PN-AAN-537

PA 37106

THE CONSEQUENCES OF SMALL RICE FARM MECHANIZATION PROJECT

Working Paper No. 38

SITE DESCRIPTION: MECHANIZATION CONSEQUENCES PROJECTS IN WEST JAVA, INDONESIA

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1981

The Consequences of Small Rice Farm Mechanization Project is supported by the United States Agency for International Development under Contract tac-1466 and Grant No. 931-1026.01 and is being implemented by the International Rice Research Institute and the Agricultural Development Council, Inc.

ABSTRACT

Subang and Indramayu Districts West Java were selected for the survey because of the extent of rice production and the presence of a significant number of tractors. Initial results indicate that the villages are homogeneous with almost all of the land irrigated and growing modern rice varieties. By mechanization category, minor differences only were found for social characteristics and rice yield. The major differences between groups were that mechanized farms are much larger and include a higher percentage of owner occupied land than the non-mechanized farms.

INTRODUCTION

The Consequences of Farm Mechanization project was conducted in West Java as cooperative research between Rural Dynamic Study Agro-Economic Survey (RDS-SAE) and the International Rice Research Institute (IRRI). West Java, one of the 27 provinces of Indonesia, is an area with a high population density. It is also known as the rice granary of Indonesia, and most of tractors are found there.

The area of West Java is 46,300 km^2. The population in 1978 was 24.7 million, 18 percent of the total population of the country. Hence, the population density was 534 person/km^2. Fifty-two percent of the population are classified as adult, with 70 percent of the labor force working in agriculture (BPS, 1975-80). Sixty-three percent of the land area is farmed, including 1.85 million hectares of lowland (Sawah), of whichabout 72.1 percent is irrigated and 82 percent of the irrigated area was planted to rice twice a year. Table 1 shows the province's share in rice production to other provinces in the country from 1974 - 1978. Some 22 - 24% of Indonesia rice is typically produced in West Java. The second table shows West Java's average yield/ha compared to all provinces for 1974-1978. Yield in this province tends to be 5.17% higher than the national average (BPS, 1980).

The extent of farm mechanization for various years is shown in Table 3. In 1974, 1975 and 1976, the total number of hand tractors was 431, 441 and 520, respectively. During the period 1974 - 1978 the number of tractors increased by 168%.

Site Selection and Description

The research sites in West Java were selected through a combination of random and purposeful procedures. Secondary date on farm area, production and the number of tractors in each of 20 districts in West Java were collected to determine their distribution in the province. Subang and Indramayu districts were chosen as the research site due to their role in rice production and also because 34 percent of all tractors are found there. This districts are located on the north coastal plain of Java.

Subang District is 161 km east of Jakarta and 60 km north of the provincial capital of Bandung (Fig. 1). It consists of 11 sub-districts and 160 villages. In 1978 the population was 972,707. With an area of 1,887 km^2, the population density was 515 persons/km^2.

The total number of households was 234,971, of which about 83 percent were headed by farmers.

The lowland area (Sawah) is 82,184 ha or 45,2 percent of the total of agricultural land, and 86 percent is irrigated. Some 14 - 16 percent of West Java rice was produced in this district during 1975-1978 (Table 4). The average paddy yield was 5.8t/ha in the 1978/79 wet season and 4.1 t/ha in the 1979 dry season.

The population of hand tractors was 197 in 1979, compared to 28 in 1974. On the other hand, the carabao and cow population was 33.375 in 1977 compared to 44.052 in 1974 (DIPERTA Subang, 1978-1980).

Indramayu District, is located 205 km east of Java (Fig.2). It consists of 17 sub-districts and 186 villages. The population in 1978 was 1,132,429. With an area of 1,964 km^2, the population density was 577 person/km^2. The total number of households was 276,926, of which about 70 per cent were headed by farmers.

The lowland area (Sawah) is 120,806 ha or 61.4 percent of the total of agricultural land, of which about 73.1 percent is irrigated. As was the case with Subang, 14-15 percent of West Java rice was produced in Indramayu during 1975-1978 (Table 4). The average paddy yield was 4.7 t/ha in the 1977-78 wet season or 40 t/ha in 1978 dry season. The hand tractor population was 260 in 1978 compared to 12 in 1974. The carabao and cow population was 38,963 in 1978, compared to 27,858 in 1975. (BAPPENKA INDRAMAYU, 1980).

VILLAGE SELECTION AND DESCRIPTION

Procedures were developed to identify a stratified sample of respondents adequately reflecting the diversity of agriculture. First, a random sample of eight sub-districts (within the two districts) with the greatest number of hand tractors was selected. Then, four villages with four or more tractors were randomly selected in each district. Next a block census of the eight villages was conducted covering 1600 households. Finally a stratified random sample was obtained for the survey. Data were collected as in South Sulawesi during the following seasons: 1979 dry

season (second crop), 1979 dry season (third crop), 1979/80 wet season, 1980 dry season (second crop) and 1980 dry season (third crop).

Weekly record keeping was carried out during the first four seasons. All power source strata covered by the survey were included, but data collection was concentrated in four of the eight villages. The activities of a total of 48 farmers and 12 landless laborers were monitored. The characteristics of sample villages are shown in Table 5.

Results from the secondary data show that in 1979 the majority of households in the sample villages were headed by either a farmer or a landless labor. The size of household varied between 3 and 4.5 persons. The average, population and total households in every village were 11,282 and 2,874, respectively.

In terms of farm land and lowland, Anjatan had the biggest area at roughly 4,054 ha and 3,631 ha. Average lowland area in every village was 1,457 ha. With the exception of Gabuskulan, all of the lowland area was irrigated and planted to improved rice twice a year.

The distribution of hand tractors by village in 1979 varied between 4 and 76. Angatan had the highest number of tractors.

THE CHARACTERISTICS OF RESPONDENT BY MECHANIZATION LEVEL

In following section, a preliminary evaluation of the data collected during the 1979/80 wet season and the 1980 dry season is presented.

Socio-economic characteristics. Among the farmers interviewed, there were only minor differences in terms of social characteristics. We observe that in both seasons the non-mechanized cooperators had less formal education than the mechanized farmers (Table 6). Also, tractor owners characteristically have a permanent laborer to assist with the management of the farm.

In terms of tenure status, cooperators in all cells are primarily owners (Table 7). Yet, in both seasons the concentration of owners is highest among tractor hire (82 and 86 percent), followed by tractors owners (83 and 79 percent), animal (65 percent) and manual (57 and 66 percent) cooperators.

Total operated area was also associated with power source. In the wet season, tractor owners operated on the average over 5.5, 3.4, and 2.5 times as much land as manual, animal and tractor hire cooperators. In the dry season, tractor owners operate on the average of 3.2 and 2.3 times as large holdings as manual and tractor hire farmers.

Yields. The 1979/80 wet season was a typical year with a normal rainfall pattern. Data in Table 8 shows small yield differences between cells, with the highest yield obtained by the tractor hire (5.1 t/ha), animal (5.0 t/ha), tractor owner (4.7 t/ha) and manual (4.6 t/ha) cooperators. Yet, these differences in means were not satisfactorily significant at the five percent confidence level. Also, there is little difference in fertilizer level, although manual cooperators applied about 20 kg/ha less than the other farmers.

In the dry season, the yields on mechanized farms averaged about 500-600 kg/ha above manual cooperators. Yet, this can not be attributed to power source, since most of the manual cooperators were located in a single village where rat and stemborer damage was extensive. As a result, 24 percent of the manual farmers harvested only 50 percent of the area they planted. At the same time, manual farmers applied about 20 kg/ha less fertilizer than the mechanized respondents.

Labor use

During the wet season, total human labor use averaged 175 workdays/ ha for manual, about 15, 20 and 40 percent more than animal, tractor hired and tractor owners used (Table 9). Excluding harvest labor, manual farmers utilized 22, 30 and 47 percent more labor than animal, tractor hired and tractor owner farmers. Almost all of this difference in labor requirements can be explained by differences in human labor used for land preparation. In terms

of pre-harvest of labor composition, we see that manual farmers used the greatest share of family labor (23 percent), followed by animal (19 percent), tractor hired (10 percent) and tractor owners (4 percent).

During the dry season, total labor use was substantially less than during the wet season; averaging 135 workdays for manual, 127 workdays for tractor hire and 117 workdays for tractor owners (Table 9). Human labor used for land preparation by manual cooperators was significantly less in the dry season, averaging only 58 percent as much as in the wet season - by only slightly less for mechanized cooperators. This is because minimum tillage (walik jerami) - was widely practice by manual far mers. As in the wet season, manual farmers used a higher percent of pre-harvest family labor (21 per cent) than tractor hire (11 per cent) and tractor owners (7 per cent).

SUMMARY

West Java was chosen as a research site of the Consequences of Farm Mechanization project because of its characteristics in terms of rice production, number of hand tractor and population density. For the same reason, Indramayu and Subang were chosen as the sub-site.

The sample villages, were homogenous in terms of occupational distribution of household and the percentage of irrigated lowland. They varied when comparisons related to population, number of household, total lowland area and number of hand tractor were made.

Among the sample cooperators by cell, there were only minor differences in terms of social characteristics. In both seasons the non-mechanized farmers had less formal education than the mechanized farmers. In terms of tenure status and operated area, mechanized farms are significantly larger and include a higher percent of owned land than non-mechanized farmers.

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Table 1. Production [a] of paddy by province in Indonesia, 1974-1979 (in ton)

Province	1974	1975	1976	1977	1978	1979
West Java	5,224,911 (23.3)[b]	5,326,165 (23.9)	5,498,219 (23.6)	5,055,162 (21.4)	5,758,315 (22.3)	5,860,613 (22.2)
Middle Java	4,064,730 (17.8)	3,850,783 (17.2)	3,718.005 (16.0)	3,815,037 (16.3)	4,496,770 (17.4)	4,305,991 (16.3)
East Java	4,213,203 (18.7)	4,111,265 (18.4)	4,441,507 (19.1)	4,471,355 (19.2)	4,872,515 (18.9)	5,385,308 (20.4)
Total Java & Madura	13,878,747 (61.8)	13,721,148 (61.4)	14,062,052 (60.3)	13,726,163 (58.8)	15,597.877 (60.5)	15,982,434 (60.7)
Total Outer Java & Madura (23 provinces)	8,585,629 (38.2)	8,609,502 (38.6)	9,238,887 (39.7)	9,620,969 (41.2)	10,173,693 (39.5)	10,367.822 (39.3)
Indonesia	22,464,376 (100)	22,330,650 (100)	23,300,939 (100)	23.347,132 (100)	25,771,570 (100)	26,350,256 (100)

Source: Statistical Pocketbook of Indonesia 1979/80, Central Bureau of Statistics, 1980.

[a] Dry unhusked rice, wetland and dry land.

[b] Numbers in parenthesis are percentage.

Table 2. Yield[a/] of paddy by province in Indonesia, 1974-1979 (in t/ha).

Province	1974	1975	1976	1977	1978	1979
West Java	2,77	2,86	3,05	2,99	3,30	3,25
Middle Java	2,94	2,95	3,14	3,09	3,30	3,24
East Java	3,18	3,10	3,32	3,41	3,56	3,85
Total Java & Madura	2,93	2,95	3,15	3,14	3,28	3,43
Total Outer Java & Madura (23 provinces)	2,27	2,24	2,37	2,42	2,44	2,48
Indonesia	2,64	2,63	2,78	2,79	2,89	2,98

a/ Dry Unhusked Rice, Wetland and dryland.

Source: Statistical Pocketbook of Indonesia 1979/1980, Central Bureau of Statistics, 1980.

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Table 3. Status of Farm Mechanization in West Java 1977-1978

	1977	1978
Hand tractor	662	1,154
Mini tractor	NA	13
Water pump	365	449
Hand sprayer	42,648	59,080
Motor sprayer	2,884	2,055
Power sprayer	1,174	900
Power thresher	476	495
Dryer	3	20
Rice milling units	7,897	10,500

Source: "Farm Mechanization", Annual Report 1978, Agriculture Extension Office, West Java.

Table 4. Production of Paddy in Subang and Indramayu 1975-1978

Year	Subang Total ('000 ton)	Subang Yield (t/ha)	Indramayu Total ('000 ton)	Indramayu Yield (t/ha)	West Java Total ('000 ton)	West Java Yield (t/ha)
1975	731.7	4.73	821.4	4.47	5,326.1	2.86
	(13.7)[a]		(15.4)			
1976	883.7	5.51	818.5	4.55	5,498.2	3.05
	(16.1)		(14.9)			
1977	786.7	5.46	630.9	3.51	5,055.2	2.99
	(15.6)		(12.5)			
1978	814.5	NA	784.7	3.95	5,758.3	3.30
	(14.1)		(13.6)			

[a] Numbers in parenthesis are percentage total paddy production of West Java.

NA - not available

Sources: Statistik Indramayu 1978, Bappemka Indramayu, 1979.
Subang dalam angka 1977, Bappemka Subang, 1978

Table 5. Characteristics of sample villages, Indramayu and Subang, 1979

Sample Villages	Population	Household			Farm Land			Hand Tractors (No.)
		Total (%)	Farmer (%)	Landless (%)	Total (Ha)	Lowland (Ha)	Irrigated (%)	
INDRAMAYU								
Sukadana	4,057	912		88.3[a]	459	416	99	11
Gb. Kulon	12,687	2,841		90.0[a]	2,911	2,476	67	16
Angatan	28,788	6,346	45.6	43.4	4,054	3,631	100	76
Sukra	13,081	4,785		79.9[a]	1,664	1,474	100	19
SUBANG								
Bajongtengah	5,622	1,560		87.0[a]	954	896	100	4
Pmk. hilir	8,450	1,950	47.0	40.0	566	505	100	21
Mariuk	7,293	2,045	47.5	48.3	1,194	1,116	100	44
Tambakdahan	10,279	2,555	31.0	67.0	NA	1,139	100	5

[a] Total of farmer and landless

Source: Sample Village Offices, 1979.

Table 6. Social characteristics of Consequences Survey irrigated cooperators, Subang and Indramayu Districts, West Java, 1979-80.

Characteristics	Wet Season 1979/80				Dry Season 1980		
	Non-mechanized		Mechanized[a]		Non-mechanized	Mechanized[a]	
	Manual	Animal	Hire	Owner	Manual	Hire	Owner
No reporting	56	100	61	68	161	61	64
Head of household							
Age (yrs)	39.0	39.3	39.6	40.0	39.4	39.7	40.0
Education (yrs)	2.6	3.6	5.1	5.0	3.3	5.0	4.9
Experience (yrs)[b]	13.6	15.2	15.2	15.2	14.6	14.9	14.7
Household							
Members (no.)	4.6	4.8	4.7	4.7	4.5	5.1	4.5
Males (no.)	1.7	1.6	1.7	1.8	1.7	1.7	1.7
Females (no.)	1.5	1.4	1.7	1.5	1.5	1.7	1.4
Children (no.)	1.4	1.8	1.3	1.4	1.3	1.7	1.4
Permanent laborers (no.)	0.1	0.2	0.1	0.8	0.1	0.2	0.8

[a]Two-wheel walking tractor

[b]Farming experience

Source: Consequences Mechanization Survey.

Table 7. Land tenure of Consequences Survey irrigated cooperators, Subang and Indramayu Districts, West Java, 1979-80.

Tenure[a]	Wet Season 1979/80				Dry Season 1980		
	Non-mechanized		Mechanized		Non-mechanized	Mechanized	
	Manual	Animal	Hire	Owner	Manual	Hire	Owner
Owner (75% or more owned)							
No. reporting	35	59	47	57	100	49	55
Average size (ha)	0.92	1.81	2.36	5.47	1.45	2.0	4.
Part owner (25-75% owned)							
No. reporting	8	16	5	6	29	2	5
Average size (ha)	1.53	1.88	2.35	6.03	1.55	2.37	6.
Lessee (> 50% leased)							
No. reporting	4	5	6	3	12	6	3
Average size (ha)	0.85	1.34	1.75	8.01	1.01	1.49	7.
Share cropper (> 50%)							
No. reporting	8	15	2	2	16	4	2
Average size	0.46	1.02	0.96	0.84	0.72	1.28	0.
Other combinations							
No. reporting	1	5	1	0	4	0	0
Average size (ha)	4.75	1.00	0.74	NA	1.16	NA	NA
Total							
No. reporting	56	100	61	68	161	61	64
Total size (ha)	56.34	163.72	135.87	373.67	218.07	114.42	279.
Average size (ha)	1.01	1.64	2.23	5.50	1.35	1.88	4.

[a]All operated parcels

NA = Not applicable

Source: Consequences of Mechanization Survey, all respondents.

Table 8. Paddy yield (kg/ha) of largest irrigated parcel and factors associated with yield differences, Subang and Indramayu Districts, West Java, 1979-80.

	Wet Season 1979/80				Dry Season 1980		
	Non-mechanized		Mechanized		Non-mechanized	Mechanized	
	Manual	Animal	Hire	Owner	Manual	Hire	Owner
No. reporting	56	100	61	68	161	61	64
Total size (ha)	34.41	90.69	76.35	173.12	134.41	71.56	140.65
Fertilizer							
Urea	226	250	238	242	207	220	230
TSP	74	70	81	84	72	84	71
Total	300	320	319	326	279	304	301
Yield (kg/ha)[a]	4,613	4,966	5,116	4,709	2,993	3,632	3,528
Crop failure (% area)	0	0	0	0	24.0[b]	2.6[b]	2.6[b]

[a]In the wet season, yield differences between cells were not significantly different at the 5 percent level. A statistical test was not calculated in the dry season.

[b]One village; rat and stemborer damage. Harvested only 50% of planted area.

Source: Consequences of Mechanization Survey, all respondents.

Table 9a. Number of workdays/ha (8 hours), Subang and Indramayu Districts, West Java, 1979-80.

Season operation	Non-mechanized						Mechanized					
	Manual			Animal			Hired			Owner		
	Family	Hired[a]	Total	Family	Hired[a]	Total	Family	Hired[a]	Total	Family	Hired[a]	Total
Wet 1979/80 (No.)			56			100			61			68
Land preparation[b]												
Human[c]	11.0	43.3	54.3	7.6	27.4	35.0	2.0	23.7	25.7	1.0	20.3	21.3
Animal	0.0	0.0	0.0	3.2	5.6	8.8	0.2	0.6	0.8	0.0	0.0	0.0
Tractor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.3	3.0	0.0	3.0
Planting	2.0	25.7	27.7	0.8	23.8	24.6	0.5	24.2	24.7	0.1	22.8	22.9
Fertilizing	2.4	2.0	4.4	1.4	2.9	4.3	0.7	3.5	4.2)			
Weeding	4.8	26.5	31.3	3.1	26.9	30.0	1.6	33.6	35.2)	1.1[d]	38.3[d]	39.4[d]
Pesticide	3.0	1.7	4.7	1.8	2.9	4.7	1.1	3.0	4.1)			
Harvest	0.4	43.9	44.3	0.2	45.5	45.7	0.1	44.0	44.1	0.1	35.4	35.5
Other	6.7	1.1	7.8	5.9	1.9	7.8	3.9	2.1	6.0	1.7	2.8	4.5
Total human	30.3	144.2	174.5	20.8	131.3	152.1	9.9	134.1	144.0	4.0	119.6	123.6
Excluding harvest	29.9	100.3	130.2	20.6	85.8	106.4	9.8	90.1	99.9	3.9	84.2	88.1

[a]No exchange labor used

[b]Including seedbed preparation

[c]Includes human labor used with animal and tractor

[d]Total for fertilizing, weeding and pesticide.

Source: Consequences of Mechanization Survey.

Table 9b. Number of workdays/ha (8 hours), Subang and Indramayu Districts, West Java, 1979-80.

Season operation	Non-mechanized						Mechanized					
	Manual			Animal			Hired			Owner		
	Family	Hired[a]	Total	Family	Hired[a]	Total	Family	Hired[a]	Total	Family	Hired[a]	Total
Dry 1980 (No.)			161						61			64
Land preparation[b]												
Human[c]	6.3	25.0	31.3		NA		1.9	18.7	20.6	1.1	17.5	18.6
Animal	0.0	0.0	0.0		NA		0.0	0.0	0.0	0.0	0.0	0.0
Tractor	0.0	0.0	0.0		NA		0.0	2.0	2.0	2.8	0.0	2.8
Planting	1.2	22.9	24.1		NA		0.6	24.1	24.7	0.3	21.7	22.0
Fertilizing	1.4	2.4	3.8		NA		1.1	2.8	3.9	2.1	3.6	5.7
Weeding	4.3	25.4	29.7		NA		1.3	30.1	31.4	0.5	26.0	26.5
Pesticide	1.8	2.2	4.0		NA		0.8	2.5	3.3	0.4	2.4	2.8
Harvest	0.2	33.7	33.9		NA		0.1	35.5	35.6	0.0	34.7	34.7
Other	5.7	2.2	7.9		NA		4.0	3.9	7.9	2.0	4.9	6.9
Total human	20.9	113.8	134.7		NA		9.8	117.6	127.4	6.4	110.8	117.2
Excluding harvest	20.7	80.1	100.8		NA		9.7	82.1	91.8	6.4	76.1	82.5

[a]No exchange labor used

[b]Including seedbed preparation

[c]Includes human labor used with animal and tractor

NA = No cooperators of this type in the dry season.

Source: Consequences of Mechanization Survey.

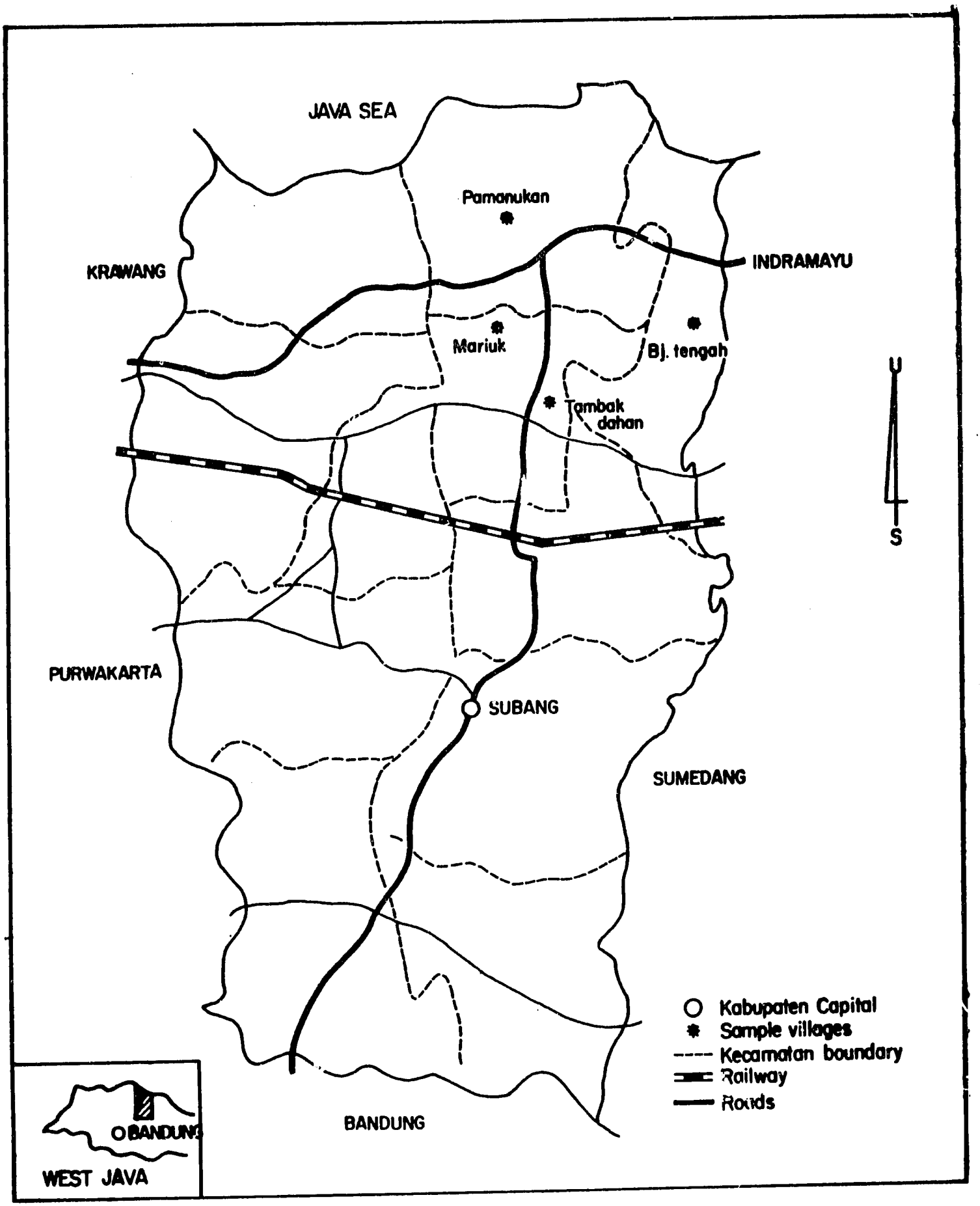

FIGURE 1. SUBANG KABUPATEN

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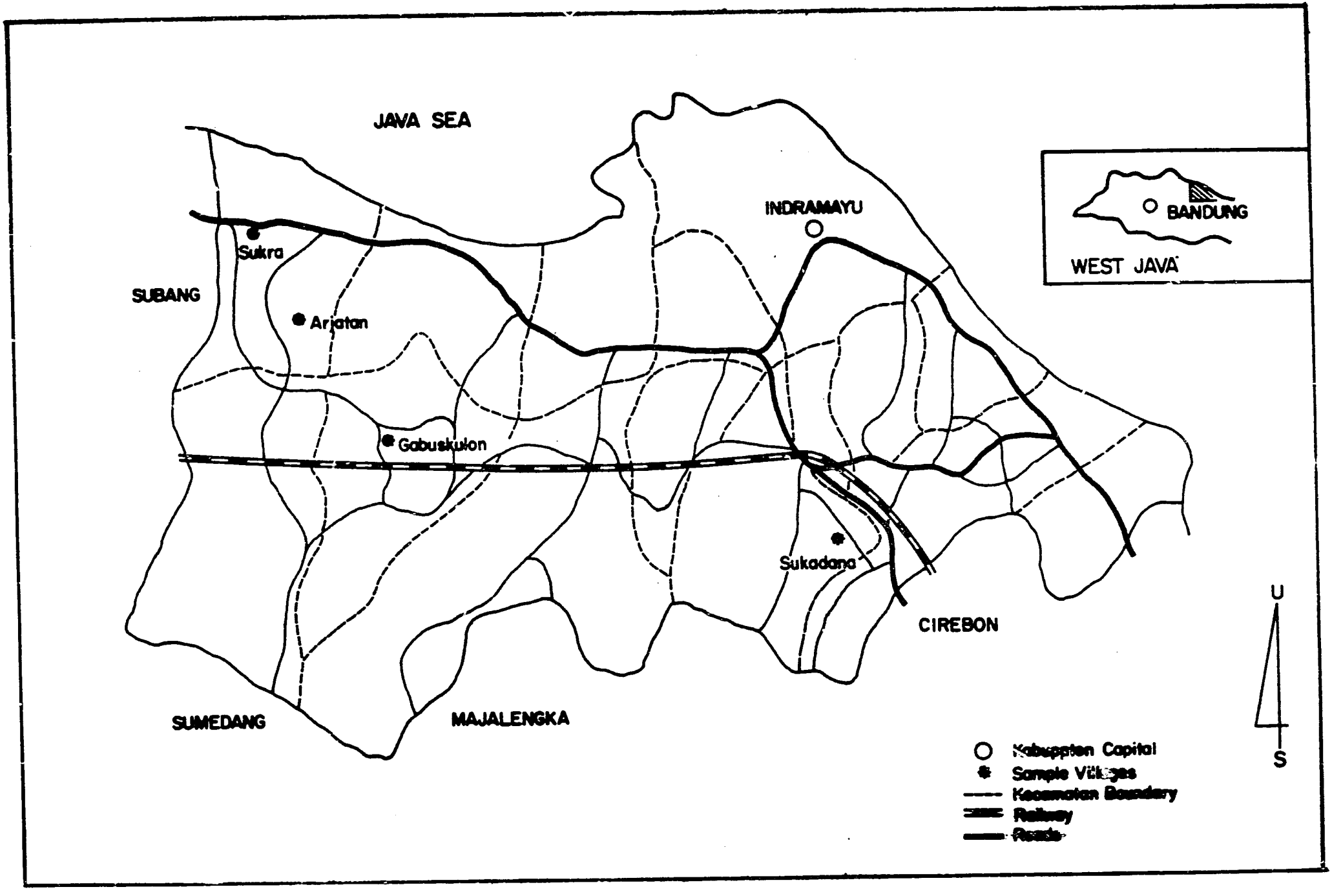

FIGURE 2. INDRAMAYU KABUPATEN

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