landless labor (LL)	$\frac{\text{Total land owners}}{\text{Total farmers}}$

LP = land preparation
WS = wet season
DS = dry season

Table 2 - Index of Indicator Variable Scores For Five Villages, an Illustrative example.[a/]

Indicator variable	Village A	B	C	D	E
WC	1	2	3	4	5
TM	2	3	4	1	5
A	1	5	2	4	3
CX	3	2	4	5	1
R	2	1	4	5	3
TLS	3	2	1	4	5
SLS	4	2	1	3	5
GLS	1	4	3	5	2
ILS	3	2	1	4	5
NET	2	1	4	3	5
OFF	1	3	5	4	2
NON	4	2	3	5	1
LL	3	1	2	5	4
Σ	30	30	37	52	46

a/ The values assigned to each variable for each village are to illustrate the concept. No attempt is made to represent the probable relationship between any variables for a given village. In this example villages A and B show greates potential for mechanization.

Table 3. - Value of Index Variables for the Villages in Bondowoso Kabupaten

Value of Index Variables	Bondowoso Kabupaten							
	Bondowoso Kota Kecamatan		Tenggarang Kecamatan		P u j e r Kecamatan		Prajekan Kecamatan	
	V i l l a g e				V i l l a g e			
	Pance-ran	Suko-wiryo	Bata-an	Koncer	Geja-yan	Suko-kerto	Praje-kan K.	Praje-kan L.
WC	-	-	-	-	11	-	-	-
TM	15	11	16	10	8	7	12	9
A	-	-	-	-	-	-	-	-
CX	8	6	3	4	9	1	5	2
R	15	9	15	15	9	15	15	9
TLS	3	17	4	1	19	19	7	7
SLS	8	10	4	2.5	2.5	1	7	6
GLS	-	-	-	-	-	-	-	-
ILS	12	12	12	12	12	24	12	23
NET	10	2	5	1	9	15	7	-
OFF	15.5	15.5	3.5	15.5	3.5	15.5	3.5	3.5
NON	22.5	13	1	[illegible]	13	22.5	22.5	13
LL	12.5	12.5	8.5	5	18	4	16	10
TOTAL	121.5	108.0	72.0	79.0	114.0	124.0	197.0	87.5

Table 4. - Value of Index Variables for the Villages in Jember Kabupaten

Value of Index Variables	Jember Kabupaten							
	Sumber Sari Kecamatan		Jenggawah Kecamatan		Arjasa Kecamatan		Patrang Kecamatan	
	Village				Village			
	Kranjingan	Wirolegi	Wirowongso	Kembang Sari K.	Arjasa	Biting	Bintoro	Baratan
WC	1	2	-	-	-	-	-	-
TM	-	-	2	-	1	-	-	-
A	-	-	-	-	-	-	-	-
CX	16	21	14	15	19	18	20	17
R	1	1	4	5	2	9	3	1
TLS	2	22	5	24	10	9	19	7
SLS	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
GLS	-	-	-	-	-	-	-	-
ILS	12	12	12	1	12	12	12	12
NET	3	-	-	4	17	6	-	-
OFF	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
NON	13	3.5	3.5	13	13	22.5	3.5	13
LL	8.5	-	14	15	19	7	17	11
Total	89.5	95.5	88.5	111	127	117.5	108.5	103

Table 5. - Value of Index Variables for the Villages in Probolinggo Kabupaten

Value of Index Variables	Probolinggo Kabupaten							
	Kraksaan Kecamatan		Dringu Kecamatan		Gending Kecamatan		Pajarakan Kecamatan	
	Village				Village			
	Kebun Agung	Asem Bagus	Taman Sari	Sumber Kleding	Paju-rangan	Jati-adi	Karang geger	Karang pranti
WC	5.5	5.5	5.5	5.5	10	5.5	9	5.5
TM	5	-	13	17	3	6	4	14
A	-	-	-	-	-	-	-	-
CX	11.5	11.5	11.5	-	11.5	7	-	-
R	9	-	9	-	-	-	-	-
TLS	21	15	23	13	11	16	12	14
SLS	12	11	9	18.5	18.5	18.5	18.5	5
GLS	-	-	-	-	-	-	-	-
ILS	12	12	12	12	12	12	12	12
NET	19	11	16	18	8	13	14	12
OFF	15.5	15.5	15.5	15.5	15.5	3.5	15.5	3.5
NON	13	13	13	13	13	13	3.5	13
LL	1	-	3	-	-	6	-	2
Total	124.5	94.5	130.5	112.5	102.5	100.5	88.5	81

Table 6 - Demand for Mechanization and Index of Indicator Variable Scores for the 24 Villages in East Java 1980/1981

Kabupaten	Kecamatan	Village	S_{ha} a/ (Ha)	Area of agricultural land (Ha)	Total value of indicator variables
Bondowoso	Bondowoso Kota	Panceran	21.	163.	121
		Sukowiryo	197.	197.	108
	Tenggarang	Bataan	191.	258.	72.
		Koncer	136.	215.	79
	Pujer	Gejayan	367.	253.	114
		Sukokerto	335.	388.	124
	Prajekan	Prajekan Kidul	140.	122.	107
		Prajekan Lor	216.	106.	83
Jember	Sumber Sari	Kranjingan	81.	329.	90
		Wirolegi	571.	497.	96
	Jenggawah	Wirowongso	399.	568.	89
		Kemuning Sari Kidul	435.	846.	111
	Arjasa	Arjasa	295.	619.	127
		Biting	149.	378.	118
	Patrang	Bintoro	290.	287.	109
		Baratan	211.	302.	103
Probolinggo	Kraksaan	Kebun Agung	56.	259.	125
		Asem Bagus	41.	147.	95
	Dringu	Taman Sari	24.	130.	131
		Sumber Kleding	126.	220.	113
	Gending	Pajurangan	60.	207.	101
		Jatiadi	41.	225.	103
	Prajekan	Karang geger	61.	219.	89
		Karangpranti	39.	177.	81

Source: Based on data in Appendix I and II

a/ Estimated hectares/months that is prepared by existing supply of human labor, animals, and machinery.

Table 7. - Demand for Mechanization and Index of Indicator Variable Scores for the 12 Kecamatan in East Java 1980/1981

Kabupaten	Kecamatan	S_{ha} (Ha)	Area of agricultural land (Ha)	Total value of indicator variables
Bondowoso	Bondowoso Kota	280.87	367.99	299.50
	Tenggarang	326.24	472.95	151.00
	P u j e r	703.20	641.00	238.00
	Prajekan	357.07	288.31	189.50
J e m b e r	Sumber Sari	652.78	826.05	185.00
	Jenggawah	835.24	1414.00	198.50
	A r j a s a	444.87	996.82	244.50
	P a t r a n g	501.06	589.39	211.50
Probolinggo	Kraksaan	97.63	406.33	219.00
	D r i n g u	151.06	349.60	243
	Gending	101.48	432.17	203
	Pajarakan	100.63	396.48	169.5

Source: Data is in Appendix II and III.

Table 8. - Demand for Mechanization and Index of Indicator Variable Scores for the 3 Kabupaten in East Java 1980/1981

Kabupaten	S_{ha} (Ha)	Area of agricultural land (Ha)	Total value indicator variables
Bondowoso	1667.38	1770.25	878
J e m b e r	2433.95	3826.26	839.5
Probolinggo	450.80	1581.58	834.5

Source: Data is in Appendices II and III.

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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.

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