Table 2.11 Projected Growth of Population, 1971 to 1991

	1971	1976	1981	1986	1991
Population	21,865,263	23,784,581	25,857,696	28,411,700	31,511,437
Crude Birth Rate (%)	3.686	3.626	3.930	4.128	
Crude Death Rate (%)	1.806	1.773	1.873	1.894	
National Growth Rate (%)	1.880	1.853	2.057	2.234	
Net Social Mobility (%)	-0.183	-0.168	-0.155	-0.141	
Annual Growth Rate (%)	1.697	1.685	1.902	2.093	

Source : Table B.4.

Table 2.12 Growth of Population by Age Strata, 1971 to 1991

	1971	1976	1981	1986	1991
Age 0 - 14	9,510,672	9,954,416	9,936,785	10,809,512	12,312,854
Share (%)	43.5	41.9	38.4	38.4	39.0
Growth Rate(%)	0.9	0.0	1.7	2.6	
Age 15 - 29	4,881,971	5,807,124	7,692,073	8,572,684	8,988,605
Share (%)	22.3	24.4	29.7	30.4	28.5
Growth Rate(%)	3.5	5.8	2.2	1.0	
Age 30 - 44	4,211,608	4,276,268	3,827,328	4.107.880	4,985,306
Share (%)	19.3	17.9	14.8	14.6	15.8
Growth Rate(%)	0.3	2.2	1.4	3.9	
Age 45 -	3,260,952	3,892,891	4,401,512	4,689,055	5,224,672
Share (%)	14.9	16.3	17.0	16.6	16.6
Growth Rate(%)	3.6	2.5	1.3	2.2	
Total	21,805,263	23,784,581	25,857,698	28,179,131	31,511,437
Share (%)	100.0	100.0	100.0	100.0	100.0
Growth Rate(%)	1.7	1.7	1.9	2.1	

Source : Table B.4.

education for the younger generation will be lessened somewhat toward the end of the 1970s unless the enrollment rate sees a dramatic upsurge. But the remarkable expansion of those people that fall in the category of age 15 to 29 from 4,882 thousands in 1971 to 8,989 thousands in 1991, a nearly two-fold increase, will render the problem of employment creation the most serious and critical issue in the coming 15 years. This seemingly insurmountable problem deserves wide recognition of the people in the Province.

(c) Population Projection by Kabupaten/Kotamadya

02.054 The future population for each kabupatens was calculated by the procedure presented in Section B.2 Appendix B. The result is in Table 2.13. Until 1983, when the total population for the Province is projected at 26,851 thousands, Kotamadya Semarang will gain another 177 thousand population excluding the population gained by boundary change to mark 924 thousand population; Kotamadya Tegal will gain another 23 thousands to reach 143 thousands; Kabupaten Rembang will gain another 88 thousands to reach 507 thousands; and Kabupaten Tegal will gain another 166 thousands to reach 33 thousands.

02.055 However, it should be remembered that the reliability of these results is greatly influenced by the reliability of the estimates of the 1971 to 1976 average growth rate. Especially the amazing growth of Kabupaten Cilacap is based on its high growth rate in 1971 to 1976, but the reliability of this is limited because of the possible abnormality of data as is noted above. Because of this problem of data, too much credit not be given to the projection of Cilacap population. At the same, it should be noted that a grow rate is likely to change following the economic and social differences between areas and resulting in the lessening of the difference.

2.3 Labor Force

2.3.1 Outline of the Labor Force

02.056 After the inquiry into the structure of the population and its future growth, we now turn to the examination of the labor force in Central Java and its future. The topics reviewed include the size of the labor force, reserved human capital in the population, employment structure by industry and profession, un- and under-employment, and the assessment of future change of the labor force in the coming two decades. Some of the discussions here are based on the 1971 Census, since it gives the most accurate and comprehensive data available on the subject. The necessary estimates to evaluate the major change of the labor force, together with the projection of its future, are undertaken in the last part of this Chapter.

Table 2.13 Population Projection by Kabupaten/Kotamadya

		Population		Average Annual Growth Rate	
		1976	1983	1976-81	1981-83
1.	KDY Magelang	110,396	11,244	0.051	0.241
2.	KDY Surakarta	430,756	457,633	0.815	1.002
3.	KDY Salatiga	75,944	85,848	1,713	1,901
4.	KDY Semarang	746,467	923,706	3.034	3.232
5.	KDY Pekalongan	118,091	129,175	1.233	1.432
6.	KDY Tegal	119,567	142,695	2.501	2.702
7.	KB Cilacap	1,378,414	1,701,436	2.998	3.192
8.	KB Banyumas	1,129,077	1,263,952	1.570	1.763
9.	KB Purbalingga	629,504	700,055	1,476	1.662
10.	KB Banjarnegara	640,779	718,100	1.588	1.773
11.	KB Kebumen	992,334	1,080,925	1.176	1.362
12.	KB Purworejo	672,579	693,575	0.387	0.573
13.	KB Wonosobo	564,476	639,272	1.736	1.933
14.	KB Magelang	909,374	998,691	1.810	2.002
15.	KB Boyolali	751,459	817,294	1.153	1.342
16.	KB Klaten	1,026,214	1,133,236	1.373	1.563
17.	KB Sukoharjo	551,183	644,386	2.203	2.392
18.	KB Wonogiri	944,693	1,024,029	1.105	1.293
19.	KB Karanganyar	547,616	623,055	1.718	2.216
20.	KB Sragen	703,488	801,304	1.823	2.013
21.	KB Grobogan	955,592	1,069,722	1.570	1.762
22.	KB Blora	673,747	757,152	1.625	1.822
23.	KB Rembang	419,759	507,621	2.698	2.888
24.	KB Pati	924,127	1,054,255	1.847	2.032
25.	KB Kudus	479,532	531,178	1.420	1.602
26.	KB Jepara	661,372	774,721	2.231	2.422
27.	KB Demak	639,992	711,123	1.463	1.652
28.	KB Semarang	714,683	770,844	1.024	1.243
29.	KB Temanggung	517,082	589,257	1.829	2.022
30.	KB Kendal	692,509	756,908	1.225	1.412
31.	KB Batang	477,931	513,070	0.965	1.153
32.	KB Pekalongan	606,355	689,182	1.792	1.981
33.	KB Pemalang	859,541	944,633	1.304	1.492
34.	KB Tegal	967,470	1,133,058	2.231	2.412
35.	KB Brebes	1,151,753	1,314,009	1.902	2.091
	Total	23,784,581	26,850,676	1.685	1.902

Source: Table B.6 in Appendix B.

(a) Economically Active Population and Labor Force Participation Rate

02.057 The total population defined as "economically active" numbered 8,116 thousands in 1971; this was about 54 percent of the population of 10 years old or more, and consequently 37 percent of the total population. Presented in Table 2.14 is the categorization of the population of age ten years or over into several types of activities; a more detailed breakdwon is given in Table C.1 in Appendix C "Labor Statistics." In Table 2.14, one may see that of the 15,041 thousand population of 10 years or more in the Province, 54 percent are classified as economically active, 13 percent as attending school, 24 percent as engaged in housekeeping, and 10 percent as income recipient and others. But, needless to say, these figures drop by 32 percent if the total population is taken into account and hence, the very numerous younger generation is included in the calculaiton; in fact, the share of the economically active population in the total population, roughly the equivalent to labor force participation rate, is as low as 37 percent. Considering the fact that in the Census there may be under-rating of the population who are seeking work, and overrating of the population classified as engaged at housekeeping, this figure for the labor force participation rate is considerably low.

02.058 Urban-rural and male-female splits are both significant in this aspect. For the urban population, economically active population is 46 percent of the total population of age 10 years or more, while the percentage for the total population is 55 percent. This is partly due to high proportion of the children who are going to school and are beyond age 10 in the urban area; the ratio is 23 percent for the urban area against 11 percent in the rural area. If economically active and attending-school populations are added together, the resulting figures are almost the same; 64 percent for the urban area and 66 percent for the rural. In short, the labor force participation rate of 38 percent for the rural area is higher than the 33 percent for the urban area despite the fact that the urban population includes a higher percentage of adults; the reason for this is the higher share of the younger generation who are still attending school. The male-female split is also formidable as seen in Table C.1, but more remarkable is the fact that the difference between urban and rural changes its pattern from male to female. For males in the urban area 59 percent of the population is economically active; this is 15 percent lower than the rural figure. On the contrary, for the female population the share of economically active population for the urban area is 34 percent, which is lower than the rural share only by 4 percent age points. For the female population, this appears to be contradictory to the relatively high school-attending population in the urban area, but the difference should apparently be attributed to the extremely high percentage of those in the rural area who are classified as housekeeping viz. 43 percent, almost twice as much as that for the urban. This, incidentally, may be hinting at the possible tendency of under-estimating economically active proportion among females in the rural area.

Table 2.14 Population Age 10 Years or More by Types of Activity, Central Java, 1971

	In Thousand Persons	As % of Total Population 10 Years or More
Economically Active		
Employed	7,746	(51.4)
Seeking Work	371	(2.5)
Total Economically Active	8,117	(53.9)
Attending School	1,875	(12.5)
Housekeeping	3,588	(23.9)
Income Recipients and Others	1,451	(9.7)
Total Population 10 Years or More	15,041	(100.0)
Total Population Age 10 Years or More as Percent of Total Population	(68.8)	-

Source: Table C.1 in Appendix C.

02.059 In summary, the labor force participation rate in the area is considerably small, the reason being the high proportion of the young population. Quite remarkable variation is found in male-female and urban-rural splits. The highest percentage of economically active population out of the total population of 10 years or more is that for rural male, and the lowest for rural female, the reason for the former being the small share of school-attending population, and for the latter the high proportion of housekeeping population.

(b) Labor Force Participation Rate by Age

02.060 Tables C.2 and C.3 in Appendix C give an insight to the variation of labor force participation over generations (see Table C.2). The labor force participation pattern over generation seems to be dominated by a difference between figures for each sex rather than an urban-rural dichotomy. For males as a whole, the proportion of economically active portion exceeds 90 percent at the bracket of age 25 to 29, and for other age brackets the share is above 90 percent until beyond the bracket of age 50 to 54 when it turns to a rapid decline. For the female population the difference between generations is rather moderate, and the peak comes later than those for males, at the late 30s and 40s. The observed urban-rural differences as a whole for the male population seems to be taking place in the generation less than age 25 and in the generation beyond age 50. In the age bracket of 10 to 14 the share is 6 percent for the urban against 24 percent for the rural; in age 15 to 19 it is 28 percent against 60 percent. At the other extreme, the economically active population is 58 percent for age 60 to 64, which is 26 percent age points lower than its counterpart in the rural area. The urban-rural difference in labor force participation for the female population appears to be concentrated in the generations below age 20: the population economically active is 8 percent in the urban against 18 percent in the rural for the age 10 to 14 bracket, and 27 against 38 percent for the age 15 to 19 bracket.

02.061 It should be stressed again that the major urban-rural difference is caused by school attendance at the ages below 25 in the case of male population and in the ages below 20 in the case of female population. This is well evidenced by Table C.3 where breakdowns of population by types of activities are given.

(c) Geographic Distribution of the Labor Force

02.062 Further examination on the size of the labor force in the setting of the total population is undertaken at the level of each kotamadya and kabupaten. The percentage distribution of each kotamadya and kabupaten's population by the types of activity is shown in Table C.4. Several kabupatens and kotamadyas are peculiar in that they have a low proportion for economically active population: the percentage of it in the total population of age 10 years or more is 41 percent for Kotamadya Tegal, 42 percent for Surakarta, 43 percent for Magelang; 43 percent for Kabupaten Sragen, and 46 percent for Karanganyar. For

the three kotamadyas the low rates of economically active population are accompanied by the high school attendance rate of more than 22 percent. On the other extreme, kabupatens Wonosobo, Banjarnegara, Magelang, and Kendal are peculiar in that their porportion of the economically active population is high: 65 percent, 64 percent, 64 percent, and 61 percent respectively. All four kabupatens are also characterized with the low school-attending population of less than 12 percent.

(d) Conclusion on the Labor Force Participation Rate

02.063 In conclusion, the labor force participation rate for the whole Central Java is 37 percent, which is low relative to the national average. The two factors influential behind the scenes are the massive population of school-attending age and the high proportion of those classified as housekeeping. How this structure will change in the coming decades, and what the economic and social implication are, are discussed in the later part of this chapter.

2.3.2 Human Capital Reserve of the Population

02.064 An important point with regard to the labor force is not only its absolute scale but also the skill level that the individuals maintain, in other words the value of human capital that the population is endowed with. While it is essential to evaluate total skills including those acquired through informal processes, we limit our focus on the attainment of formal education due to lack of data.

(a) Educational Attainment of the Population by Urban-Rural and Male-Female

02.065 The profound fact is that the population having less than a primary education, which includes those without any schooling and those who did not finish school, amounts to as much as 80 percent of the total population of age 10 years of over; those with primary school education are 14.9 percent, junior high school education 2.0 percent, senior high school education 1.5 percent, and higher education 0.2 percent. As is seen in Table C.5, each of the male-female split as well as urban-rural split, are very divergent. For the male population, those with less than primary education account for 73 percent, as contrasted with the 86 percent for female. On the other hand, for the urban population of age 10 years or more, the people with less than primary school education account for 54 percent of it, but for the rural the ratio is 83 percent. It appears that the urban-rural difference is more significant than the difference by sex. Moreover, the population which has at least a junior high school education amounts to 22 percent for the urban population, but they account for only 3 percent of the rural population. The other side of the fact is evident from a glance at Table C.6. While the population of 10 years and over in the urban area only accounts for 11 percent of the total, 19 percent of the total with elementary school education lives in the urban area; so do 41 percent of junior

high school graduates, 53 percent of senior high school graduates and 71 percent of academic and university graduates. Quite serious is the concentration of those with more than junior high school education in the urban area.

(b) Educational Attainment by Age

02.066 Although the general level of educational attainment in the population is limited, it is undoubtedly making a steady increase through the growing enrollment among the young generation. As is shown in Figure 2.6, the number of people with an education is high among the young generations. Those with primary school education or more in the bracket of age 35 to 39 were 222 thousands, and their counterpart in the bracket of age 15 to 19 amounted 840 thousands--nearly four fold increase for the four age cohorts. On the other hand it is a remarkable fact that the population with less than primary education remains rather stable from the bracket of age 40 to 45 to age 15 to 19; for the bracket of age 40 to 44, it was 1,053 thousands; and for the age 15 to 19, it was still 1,221 thousands. Apparently the rapid growth of the educated among youth was still not enough to well exceed the expansion of the population. For the age bracket of 15 to 19 those with primary education or more were 840 thousands, but those with less than primary education amounted to 1,221 thousands. Yet, it is at least true that the population with no experience in school is definitely small in the ages below 24, the number being 340 thousands for the age 20 to 24 bracket as against 882 thousands for the age 35 to 39 bracket. The implication of the above analysis is that as time elapses the population without any education will gradually lessen its share while the population with primary education and the primary school dropouts will gain a larger share.

02.067 The urban-rural differential in terms of educational attainment appears sharply in the young generations. The percentage distribution of the population by educational attainment for each of the urban and rural population is to be found in Table C.8. For the brackets of age 10 to 14 and age 15 to 19 those with no educational experience are 6 percent and 8 percent for the urban, whereas they amount 22 percent and 28 percent for the rural; if those who dropped out of primary school are added in, the corresponding figures are 28 percent and 25 percent for the urban, but 64 percent and 65 percent for the rural. Even when the concentration of schools in the urban area is taken into consideration there seems to be little hope of shortening the urban-rural disparity in terms of human capital endowment in near future.

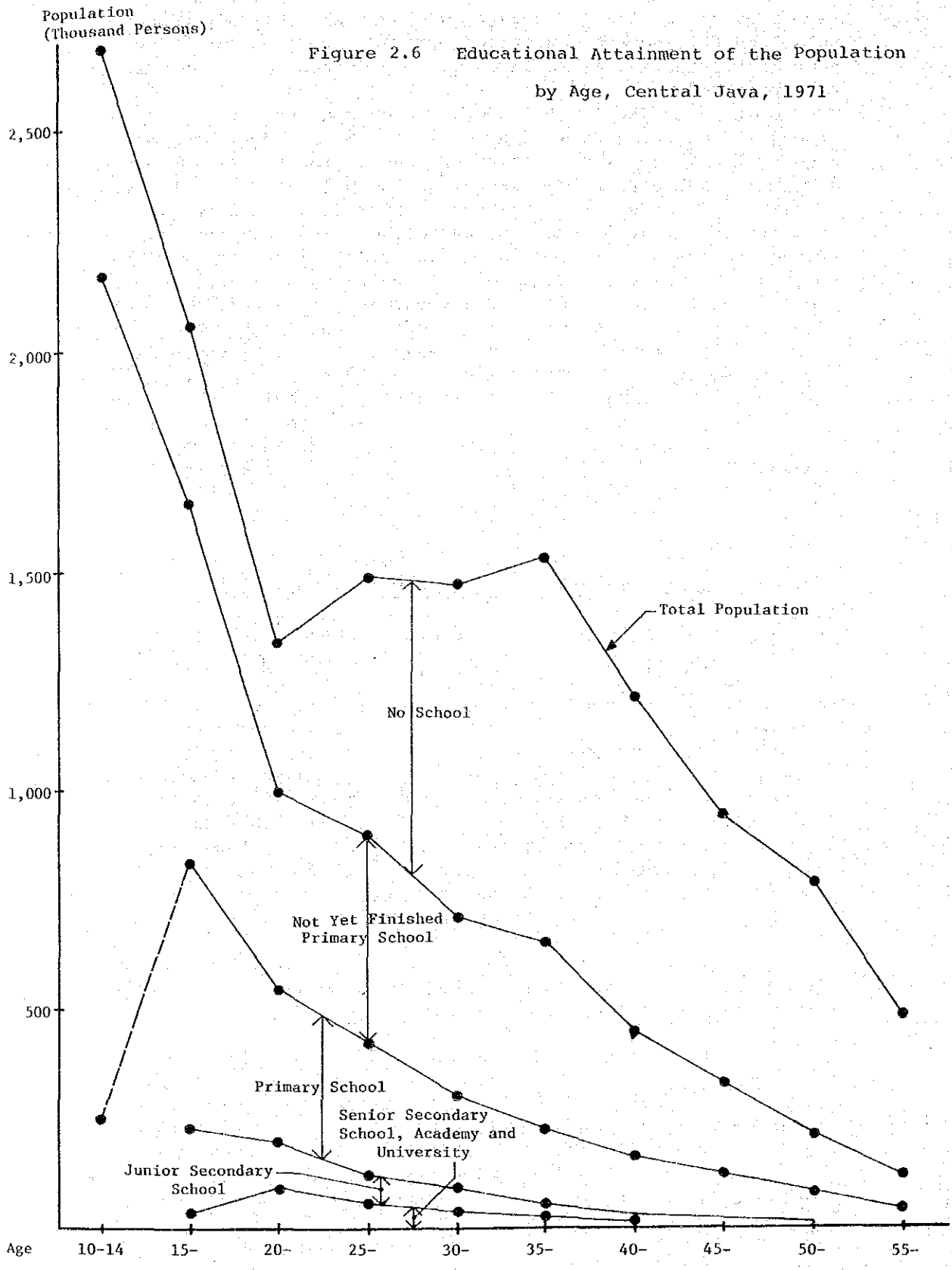
(c) Educational Attainment by Geography

02.068 For the sake of geographical comparison within the Province, percentage distribution and average year of education per person of 10 years old or more are calculated in Table C.9.[4/] Two indices from

---

4/ Average years of education was calculated by assuming 0 year for "no school", 2 years for "Not Finished Primary School", and the legal duration required for completion for the other educational attainments. The total education year was divided by the total population of age 10 years or more.

Figure 2.6 Educational Attainment of the Population by Age, Central Java, 1971



Source: Table C.7.

the calculation, the percentage for those with primary education and more, and the average education year, are presented in Figure 2.7. The average for the whole Province was 20.3 percent of those with primary education and more, and 2.17 years of education. Kotamadyas unanimously show high educational attainment, the average year of education ranges from 3.27 years for Kotamadya Tegal to 4.84 for Magelang, about two times higher than that for the entire Province. The figure for Semarang is 4.25. For kabupatens the figures are much lower, the minimum being 1.39 for Kabupaten Brebes and the minimum 3.23 for Kabupaten Temanggung. It attracts attention that the kabupatens with more than 2.00 years of average education duration locate on the corridor that runs through the northeast-southwest diagonal of the Province, as in shown as the shaded area in the figure. Among the kabupatens in the corridor, particularly high educational endowments are found in kabupatens Temanggung, Banyumas, Kebumen, and Purworejo; the average years of education being 3.23, 2.58 and 2.64 respectively, and the share of those with primary education or more which are 24 percent, 30 percent, 26 percent, and 29 percent respectively. In contrast the kabupatens on the north coast appear to have low human capital per capita, the average educational attainment ranges from 1.39 for Kabupaten Brebes to 1.86 for Batang.

2.3.3 Employment

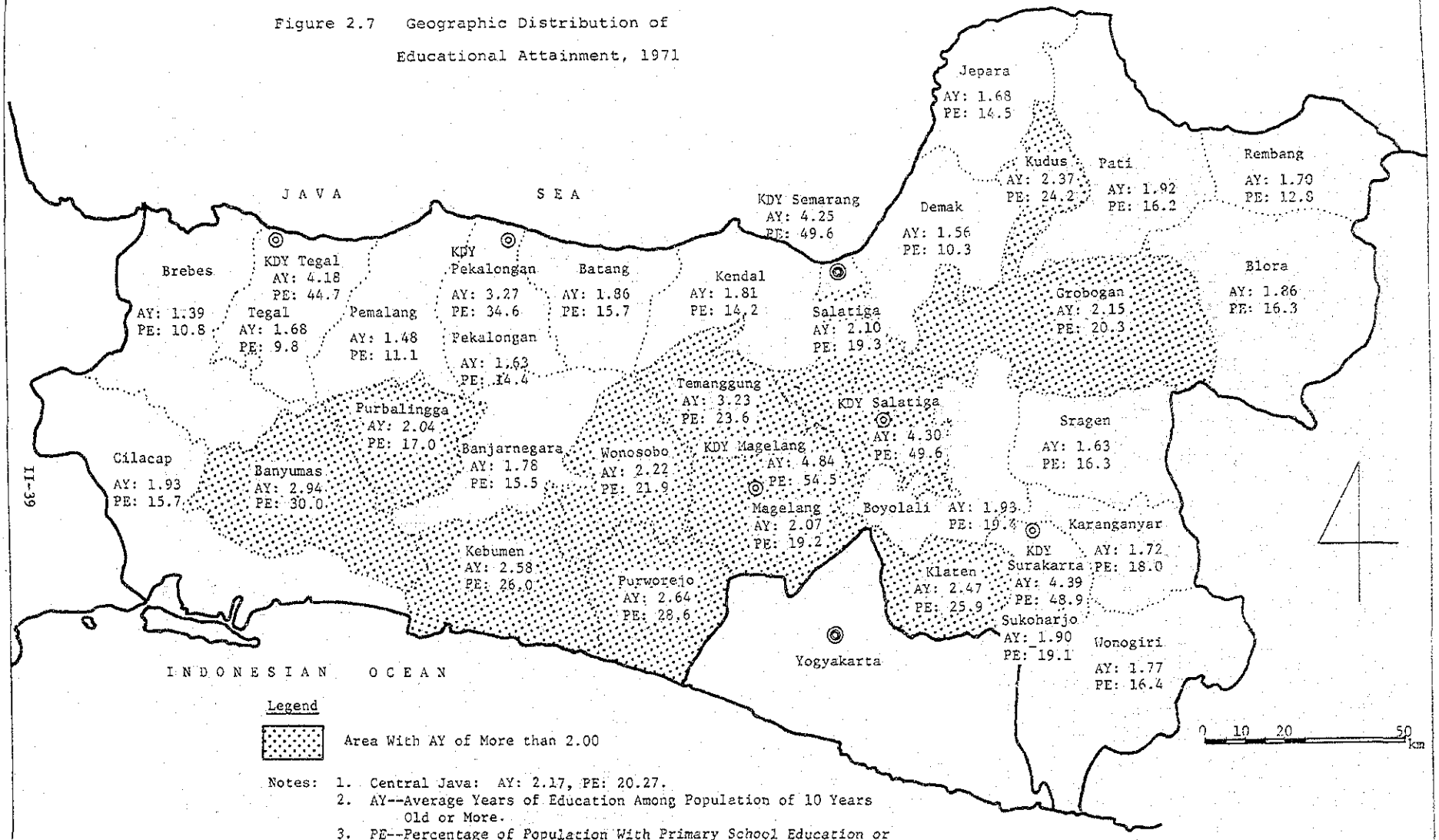
(a) Distribution by Industry

02.069 Table C.10 presents the distribution of the economically active population by industry in 1971. Of the total of 8,116 thousands economically active population in the entire Province, 63 percent are engaged in agriculture, 12 percent in trade and hotels, 10 percent in manufacturing, 9 percent in community and other services, and others are nil. Naturally the proportion of those in the agriculture sector is large in the rural population, the share being 74 percent for males, and 60 percent for females. In manufacturing and trade-and-hotel sectors female workers number more than males. On the other hand, for the urban population the major employment opportunities are found in community and other services, trade and hotels, manufacturing, and transport and communication; the shares being 32 percent, 19 percent, 17 percent, and 12 percent respectively for males. The females in the urban area concentrate on trade and hotel, the percentage being 40, and they are absent from the transport and communication sector. Overall, the difference of the distribution pattern is found in urban-rural dichotomy rather than the difference by sex.

(b) Geographic Distribution of Economically Active Population

02.070 The variation of the distribution pattern of the economically active population from one region to another in the Province is another problem. The whole percentage shares for the kabupatens and kotamadyas are tabulated in Table C.11. For kotamadyas, the high concentration on manufacturing sector is found in Pekalongan, Surakarta and Tegal, the

Figure 2.7 Geographic Distribution of Educational Attainment, 1971



Legend

Area With AY of More than 2.00

Notes: 1. Central Java: AY: 2.17, PE: 20.27.
2. AY--Average Years of Education Among Population of 10 Years Old or More.
3. PE--Percentage of Population With Primary School Education or More Among 10 Years Old or More Population.

Source: Table C.9.

share of the workers in mining and manufacturing sector being 43 percent, 24 percent and 25 percent respectively. On the other hand, the share for trade, transport and service sector and community services sector are substantial for Magelang and Semarang, with 33 percent and 48 percent respectively for Magelang, and 35 percent and 38 percent for Semarang. Salatiga's pattern appear close to the latter group. For kabupatens, the shares of agriculture, hunting, and fishery are invariably dominant relative to other industries, but in Kudus, Pekalongan and Klaten, they are extremely low relative to other kabupatens, with the shares of 37 percent, 41 percent, and 47 percent respectively. It matches our knowledge of the existence of small-scale industries in Kudus and Pekalongan, where the proportions in manufacturing and mining sector are 27 percent and 35 percent in the two kabupatens respectively. At the other extreme, kabupatens Wonogiri, Wonosobo, Cilacap and Grobogan are peculiar with their conspicuously high population in agriculture, i.e., the shares are 84 percent, 79 percent, 78 percent, and 77 percent respectively.

(c) Economically Active Population by Trade

02.071 The distribution of the economically active population by trade is presented in Table C.12. Of the total 8,116 thousand labor force, 61 percent are classified as farmers, 14 percent as construction and transport workers, and 12 percent as sales people. Naturally for the urban population, those engaged with construction and transportation work, and sales are dominant, the shares being 39 percent and 27 percent. A conspicuous fact is that the female population includes as many professional and technical workers as the male population, the proportion being 8 percent, while the male population accounts for a substantial part of clerical workers, its share in the whole male urban population being 13 percent. The female population in the urban area also shows a strong concentration in the category of sales workers. For the rural population the most important area of concentration is naturally farming, i.e., 72 percent of the male and 58 percent of the female work force are classified as farmers. The occupations following farmer in terms of share is construction and transport workers for males, and sales workers for females.

02.072 Overall, the result of the observation is not much different from the trend detected from the distribution over industries. It should be noted, however, that the share for professionals and technical workers for the female population is 8 percent, higher than the corresponding figure for males.

(d) Labor Force by Employment Status

02.073 Another useful insight on labor is obtained from the point of view of employment status. Table C.14 gives a rough picture of the share of the workers in each of the four categories of employment status by industry. The total work force consists of 38 percent of employees, 33 percent of self-employed workers, 24 percent of unpaid family workers, 5 percent of employers, and others. The distribution pattern of the

work force over the five categories appear to vary significantly from one industry to another. In the first place, employers account for 6 percent of the total labor force in the agriculture sector, leaving the remaining share almost evenly to self-employed workers, employees, and unpaid family workers. Although the figures are not necessarily accurate due to the complicated cropping arrangements, it is a remarkable fact that 1,555 thousands, or 31 percent of the work force in the sector, fall in the category of agricultural laborers, and that 1,577 thousands or 31 percent are unpaid family workers. For trade, restaurants and hotels sector, the second largest employment absorber, the workers' employment status are mainly self-employed worker, the percentage share being 71 percent. Of the 818 thousand workers in the manufacturing sector, 59 percent are employees, but still it should be noted that a considerable portion of 22 percent and 15 percent are those classified as self-employed workers and unpaid family workers respectively.

02.074 A tabulation of the population, crossing employment status with occupation, is presented in Table C.15. Not much is known from the table beyond what we learned from the break-down by employment status and industry. While employees are predominant with professional, administrative and managerial workers, and clerical workers; self-employed workers are predominant among sales workers. Services workers, and production workers are of the similar pattern to the former group. Male-female difference is conspicuous. More proportion of the male labor force are self-employed workers than their female counterparts, 37 percent as against 27 percent, while less are unpaid family workers, 18 percent as against 33 percent. As for the distribution over occupations no particular difference by sex is found.

(e) Employment Status by Age

02.075 The employment status pattern greatly varies by age group (see Table C.16 in Appendix C). For the total population the tendency is clear: employees' share is initially 29 percent for the age bracket of 10 to 14, rises to a peak for the brackets age 20 to 24 to age 30 to 34 at the level above 40 percent, and then lessens gradually towards the oldest bracket. The share of self-employed (own-account) workers starts at the much lower level of 5 percent, and gains magnitude rapidly as the population's age goes up to cross the level of 40 percent between brackets of age 30 to 34 and 35 to 39, and still gradually increase. On the contrary family workers account for as much as 62 percent for the age 10 to 14 bracket, but the ratio definitely decreases through all the age brackets. The trend is indicative of the tendency that a considerable part of young labor force start their career as family workers, and become employees or self-employed workers in later years. One major difference between the male and female populations lies in that self-employed workers' share grow more rapidly and maintains a higher figure for higher age brackets more for the male population than for the female population. Another is that while the employees' share for the male population is about the same as that for the female population at the bracket of age 10 to 14, and in the following age brackets that for the male population reaches at the peak which is 9

percent points higher than that for the female counterparts; and that male family workers, which account for 64 percent at the youngest brackets, show a sharp decline towards the end of 20s, whereas the corresponding figures for the female population draw much milder decrease and remain to be high over the age brackets.

02.076 Although changes observed with the existing age brackets above are not necessarily the change of age-cohorts over time, it is at least not too hazardous to infer from the observations that the workers are mobile with regard to employment status, the mainstream being from family-worker to employee and to self-employed worker, and from employees to self-employed worker. It seems also the case for the Province that the mobility among statuses is much more intense among the male population.

2.4 Future Growth of the Labor Force and Its Implications

2.4.1 Projected Growth of Labor Force from 1971 to 1991

(a) Assumptions for the Projection

02.077 As the last step of the analysis of labor force, a projection was made of the growth of the labor force in the Province. Since the most adequate data that the projection can be based upon is the 1971 Census, the base year of the projection is set in 1971, and the duration of the projection covers the two decades following that year. A summary of the result is presented in Table 2.15, but due explanations on the procedures taken for projection and the assumption made preceed the analysis of the results.

02.078 The method taken was the allocation of the population in every age bracket into several categories of activities including economically active, in steps of 5 years. The size of the population by age strata was projected in Section 2.2 of this report, and these were directly used as the base figures for the projection. The percentage distribution of the population over the types of activities for each of the age brackets is from the 1971 Census, which was analyzed in section 2.3. But since the labor force participation by the younger generation is greatly affected by the school attendance rate, which is rapidly growing in Central Java, the allocation patterns for the bracket of age 10 to 14, age 15 to 19, and age 20 to 24 were adjusted for each year of projection to allow the growth of school enrollment. The steps taken for this adjustment is presented in Table C.17 in Appendix C. The absolute numbers of the school-attending population for the years of projection was led assuming 3.00 percent annual increase for the age 10 to 14 bracket, 4.00 percent annual increase for the age 15 to 19 bracket, and 4.50 percent increase for the age 20 to 24 bracket. This raises the ratio of school attendants from 57 percent in 1971 to 85 percent in 1991 for age 10 to 14 male, from 48 percent to 68 percent for age 10 to 14 female; from 25 percent to 37 percent for age 15 to 19 male, from 13

Table 2.15 Economically Active Population in Central Java, Projected from 1971 to 1991

(Unit: Persons)

		1971	1976	1981	1986	1991
Age 10-24	Male	1,366,099	1,992,400	2,278,943	2,277,288	2,016,587
	Female	868,666	1,152,541	1,370,593	1,383,157	1,302,316
	Total	2,234,765	3,144,941	3,649,536	3,660,445	3,318,903
	Index (1971=100)	100	141	163	164	149
25-39	Male	1,819,269	1,673,415	1,864,081	2,420,747	3,340,970
	Female	1,045,951	962,277	988,171	1,099,047	1,448,790
	Total	2,865,220	2,640,692	2,852,252	3,519,794	4,789,760
	Index	100	92	100	123	167
40-54	Male	1,385,264	1,601,298	1,669,380	1,595,655	1,386,404
	Female	711,150	842,616	952,199	1,008,257	917,716
	Total	2,096,414	2,443,914	2,621,579	2,603,912	2,304,120
	Index	100	117	125	124	110
55-	Male	479,295	554,931	663,982	798,269	937,042
	Female	233,001	263,676	291,976	349,729	833,596
	Total	712,296	818,607	955,958	1,147,998	1,770,638
	Index	100	115	134	161	249
Total	Male	5,049,297	5,822,044	6,576,386	7,091,959	7,681,003
	Female	2,858,768	3,226,110	3,602,939	3,840,190	4,502,418
	Total	7,908,065	9,048,154	10,079,325	10,932,149	12,183,421
Eco. Act. Growth		1,140,089	1,031,171	852,824	1,251,272	-
Eco. Act. Growth per Year		228,018	206,234	170,565	250,254	-
Annual Growth Rate		2.73	2.18	1.64	2.19	-
Index		100	114	127	138	154

Source : Table C.19 in Appendix C.

percent to 20 percent for age 15 to 19 female; and 8 percent to 8 percent for age 20 to 24 male, and from 2.0 percent to 3.0 percent for age 20 to 24 female. Although these assumptions of attendance rates may appear to have been set arbitrarily, from examinations on the past trend it does not appear to be likely that the real growth rate would deviate from these figures by more than 2 percent. Through these assumptions the rate of the school attendance for each age bracket and for each year of projection was calculated, these were extrapolated into the distribution patterns, and the remaining percentages are allocated to other types of activities proportionately to the distribution in 1971. The result is shown in Table C.18. For the brackets beyond age 20 to 24, a constant distribution pattern over time was assumed. The resulting figures of population by types of activity for all age brackets and by each projected year are presented in Table C.19, and its summary table is Table 2.15.

(b) Result of Labor Force Projection

02.079 The projection shows that with the assumptions made and all other things the same the labor force in Central Java, which was 7,908 thousands in 1971, will grow to 12,183 thousands in 1991, increasing 54 percent in 20 years. There will be about an increase of 1 million every 5 years, or a 200 thousand increase in the labor force every year for two decades in the Province. More precisely, the annual growth rate of the labor force is estimated to have been as high as 2.73 percent for 1971 to 1976, and it will show a moderate decrease in the latter half of the 1970s and the beginning of 1980s, the growth rate being estimated at 2.18 for 1976 to 1980 and 1.64 for 1981 to 1985. But even with the drop in growth rate, the Province will see a growth of 1,030 thousands in the labor force from 1976 to 1980, and 852 thousand growth from 1980 to 1984. In the latter half of the 1980s the increase will again assume momentum, the increase rate being 2.19 percent from 1986 to 1991. The absolute number of increase will in fact amount to 1,251 thousands from 1986 to 1991. If seen for age components, it is clear that the youngest portion, 10 to 24 years old, will greatly increase until 1981, the 1981 labor force in this bracket being 63 percent higher than that in 1971, but it will level off afterwards. On the other hand, the age 25 to 39 bracket will see a dramatical increase from 1986 to 1991, which is the major reason for the resumption of high increase rate of the whole labor force in 1986 to 1991.

02.080 The social and economic consequence that this rapid expansion causes will be enormous and serious. The creation of employment opportunities is surely of ultimate priority, but short-run measures may have to be taken. One such measure is in the labor-intensive public projects and the other is the expansion of educational opportunities. The latter will help to keep the massive young generation out of the labor market if only temporarily.

2.4.2 Future Sectoral Composition of Labor Force

(a) Assumptions for Sectoral Composition Estimation of Labor Force

02.081 In the previous sector the future growth of the economically active population in the Province was estimated, mainly from the estimated future population and other demographic factors. The next task is to see the nature and magnitude of the change of economic and social conditions that the growth of labor force will bring about. The first step of the analysis is estimation of the distribution of the labor force over different sectors of economy. For this the Study team employed the basic categorization of the economy into three sectors, i.e., agriculture and fishery; manufacturing, mining, utilities and construction; and trade, services and others. Further, the labor force in the agriculture sector was divided into three parts depending on employment status, i.e., self-employed workers; family workers; and employees. Hence there are five categories of labor force in the scope of the present analysis.

02.082 The bases of the estimate and the assumptions taken are itemized below:

(1) The basic composition of labor force was taken from the 1971 Census. The labor force was split into the five categories given above, and are adjusted to allow for the difference between the total labor force in the Census and that in the labor force projection in the previous section, the difference being about 2 percent. The result is presented in Table C.20.

(2) As is alluded elsewhere in this report, the size of land-holdings in the Province is extremely small in general, and in fact neither is the average size decreasing significantly nor is the number of farms increasing in spite of the tremendous population pressures. It was assumed, therefore, that the number of farmers who are mainly cultivating their lands or hiring others will show little increase in the projected period. The number of family workers in the agriculture sector was assumed to grow at the same pace as the whole labor force. The increase of agricultural employees is thought to be determined not by the innate factors in the sector.

(3) The manufacturing, mining, utilities and construction sector is assumed to sustain a 3 percent growth in terms of employment. It may to slightly biased upward, but it is not a wholly unrealistic presumption. As is shown in Table 1.10 in Chapter I, the average annual growth rates of GRDP for 1973 to 1975 were 5.5 percent for the industry and mining sector, and 7.2 percent for the construction

and utilities sector, while the whole GRDP grew at a rate of 4.8 percent per annum. If productivity in the sectors grew by 3.0 percent annually for the same period the weighted average for the growth rates of employment becomes 2.7 percent. If 2 percent and 4 percent productivity growth are assumed, the implied growth rates of employment are 3.7 and 1.7 percent respectively. Thus 3.0 percent of growth will not be impossible if proper measures are employed.

(4) The remaining labor force is assumed to be absorbed by the trade and services sector and by the agricultural employee sector, with the same growth rate as that for the two sectors. In other words most of the labor force are to be forced either to remain in the rural area as landless laborers or find a way to become small peddlers or other miscellaneous service workers, and the choice between the basic two directions are not strained by institutional factors.

02.083 The resulting figures are presented in Table 2.16, and the implied employment elasticity to GRDP increase, for the future can be calculated based on above assumptions.

(b) Result and Implications of Sectoral Composition Estimation

02.084 Major findings in the projected composition of labor force are summarized below.

02.085 First, the percent distribution of the labor force will show a marked change. The share in the labor force of the agriculture sector will decline from 63.4 percent to 57.7 percent in 1991; while the manufacturing, and trade and services sectors are to see an expansion from 11.8 to 13.8 percent and from 24.8 to 28.5 percent respectively for the same period. The loss of 5.7 percent by the agriculture sector is taken up by 2.0 percent by the manufacturing sector and by 3.7 percent by the trade and services sector.

02.086 The employment in the agriculture sector will see a 1.4 fold increase over the projected 20 years, or 2.0 percent growth annually. Needless to say the number of family workers will show a tremendous 1.5 fold increase, but the number of employees are to expand with an even higher ratio of 1.8 fold. Indeed, about 1.2 million new landless laborers would be created in the villages for the 20 years. On the other hand, the manufacturing sector is to expand steadily to gain another 0.8 million employment in the projected period. The trade and services sector will inflate with a considerable momentum, absorbing an additional 1.5 million employment, to hold 3.5 million of total labor force in 1991.

02.087 The absolute elasticity of the employment of trade and services sector to that of manufacturing sector is 2.0 and the relative elasticity is 0.98 for the whole period based on the projection (the absolute

Table 2.16 Projected Labor Force[1/] Composition by Industry

(Unit: Thousand Persons)

	1971	1976	1981	1986	1991
Agriculture					
Own Act. & Employer	1,930	1,930	1,930	1,930	1,930
Family Worker	1,558	1,783	1,986	2,154	2,400
Employee	1,526	1,861	2,148	2,361	2,699
Sub Total	5,014	5,574	6,064	6,445	7,029
Manufacturing, Mining					
Utilities and Construction	933	1,082	1,254	1,454	1,685
Trade Services & Others	1,961	2,392	2,761	3,033	3,469
Total	7,908	9,048	10,079	10,932	12,183
As Percent of Total					
Agriculture	63.4	61.6	60.2	60.0	57.7
Manufacturing, Mining Utilities and Construction	11.8	12.0	12.4	13.3	13.8
Trade Services	24.8	26.4	27.4	27.7	28.5
Total	100.0	100.0	100.0	100.0	100.0

Note: 1/ The same as the Economically Active Population. These numbers includes those unemployed in each sector. In addition, these result is just a projection of labor force and not the opportunity of employment.

Source: Study Team's Projection.

elasticity is defined as the absolute increase of employment in trade and services as divided by that in manufacturing and the relative elasticity the percent increase in trade and services as divided by that in manufacturing).

2.4.3 Employment Situation in the Future

02.088 The above discussion shows the future composition of labor force by industrial sector under several assumptions. On the other hand, the situation of employment in each sector cannot remain the same as at present over the period. The present discussion is not going into the needed but difficult-to-undertake analysis on underemployment and income distribution for the present and the future in the Province. It only attempts to indicate the major trends that are likely to take place in the labor market and society in the near future. Of prime importance is the plight of the labor force in the rural villages which comprise by far the majority of the total labor force in the Province. Typically the problem centers upon the future employment situation of agricultural employees and small peddlers and miscellaneous servicemen which comprise more than a third of total labor force and, moreover, represents the marginal population in terms of living level.

(a) Future Situation of Agriculture Employment

02.089 There are several favorable factors for the agriculture sector. Since the GRDP of the agriculture sector is estimated to have grown at around 3 percent per annum for the first half of the 1970s, which is well above the population growth, and is expected to grow steadily in the future, it is not an unfounded expectation that the general situation of employment is being ameliorated: an increased harvested area and intensification of cultivation may be increasing the labor required for production, and the elevated consumption level of farmers may be making room for more laborers in trade and services sector.

02.090 Nevertheless, a study on relating data and case studies in the area indicate that the situation is not being directing to a desired objective.

02.091 In the first place, the intensification of agricultural cultivation and the increase in the yield of rice production are not necessarily accompanying increased labor input at least in the Province. The Study team examined the Agriculture Census by the Biro Pusat Statistik for the duration of 1972 to 1975 and followed the wage component of production cost of paddy and wet land paddy. The resulting findings are that the wage cost per hectare as deflated by the price of rice did not show significant increases, if not decreases for the duration, while the production itself was improving steadily. It is noteworthy, incidentally, that the cost for fertilizer and the rent of animals were in general showing a marked increase. It is not definitely known whether this was accompanied by an increased employment with lower

wage-rate or the decreased employment with the same wage-rate, but at least it seems to be the case that the total funds per hectare for employees did not rise despite the remarkable expansion of the total number of employees. Some surveys showed still other reasons for the reduced labor requirement in the sector, including institutional problems and the use of sickle.[5/]

02.092 In the second place, although the use of mechanical power for cultivation is not yet prevailing in the Province, the spreading introduction of powered hullers is likely to be depriving a considerable number of people, especially women, of employment opportunities. The incidence is not only vividly described by a recent case study of a village close to the border between Yogyakarta and the Province, but can be proved for the whole island of Java utilizing macro data.[6/]

02.093 Given the fact that the increase of total harvested area in the Province is not going to be substantial as is pointed out elsewhere in this Study, the future potential of employment absorption in the sector is thus considerably limited.

(b) General Employment Situation

02.094 With the limited increase of employment opportunities in face of the substantial growth of total agricultural employees--averagedly 2.9 percent or 59 thousands of annual increase--there is no doubt that there will be either a substantial increase in the number of un- and under-employed or a drop in the real wage-rate in the agriculture sector; or probably both, if necessary measures are not taken promptly. The situation will not be much better for the farmers who own lands, since the number of family workers is to grow with substantial momentum. The total employment of the trade and service sector may increase substantially depending upon the increase in productivity in agriculture sector, but again the marked increase in the labor force will hinder a tangible increase in employment or wage-level in the rural area. The growth of the manufacturing sector in the Province is not likely to produce a substantial linkage effect an employment in other sectors in future.

2.4.4 Implications for Policy

02.095 The above discussions implied that even with a rampant 3 percent annual increase of employment in the manufacturing sector the

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5/ Widya Utami and John Ihalaw, "Some Consequences of Small Farm Size", BIES, July 1973; and Collier, Gunawan and Wiradi and Soentro, "Recent Changes in Rice Harvesting", BIES, July 1973. BIES: Bulletin of Indonesian Economic Studies.

6/ M. Singarimbun, Note--Sriharjo Revisited, mineographed, January, 1976; and Collier, Colturm, Sinarhadi and Shaw, "Choice of Techniques in Rice Milling: A Comment," BIES, March 1974.

worsening employment situation and lowering living standards of landless laborers and a substantial workers in the trade and service sectors are almost inevitable if relevant policy measures are not undertaken. The directions of the policies called for would include the following:

(1) The strategies for improvement of employment situation and living standard of the marginal population should be basically considered in the framework of the whole nation. The labor absorbing potential of the manufacturing sector does not seem to suffice even to keep the situation unchanged.

(2) It should be noted that the investment in the agriculture sector is not significantly alleviating the employment situation of landless laborers as is generally believed. Admittedly there are occasional employment creation by the construction of infra structure but their effect is limited relative to the whole population. Efforts should be taken to develop the type of intensification which requires more labor inputs.

(3) The technological difficulties should be overcome to lower the required investment per employment in the manufacturing sector. Necessary resources should be allocated for the necessary researches and trainings.

(4) Efforts should be made to help keep the development of the trade and services sector well balanced so that the increase in output is accompanied by the increase of employment.

(5) The Government, National and Provincial, should be well aware of the fact that a substantial part of the population will remain in a deprived situation for a prolonged period. Substantial resources should be allocated for keeping up the welfare standard, and a well designed plan in this field is needed even if the investment in this field is not actively contributing to the economic development itself.

CHAPTER III

WATER RESOURCES DEVELOPMENT

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WATER RESOURCES DEVELOPMENT

3.1 Present Situation and Development Prospects

3.1.1 Climate and Rainfall

03.001 Climate of the area is essentially maritime-tropical being hot and humid with high rainfall, characterized by well distinguished wet and dry seasons corresponding with the timing of monsoons.

03.002 Rainfall varies considerably from area to area (see Table 3.1 and Figure 3.1): (1) In the northwestern portion of the Study area, known as the Pemali-Comal basin, the average annual rainfall is 1,700-2,600 mm in the low land along the Java Sea and 2,600-4,900 mm in the mountainous area. (2) In the southwestern portion, the average annual rainfall is 2,200-3,300 mm in the low land and exceeds 6,000 mm in the upper reaches of the Serayu River. (3) In the northeastern portion, known as the Jratunseluna basin, the annual rainfall is 2,100-2,500 mm in the low land and about 3,000 mm in the mountainous area. (4) In the southeastern portion, the annual rainfall in the Progo River basin is about 2,400 mm in its upper reaches and about 2,200 mm in its lower reaches. The flat land in the Upper Solo River basin receives about 2,000 mm of annual rainfall.

03.003 Generally, about 80-85 percent of the annual rainfall occurs during the wet season from October through April, and the rest falls during the dry season from May through September. However, the rainfall patterns, both monthly and annual, are erratic according to years.

03.004 According to the observation data during the period of 1964-1973 at main locations in the Study area, the minimum monthly rainfall is to almost zero in every month of the dry season, while the annual rainfall fluctuates widely between 50 percent and 160 percent of the average (Table 3.1).

03.005 Further efforts for development of water storage schemes are needed to cope with the low river discharges during the dry season.

Table 3.1 Monthly and Annual Rainfall in Selected Locations of Central Java, 1964-1973

(Unit: mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%
Brebes[1] (El 3 m)	388	254	245	133	132	75	41	22	56	45	112	198	1,701	100
max[2]	791	528	448	257	234	224	249	101	190	134	235	402	3,039	178
min[2]	148	74	53	47	47	0	0	0	0	0	26	79	1,066	63
Pekalongan (El 4 m)	628	453	392	153	171	106	64	64	75	118	107	229	2,560	100
max	1,285	795	949	377	528	265	208	238	256	220	232	428	3,669	143
min	89	163	174	27	33	5	0	0	8	0	29	57	1,636	64
Watukumpul (El 415 m)	975	857	668	430	369	180	116	68	94	243	349	592	4,941	100
max	1,997	1,371	1,407	648	756	545	497	305	619	399	515	769	6,406	130
min	607	355	215	209	72	0	0	0	0	35	218	368	3,691	75
Bumiayu (El 152 m)	381	388	423	265	181	125	47	52	56	151	177	379	2,625	100
max	556	858	677	516	347	261	262	302	193	324	306	671	3,827	145
min	261	195	183	72	44	0	0	0	0	8	96	217	1,457	56
Cilacap (El 6 m)	260	255	289	364	295	258	165	90	152	447	363	381	3,319	100
max	440	646	557	606	572	632	727	473	867	1,096	742	574	5,212	157
min	111	135	126	194	72	0	0	0	0	0	133	252	1,547	47
Kutoarjo (El 35 m)	352	282	308	153	155	73	28	24	32	195	217	415	2,234	100
max	582	423	610	308	529	279	190	241	221	911	415	837	3,363	150
min	203	169	166	8	0	0	0	0	0	0	64	152	1,333	60
Purwokerto (El 73 m)	386	319	355	294	240	159	79	58	115	277	318	318	2,918	100
max	820	449	699	405	460	379	309	221	442	561	524	504	4,092	140
min	171	125	103	140	13	0	0	0	5	10	80	73	1,416	49

(continued)

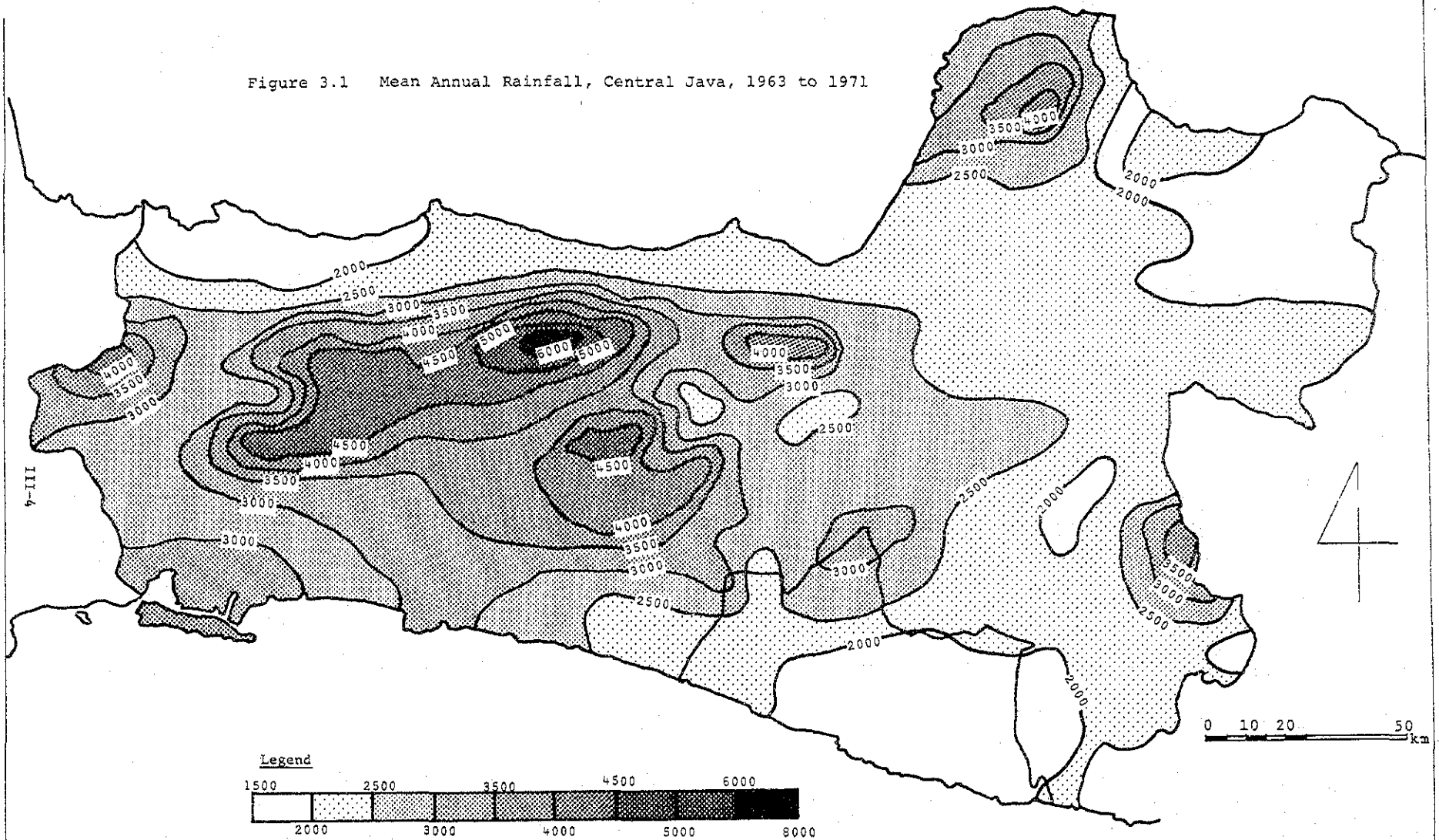
(Table 3.1 continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%
Wonosobo (El 755 m)	793	690	750	631	531	266	190	138	228	507	721	814	6,259	100
max	1,218	1,027	1,204	947	1,033	889	653	503	638	1,484	945	1,364	9,531	152
min	417	404	291	349	113	0	0	8	3	32	433	381	2,812	45
Kendal (El 2 m)	413	210	246	109	76	101	60	42	45	168	118	197	1,785	100
max	876	318	482	220	197	137	208	124	152	452	158	321	2,360	132
min	81	28	59	69	8	27	0	0	0	7	69	105	1,067	60
Tuntang (El 480 m)	360	386	383	366	258	118	88	53	98	194	311	399	3,014	100
max	502	524	521	580	458	274	286	250	474	525	485	502	4,251	141
min	118	204	292	235	39	0	0	0	0	2	191	245	1,898	63
Kudus (El 17 m)	630	422	378	176	143	51	44	23	59	77	171	362	2,536	100
max	953	727	572	295	286	136	332	128	187	244	231	629	3,718	147
min	221	294	188	43	0	0	0	0	0	5	119	226	1,912	75
Purwodadi (El 22 m)	356	262	239	176	129	62	45	47	91	154	249	303	2,113	100
max	537	368	373	257	333	113	171	145	178	333	314	446	2,675	127
min	165	193	152	80	28	0	0	0	9	22	134	157	1,628	77
Temanggung (El 580 m)	365	322	383	255	153	69	53	53	56	138	208	331	2,386	100
max	530	428	536	361	388	147	211	171	176	296	287	618	2,992	125
min	248	127	244	129	56	0	0	0	0	4	99	220	1,481	62
Wonogiri (El 100 m)	319	336	407	129	149	100	42	19	42	129	182	223	2,077	100
max	407	601	638	267	243	216	174	81	181	303	320	421	2,921	141
min	178	144	223	33	41	0	0	0	0	0	37	51	1,043	50

Notes: 1/ Average monthly and annual rainfall in the period of 1964-1973 in mm.
2/ Max. and min. show the maximum and the minimum values in the same period.

Source: Pemeriksaan Hujan di Indonesia, Pusat Meteorologi dan Geofisika Departemen Perhubungan Indonesia. No. 77-No. 86.

Figure 3.1 Mean Annual Rainfall, Central Java, 1963 to 1971



Such schemes could also serve for flood control purposes in the wet season.

3.1.2 Pemali-Comal Basin

03.006 The area (see Figure 3.3 for the location of the area) extends for about 120 km along the coast of the Java Sea in the northwestern portion of Central Java Province, and occupies a total area of about 5,000 sq. km. The Pemali River (1,175 km) and the Comal River (835 km), both originating from Mt. Slamet (elevation 3,428 m), are the major rivers in the area.

03.007 The basin embraces the towns of Brebes, Tegal, Pemalang and Pekalongan which together constitute one of the most developed areas in Central Java.

03.008 The wet fields and dry fields occupy about 40 percent and 15 percent of the total area respectively, while the forests occupy only about 15 percent which is quite a small portion of the total area, leading to serious erosion problems in the watershed.

03.009 The Pemali-Comal irrigation system has been in operation since 1888 when at the start it served 7,500 ha under the Sungapan weir. The technical irrigation area gradually has been increased to 123,000 ha under 42 weirs and 3 reservoirs. However, in the dry season, only about 25 percent of the total area can be dependably irrigated.

03.010 The irrigation system consists of 8 service areas diverting waters from 28 rivers, 170 km of primary canals of and 690 km of secondary canals.

03.011 After considerable deterioration of the system during the past 30 years, the Pemali-Comal irrigation rehabilitation started during Repelita I. Rehabilitation of primary and secondary canals was completed in 1976.

03.012 Tertiary canal development was started recently to improve the minor systems of the Pemali-Comal irrigation. Many model plots, covering a total area of 5,000 ha, were already set up for demonstration. The actual implementation of the tertiary development will start in 1977.

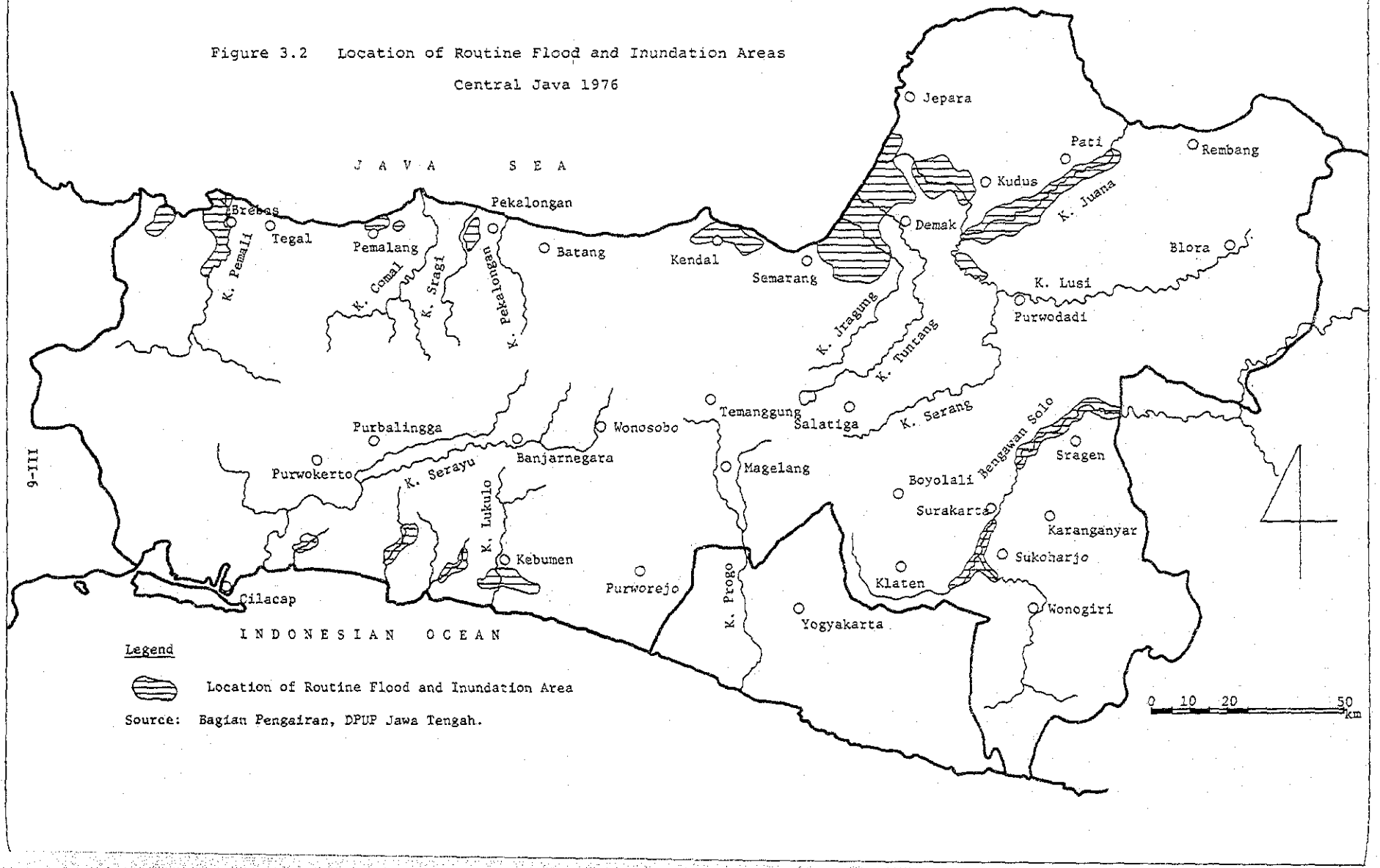
03.013 To encourage farmers' participation in the development, some incentives have been introduced such as payment of about half of normal laborers' wages for the canal works.

03.014 The Pemali, Comal, Sragi and Pekalongan rivers have some flood and inundation problems along their lower reaches (see Figure 3.2).

03.015 The Pemali River has a dike on the right bank near Brebes town, thus causing routine inundations on the paddy fields on the left bank of the river. It is reported that the flood of February 11, 1977

Figure 3.2 Location of Routine Flood and Inundation Areas

Central Java 1976



Legend

Location of Routine Flood and Inundation Area

Source: Bagian Pengairan, DPUP Jawa Tengah.

caused inundation of about 3,300 ha of paddy fields, about 1,890 ha of village areas, and about 8,320 houses, with 10 houses destroyed and 3 persons lost. The flood overflowed the dike and caused some breaches in the embankment.

03.016 The Sragi and Comal floods have caused routine inundations mainly on the agricultural fields. The town area of Pekalongan has often suffered from inundations caused by the flooding of the Pekalongan River.

03.017 The proposed major water storage projects in the area are the Bantarkawung project on the Pemali River and the Karanganyar project on the Comal River. The Bantarkawung storage project on the Pemali River, with an effective storage capacity of about 580 million m^3, will supply additional dry season irrigation water for the western half of the area. It will serve for the flood control on lower reaches of the Pemali River. The Karanganyar storage project on the Comal River, with an effective storage capacity of about 350 million m^3, will provide additional irrigation water for the eastern half of the area. It will also serve for the flood control of the lower reaches of the Comal River.

03.018 Flood control on the lower reaches of the Pemali and Comal along with the water storage shcemes will be important for realization of the full benefits of irrigation. Under both storages, the required length and required channel-enlarging volume of river improvement along the lower Pemali and lower Comal would be fairly reduced. A flood diversion canal, as an alternative plan, is proposed for the flood control of the lower Pemali River.

03.019 While, the flood control of the lower Pekalongan River, because of absence of the possibility of construction of a potential reservoir, would require considerable widening of the river channel over a fairly long distance, and creation of a new diversion canal detouring the town area.

03.020 A hydro-power generation plant with maximum output of approximately 10 megawatts (MW) is planned at the Karanganyar storage.

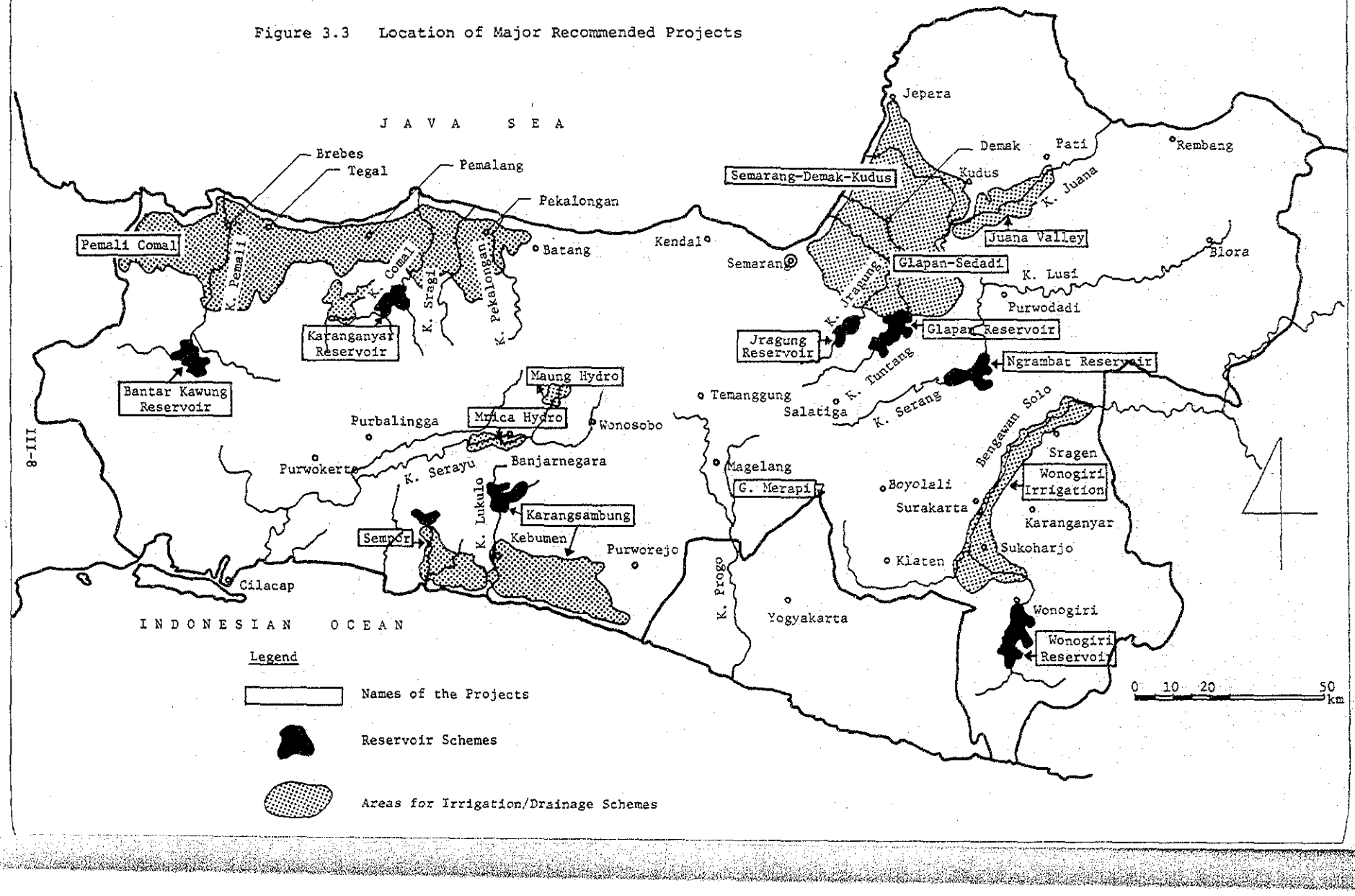
3.1.3 Jratunseluna Basin

03.021 The area (see Figure 3.3) is located in the northeastern portion of Central Java Province. Of the total area of approximately 7,700 sq. km, about 61 percent (470,000 ha) is used for agriculture, while the forests occupy about 24 percent (1,820 sq. km). The composite anme of Jratunseluna is derived from the names of five major rivers in the area, the Jragung, Tuntang, Serang, Lusi and Juana.

03.022 The area can be divided, based on natural and artificial conditions, into the following areas:

(1) the Plain of East-Semarang, located between Semarang and the Tuntang River;

Figure 3.3 Location of Major Recommended Projects



(2) the Glapan-Sedadi area, located in the plain of Demak, including the Wedung area;

(3) the upper reaches of the Tuntang River;

(4) the Lusi Valley;

(5) the Juana Valley; and

(6) the Kedung-Semat and Welahan areas, located to the northwest of Kudus.

03.023 During the wet season ,the total wet land (sawah) area amounts to about 273,000 ha, which consists of about 100,000 ha under technical irrigation, 44,000 ha under rural irrigation, and some 129,000 ha rainfed. Of the technically irrigated areas of 100,000 ha, about 29,500 ha lie in the Plain of East-Semarang, about 47,600 ha in the Glapan-Sedadi area, about 20,500 ha in the Juana Valley and Mria slopes, and 2,500 ha in the Lusy Valley. However, only about one-fourth of the technically irrigated areas can be dependably irrigated in the dry season.

03.024 Two major rehabilitation projects are being carried out in the basin. The first project, the rehabilitation of the Glapan-Sedadi irrigation, started in 1969, is almost completed already with regard to its major irrigation systems. Rehabilitation of its minor systems will be commenced in 1977. The second project, the Semarang-Kudus rehabilitation project, started in 1970 covering a wide low-lying area between Semarang and Demak-Kudus, is for irrigation rehabilitation and drainage improvement.

03.025 Inundations have been experienced extensively in the low-lying coastal areas and in the Juana Valley, caused by both floods and insufficient drainage. In the Plain of East-Semarang, an area of some 30,000 ha is reported to be regularly affected by inundation of 6,000 ha by flooding from the Penggaron, Dolok, Setu and Jragung Rivers. In the Welahan area, situated in the northwestern part, about 3,500 ha is regularly inundated by flooding of relatively small Muria rivers and by stagnated drainage of the area. In the Juana Valley, about 5,000 ha of the irrigated areas are inundated every year, caused by flooding due to the small capacity of the Babalon and Juana Rivers and by the absence of adequate drainage.

03.026 Diversion of flood water of the lower Serang River to the Juana River at Wilalung, which was intended to create arable lands by silting up the low-lying Juana areas, has decreased the discharging capacity of the Juana River severely during the past half century.

03.027 The lower Tuntang, lower Serang and Wulan rivers are provided with dikes along their lower courses. However, due to heavy siltation, river beds of lower courses of these rivers have risen, consequently decreasing their discharging capacities. At present their elevation

is several meters higher than that of the adjacent paddy fields, and a small freeboard is left below the embankment crest. Besides, the Wulan River, which forms a downstream part to the lower Serang River, has a small capacity compared to the lower Serang. These situations have been a continuous menace to the area. It is reported that during the January 1972 flood, 165 million m^3 of water flooded through the breach in the left-bank dike, inundating some 25,000 ha in the Glapan-Sedadi area.

03.028 Because of the nature and importance of the Jratunseluna basin, many development programs have been laready proposed for it; they are as follows.

(1) Jragung reservoir on the Jragung River:
Flood control, water supplement for irrigated areas of 7,900 ha in the wet season and 2,800 ha in the dry season, and power generation of 2.6 MW and 11.7 giga-watt-hour (GWh) per annum.

(2) Ngrambat reservoir on the Serang River:
Flood control, additional irrigation areas of 20,000 ha in the wet season and 14,000 ha in the dry season, and power generation of 7 MW and 38 GWh.
By this program, some reduction of floods in the Serang river basin is expected, but still the problems related to Wilalung flood diversion structure and the Juana Valley will not be solved.

(3) Glapan reservoir on the Tuntang River:
Flood control, additional irrigation areas of 18,000 ha in the wet season and 19,000 ha in the dry season, and power generation of 4.9 MW and 30 GWh.

(4) Banjarrejo reservoir onthe Lusi River:
Mainly for irrigation, additional irrigation areas of 11,000 ha in the wet season and 5,000 ha in the dry season, and power generation of 1.8 MW and 10 GWh.

(5) Penggaron reservoir on the Penggaron River:
Flood control, and water supplement for irrigated areas of 4,600 ha in the wet season and 5,050 ha in the dry season.

(6) Dolok reservoir on the Dolok River:
Flood control, and water supplement for irrigated areas of 2,750 ha in the wet season and 1,950 ha in the dry season.

(7) Flood diversion canal:
Flood diversion canal from the Serang at Brakas to the Java Sea.

(8) Juana Valley drainage:
The drainage of Juana Valley together with the flood diversion canal from the lower Serang.

(9) Small reservoirs on the tributaries in the Lusi Valley.

(10) Small reservoirs on the slopes of Muria.

(11) Prevention of sea water intrusion into the lowlands along the sea.

3.1.4 Serayu River Basin

03.029 The Serayu River basin (see Figure 3.3) is located in the southwestern portion of Central Java Province and covers about 3,700 sq. km. About 78 percent of the basin area is used for agriculture and homesteads, while forests occupy only 16 percent of the total area. Over-cultivation has led to extensive erosion of soils in many parts of foothills in the basin.

03.030 The Central Government controls many irrigation schemes, with a total area of 62,000 ha. The major ones are for the upper reaches of the Singomerto (5,600 ha) and Banjarcahyana (5,100 ha), and the lower reaches of the Gambarsari (16,100 ha), Pesanggrahan (4,000 ha) and Tajum (3,200 ha). Others are small and located on the tributaries. Besides, there are many village irrigation schemes, covering an area of about 35,000 ha and rainfed paddy fields with a comparable amount of area.

03.031 Total water resources in the basin have been estimated to be sufficient to meet the water requirement. However, in the dry season, lands along the lower end of the irrigation systems have experienced water shortage due to the progressive deterioration of the irrigation systems.

03.032 The larger irrigation systems are currently being rehabilitated with restoration of major structures and canals. The rehabilitation of the major systems of Gambarsari and Pesanggrahan irrigations is scheduled to be completed in 1976/77, and when completed the detailed designs for the minor systems rehabilitation will be handed over to local (kabupaten) governments. And there are proposed new irrigation schemes, which are the construction of a new weir at the Singomerto irrigation intake and of a new Sapi irrigation system for the area of about 2,300 ha.

03.033 The Serayu River has been given special attention because of its hydro-power potentials. The Garung hydro-power proejct (28 MW) is under construction in the upper course of the Serayu River. Lake Menjer, a natural crater lake at the elevation of 1,200 m, will be used as a regulating reservoir. It is the sole hydro-power project and listed in the National Repelita II.

03.034 In addition, two hydro-power projects have been proposed in this river basin to increase power generation in Central Java. One, the Mrica hydro-power project (180 MW) on the Serayu River, is a power generating plant planned as a base load energy producer with a dam of 95 m high and an effective water storage of 68 million m^3. According to the water budget planned in the project, no water is planned for irrigation in the Mrica storage. This project is at the stage of preparation for implementation. The other, the Maung hydro-power project (170 MW) on the Maung River, is a plant planned as a peak load energy producer with a dam of 174 m high and an effective water storage of 177 million m^3. It is still under study.

3.1.5 Progo River Basin

03.035 The Progo River basin (see Figure 3.3) is located in the southern part of Central Java, and covers an area of about 3,270 sq. km. Its lower reaches belong to D.I. Yogyakarta. About 69 percent of the upper and middle basin areas is used for agricultural lands (120,000 ha), while the forests occupy only about 18 percent of the area (32,000 ha).

03.036 Because of the relatively steep land slopes, not much severe flood inundations have been experienced. Also because of the nature of rivers and their catchments, irrigation water supplies are available in the dry season, offsetting the effects of drought.

03.037 The paddy fields of the area consist of 22,000 ha of areas irrigated by technical or semi-technical systems and 35,000 ha of areas irrigated by primitive village irrigation systems. The technical irrigation systems are generally located in the lower lying areas with government-run intakes and major canals. The primitive village irrigation systems generally exist in uphill areas supplied with water from temporary weirs in small mountain streams.

03.038 Over the past decades, the irrigation works in the technical systems have deteriorated badly, reducing the canal capacities and requiring renewal of major structures, some of them because of rivers' behavior following Mt. Merapi eruptions.

03.039 The water flows of the Progo River, after removal of intake and canal constraints and after renovation of control works, is estimated to be almost adequate for present and future water demands.

03.040 In the middle reaches, there is a serious flood problem caused heavy rain and the volcanic debris from Mt. Merapi. Mt. Merapi is the most active volcano in Indonesia, it has an eruption cycle of about 3 to 5 years. The secondary lahar flows from Mt. Merapi, which are caused by heavy rainfall on freshly deposited volcanic debris, occur occasionally and often destroy river structures and bridges and disrupt communications. In November 1976, the flood of the Krasak River caused a disaster of 28 persons lost and damages of some Rp.1,200 million. Rivers that mostly impart damage to the downstream areas are the Krasak,

Putih, Blongkeng and Pabelon rivers. They all come down from the western slope of Mt. Merapi.

03.041 A debris control project was started in 1969. Also, the Master Plan Study for Land Erosion and Volcanic Debris Control in the Area of Mt. Merapi will be commenced from 1977.

03.042 The middle and upper reaches of the Progo River have been estimated to have only small development prospects, althouth there are the Kandangan irrigation (1,500 ha) project in the upper reaches, and the rehabilitation projects of Manggis irrigation (4,118 ha) and some smaller ones in the lower reaches.

03.043 The hydro-power potential of the area appears relatively small. The only projects are for the Kaloran-Stero storage complex (1.7 MW) in the upper reaches, and Magelang (0.8 MW) and Mendut (3.5 MW) in the middle reaches on the planning stage.

3.1.6 Upper Solo River Basin

03.044 The upper Solo River basin (see Figure 3.3) is located in the southeastern portion of Central Java Province and covers an area of about 6,000 sq. km. The agricultural land occupies about 87 percent of the total basin area, while the forests account for only about 6 percent.

03.045 The many small irrigation systems, which cover an area of about 15,480 ha, depend mainly upon tributaries the basin and the Denkeng River. There are 25 small irrigation reservoirs on the tributaries and they have a total effective water storage of about 29.5 million m^3. The rainfed area amounts to 7,360 ha. The extent of plant is 95 percent of the total agricultural land in the wet season, and 30 percent in the dry season.

03.046 Extensive cultivation of arable land and consequent decrease of forest areas have aggravated surface erosion and flood outflow.

03.047 Due to the meager capacity of the present river channel, the easy flood of the river easily floods and routinely inundates vast land areas for fairly long period in the wet season. The 1966 flood imparted destructive damage to Surakarta city and its surroundings and took the lives of many inhabitants.

03.048 A large quantity of sand from volcanic debris, flowing down the southern slopes of Mt. Merapi, is carried through the Denkeng River into the Solo River.

03.049 Work on the dam and power sectors of the Wonogiri multi-purpose project have proceeded to the stage of detailed design and construction, and the feasibility study of the irrigation (23,200 ha) and river improvement sectors has been completed recently.

03.050 The Wonogiri Dam will serve for the irrigation, flood control and power generation. The downstream irrigation area, about 23,200 ha, will be benefited by the irrigation water storage of about 400 million m^3 in the reservoir. The Wonogiri irrigation project covers agricultural lands of about 23,200 ha with main canals extending 94 km on both banks of the Solo River. The existing irrigation and drainage canals are to be rehabilitated. Inflowing flood discharge of 4,000 m^3 per second will be regulated to 400 m^3 per second by the flood control spaces of 220 million m^3 in the reservoir. The power generation plant of the maximum output of 10.2 MW with annual energy output of 28,200 MWh will be installed associated with the dam and the reservoir.

03.051 The river improvement project includes the construction of dikes of 33 km along both banks of the upper Solo and of 30.5 km along eight tributaries, and two retarding basins with the total capacity of 4.5 million m^3. By both flood control of the Wonogiri Dam and the river improvement along the upper Solo, flood discharges of less than 2,000 m^3 per second will never cause inundations on riparian lands which have previously suffered from frequent inundation. The flood discharge of 2,000 m^3 per second corresponds to a 40-years flood.

03.052 In the upstream area from the Wonogiri storage, 6 small irrigation projects, in the form of reservoirs on tributaries, are proposed to cover 2,500 ha from the Gares River and 3,600 ha from the Pidesko River.

3.1.7 South Kedu Basin

03.053 The South Kedu basin (see Figure 3.3) is located in the middle of the southern portion of the Province, stretching about 80 km along the Indonesian Ocean. The Cincingguling, Lukulo, Wawar, and Bogowonto Rivers are the major rivers in the area. They flow down almost in parallel to the sea, but with relatively small catchment areas.

03.054 Of the total area of about 3,000 sq. km, about 79 percent is used for agricultural lands, while the forests occupy only about 15 percent. The agricultural lands consist of about 88,700 ha of paddy fields and about 147,400 ha of dry fields.

03.055 The paddy fields of the area are made up of about 34,100 ha of technically irrigated lands, about 25,700 ha of semi-technically irrigated lands, and the remaining rain-fed lands. Generally, in the wet season about 95 percent of the paddy fields are planted with rice. In the dry season, only 30 percent of the paddy fields are planted with rice, 10 percent with palawija, and the rest are left almost uncultivated.

03.056 Routine floods and inundations occur along the lower parts of the rivers in the area, especially in the lower reaches of Telamaya and Wawar rivers. The sand dune along the coast and the shallow river mouths caused by sediments are hampering drainage.

03.057 The Sempor Dam is under construction in the upper reaches of the Cincingguling River. It is to have an effective water storage of 4.5 million m^3, and will be completed in 1977. The Sempor Dam will serve for downstream irrigation of about 12,000 ha, and generation of 1.1 MW of power.

03.058 The Karangsambung Dam, on the upper reaches of the Luklo River, is in the preparatory stage; construction will start in 1977. The Karangsambung Dam will serve for the irrigation of 39,200 ha, and generation of 30 MW of power.

03.059 In the eastern part of the area, two small water storage schemes are proposed, namely Jali Dam on the Cakrayasan River and Bogowonto Dam on the Bogowonto River. They will serve for the irrigation of 1,000 ha and 5,000 ha respectively.

3.1.8 Other Basins

(a) Southwestern Part of Central Java, out of the Serayu River Basin

03.060 To the east of the Citanduy River, which forms the border of Central and West Java, many small tributaries flow down to Segara Anakan. Most of the paddy fields within these tributary basins are rainfed at present. An irrigation project to cover 4,000-6,000 ha of this area is proposed in the Citanduy project.

03.061 Due to the small capacities of these tributaries, the area suffers from inundation every year. Along the left bank of the Citanduy River, a part of the dike was already completed, but the channel capacity is still less than the maximum flood discharge in the past.

(b) Tipar River and Ijo River

03.062 The Tipar and Ijo rivers, located to the east of the Serayu River, cause routine floods in their lower reaches, whose areas amount to about 3,400 ha. A part of the area will be included in the Gambarsari project for drainage improvement in the near future.

(c) River Basins in Kendal and Batang

03.063 In Kabupaten Kendal and Batang, located between Semarang and Pekalongan, there are many small rivers flowing down to the Java Sea. The total irrigated areas within these river basins amounts to about 40,000 ha, which consists of about 15,900 ha of technically irrigated lands, about 15,600 ha of semi-technically irrigated lands, and about 15,600 ha of simple irrigation lands.

03.064 Routine floods occur along the Glagah and Kaliwungu rivers on about 2,800 ha of paddy fields almost every year. No comprehensive study has ever been made of the area.

3.2 Assessment of Progress of Flood Control and Water Resources Development

03.065 The actual and proposed budgets for flood control and water resources development in Central Java during 1969/70 and 1976/77 are presented in Table 3.2. The total sum during Repelita I amounts to Rp.22,077 million, while the total budget for Repelita II up to 1976/77 amounts to Rp.37,300 million.

03.066 The annual amount has increased from Rp.4,139 million in 1969/70 to Rp.6,142 million in 1973/74 during Repelita I, showing an increase of about 48 percent of the budget in 1969/70. The increase in the total annual budget has been remarkable since 1974/75, the first year of Repelita II. The total for 1976/77 reached Rp.20,047 million, about 3.26 times as much as the Rp.6,174 million of 1974/75.

02.067 The most remarkable progress was that made by the Special Projects controlled by the Central Government, which have accounted for half of the total budget throughout the period. These Special Projects consist of the following: (1) Gambarsari Irrigation; (2) Karanganyar Irrigation; (3) Semarang-Kudus Irrigation; (4) Prosida, Semarang; (5) Prosida, Glapan-Sedadi Irrigation; (6) Prosida, Pemali-Comal Irrigation; (7) Serayu Irrigation; (8) Lalung Irrigation; (9) Tajum Irrigation; (10) Sempor Irrigation; and (11) Jragung Irrigation, Jratunseluna.

03.068 Other budget categories where there have been remarkable increases are the Medium/Small Irrigation and the Bengawan Solo project. But the Irrigation Rehabilitation and the River Rehabilitation and Development categories, both distributed through and controlled by the Provincial Government, have shown only small amount of increase since Repelita I. The Simple Irrigation started in 1974/75, the first year of Repelita II, and has helped the development of local irrigation.

03.069 Table 3.3[1/] shows the actual and proposed budgets, which is distributed through and controlled by the Provincial Government.

3.3 Development Priorities

3.3.1 General Development Priorities

03.070 The Study area has two severe problems: the water shortage in the dry season and flood and inundation in the wet season.

03.071 The total area of the government-run irrigation systems in Central Java amounts to 733,800 ha as presented in Table 3.4. About

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1/ Table 3.2 and Table 3.3 show slightly different figures in some parts, reflecting use of different sources. Both tables do not include the foreign currency portions.

Table 3.2 Yearly Budgets for Flood Control and Water Resources Development in Central Java, 1969/70 to 1976/77

(Unit: Rp.1,000)

	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77
Irrigation Rehab.	973,000	782,000	700,000	640,352	934,095	-	-	-
Medium/Small irr.	220,000	220,000	295,000	396,068	389,105	682,989	972,000	976,500
Special Projects	1,940,015	2,048,966	2,478,384	2,810,433	3,406,560	3,669,900	7,877,200	11,491,630
Village Irr. Devel.	-	22,375	12,300	15,500	10,000	17,500	13,000	4,610
Simple Irrigation	-	-	-	-	-	325,924	118,120	187,500
Program. Develop.	-	-	-	-	-	25,000	212,634	384,112
River Rehab. & Dev.	175,000	100,000	100,000	122,963	143,432	195,660	201,500	205,451
River Improvement	-	7,800	2,000	13,500	14,000	13,625	-	-
Mr. Merapi Debris	231,000	180,000	117,600	136,400	165,000	245,000	359,300	368,600
Beng. Solo Project	600,000	140,000	109,000	308,000	661,840	838,000	1,209,291	6,393,912
Surv. & Plan. River	-	-	-	37,025	418,156	94,000	-	-
Program. Develop.	-	-	-	-	-	66,700	116,324	34,500
Total	4,139,015	3,501,141	3,814,284	4,480,241	6,142,188	6,174,298	11,079,373	20,046,815

Source: Direktorat Jendral Pengairan, DPUTL.

Table 3.3 Flood Control and Water Resources Development by Central Java Provincial Government 1969-1978

(Unit: Rp.1,000)

	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
Irrigation Rehab.	973,000	782,000	700,000	640,350	934,095	1,000,000	1,100,000
Medium/small Irr.	200,000	220,000	295,000	396,068	389,105	682,989	982,700
Lalung Irrigation	-	-	-	-	-	-	294,750
Simple Irrigation	-	-	-	-	-	345,224	118,120
River Rehab. & Dev.	175,000	100,000	100,000	122,963	143,432	195,660	201,500
Total	1,348,000	1,102,000	1,095,000	1,159,000	1,466,632	2,223,873	2,697,070

	1976/77	1977/78 1/	1978/79 2/
Irrigation Rehab.	1,322,000	1,326,871	1,592,245
Medium/small Irr.	976,500	1,165,000	1,398,000
Lalung Irrigation	350,000	400,000	480,000
Simple Irrigation	187,500	475,000	570,000
River Rehab. & Dev.	205,451	260,000	312,000
Total	3,041,451	3,626,871	4,352,245

Notes: 1/ Still in proposal.
2/ Estimation.

Source: Bagian Pengairan DPUP Jawa Tengah

60 percent of the paddy fields is located within the coverage of Wilayah[2/] Pekalongan, Semarang, and Pati in the northern plain along the Java Sea. Another concentration appears in the area of Wilayah Surakarta.

Table 3.4 Irrigated Area of Central Java

(Unit: ha)

Wilayah[1/]	Technical	Semi-Technical	Simple	Total
Pekalongan	122,291	13,642	35,704	171,637
Semarang	81,279	15,948	41,416	138,643
Pati	50,101	23,068	37,164	110,333
Surakarta	66,494	18,882	60,470	145,846
Kedu	58,846	13,361	5,633	77,840
Banyumas	54,261	7,374	27,902	89,537
Total	433,272	92,275	208,289	733,836

Note: 1/ Regional Office of Provincial Irrigation.

Source: Bagian Pengairan, DPUP Jawa Tengah.

03.072 The technical irrigation areas occupy 433,300 ha or 59.0 percent of the total area, while the semi-technical irrigation areas account for 92,300 ha which is a relatively small portion (12.6 percent) of the total area, and other 208,300 ha or 28.4 percent of the total area is covered by the simple irrigation.

03.073 Besides the government-run irrigation systems, there are paddy fields of about 52,600 ha served by village irrigation systems and about 229,500 ha rain-fed.

03.074 In the dry season, in many parts of the irrigation area, the rice cultivation area usually declines to about one-fourth of that in the wet season due to the shortage of irrigation water. The way to improve the situation is as follows:

(1) to develop water resources by means of new storage schemes, and

(2) to improve the irrigation systems so as to utilize the available water to the maximum extent. At present, in many places almost all of the available river water is used for irrigation, and no further expansion of the irrigation could be achieved without providing additional water sources in the rivers.

2/ Regional Office of Provincial Irrigation.

03.075 The routine floodings and inundations in the wet season, which have been experienced in many parts of the study area, is hampering the productivity of the region. The major areas suffering from routine floods and inundations amount to about 52,000 ha in total as presented in Table 3.5.

03.076 The largest area of floods and inundations is within the low-lying land to the east of Semarang within the jurisdiction of Semarang and Pati, covering about 31,100 ha. About 4,000 ha in the Wilayah Pekalongan area located in the northwestern portion, about 5,000 ha in the Wilayah Surakarta area located along the Solo River, and about 4,100 ha in the Wilayah Kedu area located along the southern coast come next.

03.077 Damages to structures are as presented in Table 3.5, and total about Rp.340 million yearly. These are partly due to the very low capacities of the river channels, a problem made even worse by heavy sediments on the river beds, and partly due to the insufficient drainage of the low-lying lands. An integrated approach is needed to cope with this situation. This approach could comprise:

(1) flood control by means of upstream reservoirs;
(2) provision of dikes at strategic locations;
(3) enlargement of the river channels; and
(4) drainage improvement, especially in the low-lying areas along the coast.

03.078 At present, the drainage improvement would be of great importance, especially for the productive low-lying areas where irrigation rehabilitation have been almost completed. The multi-purpose storage projects, though they generally require large amounts of investment and longer periods of construction, would be of great importance, too, for the flood control purpose. The river channel improvement and the provision of protection dikes can not be achieved in a short period. However, continuous efforts for implementation of these works, are necessary.

3.3.2 Development Priorities by River Basins

03.079 Taking those situations mentioned in 3.3.1 into consideration, and reviewing 3.1 "Present Situation and Development Prospects," the development priorities on the basis of characteristics of each river basin are briefly presented below.

(a) Pemali-Comal Basin

03.080 The rehabilitation of primary and secondary canals in the Pemali-Comal irrigation systems has been completed. Tertiary canal development started recently with model plots and the actual implementation will start in 1977, which will benefit the area by increasing the efficiency in using available irrigation water and consequently will improve productivity in the area.

Table 3.5 Main Areas of Floods and Inundation, 1974 - 1976

No.	Wilayah	Seksi	River	Location (Kabupaten)	Flooded Area (ha)	Month	Estimation of Damages[1] (Rp.1,000)
I.	PEKALONGAN	Padakaton	Tanjung	Brebes	3,900	Dec. 74	9,000
		Brebes	Pemali	Brebes			
		Pemalang	Waluh	Pemalang	4,609	Dec. 75	45,000
		Sragi	Comal	Pemalang	4,609	Jan. 76	
II.	SEMARANG	Kendal	K. Glagah	Kendal	2,750	Dec. 74	110,000
			K. Kaliwungu		2,750	Dec. 75	116,016
					2,750	Jan. 76	
		Semarang	Sayung	Semarang	-	-	
			Onggorawe		8,500	Dec. 74	80,000
			Gajah	Demak	8,500	Dec. 75	84,000
			Batu		8,500	Jan. 76	
		Demak	Jajar		10,145	Dec. 74	70,000
			Tuntang	Demak	10,145	Dec. 75	60,000
			Wulan		10,145	Jan. 76	
		Godong	Tuntang	Demak/Purwodadi	3,213	Dec. 74	10,000
					3,213	Dec. 75	9,000
					3,213	Jan. 76	

(continued)

(Table 3.5 continued)

No.	Wilayah	Seksi	River	Location (Kabupaten)	Flooded area	Month	Estimation of damages 1/ (1000 Rp)
III	PATI	Jepara	Serang lama		2,600	Dec. 74	12,000
			Kenceng	Jepara	2,600	Dec. 75	15,000
			Pening		2,600	Jan. 76	
		Kudus	Juana				
			Longung	Kudus	3,600	Dec. 74	5,000
			Jajar	Pati	3,600	Dec. 75	20,000
					3,600	Jan. 76	
		Pati	Juana	Pati/Kudus	3,042	Dec. 74	5,000
					3,042	Dec. 75	
					3,042	Jan. 76	6,000
IV	SURAKARTA	Sragen	Bengawan Solo	Sragen	5,000	Feb. 74	
		Klaten	Simping, Woro	Klaten	540		
		Sragen	Bengawan Solo	Sragen	5,642	Dec. 75	11,597
		Klaten	Simping, Woro	Klaten	500		
		Sragen	Bengawan Solo	Sragen	5,642	Jan. 76	
		Klaten	Simping, Woro	Klaten	500	Jan. 76	

(continued)

(Table 3.5 continued)

No.	Karesidenan Wilayah	Seksi	River	Location (kabupaten)	Flooded area	Month	Estimation of damages 1/ (1000 Rp)
V	KEDU	Kutoarjo	Wawar	Kebumen	4,000	Nov. 74	-
			Jeblok		4,262	Dec. 75	-
					4,200	Jan. 76	-
		Kubumen	Telomoyo	Kubumen	1,700	Nov. 74	33,500
			Ketak		1,750	Dec. 75	-
			Kemit		1,750	Jan. 76	-
			Idjo				
VI	BANYUMAS	Purwokerto	K. Bengawan	Purwokerto	2,500	Nov. 74	-
			K. Gatel		2,500	Dec. 75	-
					2,500	Jan. 76	

Note: 1/ Damages on structures

Source: Bagian Pengairan, DPUP Jawa Tengah.

03.081 However, the improvement of drainage systems, which were not included in the rehabilitation program should be brought into the next program, together with flood control measures, especially in the Brebes and Sragi Areas, to improve productivity there.

03.082 The water shortage in the dry season may hamper the productivity of the area, even after the above mentioned schemes are carried out. The storage schemes of Bantarkawung and Karanganyar should be brought into the earlier development program for the benefits of irrigation water supplement and the flood control of the well developed area of Pemali-Comal. In addition, a careful planning should be undertaken for allocation of water to different uses such as agriculture, industry and urban potable water.

(b) Jratunseluna Basin

03.083 Two major rehabilitation programs are being carried out in the Glapan-Sedadi and Semarang-Kudus areas. The rehabilitation of primary and secondary irrigation canals of Glapan-Sedadi systems, including some local drainage, has been almost completed, and its tertiary development will start in 1977. The rehabilitation project of Semarang-Kudus systems in on-going regarding both irrigation and drainage systems since 1970.

03.084 Both areas mentioned above suffer from regular inundations caused by floods and insufficient drainage. Besides, the Wulahan area, situated in the northwestern part of the area, suffers from regular inundations due to insufficient drainage. Emphasis should be put on drainage improvement to relieve the low-lying but productive areas of Semarang-Kudus from frequent inundations.

03.085 The water shortage during the dry season results in a decrease of the land area cultivated to about one-fourth of that cultivated in the wet season.

03.086 The storage schemes on the major rivers, the Jragung, Serang and Tuntang, which will play the most important roles of supplementing irrigation water in the area, should be brought into the early programs. They will also serve for the flood control purpose.

03.087 The lower Serang and Wulan rivers have protection dikes on both banks. However, the Wulan has smaller channel capacity than that of the lower Serang due to the existing Wilalung diversion to the Juana Valley. Moreover, the river beds and forelands of the lower Serang and Wulan have risen remarkably due to the heavy sediments of the rivers, leaving a small free-board below the embankment crest. The situation means a menace of over-topping or breach of the dike that will cause severe damages as experienced in January 1972.

03.088 A study is currently being made on flood control of the lower Serang and Wulan, including a review of the diversion canal plan from the Serang to the Java Sea.

03.089 The drainage improvement of the Juana Valley should be carried out after the flood control plan of the lower Serang is decided. However, due attention should be given to this drainage improvement in the early programs since the Juana Valley is one of the most severely affected areas by routine floods and inundations of long duration.

03.090 The small reservoir schemes in the Lusi Valley seem to have been neglected. However, due to the severe drought characteristics of the rivers in the valley, these smaller schemes should be given more attention in long-term development programs.

(c) Serayu River Basin

03.091 The recent rehabilitation of the larger irrigation systems, Cambarsari and Pesanggrahan, including restoration of major structures and canals, is almost completed.

03.092 The major potential of the Serayu basin will be in the development of hydro-power generation. The Garung hydro-power generation project with an installed capacity of 24 MW is under construction, and will be completed in 1980. It is the sole hydro-power project, and is listed in Repelita II. The proposed Mrica and Maung hydro-power projects, for the upper Serayu reaches, would be of great importance because of their large scales of hydro electricity output, amounting to 180 MW and 170 MW respectively.

(d) Progo River Basin

03.093 The major development potential of the Progo basin lies in the lower reaches which belongs to D.I. Yogyakarta. The development potential in the upper and middle reaches of the Progo basin, which belong to Central Java Province, will be of minor scale.

03.094 The special problem in the Progo basin, very clearly, is debris control around Mt. Merapi. The sediments caused by the volcanic debris have affected the Progo downstream areas very severely. Besides, the floods from the tributaries running down the slopes of Mt. Merapi are destructive at times, (at experienced in November 1976), quite different from those of other rivers flowing through low-lying flat lands. Further strengthened implementation of the debris control works is necessary after the master plan study for land erosion and volcanic debris control, which will start in 1977.

(e) Upper Solo Basin

03.095 The Wonogiri multi-purpose project has been started in accordance with the Master Plan of Solo River. The objectives of the project are related to flood control, irrigation and power generation for the major parts of the upper Solo basin. Work on the dam and power sectors of the project have proceeded to the stage of detailed design and construction, and the feasibility study of the irrigation and river improvement has been completed recently. Continuous efforts

for project implementation, especially including the river improvement portion, would be most important in the basin.

(f) South Kedu Basin

03.096 The Sempor project is under construction in the western part of the basin, and will serve to irrigate about 12,000 ha of paddy fields. However, the basin embraces about 88,700 ha of paddy fields, of which only about 30 percent can be irrigated in the dry season at present. The South Kedu multi-purpose development has been planned to supplement the irrigation water supply and to serve for other purposes in the area.

03.097 The Karangsambung storage schemes on the Luklo River would be of most importance in the area, as they will help irrigate about 39,200 ha.

03.098 Routine floods and inundations occur in some low-lying areas, especially in the lower reaches of the Telamaya and Wawar rivers. Flood control in these areas would also be of major importance.

(g) Other River Basins

03.099 The small rivers, the Tipar and Ijo, located to the east of the Serayu ahve routine floods and inundations of about 3,400 ha, which are under study at present. Some flood control measures would be necessary after the completion of the study.

03.100 The area Kabupaten Kendal and Batang, which has smaller rivers and lies between Semarang and Pekalongan, has 40,000 ha of irrigated lands and suffers from regular floods and inundations on about 2,800 ha almost every year. The area has never been covered by any comprehensive study.

3.3.3 Development Priorities by Categories

03.101 Generally, development priorities should be primarily determined according to the characteristics of each river basin. However, some common components which should have higher priorities are listed below.

(a) Development of New Water Resources

03.102 The study area has clearly distinguished wet and dry seasons. In the dry season, the cultivation area of paddy generally declines to about one-fourth of the wet season cultivation area, even within the technical irrigation areas, due to the shortage of available irrigation water. The development of water resources by means of new storage scheme is required in many parts of the Study area, to improve the productivity of the existing irrigation systems. The first priority should be given to those river basins where water distribution facilities already exist and the larger portions of the systems are already rehabilitated.

(b) Rehabilitation of the Irrigation Systems

03.103 The run-down conditions in many places in the irrigation systems have been the major constraints on the Government's efforts to increase rice production. However, the rehabilitation of the major irrigation systems was started in Repelita I.

03.104 Some of the rehabilitation programs of major irrigation systems have been already completed. However, the same rehabilitation efforts should be made for other irrigation systems which would be benefited by achieving efficient use of available irrigation water.

(c) Tertiary Development

03.105 The emphasis in rehabilitation works for the government-run irrigation systems, which started in Repelita I, was on putting the systems back in working order along the primary and secondary canals extending to irrigation units serving for about 1,000-1,500 ha.

03.106 At that time, work on tertiary and quarternary systems, covering 150-200 ha and 10-15 ha respectively, were left to farmers to be carried out by themselves with their voluntary labor. However, many difficulties were encountered in executing these minor systems.

03.107 Without tertiary and other minor systems, water from the secondary canal has to pass over 50-100 plots to the farthest fields in the command areas of 1,000-1,500 ha, resulting in very long travel times and in some fields being flooded deeper than their optimum. Consequently, the coverages in the dry season are restricted to no more than 300-500 m beyond the secondary canals, while in the wet season some parts suffer from flooding for fairly long periods.

03.108 Because further upgrading and improvement of the total systems were urgently required, the Government recently started work on tertiary development. Its design and layout as well as construction of main structures are done by the government offices. The farmers are expected to participate fully in works they are capable of undertaking. The canal works will start in 1977, in which some incentives will be provided in the form of payment of about half of the normal labor wages to encourage the farmers to participate.

03.109 Tertiary development must be done over a wide area in order to increase the irrigation productivity and efficiency of use of available irrigation water which are quite limited at present.

(d) Flood Control and Drainage Improvement

03.110 As shown in Table 3.5, the total area suffering from regular inundation within the government-run irrigation areas amounts to about 52,000 ha yearly. Damages to structures are estimated at about Rp.340 million. Frequent floods and inundation would also cause serious damage to agricultural products, besides this figure.

03.111 The inundations are partly due to the flooding of rivers, and partly due to the deficiency of internal drainage. Consequently, in

many areas, both flood control and drainage improvement would be needed to improve the situations.

03.112 Drainage improvement would require a wide-ranging study on the area's characteristics and would require integrated measures such as rehabilitation and improvement of existing drainage systems, construction of new drainage canals and other facilities, and provision of proper flood-opening in the highway embankment where necessary.

03.113 Special attention is needed to the drainage improvement, especially for the areas which have been already provided with irrigation rehabilitations.

03.114 The flood control by storage schemes would require large amounts of investment and longer periods of construction. However, it would be one of the most important issues, if appropriate sites are found, to be carried out together with other purposes of irrigation and power generation.

03.115 Flood control by means of river improvements would require longer periods of execution. However, the continuous efforts should be made, at least, for the upgrading and rehabilitation of dikes and other structures, together with some new provisions to protect the areas of high importance.

(e) Groundwater Development

03.116a Groundwater is widely distributed in the Study area, appearing as many springs along the skirt of volcanoes and also as shallow free surface groundwater in the alluvial plains. At present, groundwater is used for town water supply and also for irrigation.

03.116b Generally, the aquifer along the skirt of volcanoes has most potential for development, as it consists of lahar material and receives high recharge of water. Investigation for possibility of groundwater exploitation has already been carried out in Mt. Lawu area of the Upper Solo basin, and the southern and eastern slopes of Mt. Merapi, particularly in the Klaten area, is also reported as promising for future groundwater development.

03.116c Another important area for groundwater development would be the low lying alluvial plains where many developing towns exist. Further investigation for possibility of groundwater exploitation would be important in the northern coast alluvial plains, particularly near Brebes-Tegal, Pekalongan, Semarang and Kudus for future town water supply development.

(f) Mt. Merapi Debris Control

03.117 Mt. Merapi is the most active volcano in Indonesia and has an eruption cycle of about 3 to 5 years. The amounts of volcanic debris deposited on the slopes of Mt. Merapi are estimated or being much larger than those of Mt. Kelud in East Java. Besides, the outflowing floods are very destructive; many large stones are contained in the mud flows. The debris control project on Mt. Merapi, started in 1969, has accomplished followings: (1) 16 check dams with total control volume of 2.5 million m^3, (2) Consolidation dams to stabilize the river beds, (3) Protection dikes, and (4) Sand pockets.

03.118 A master plan study of the volcanic debris control in the area of Mt. Merapi is scheduled to start in 1977 to establish the general principles and targets. Because of the destructive nature of the floods flowing down the tributaries on Mt. Merapi, as experienced on Kali Krasak in November 1976, the debris control programs should be promoted after establishing the master plan.

3.4 Recommendations

03.119 The study area has two severe problems as described above: the water shortage in the dry season, and floods and inundations in the wet season. The recommendations presented, taking into consideration these situations, are as follows.

3.4.1 Budget Allocation

03.120 As stated in 3.2, "Assessment of Progress of Flood Control and Water Resources Development," the total amount of the budget, allocated for the sector and spent in Central Java, has been greatly increased recently.

03.121 However, the increment allocated to some sections, such as the River Rehabilitation and Development section, is very small. It would be necessary to increase the budget of this section to cope with many local flood control problems.

3.4.2 Study

03.122 A comprehensive study on flood control and water resources of the area of Kabupaten Kendal and Batang is recommended. The area lies between Semarang and Pekalongan and appears to have never been covered by any comprehensive study. According to some data, the area is assumed to have some 40,000 ha of irrigated lands and suffer from regular floods and inundations on about 2,800 ha.

03.123 For potential centers of urban and industrial growth such as Semarang, Pekalongan and Tegal, long-range planning of water use by use categories such as irrigation, industry and urban use should be undertaken.

3.4.3 Projects Recommended

03.124 The following projects are recommended for implementation (see Figure 3.3):

(1) Pemali-Comal basin

- Tertiary development in the Pemali-Comal irrigation area.
- Drainage improvement in the Pemali-Comal irrigation area.

- Storage dams on the Pemali and Comal rivers.
- Flood control in the lower reaches of the Pemali River.

(2) Jratunseluna basin

- Tertiary development in the Glapan-Sedadi irrigation area.
- Rehabilitation of the Semarang-Kudus irrigation systems.
- Drainage improvement of the low-lying lands in the coastal plain, including the Glapan-Sedadi, Semarang-Kudus, and Welahan areas.

- Storage dams on the Jragung, Serang, and Tuntang rivers.
- Flood control in the lower Serang and Wulan rivers, with an alternative of diversion canal.
- Drainage improvement in the Juana Valley.

(3) Serayu River basin

- Mrica and Maung hydro-power generation.

(4) Progo River basin

- Debris control around Mt. Merapi.

(5) Upper Solo River basin

- Wonogiri multipurpose project and upper Solo River improvement.

(6) South Kedu basin

- Karangsambung multipurpose project.

03.125 Considering the development priorities and recommended programs described above, the work schedules and estimated annual expenditures, calculated at 1977 prices, for major projects of flood control and water resources development in the Study area, are summarized in Table 3.6. Although considerable increases in the development expenditure in this field are needed to achieve the recommended targets, such increases would be possible by some expansion in the share of this field in the total development expenditure.

3.4.4 Control for Soil Erosion and Water Pollution

03.126 In most of the river basins in the Study area, the extensive cultivation of farmland prevails which occupies 60-80 percent of each basin area, while the forest occupies a very small portion of 10-20 percent of each basin area. Over-cultivation has aggravated the surface erosion of foothills in many places leading to heavy sedimentation on the river beds and in irrigation facilities.

03.127 Some administrative control of over-cultivation, especially in the foothill areas, would be necessary to lessen the aggravation of the problems

Table 3.6 Suggested Schedule and Estimates of Annual Expenditures for Flood Control and Water Resources Development in Central Java

(Unit: Rp. Million at 1977 prices)

	Total	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89
I. Pemali-Comal Basin													
1. Tertiary Development	77/78 - 88/89	(77/78 - 83/84 68,000ha,				84/85 - 88/89	55,000ha)						
2. Drainage Improvement	78/79 - 88/89	(78/79 - 83/84 15,500ha,				84/85 - 88/89	13,000ha)						
3. Bantarkawung Dam	81/82 - 85/86												
4. Bantarkawung Feeder Canal	81/82 - 86/87												
5. Karanganyar Dam	83/84 - 86/87												
6. Karanganyar Feeder Canal	83/84 - 87/88												
7. Pemali River Improvement	78/79 - 83/84												
Subtotal I	83,222	220	982	1,124	1,624	7,564	11,474	19,134	18,814	15,104	5,134	1,304	744
Foreign Currency	49,685	121	574	652	952	4,512	6,862	11,452	11,272	9,042	3,062	762	422
Local Currency	33,537	99	408	472	672	3,052	4,612	7,682	7,542	6,062	2,072	542	322
II. Jratunseluna Basin													
8. Tertiary Dev., Galpan - Sedadi	77/78 - 88/89	(77/78 - 83/84 26,000ha,				84/85 - 88/89	20,000ha)						
9. Rehab., Semarang - Kudus	77/78 - 83/84	(25,000ha)											
10. Drainage Improvement	77/78 - 88/89	(77/78 - 83/84 23,000ha,				84/85 - 88/89	17,000ha)						
11. Flood Control, Serang - Wulan	79/80 - 84/85												
12. Juana Drainage	79/80 - 84/85												
13. Jragung Dam	78/79 - 82/83												
14. Ngrambat Dam	80/81 - 83/84												
15. Glapan Dam	83/84 - 86/87												
Subtotal II	81,674	788	4,276	8,476	14,976	14,726	12,416	9,826	6,656	5,496	3,006	516	516
Foreign Currency	48,910	458	2,562	5,082	8,978	8,828	7,438	5,888	3,988	3,292	1,792	302	302
Local Currency	32,764	330	1,714	3,394	5,998	5,898	4,978	3,938	2,668	2,204	1,214	214	214

(continued)

(Table 3.6 continued)

	Total	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89
III. Other Basins													
16. Mt. Merapi Debris Control	77/78 - 88/89												
17. Wonogiri Dam	77/78 - 80/81												
18. Wongiri Irrigation	77/78 - 82/83												
19. Upper Solo River Improvement	77/78 - 83/84												
20. Karangsambung Dam	79/80 - 82/83												
21. Karangsambung Irrigation	79/80 - 83/84												
Subtotal III	140,500	16,340	23,760	27,300	25,180	20,490	16,070	7,360	800	800	800	800	800
Foreign Currency	69,430	6,890	8,790	14,670	14,060	11,870	9,220	3,930	-	-	-	-	-
Local Currency	71,070	9,450	14,970	12,630	11,120	8,620	6,850	3,430	800	800	800	800	800
Total I, II, and III	305,396	17,348	29,018	36,900	41,780	42,780	39,960	36,320	26,270	21,400	8,940	2,620	2,060
Foreign Currency	168,025	7,469	11,926	20,404	23,990	25,210	23,520	21,270	15,260	12,334	4,854	1,064	724
Local Currency	137,371	9,879	17,092	16,496	17,790	17,570	16,440	15,050	11,010	9,066	4,086	1,556	1,336

Source: Mission's Estimates.

in watershed. Prohibitions of cultivation in some critical areas and prohibition of some crops from certain areas will be required.

03.128 In the Study area, water pollution of the rivers appears to have been very slight by this date. However, some preparation for administrative directives and proper guidances would be necessary in some parts of the Study area, where industrialization will be promoted in the near future.

03.129 One administrative directives is to restrict draining of polluted waste waters, and the guidance should be to persuade entrepreneurs to re-circulate water in order to minimize the volume of waste water discharged, and to persuade them to provide adequate processing and disposal facilities.

03.130 Spreading of water-borne diseases through polluted waste water is another problem in the Study area, and this is discussed in 9.3, "Water and Sanitation."

CHAPTER IV

AGRICULTURE, LIVESTOCK, FISHERY, AND FORESTRY

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AGRICULTURE, LIVESTOCK, FISHERY AND FORESTRY

4.1 Characteristics and Present Situation

4.1.1 General

04.001 Agriculture is the largest sector of the economy of Central Java, as well as in Indonesia as a whole. It contributes about half of the Gross Regional Domestic Product and engages 61 percent of the work force. With the exception of "minus areas", Central Java is endowed with favorable conditions for agriculture. Fishery resources also are rich along the coast of the Province. Annual precipitation is adequate for a variety of crops. Rainfall is concentrated in November to March (the wet season) and very little rain falls during June to October. Yearly variation of rainfall and its seasonal distribution greatly influence the crop production.

04.002 The wide variety of ecological conditions within the Province permits cultivation of most of the common tropical and sub-tropical crops. Moreover, temperate crops can also be grown in the Province, taking advantage of the cooler temperatures in highland areas.

04.003 Crop production in the Province, as is true for other parts of the country, is carried out under two farming systems, the small-holder and estate subsectors. Staple food crops are almost exclusively produced by small-holders (peasant farmers), while production of cash crops is shared by the two subsectors.

4.1.2 Agricultural Land

04.004 Agricultural land and forests occupy about 53 percent and 19 percent respectively of the total land area of the Province which is 34,503 sq. km. As the topography of the Province is mountanous, about 20 percent of the land area are higher than 500 meters above sea level, and more than 20 percent of the land is sloped land of more than 15° which can not be easily used for cultivation.

04.005 Agricultural land is classified into wet land (sawah) and dry land (tegal). The composition of these two categories of land is about one million hectares of sawah and 0.78 million hectares of tegal (see Figure 4.1).

04.006 Sawah is further classified into irrigated sawah and rain-fed (non-irrigated) sawah. Of the total area of one million hectares of sawah, 735,000 hectares are irrigated and the rest is rain-fed.

04.007 Sawah is mostly planted with rice during the wet season and some with sugar cane throughout the wet and dry seasons. A second crop of rice is grown in sawah in the dry season where water is available by irrigation, otherwise "secondary food crops" (palawija) such as maize, cassava, peanut and beans or cash crops, especially tobacco, are grown in the dry season. Tegal is planted with palawija, upland rice (padi gogo) and other dry land crops.

04.008 The most striking feature of Java is the presence of a chain of high volcanos along the axes of the island. This feature strongly influences the natural setting such as geological framework, soils, river-flow and controllability of water. Figure 4.2 presents the soil condition of Central Java.

04.009 According to the study made by the Center for Southeast Asian Studies of Kyoto University, the land of Central Java can be classified into the following physiographical categories (see Figure 4.3):

(1) Volcanic Cone

(2) Volcanic Fan
   a. Upper Volcanic Fan
   b. Lower Volcanic Fan

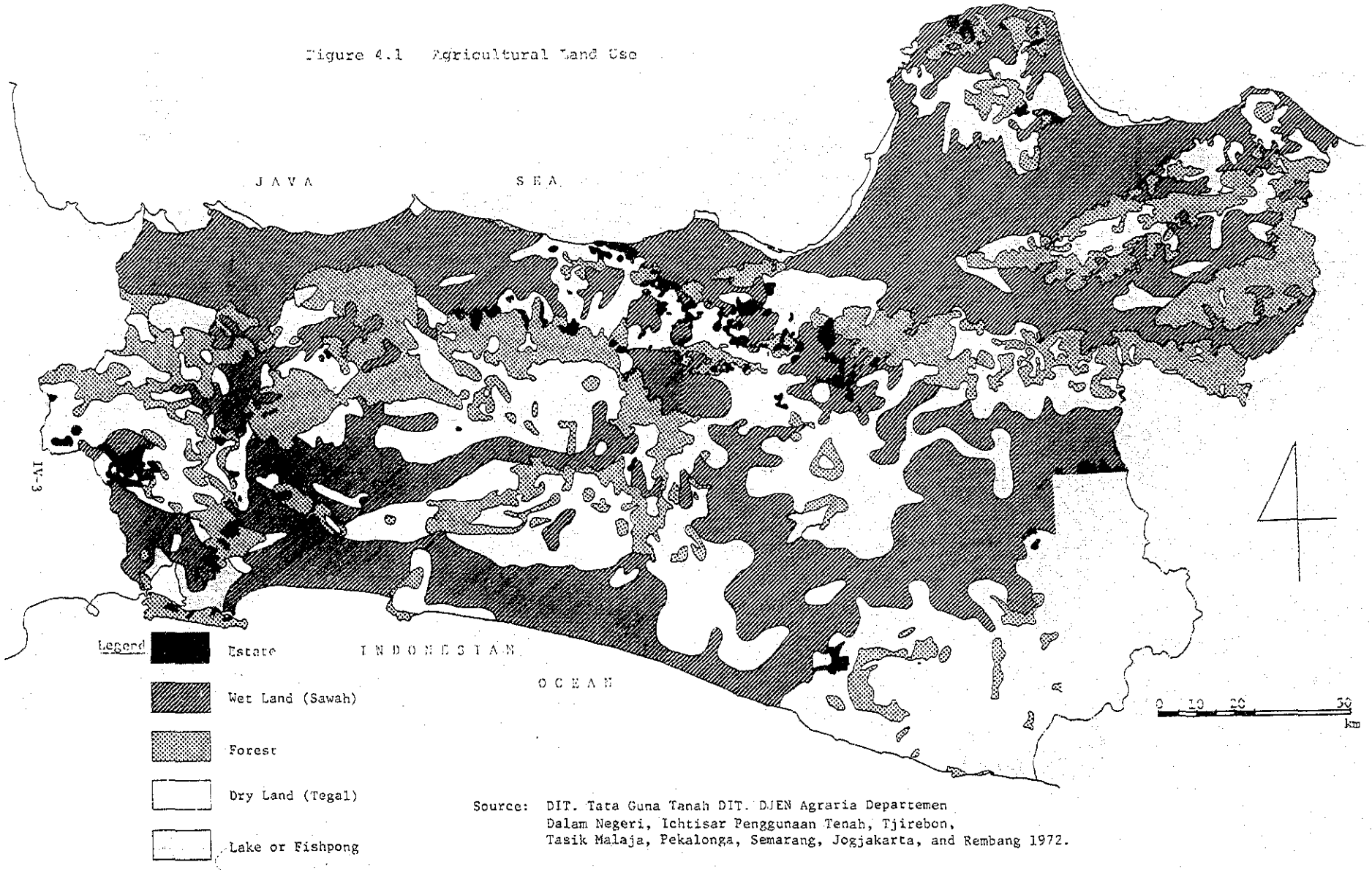
(3) Coastal Plain
   a. Alluvial Lowland
   b. Quaternary Terrace

(4) Tertiary Highland
   a. Limestone Plateau
   b. Less-calcareous Hill

(a) Volcanic Cone

04.010 The upper part (above 600 m in altitude) of volcanic cone, with steep slopes of rocky surface, is hardly used for agriculture, but some limited areas may be used profitably taking advantages of cooler climate: tea, arabica coffee and temperate fruits and vegetables are suitable. The lower part is used for rice growing by terracing and utilizing spring water.

Figure 4.1 Agricultural Land Use



Source: DIT. Tata Guna Tanah DIT. DJEN Agraria Departemen Dalam Negeri, Ichtisar Penggunaan Tenah, Tjirebon, Tasik Malaja, Pekalonga, Semarang, Jogjakarta, and Rembang 1972.

Figure 4.2 Soil Exploration Map

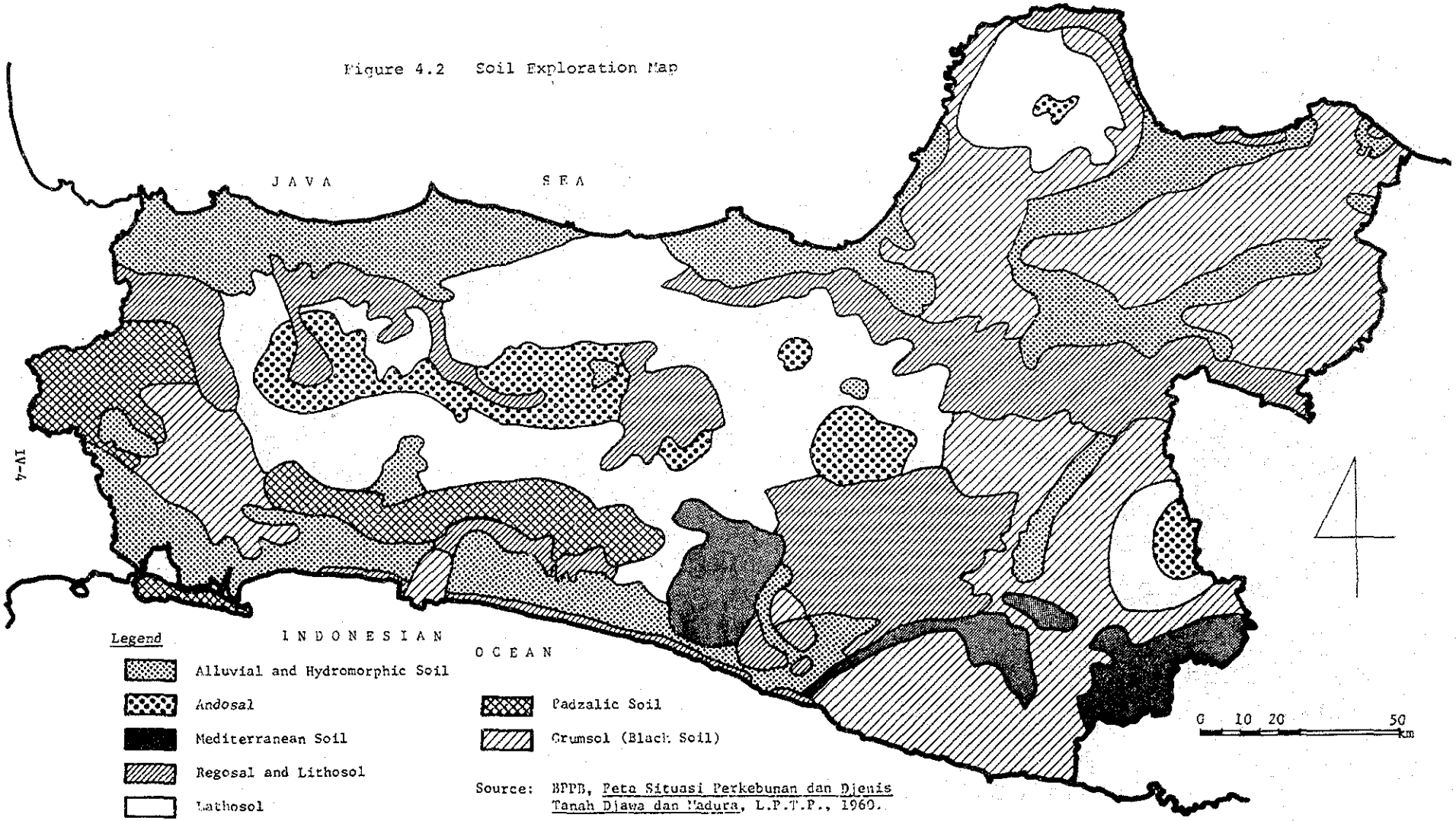
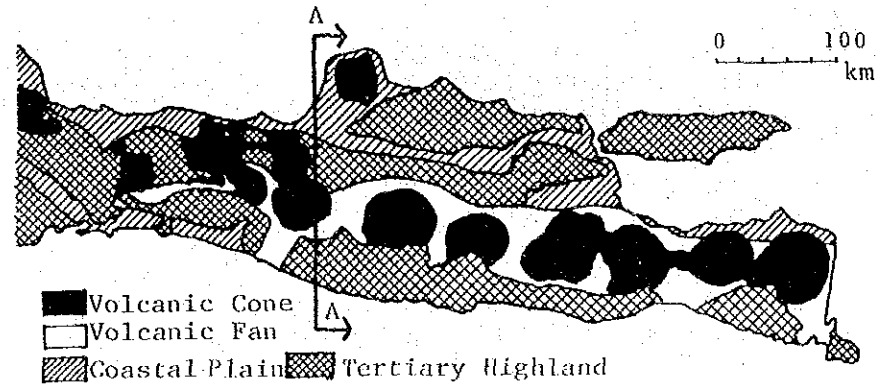
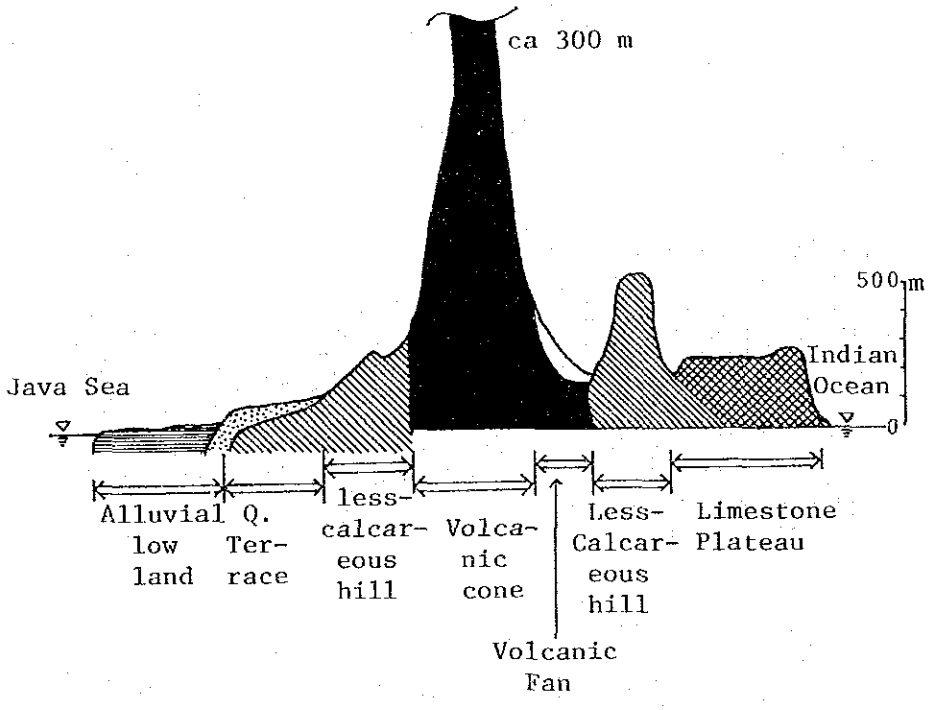


Figure 4.3 Phisiographical Classification of Central & East Java





Schematic N-S cross-section of Central Java

Source: The Center for Southeast Asian Studies, Kyoto University, Southeast Asian Studies, Vol. XII No.3, Dec. 1974.

(b) Volcanic Fan

04.011 The upper part of the volcanic fan is favored by the numerous rivers which are fed by abundant rain which falls in the volcanic cone, and, hence, the double cropping of rice which is commonly practiced there gives high yields. Kabupaten Klaten where the yield of rice is highest in the Province belongs to this land type. The lower part of the volcanic fan is less favored in respect of water availability; upland rice and palawija are planted in the greater part of the area.

(c) Coastal Plain

04.012 The alluvial lowland of coastal plain is mostly planted with rice. Poor drainage capacity causing inundation in the wet season and sea water invasion in the dry season are serious problems in some areas.

04.013 The quaternary terraces which occupy relatively wide areas between the alluvial lowlands and the volcanic fans have an undulating surface with low fertility lithosol. Water conditions are inferior compared with the adjoining two areas.

(d) Tertiary Plateau

04.014 The Tertiary Plateau which is located along the volcanic axis is divided into the limestone plateau and less-calcareous hills. The former represents the worst area of "minus areas".

04.015 Although the surface soil consisting of grumsol (black soil) and red Mediterranean soil, which are not very bad, for agricultural use, the land is greatly handicapped by water conditions. The river flow is of the flush-flow type and seldom perennial. Moreover, surface water seeps rapidly into deeper layers through cracks in the limestone. Except for small patches in alluvial swales, paddy is not grown in this plateau. Upland rice (gogo) can be grown in selected areas of black soil which can retain more soil moisture than can other parts. The red soil is used for cassava and maize.

04.016 The loess-calcareous hill is dissected deeply by streams, and paddy fields extend in narrow zones along the streams. Cassava and maize are planted along the marginal zones between the streams and the side slope. On the higher portion of the side slopes are planted fruit trees, rubber and occasionally coffee trees. Soil erosion is a serious problem of this area.

04.017 The Land Capability Appraisal undertaken by the Indonesian Government jointly with UNDP (FAO as the executing agency) classified the land of Java, Bali and Kalimantan into 58 "Land Development Units". Of the 58 units, 22 are in Central Java, their location, characteristics and suitability to crops are shown in the attached map and related data table (see Figure 4.4 and Table 4.1).

Table 4.1 Suitability of Land Development Units[1] for Specific Crops[2]

DEVELOPMENT UNIT NUMBER	IRRIGATED CULTIVATION					RAINFED CULTIVATION																							
	WETLAND RICE	TOBACCO	VEGETABLES	COTTON	SUGAR CANE	FODDER CROPS	WETLAND RICE	UPLAND RICE	MAIZE	GRAIN SORGHUM	SESAME / SAFFLOWER	COTTON	CASTOR	TOBACCO	PEPPER (CAPSICUM)	SOYBEANS	GROUND NUTS	SWEET POTATOES	CASSAVA	VEGETABLES	PINEAPPLE	RUBBER	OIL PALM	COCONUTS	COCOA	BANANAS	SPICES	ROBUSTA COFFEE	PEPPER (PIPER)	ARABICA COFFEE	TEA/CHOCHONG	GRAZING / ROUGH	IMPROVED PASTURE / FODDER CROPS	FORESTRY
LOW LEVEL PLAINS < 100 m. ELEVATION, SLIGHTLY DISSECTED, SLOPES PREDOMINANTLY 0 – 8%																													
1	L/M	O/L	O/M	O	O/L	O/M	L/M	NR	O	O	O	O	O	O	O/L	O/M	O/L	O/L	O/M	O/L	O/L	O	O	L	O	O	O	O	O	O	O	L	L	L
2	L/M	O/M	O/M	O	O/M	O/H	L/M	NR	O	O	O	O	O	O	O/L	O/M	O/M	O/M	O/M	O/M	O/M	L	O	L	O	O	O	O	O	O	O	L	L	L
3	L/M	O/L	O/M	O	O/L	O/M	L/M	NR	O	O	O	O	O	O	O/L	O/L	O/L	O/L	O/M	O/M	O/L	O/L	L	O	L	O	O	O	O	O	O	O	L	L	L
4	O/L	O	O	O	O	O/L	O/L	NR	O	O	O	O	O	O	O	O	O	O	O/L	O	O/L	L	O	O	O	O	O	O	O	O	O	O	L	L	L
5	M	L	M	L	M	M	L	NR	O	O	O	O	O	O	L	L	O	L	L	L	L	L	O	L	O	O	O	O	O	O	O	O	M	L	M
6	H	L	M	O	M	M	M	NR	L	L	O	O	O	O	L	L	M	L	M	M	L	M	L	O	L	O	L	L	O	L	O	O	M	M	M
7	H	M	M	O	H	H	M	NR	L	L	L	O	O	O	L	L	L	L	M	M	L	L	L	L	O	L	L	L	O	L	O	O	M	M	M
8	H	L	M	L	M	M	H	NR	M	M	L	L	L	L	L	M	M	L	M	M	L	M	M	L	M	O	L	L	L	M	O	O	M	M	M
9	O/L	O	O	O	O	O/L	O	NR	O	O	O	O	O	O	O	O	O	O	O	O	O/L	L	O	L	O	O	O	O	O	O	O	O	L	L	L
10	H	M	H	M	H	H	H	NR	M	M	M	M	M	H	H	M	H	H	M	M	M	M	M	H	M	M	M	M	M	L	O	H	H	H
11	M	L	L	L	L	M	M	NR	L	L	L	L	L	L	L	M	L	L	M	L	M	M	M	L	O	L	L	M	L	L	O	L	M	M
12	M	M	L	L	L	M	M	M	M	H	M	L	L	M	M	M	L	M	H	L	M	H	M	L	L	L	M	M	M	L	L	H	M	H
13	M	H	M	M	M	M	M	M	H	M	M	M	M	H	H	H	M	H	H	M	H	H	H	H	H	H	H	H	H	M	L	H	H	H
14	L	L	L	L	L	M	L	L	L	M	L	L	L	L	L	M	L	L	M	L	M	M	M	M	L	L	M	L	L	L	L	M	M	M
15	H	M	M	H	M	H	H	NR	M	M	M	M	L	L	M	M	M	M	M	H	M	M	M	H	M	M	M	M	M	M	L	O	H	H	M
LOW LEVEL PLAINS < 100 m. ELEVATION, SLIGHTLY TO MODERATELY DISSECTED, SLOPES PREDOMINANTLY 0 – 15%																													
16	M	L	L	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L	M	L	M	M	M	M	L	L	L	M	L	L	L	L	M	M
17	M	M	M	L	L	M	L	M	M	M	L	L	L	M	M	M	M	M	H	M	M	M	M	M	M	M	M	M	M	M	L	M	M	M
18	L	L	L	L	L	M	O	L	L	M	L	L	L	M	L	M	L	L	M	L	L	M	M	M	L	L	M	M	L	L	L	M	M	M
19	O	O	O	O	O	L	O	O	O	L	O	O	O	O	O	L	O	O	L	O	L	L	O	O	O	O	O	O	O	O	O	O	L	L	L
20	M	H	H	M	H	H	M	NR	H	H	H	M	H	H	H	H	H	H	H	M	H	H	H	H	H	H	H	M	L	H	H	H	H	H
21	M	H	M	M	M	H	M	NR	M	H	M	M	M	H	M	H	M	H	H	M	H	H	M	H	M	H	H	H	M	L	H	H	H	H
22	L	M	M	M	M	M	L	M	M	M	M	M	M	M	H	M	M	H	M	H	M	L	M	L	M	M	M	M	M	O	H	H	H	M
23	M	H	M	M	H	H	M	H	H	H	H	M	H	H	H	H	H	H	H	M	H	H	M	H	M	H	H	M	M	M	L	H	H	M
24	M	M	M	M	M	L	M	L	M	M	M	L	L	L	M	M	L	M	L	L	L	O	L	L	O	O	O	O	M	M	L	M	M	L
25	M	L	L	M	M	M	L	M	M	M	M	M	M	L	M	M	L	M	H	M	M	M	L	M	L	M	M	M	M	O	O	H	M	M
26	M	L	L	M	M	M	L	M	M	M	M	M	M	L	M	M	L	M	H	M	M	M	L	M	L	M	M	M	M	O	O	H	M	M
27	M	L	L	M	M	M	L	M	M	M	M	M	M	L	M	M	L	M	H	M	M	M	L	M	L	M	M	M	M	O	O	H	M	M
HIGH LEVEL PLAINS >100 m. ELEVATION, SLIGHTLY TO MODERATELY DISSECTED, SLOPES PREDOMINANTLY 0 – 15%																													
27	M	O	L	O	L	M	M	NR	O	L	O	O	O	O	L	O	L	L	L	L	L	O	O	O	O	O	O	O	O	L	M	M		
28	M	H	H	O	M	H	M	H	H	H	M	O	M	H	H	H	H	H	H	H	M	L	M	L	M	L	M	L	H	H	H	H		
29	M	M	H	L	M	H	M	M	H	H	M	L	M	H	M	H	H	M	H	M	H	H	M	M	M	M	M	M	H	H	H	H		
30	M	H	M	M	M	H	M	H	H	H	M	M	M	H	H	H	M	H	H	H	H	H	M	H	H	H	H	M	M	M	H	H		
31	M	M	M	M	M	H	M	M	M	H	L	M	M	M	M	H	M	M	H	M	M	H	L	M	M	M	M	H	M	M	M	H		
32	H	M	M	M	H	H	H	NR	M	M	M	L	L	M	M	H	M	H	H	M	M	M	L	M	L	M	M	M	M	L	L	H		
33	H	M	M	M	M	H	M	M	M	M	H	M	M	L	M	M	L	M	H	M	M	M	L	L	L	M	M	M	L	O	H	M		
34	O	L	L	L	L	M	O	M	M	M	M	M	M	M	M	H	M	M	M	M	M	L	M	M	M	M	M	M	O	H	H	M		
HIGH LEVEL PLAINS > 100 m. ELEVATION, MODERATELY TO STRONGLY, DISSECTED, SLOPES PREDOMINANTLY > 15%																													
35	O/L	O/L	O/M	O/L	O/M	O/M	O	O/L	L/M	L/M	O/L	O/L	O/L	O/L	O/L	L/M	O/M	O/L	L/M	O/L	L/M	O	O	L	O	O	O	O	O	O	O	M	L	L
HILLS < 500 m. ELEVATION, MODERATELY DISSECTED, SLOPES PREDOMINANTLY > 15%																													
36	O/M	L/M	L/M	O/L	O/L	L/M	O/L	L/M	L/M	M/H	L/M	O/L	O/L	L/M	L/M	M/H	L/M	L/M	M/H	L/M	L/M	M	L	M	L	L	L	M	L	M	M	M	M	H
37	O	O/L	O/L	O	O	O/L	O	O/L	O/L	O/L	O/L	O	O	O/L	O/L	O/L	O/L	O/L	O/M	O/L	O/L	L	O	L	O	L	L	L	L	L	L	M	L	M
38	O/M	L/M	L/M	L/M	L/M	M/H	O/M	O/L	L/M	M/H	L/M	L/M	L/M	L/M	L/M	M/H	L/M	L/M	M/H	L/M	M/H	M	O	L	O	L	L	L	L	L	O	M	M	M
39	O/M	O/L	O/L	L/M	L/M	L/M	O/L	NR	O/L	O/L	O/L	O/L	O/L	O	O/L	O/L	O	O/L	O/L	O/L	O/L	O	O	O	O	L	O	O	O	O	O	M	L	L
40	O/L	L/M	L/M	L/M	O/M	L/M	O/L	L/M	L/M	M/H	L/M	L/M	L/M	L/M	L/M	M/H	L/M	L/M	M/H	L/M	M/H	M	L	M	M	M	M	M	M	O	H	H	M	
41	O/L	L/M	L/M	L/M	L/M	O/L	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L	O	L	O	M	L	L	L	L	O	H	H	M	
42	O/L	L/M	L/M	L/M	L/M	L/M	O	O/L	O/L	O/L	O/L	O/L	O/L	O/L	O/L	L/M	O/L	O/L	O/L	O/L	O/L	O	O	O	O	L	O	O	O	O	O	M	L	L	
43	O/M	O/L	O/L	O/L	O/L	O/M	O/L	O/L	O/L	O/M	O/L	O/L	O/L	O/L	L/M	L/M	O/L	L/M	L/M	O/L	L/M	H	O	M	L	L	M	M	L	L	L	M	M	H	
44	L/M	M/H	L/H	L/H	M/H	M/H	L/M	L/M	M/H	M/H	L/M	L/M	M/H	M/H	M/H	M/H	L/H	L/M	M/H	L/M	M/H	H	L	M	M	M	M	M	M	M	L	M	M	M	
HILLS < 500 m. ELEVATION, STRONGLY DISSECTED, SLOPES PREDOMINANTLY > 30%																													
45	O/L	O/L	O/L	O	O	O/L	O/L	O/M	O/M	O/M	O/L	O	O	O	O/L	O/L	O/M	O/L	O/M	O/L	O/L	O/M	M	O	L	L	L	L	L	L	L	M	M	M	
46	O/L	O	O/L	O	O	O/L	O/L	O/L	O/L	O/L	O	O	O	O	O/L	O/L	O/L	O/L	O/M	O/L	O/L	O/M	L	O	O	O	L	L	O	M	L	M	M	M	
47	O/M	L/H	O/H	O/L	O/M	L/H	O/M	O/M	O/H	O/H	O/M	O/L	O/H	O/H	O/M	O/H	O/H	O/M	O/H	O/H	O/H	O/H	L	O	L	L	L	L	L	L	L	M	M	M	
48	O/L	O/L	O/M	O/M	O/L	O/M	O/L	O/L	O/M	O/M	O/L	O/L	O/L	O/L	O/L	O/M	O/L	O	O/L	O	O/L	O	O	O	O	O	O	O	O	O	O	M	L	L	
49	O	O	O	O	O	O	O	O/L	O/L	O/L	O	O	O	O	O	O/L	O/L	O/L	O/L	O	O/L	L	O	O	O	O	O	O	O	O	O	L	L	L	
LOW AND HIGH MOUNTAINS > 500 m. ELEVATION, MODERATELY INCISED, SLOPES PREDOMINANTLY > 30%																													
50	O/L	O/M	L/M	O	O/L	L/M	O/L	L/M	L/M	L/M	O/L	O	O	O/L	O/L	L/M	O/L	O/L	L/M	L/M	L/M	O	O	O	O	L	L	L	L	M	M	H	M	M	
51	O/L	O/L	O/L	O	O/L	O/L	O/L	O/L	O/L	L/M	O/L	O	O	O/L	O/L	O/L	O/L	O/L	L/M	O/L	O/L	O	O	O	O	O	L	L	L	L	M	M	M	M	
52	L/M	L/M	L/H	O	L/M	L/H	O/M	L/M	L/M	L/H	O/L	O	O	O/M	L/M	L/M	O/L	L/M	L/H	L/H	L/H	L	O	O	O	L	L	L	L	L	M	M	H	M	
53	O/L	O/L	O/M	O	O	O/M	O	O	O	O/L	O	O	O	O	O	O/L	O	O	O/L	O	O	O	O	O	O	O	O	O	O	O	O	O	L	L	L	
54	O/M	L/H	L/H	O	L/M	L/H	L/M	L/M	L/M	L/H	L/M	O	O	L/M	L/M	L/H	L/M	L/M	L/H	L/M	L/M	L	O	O	L	L	L	L	L	M	M	H	M	M	
LOW AND HIGH MOUNTAINS > 500 m ELEVATION, STRONGLY INCISED, SLOPES > 30%																													
55	O/M	O/M	O/M	O	O/L	O/M	O/L	O/M	O/M	O/M	O/L	O	O	O/M	O/L	O/M	O/L	O/M	O/M	O/M	O/L	O	O	O	O	O	O	O	O	L	L	M	L	L	
56	O/M	O/M	O/M	O	O/L	O/M	O/M	O/M	O/M	O/M	O/L	O	O	O/M	O/L	O/M	O/L	O/M	O/H	O/M	O/M	O	O	O	O	O	O	O	O	O	M	M	M	M	
57	O/M	O/M	O/M	O	O/L	L/H	O/M	O/M	O/M	O/H	O/L	O	O	O/M	O/M	O/M	O/L	O/H	O/H	O/H	O/M	O	O	O	O	O	O	O	O	L	L	M	M	M	
58	O/L	O/L	O/M	O	O	O/M	O	O	O	O/L	O	O	O	O	O	O/L	O	O	O/L	O	O	O	O	O	O	O	O	O	O	O	O	L	L	L	

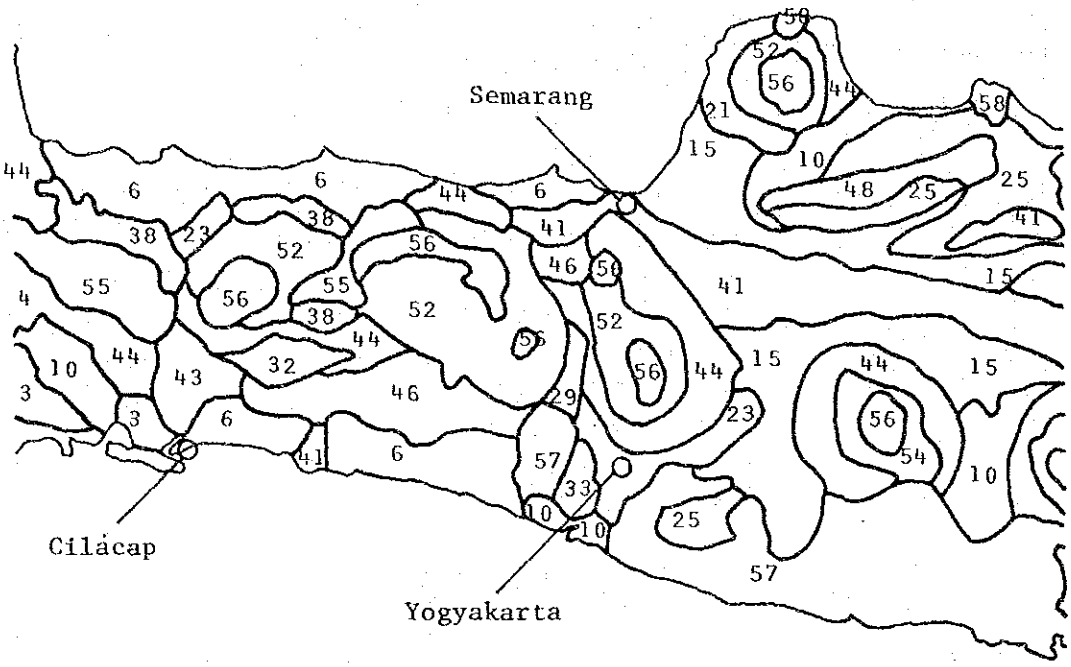
Notes:

1) Suitability classes are as follows: H – highly suitable, M – Moderately suitable, L – poorly suitable, O – unsuitable, and NR – not rated.

2) Based upon the capability of the predominant soils of the unit under improved management. Double ratings given for certain units that are predominantly non cultivable but contain some areas of cultivable soils, i.e. Total unit/cultivable part e.g. O/M.

Source: Same as Figure 4.4.

Figure 4.4 Map of Development Units (Ref. I-2)



Legend: See Following Pages.

Note: See the text for definition of land development unit.

Source: FAO/Gogor, Design and Evaluation of Land Development Units for Indonesia, AGL/INS/011, Working Papter No. 9, Bogor.

Figure 4.4 Legend

Development Unit No.	Certain Distinguishing Characteristics of the Units
Low Level Plains < 100m Elevation, Non to Slightly Dissected, Slopes Predominantly 0-8%	
1	Wet Strongly Acid Peat
2	Wet Neutral Peat
3	Wet Acid Humic Clays
4	Wet extremely Acid Sandy Alluvial Soils
5	Complex of Alluvium and Wet Acid Peat
6	Wet Acid Alluvial Soils
7	Wet Neutral Alluvial Soils
8	Slightly Acid Wet Alluvial Soils
9	Extremely Acid Wet Alluvial Soils
10	Neutral Alluvial Soils, Imperfectly Drained
11	Strongly Acid Sandy Clays, Imperfectly Drained
12	Strongly Acid Sandy Clays
13	Slightly Acid Clays
14	Strongly Acid Sandy Loams
15	Cracking Clays
Low Level Plains < 100m Elevation, Slightly to Moderately Dissected, Slopes Predominantly 0-15%	
16	Strongly Acid Sandy Clays, Imperfectly Drained
17	Strongly Acid Sandy Clays
18	Strongly Acid Sandy Loams
19	Strongly Acid Sands
20	Slightly Acid Humic Loams
21	Slightly Acid Clays
22	Neutral Clays, Shallow
23	Slightly Acid Sandy Loams
24	Volcanic Ash and Sands, Dry Climate
25	Cracking Clays
26	Cracking Clays, Dry Climate
High Level Plains > 100m Elevation, Slightly to Moderately Dissected, Slopes Predominantly 0-15%	
27	Wet Strongly Acid Humic Clays
28	Slightly Acid Humic Loams
29	Young Volcanic Ash Soils
30	Slightly Acid Clays
31	Strongly Acid Sandy Clays
32	Slightly Acid Alluvial Clays
33	Cracking Clays
34	Shallow Clays on Limestone

(continued)

Development Unit No.	Certain Distinguishing Characteristics of the Units
High Level Plains >100m Elevation, Moderately to Strongly Dissected, Slopes Predominantly 15%	
35	Shallow Clays on Limestone
Hills <500m Elevation, Moderately Dissected, Slopes Predominantly >15%	
36	Strongly Acid Clays
37	Strongly Acid Sandy Loams
38	Cracking Clays
39	Cracking Clays, Dry Climate
40	Slightly Acid Clays on Limestone
41	Neutral Clays on Limestone
42	Neutral Clays, Dry Climate
43	Slightly Acid Clays
44	Young Volcanic Ash Soils
Hills <500m Elevation, Strongly Dissected, Slopes Predominantly >30%	
45	Strongly Acid Humic Sandy Clays
46	Strongly Acid Sandy Clays
47	Slightly Acid Clays
48	Shallow Clays on Limestone
49	Strongly Acid Sands
Low and High Mountains >500m Elevation, Moderately Incised, Slopes Predominantly >30%	
50	Strongly Acid Humic Sandy Clays
51	Strongly Acid Sandy Clays
52	Slightly Acid Humic Loams
53	Slightly Acid Clays
54	Young Volcanic Ash Soils
Low and High Mountains >500m Elevation, Strongly Incised, Slopes >30%	
55	Strongly Acid Humic Clays
56	Slightly Acid Humic Loams
57	Slightly Acid Clays
58	Shallow Soils on Limestone, Dry Climate

Source: Same as Figure 4.4.

04.018 Also, the Agricultural Department (Dinas Pertanian Rakyat) of the Provincial Government divided the Province from agricultural viewpoints into four sub-regions as the basis of establishment of Agricultural Development Centers (ADC), as shown in the attached map (Figure 4.5).

4.1.3 Food Crops

04.019 Crops are classified into two groups, i.e., food crops and commercial crops. The former group consists of rice, palawija, fruit and vegetables, grown almost exclusively by small-holders (rakyat). The latter consists of many kinds of non-food crops such as rubber, coconut, sugarcane and tobacco, which are grown both by small-holders and estates.

04.020 As shown below (Table 4.2), rice is the most important among food crops with respect to both the planted areas and the amount of production. Among the secondary food crops or palawija, maize is the most important, followed by cassava and soybean.

Table 4.2 Estimated Harvested Area, Production and Yield of Major Food Crops,[1/] 1976

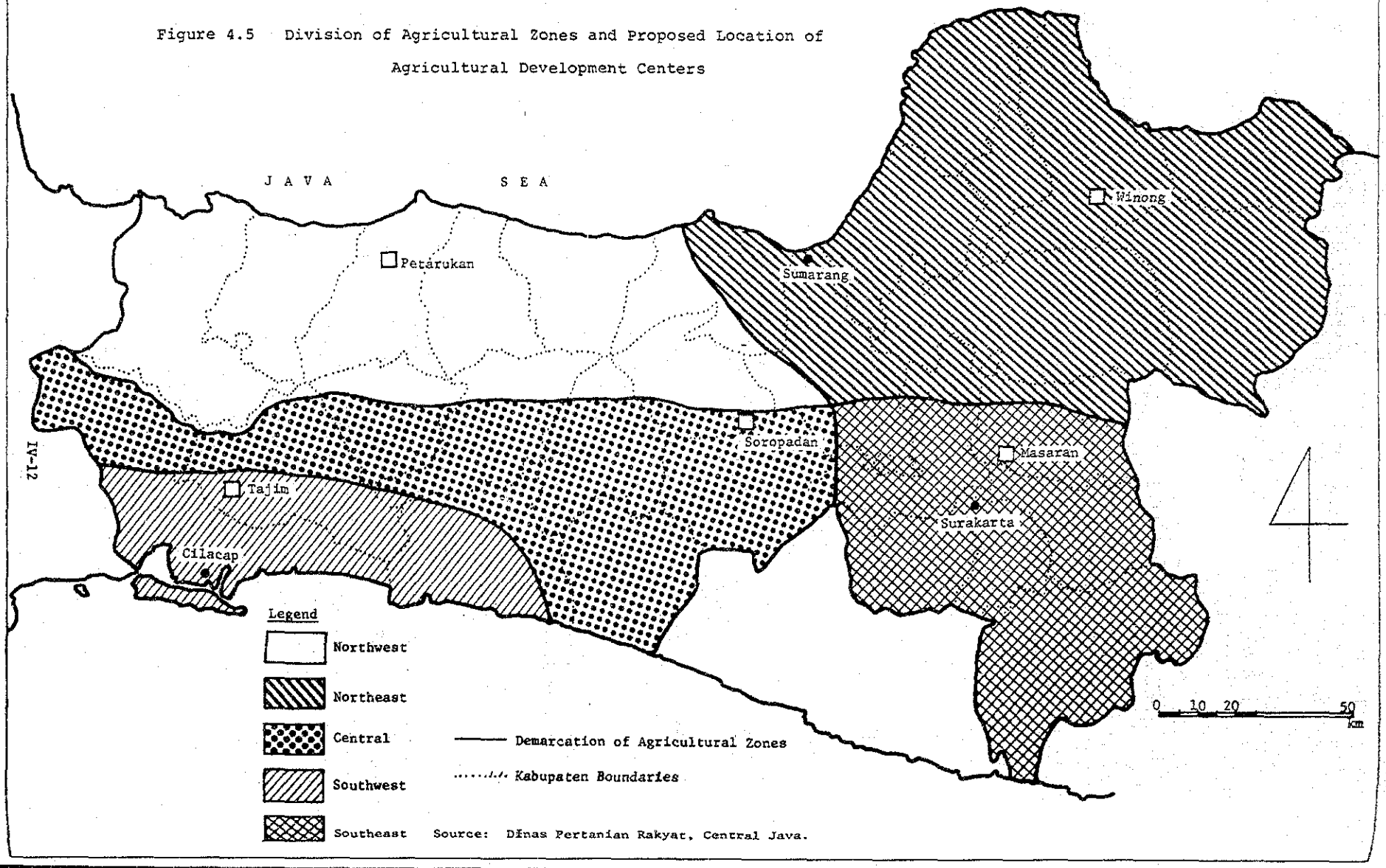
(Unit)	Lowland Rice (Padi Sawah)	Upland Rice (Padi Gogo)	Maize	Cassava	Sweet Potato	Peanut	Soybean	Sorghum
Harvested Area(ha)	1,136,743	44,353	471,998	312,933	40,637	92,097	125,875	13,042
Production (tons)	4,212,256	84,639	509,386	1,950,725	196,725	65,114	71,929	18,222
Yield[2/] (ql./ha)	39.40	19.08	10.79	60.59	48.44	7.07	5.71	13.07

Note: 1/ Rice weight is of dry stalk paddy, whereas other grains are of dry weight. Cassava and sweet potato are of raw weight.

2/ ql. stands for quintals, which means 100 kg.

Source: Dinas Pertanian Rakyat

Figure 4.5 Division of Agricultural Zones and Proposed Location of Agricultural Development Centers



(a) Rice

04.021 Rice is mostly grown in sawah but some upland rice (padi gogo) is also planted in tegal. The yield of upland rice is much lower than lowland rice (padi sawah). Transplanting is common for padi sawah. In areas where availability of irrigation water is uncertain, farmers sow seeds directly in sawah and after one or two months they introduce water into the field if irrigation water is available, otherwise the plants grow as upland rice. This system is called gogoranca; the yield under this system is between those of padi sawah and padi gogo, depending upon the water supply of the year.

04.022 The yield of paddy in Central Java is considerably high and favorable compared with other rice producing countries in Southeast Asia. Use of improved high-yielding varieties with application of fertilizer is the main factor for this high yield. Main varieties recommended by the Government and used widely by farmers are IR varieties, and C-4 varieties. The IR varieties have been introduced from the International Rice Research Institute since 1966 and called in Indonesia as PB standing for Peta Baru (New Peta), as the original IR varieties were crosses between Peta (Indonesian local varieties) and Taiwan varieties. The C-4 varieties were introduced from Agriculture College of the Philippines. Improved local varieties such as Syntha and Bengawan also give fairly high yields.

(b) Palawija

04.023 Maize and cassava which are the most important among palawija are grown almost throughout the Province. In fact, Central Java is the second largest producer of these two crops, following East Java, among all provinces of the country.

04.024 Differing from most other provinces where yellow maize are generally grown, more white maize are grown in this Province due to the traditional preference of the people. Although the Government is advising farmers to grow yellow maize because of its higher yield, farmers are reluctant to do so.

04.025 In contrast to the high yield of rice, the yield of maize in Central Java is low, compared with that in some provinces in outer inlands, such as North Sumatra and Lampung, and more so in comparison with maize producing countries in Southeast Asia, particularly Thailand. This is due mainly to the differences of varieties. In outer islands and in Thailand, where land is abundant, long maturity varieties, mostly Guatemala varieties which give higher yield, are used. The farmers in Java, however, do not use such varieties because their longer maturity period interferes with the planting of preceeding or succeeding crops to be grown in rotation. However, farmers in highland areas of Central Java grow high-yielding long maturity varieties, because the cool climate prolongs the maturity of short maturity varieties and thus the difference in maturity period among varieties becomes insignificant.

04.026 The yield of cassava too is low in Java compared with some other provinces in outer islands. Compared with 71 quintals (1 ql. = 100kg) per hectare, which is the average yield in Central Java (in 1974), the average yield perhectare in South Sumatra is 139 quintals and that in East Kalimantan is as high as 153 quintals.

04.027 Maize and cassava are mostly consumed locally as staple food. Some portion of cassava production is processed into pellets or chips for commercial animal feed or for export. In the Province there is one estate which undertaken commercial production of cassava.

04.028 Although the area planted as well as production of peanut and soybean are much smaller than those of maize and cassava, they are important food crops as they are a source of protein supply. Soybean is processed locally into soybean curd (tahu) and "tempe" which are very popular foods.

(c) Fruit and Vegetables

04.029 The bulk of fruit and vegetables production is from house-gardens (pekarongan), and is grown by villagers primarily for home consumption and with some surplus for sale at domestic markets. Since the total area of house-sites is as much as 580,000 hectares, accounting for nearly 17 percent of the total area of the Province, and every house-site is planted with a few fruit trees and vegetables, the total production must be considerably high.

04.030 Although accurate statistics on horticulture are lacking, the figures provided by the Agricultural Department of the Provincial Government (Dinas Pertanian Rakyat) indicate that there are over 27 millions banana trees, 1.7 millions mangostin (Nangka) trees, 1.4 millions papaya trees and 1.2 millions mangosteen trees.

04.031 Among vegetables, various kinds of beans, onion, Mexican pepper, egg plant, cucumbers and tomato are the main products. In areas of high elevation, such temperate vegetables as cabbage, Chinese cabbage (Chinese lettuce), white potato (Irish potato) and carrots are grown.

4.1.4 Non-Food Crops

04.032 In Indonesia, non-food crops are called "estate crops" although they are now produced by both estates and a large number of small-holders. Among this group of crops, those which are important in Central Java in terms of planted area and/or production value are tobacco, sugar, coconut, rubber and tea. In addition, clove and cotton have been gaining in importance in recent years.

04.033 These crops were mainly produced by estates before the War, but the share of estates declined sharply after independence was attained, and now a large number of small-holders are engaged in the cultivation of these crops. Statistics on these crops are produced by two separate agencies of the Government, one being responsible for administration and services for small-holders' plantations (Perkebunan Rakyat) and the other being responsible for estate plantations (Perkebunan Besar). According to the statistics from these two sources, the area planted by small-holders in Central Java is 204,308 hectares and the area occupied by estates is 90,522 hectares (both in 1974).

04.034 The planted area and production of small-holders and planted area by estates are as in Table 4.3. There are 125 estates in Central Java, of which 53 are state-owned (PTP or PNP). Estates generally specialized in one crop, but some estates plant two or three. Some estates have only one plantation unit (kebun) but estates usually have several units in different localities. The largest estate enterprise in the Province is state-owned PTP XIII, which, with headquarters in Semarang, has 32 plantation units in the Province, most of which are for rubber although there are some for coffee, coconut and cocoa. The total area occupied by this estate in Central Java is 37,300 hectares.

(a) Coconut

04.035 Indonesia is the second largest producer and exporter of coconut products in the world, although its exports have declined in the past two decades as a result of increasing domestic consumption. This crop is the most important non-food crop in Central Java both in terms of planted area and production value.

04.036 Although the coconut tree is found almost everywhere in the Province, commercial production is heavily concentrated in two areas, i.e., Banyumas/Cilacap/Kebumen/Porworejo/Magelang and Karanganyar. Coconut cultivation in the Province is almost all by small-holders; the area of estate plantation is only 2,000 hectares against some 130,000 hectares of small-holders' plantation.

04.037 Most coconut is consumed locally; a small portion processed (sun-dried) into copra for sale to oil factories. Small-holders usually sell the raw coconuts or extract oil with primitive equipment. They also make coconut sugar from liquid taken from coconut flowers.

04.038 There are 10 coconut oil mills in the Province which extract oil from copra, but they are operating at far below capacity due to the short supply of the raw material, even though they are supplementing locally-grown input with copra imported from outer islands.

(b) Rubber

04.039 The same as coconut, Indonesia is the world's second larger producer of rubber, but the share of Central Java in the national rubber production is only a fraction. The area of rubber tree plantings in the province is about 27,000 hectares against the national total of 2.3 million hectares.

Table 4.3 Area and Production of Non-Food Crops in Central Java by Small-holders and Estates

(Unit: Area in hectares unless otherwise marked. Production in tons unless otherwise marked.)

	Small-holders 1975		Estates 1974	
	Harvested Area	Production	Planted Area	Production
Java Tobacco	47,972	22,752		
Virginia Tobacco	843	292	130	123
Vorstenland Tobacco			1,998	2,204
Cotton	2,411	550		
Castor Seeds	618	254		
Roselle	239	178		
Klembak (Eagle-Wood Tree)	1,042	622		
Pyrethpum	82	53		
Kapok	8,834 (1,000 trees)	8,800		685
Coconut	20,841 (1,000 trees)	698,669 (1,000 pieces)	1,946	3,172
Coffee	17,663 (1,000 trees)	6,813	4,257	1,182
Cocoa			1,826	301
Cloves	2,578 (1,000 trees)	1,125	455	211
Vanilla	985	97		
Sugar Cane	4,139	302,843	26,098	286,258
Rubber	114,996 (Number of trees)	82	27,410	18,521
Tea	13,635 (1,000 trees)	2,625	3,425	2,421
Cashew Nut	945,164 (Number of trees)	4,579		
Cinnamon	185 (1,000 trees)	131		
Pepper	87,367 (Number of trees)	30		
Nutmeg			742	50

Source: Small-holders; Jawa Tengah Dalam Angka, 1975.
Estates: Statistik Perkelunan Besar, Jawa Tengah, 1974

04.040 In contrast to coconut, most rubber plantations in Central Java are estates. The above mentioned state-owned PTP XIII has the dominant position in rubber plantations in this Province, accounting for about 73 percent of the planted area and 83 percent of the production amount of the Province. The remaining portion is shared by foreign-invested estates and those owned by Indonesians in a ratio of about half and half. Rubber plantations in Central Java are concentrated in two areas: Kabupaten Cilacap and kabupatens Kendal and Semarang. Rubber tree farms in these two areas account for about 80 percent of the Province total.

04.041 The problem facing rubber producers in Central Java is the low yield of rubber which has resulted from negligence of replanting in the private estates owned by Indonesian capital. The yields per hectare of estates of this category are generally about half of those in PTP and foreign-owned estates.

(c) Tobacco

04.042 Tobacco is planted in Central Java on about 40,000 hectares of land (for 1974; the area fluctuates year to year) mostly by small-holders in rotation with rice or palawija.

04.043 The tobacco grown in the Province is native tobacco called Java tobacco or farmers,tobacco (tembakau rakyat). Virginia tobacco is also produced by estates and small-holders, but the amount is not significant. A special variety of tobacco named Vorstenland is produced exclusively by a state-owned estate (PTP XVIII) in Kabupatens Klaten and Wonosobo.

04.044 The production of small-holders' tobacco (Java tobacco) is concentrated in two areas, one centering on Kabupaten Temanggung and the other is Kendal. About 75 percent of the area planted to tobacco in the Province are in these two areas. The production of Virginia and Vorstenland is almost exclusively in Klaten and its neighboring Kabupaten Sragen.

(d) Sugar Cane

04.045 Central Java, together with East Java, was known to the World for the production of cane sugar. The sugar industry declined sharply after the War, giving way to rice, yet it is a very important sub-sector of agriculture the Province. The Province is at present the second largest sugar producing province in Indonesia, following East Java.

04.046 The sugar cane in Central Java is mainly grown on estate plantations. Of the total planted area of 32,053 hectares (in 1974), estate plantation was 27,914 hectares; the remaining 4,139 hectares were planted by small-holders. There are two main sugar cane areas in the Province; the largest is the western zone of the northern cost including kabupatens Brebes, Tegal, Pemalang and Pekalongan and the other is the southeastern part of the Province consisting of kabupatens Sragen, Karanganyar and Klaten. Other kabupatens such as Kudus, Kendal and Pati also produce sugar cane but in smaller amounts.