

Since large production increase is not expected with those type of development, contribution to national food balance by producing surplus will not be expected. Instead regional self-sufficiency may be a target in a short term.

- (3) Rehabilitation/upgrade of existing irrigation network to contribute to the assurance of high water use efficiency as well as maintenance of crop productivity

Rehabilitation/upgrading of existing irrigation network is expected to maximize the water and land utilization efficiency. Irrigation networks need regular maintenance works to keep their condition normal. Proper O&M needs to be put emphasis to make the operation period of existing facilities longer.

Farmers, direct beneficiaries from the irrigation system, will be responsible for its maintenance. Handing over the system to farmers, and collection of irrigation service fee is being implemented in limited provinces to reduce the government subsidy. Areas where are to be irrigated but not yet realized still remain in the existing scheme. Real potential area should be examined.

At present, rehabilitation/upgrading projects are being put priority, and package projects in which rehabilitation/special maintenance, extension of area, and subsequent efficient O&M are included have been done under World Bank (e.g. ISSP II, Irrigation Sub-Sector Project II) and/or Asian Development Bank (e.g. IISP II, Second Integrated Irrigation Sector Project) loans. Other rehabilitation projects include PIADP (Provincial Irrigated Agriculture Development Project) which includes land development, and Integrated Swamp Development Project.

8.3.2 Priority of Development Type

- (1) Future Rice Demand and Supply Balance

As seen before, rice supply and demand balance will be deficit in future. However, there is always a limit in any future projection as the projection is made using assumed parameters which are subject to change. For example, sensitivity of population projection by changing growth rate resulted in the difference of population by 30 million, which is equivalent to 7 million tons of paddy. We, therefore, have to be flexible enough to cope with such a range of possible change in balance through continuous efforts for monitoring parameter changes which affect demand or supply.

(2) Priority of Development Type

As described in the previous chapter, three development types are considered in the strategy making. Each of these types has its own feature which contributes to national development goals. Currently Indonesia keeps self-sufficiency in rice. Due to the favorable climate condition in 1992, even much surplus is expected in 1993 following 1992.

Considering such circumstances, small scale development and rehabilitation/special maintenance works should be put priority in earlier stage of the development period. New irrigation development in eastern islands may be reasonable as it will contribute to equitable development and alleviation of poverty, both of which will be national development objectives. In other part of the country, also small to middle scale development should be promoted to stabilize and increase harvest which will contribute to increase farm income.

From the view point of alleviation of poverty, rehabilitation /special maintenance of the existing irrigation networks in swamp area should be promoted, because of its low productivity. However, new swamp development for paddy field is not recommended from the economical view point. In such areas, drainage development for estate crops and development of fish-pond should be preceded, which are conducive to economic development.

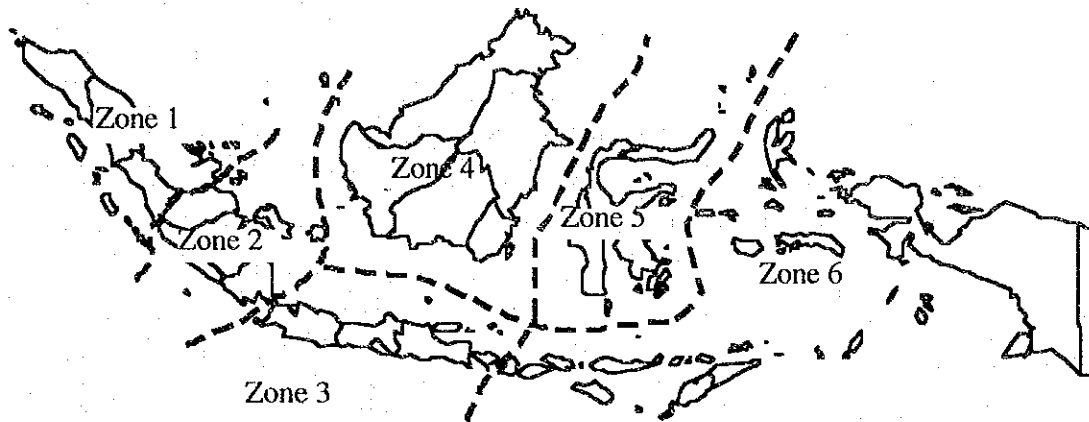
On the other hand, large scale development should be prepared in earlier stage also in view of future large deficit to be occurred centering Jawa. As it usually takes long period to construct, identification and preliminary design of projects should be made earlier for quick implementation.

8.4 Macro Zoning for Irrigation Development

Considering the existing irrigated paddy area, future paddy demand, irrigation development potential and supply balance, economic situation and human resources, strategic regions for each development type are determined.

The whole Indonesia is divided into six strategic zones: Northern Sumatera zone (Zone 1) including four provinces of D.I.Aceh, Sumatera Utara, Sumatera Barat and Riau, Southern Sumatera zone (Zone 2) including another four provinces of Jambi, Sumatera Selatan, Bengkulu and Lampung, Jawa & Bali zone (Zone 3) which includes all provinces in Jawa island and Bali province, Kalimantan zone (Zone 4) including all provinces in Kalimantan,

Sulawesi zone (Zone 5) including all provinces in Sulawesi, and Eastern zone (Zone 6) which includes the rest of provinces in eastern part of Indonesia.



Macro Zoning for Formulation Development Program

Strategy for irrigation development in each region is briefly explained as below:

Northern Sumatera zone

Centering Sumatera Barat, rice surplus province, paddy farming practice is advanced except Riau province which has wide swamp area. Development potential is high, but this zone is also suitable for high value estate crops. Agricultural productivity is rather high, and human resources seems enough. Rice supply and demand balance is a little deficit in the zone. Most parts being located on the Northern Hemisphere, rainfall pattern in the zone is different from other area of the nation, which enable the paddy harvesting time to stagger to September to December. The Development in the zone, therefore, is expected to contribute to correct the polarization of harvesting time in the nation. Rehabilitation/upgrading of existing facilities to maintain and/or increase productivity as well as new irrigation development should be promoted. Also there remains uncompleted canals or land development in the existing irrigation networks. Earlier completion of those area is recommended.

Southern Sumatera zone

Development potential is large, especially in Sumatera Selatan province. Agricultural productivity is rather low, and human resources seems enough. Rice supply and demand balance is deficit in the zone. For its locational advantage for exporting rice to

surrounding deficit region including Jawa (not at present but in future) and Kalimantan regions, large scale irrigation development should be sought in the region. Also small to medium scale irrigation development should be promoted to increase agricultural productivity.

Jawa and Bali zone

Currently rice production center in Indonesia, and supply surplus rice mainly to Sumatera and Kalimantan. Deficit, however, is anticipated in the future due to population increase as well as land conversion. Highly productive paddy farming is practiced with support of irrigation facilities. However, further development potential is little. Other sectors than agriculture is becoming the driving forces to further economic development. In this region, rehabilitation/upgrading and proper O&M should be put priority to maintain present high productivity and pursue high water use efficiency.

Kalimantan zone

Paddy farming is active only in Kalimantan Selatan province. Dryland paddy production is popular. Despite of large potential for irrigation development, it will take long time to realize it due to scarce human resources as well as poor basic infrastructure. Per capita agricultural output is rather high mainly because of high value forestry and estate crops. Rice supply and demand balance is deficit in the region. Small to medium scale irrigation development as well as upgrading and/or rehabilitation of existing system including swamp should be promoted in order to increase self-sufficiency rate.

Sulawesi zone

Another paddy production center, especially Sulawesi Selatan province. Surplus production is sent to Kalimantan Selatan and eastern islands. Rather high productivity has been attained with support of irrigation facilities. Potential for further irrigation development is low due mainly to limited water resources. Agriculture productivity is higher than that of other sectors. Remaining irrigation development potential should be fully realized to keep its position as rice supply base for eastern island while maintaining existing facilities through rehabilitation as well as proper O&M.

Eastern zone

Rice deficit region. Other staple foods such as corn, sago and sweet potatoes are popular. One of the most depressed area in terms of economic development. There is large land and water potential for development in Irian Jaya while both are scarce in

other provinces. Human resources seems not enough, and basic infrastructure are insufficient. Only small to middle scale irrigation development should be promoted to increase self-sufficiency rate and activate economy within the provinces.

Table 8.1 Loading and Unloading of Rice at Ports in Indonesia (1988-1990)

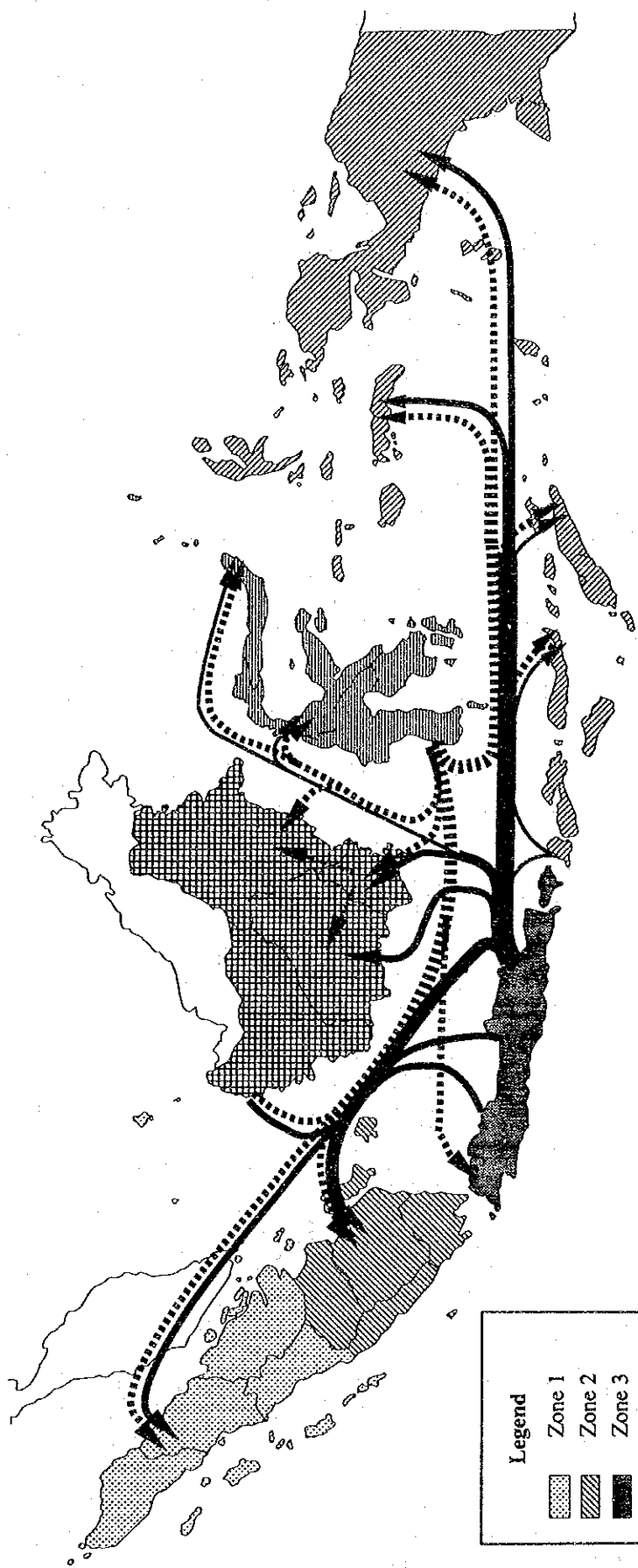
Province	1988						1989						1990						Unit: tons			
	Loading		Un-loading		Balance		Loading		Un-loading		Balance		Loading		Un-loading		Balance		Three Year Average			
11. D.I.Aceh	927	28,520	-27,593	1,157	26,087	-24,930	1,347	13,640	-12,293	1,144	22,749	-21,605	27,770	73,566	-45,796	-101,104	26,178	148,719	-122,541	27,077	116,891	-89,814
12. Sumatera Utara	0	74,584	-74,584	2	38,038	-38,036	0	57,413	-37,413	1	50,012	-50,011	12,907	133,930	-121,023	-200,960	9,674	169,741	-160,067	10,546	171,229	-160,683
13. Sumatera Barat	1,469	68,764	-67,295	1,713	75,117	-73,406	8,370	21,149	-12,779	3,851	55,011	-51,160	1,414	190,778	-189,364	-204,249	29,013	69,474	-40,461	10,182	154,874	-144,691
14. Riau	2	34,052	-34,050	0	18,213	-18,213	0	16,121	-16,121	1	22,795	-22,795	5,707	28,326	-22,619	-2,627	225	39,830	-39,605	2,070	23,687	-21,617
15. Jambi	50,196	632,520	-582,324	39,609	703,134	-663,525	74,808	516,087	-441,279	54,871	617,247	-562,376	17,998	138,190	959,304	771,782	823,684	197,258	626,426	905,719	119,882	785,837
16. Sumatera Selatan	270,664	120,176	150,488	287,445	8,202	279,243	223,652	188,685	34,967	260,587	105,688	154,899	84,994	5,000	79,994	89,847	67,217	0	67,217	80,686	1,667	79,019
17. Bengkulu	155,502	0	155,502	170,687	0	170,687	108,985	0	108,985	145,058	0	145,058	586,334	13,014	573,320	232,005	423,830	8,573	415,257	419,388	12,527	406,861
18. Lampung	1,097,494	138,190	959,304	795,979	24,197	771,782	823,684	197,258	626,426	905,719	119,882	785,837	5,884	15,143	-9,259	-6,538	243	4,552	-4,309	2,152	8,854	-6,702
Sumatera	67,008	7,083	59,925	50,087	2,237	47,850	64,889	1,731	63,158	60,661	3,684	56,978	5,106	92,366	-87,260	-50,073	2,043	84,074	-82,031	3,063	76,184	-73,121
31. D.K.I. Jakarta	0	23,833	-23,833	75	31,037	-30,962	0	29,182	-29,182	25	28,017	-27,992	77,998	138,425	-60,427	-39,723	67,175	119,539	-52,364	65,901	116,739	-50,838
32. Jawa Barat	1,457	165,533	-164,076	2,145	198,406	-196,261	1,674	181,794	-180,120	1,759	181,911	-180,152	67,008	7,083	59,925	47,850	64,889	1,731	63,158	60,661	3,684	56,978
33. Jawa Tengah	5,106	92,366	-87,260	2,039	52,112	-50,073	2,043	84,074	-82,031	3,063	76,184	-73,121	5,106	92,366	-87,260	-50,073	2,043	84,074	-82,031	3,063	76,184	-73,121
34. Jawa Timur	0	23,833	-23,833	75	31,037	-30,962	0	29,182	-29,182	25	28,017	-27,992	77,998	138,425	-60,427	-39,723	67,175	119,539	-52,364	65,901	116,739	-50,838
Bali, NTB, NTT, Timtim	4,180	311,189	-307,009	5,689	319,968	-314,279	6,376	750,836	-744,460	5,415	460,664	-455,249	1,457	165,533	-164,076	-196,261	1,674	181,794	-180,120	1,759	181,911	-180,152
61. Kalimantan Barat	117	4,698	-4,581	122	25,058	-24,936	10	438,559	-438,549	83	156,105	-156,022	117	4,698	-4,581	-4,658	5,104	6,350	-1,246	4,984	12,244	-7,260
62. Kalimantan Tengah	1,403	69,673	-68,270	3,033	37,155	-34,122	3,684	34,487	-30,803	2,707	47,105	-44,398	1,403	69,673	-68,270	-34,122	3,684	34,487	-30,803	2,707	47,105	-44,398
63. Kalimantan Selatan	1,203	71,285	-70,082	389	59,349	-58,960	1,008	95,996	-94,988	867	75,543	-74,677	1,203	71,285	-70,082	-58,960	1,008	95,996	-94,988	867	75,543	-74,677
64. Kalimantan Timur	4,180	311,189	-307,009	5,689	319,968	-314,279	6,376	750,836	-744,460	5,415	460,664	-455,249	4,180	311,189	-307,009	-314,279	6,376	750,836	-744,460	5,415	460,664	-455,249
Kalimantan	12,817	115,263	-102,447	15,350	40,500	-25,150	7,379	28,399	-21,520	11,849	61,554	-49,706	12,817	115,263	-102,447	-25,150	7,379	28,399	-21,520	11,849	61,554	-49,706
71. Sulawesi Utara	3,868	19,744	-15,876	5,981	10,639	-4,658	5,104	6,350	-1,246	4,984	12,244	-7,260	3,868	19,744	-15,876	-4,658	5,104	6,350	-1,246	4,984	12,244	-7,260
72. Sulawesi Tengah	386,511	2,362	384,149	246,675	1,653	245,022	419,188	7,721	411,467	350,791	3,912	346,879	386,511	2,362	384,149	245,022	419,188	7,721	411,467	350,791	3,912	346,879
73. Sulawesi Selatan	14	22,109	-22,095	850	16,736	-15,886	601	14,261	-13,660	488	17,702	-17,214	14	22,109	-22,095	-15,886	601	14,261	-13,660	488	17,702	-17,214
74. Sulawesi Tenggara	403,210	159,478	243,731	268,856	69,528	199,328	432,272	57,231	375,041	368,113	95,413	272,700	403,210	159,478	243,731	199,328	432,272	57,231	375,041	368,113	95,413	272,700
Sulawesi	6,167	58,051	-51,884	2,216	15,425	-13,209	5,221	32,660	-27,439	4,535	35,379	-30,844	6,167	58,051	-51,884	-13,209	5,221	32,660	-27,439	4,535	35,379	-30,844
81. Maluku	9,878	54,978	-45,100	6,444	68,150	-61,706	2,779	50,422	-47,643	6,367	57,850	-51,483	9,878	54,978	-45,100	-61,706	2,779	50,422	-47,643	6,367	57,850	-51,483
82. Irian Jaya	16,045	113,029	-96,984	8,660	83,575	-74,915	8,000	83,082	-75,082	10,902	93,229	-82,327	16,045	113,029	-96,984	-74,915	8,000	83,082	-75,082	10,902	93,229	-82,327
Maluku & Irian Jaya	1,649,123	1,492,831	156,291	1,171,322	1,292,654	-121,332	1,412,315	1,724,033	-311,718	1,410,920	1,503,173	-92,253	1,649,123	1,492,831	156,291	-121,332	1,412,315	1,724,033	-311,718	1,410,920	1,503,173	-92,253

Source: JICA-FIDP team calculation based on Cargo Loading and Unloading at Ports in Indonesia, CBS, 1988-1990

Table 8.2 Preliminary Assessment of Rice Supply and Demand Balance as of 1990

Code No.	Province	Population ¹		Per capita consumption ²		Consumption (ton)		Paddy production in 1990 (ton) ³		Seed, feed & loss (ton) ⁴	Rice supply (ton) ⁵	Adjusted rice supply (ton) ⁵	Balance (supply-demand)	
		Urban	Rural	Urban	Rural	Urban	Rural	Wetland	Dryland					Total
11	D.I. Aceh	539,740	2,875,653	170.4	187.7	91,950	539,888	631,838	1,154,225	15,640	1,169,865	697,328	685,443	53,605
12	Sumatera Utara	3,638,832	6,615,479	145.6	180.2	529,832	1,191,737	1,721,569	2,478,460	139,294	2,617,754	1,560,380	1,533,785	187,784
13	Sumatera Barat	807,983	3,190,694	159.5	193.2	1,047,454	2,233,592	3,281,046	1,619,420	26,482	1,645,902	981,083	964,361	219,010
14	Riau	1,047,454	2,233,592	137.3	152.9	143,803	341,607	485,411	330,877	88,079	418,956	249,730	245,473	-239,937
15	Jambi	432,727	1,581,327	150.0	189.7	64,919	299,971	364,891	475,243	71,118	546,361	325,673	320,122	-44,769
16	Sumatera Selatan	1,837,492	4,438,453	137.2	165.4	252,147	734,258	986,405	1,203,163	199,964	1,403,127	836,370	822,115	-164,290
17	Bengkulu	240,192	938,759	179.0	197.4	42,995	185,346	228,341	234,062	35,219	269,281	160,512	157,776	-70,565
18	Lampung	747,327	5,256,782	158.3	159.2	118,332	836,806	955,137	1,110,246	232,666	1,342,912	800,478	786,834	-168,303
31	D.K.I. Jakarta	8,222,515	0	127.9	0	1,051,391	0	1,051,391	39,174	-	39,174	23,351	22,953	-1,028,438
32	Jawa Barat	12,208,176	23,170,307	149.4	182.5	1,823,577	4,228,004	6,051,581	10,024,554	390,832	10,415,386	6,208,362	6,102,545	50,964
33	Jawa Tengah	7,694,539	20,822,247	132.0	128.2	1,015,376	2,669,838	3,685,214	7,693,200	162,812	7,856,012	4,682,780	4,602,966	917,752
34	D.I. Yogyakarta	1,294,056	1,618,555	122.1	111.6	157,984	180,577	338,561	533,271	98,865	632,136	376,801	370,379	31,817
35	Jawa Timur	8,916,011	23,571,557	127.3	118.5	1,135,432	2,793,878	3,929,309	8,011,535	223,179	8,234,714	4,908,515	4,824,854	895,544
51	Bali	734,237	2,043,119	157.6	175.2	115,734	357,932	473,666	848,414	5,229	853,643	508,836	500,163	26,497
52	Nusa Tenggara Barat	582,180	2,786,519	166.3	181.0	96,835	504,301	601,136	1,100,757	29,417	1,130,174	673,670	662,187	61,052
53	Nusa Tenggara Timur	372,242	2,895,677	148.6	107.9	55,313	312,324	367,637	210,772	119,818	330,590	197,057	193,698	-173,939
54	Timor Timur	58,221	689,336	108.0	95.8	6,287	66,055	72,342	46,109	-	46,109	27,484	27,016	-45,326
61	Kalimantan Barat	642,989	2,592,377	141.3	160.8	90,865	416,886	507,751	495,487	164,371	659,858	393,326	386,622	-121,130
62	Kalimantan Tengah	245,249	1,150,612	152.9	179.0	37,510	205,916	243,426	216,588	74,285	290,873	173,382	170,427	-72,999
63	Kalimantan Selatan	702,950	1,893,697	132.9	161.6	93,401	306,008	399,409	934,670	47,497	982,167	585,446	575,468	176,059
64	Kalimantan Timur	915,469	959,563	155.7	164.8	142,576	158,180	300,756	168,763	121,340	290,103	137,159	134,821	-165,934
71	Sulawesi Utara	564,795	1,913,151	160.3	146.2	90,530	279,780	370,310	318,315	20,318	338,633	201,851	198,411	-171,980
72	Sulawesi Tengah	281,134	1,422,196	162.0	156.2	45,556	222,138	267,694	368,808	33,094	401,902	239,564	235,481	-32,213
73	Sulawesi Selatan	1,683,443	5,295,146	160.1	174.2	269,829	922,483	1,192,314	3,109,850	22,528	3,132,378	1,835,312	1,835,312	642,997
74	Sulawesi Tenggara	229,649	1,119,649	143.0	118.8	32,841	133,001	165,842	135,728	19,510	155,238	92,534	90,956	-74,885
81	Maluku	352,438	1,498,649	129.7	83.8	45,706	125,570	171,277	8,185	8,921	17,106	10,196	10,023	-161,254
82	Irian Jaya	395,131	1,233,956	136.4	79.7	53,887	98,335	152,222	15,391	3,006	18,397	10,966	10,779	-141,443
	Sumatera	9,291,747	27,128,739	147.8	174.9	1,372,858	4,746,084	6,118,943	8,605,696	808,462	9,414,158	5,611,554	5,515,909	-603,034
	Jawa	38,335,297	69,182,666	135.2	142.7	5,183,760	9,872,297	15,056,057	26,301,734	875,688	27,177,422	16,199,809	15,923,696	867,640
	Bali, NTB, NTT & Timtim	1,746,880	8,414,651	156.9	147.4	274,169	1,240,612	1,514,781	2,206,052	154,464	2,360,516	1,407,047	1,383,065	-131,716
	Kalimantan	2,506,657	6,596,249	145.4	164.8	364,352	1,086,990	1,451,342	1,755,508	407,493	2,163,001	1,289,313	1,267,338	-184,004
	Sulawesi	2,761,021	9,750,142	158.9	159.7	438,757	1,557,403	1,996,160	3,932,701	95,450	4,028,151	2,401,084	2,360,160	364,080
	Maluku & Irian Jaya	747,569	2,732,605	133.2	81.9	99,594	233,905	333,499	23,576	11,927	35,503	21,162	20,802	-302,697
	INDONESIA	55,389,171	123,805,032	139.6	151.3	7,733,489	18,727,291	26,460,781	42,825,267	2,353,484	45,178,751	26,929,969	26,470,969	10,189

Remarks:
¹ Population Census (1990)
² SUSENAS survey (1990) adjusted
³ Production of Cereals in Indonesia (1990)
⁴ Calculated by using the same factors of Food Balance Sheet
⁵ Adjusted considering net import, change in stock and waste at milled rice found in CBS Food Balance Sheet



Legend

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Zone 6

Note: for zoning, see text pp.8-12

Source: Prepared by JICA-FIDP team based on *Angkutan Beras antar DOLOG Tahun 1991*, CBS

Figure 8.1 Schematic Flow of Marketed Paddy by DOLOG as of 1991

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 FORMULATION OF
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Chapter 9

9. IRRIGATION DEVELOPMENT SCENARIOS AND FRAMEWORKS

9.1 Development Alternatives

Three alternatives are defined to guide the formulation of a long-term irrigation development for the Indonesia. These alternatives emphasize in different degrees the two distinct alternatives for development strategy presented in subsection 8.2.1.

(1) Alternative 1 : Rehabilitation and efficient O&M

This alternative emphasizes the rehabilitation and O&M. More attention is directed to the existing irrigation systems which still have potential to increase productivity. Jawa, Bali and Nusa Tenggara Barat, Sumatera and Sulawesi will be main target regions. Institutional development for water management and O&M will be more important. In addition to irrigation practice, agricultural extension efforts including improved farming will play important roles to maximize productivity.

(2) Alternative 2 : New development

This alternative emphasizes the new irrigation development strategy. Regional self-sufficiency and/or more equitable development concept may be implied in this alternative. Irrigation areas under this alternative will be spread over the Indonesia. Outer Jawa area will be of importance, and simultaneous development efforts for basic infrastructure are assumed in those areas.

(3) Alternative 3 : Harmonious and Integrated development

This alternative represents an intermediate path between Alternative 1 and Alternative 2. While existing systems will be maintained properly to keep their productivity, new development will directed towards equity and sustenance of self-sufficiency in rice. More balanced production area will be built, and new production centers in place of Jawa will be formed.

9.2 Irrigation Development Frameworks

9.2.1 Target Production Amount

Given that the policy of self-sufficiency in rice in Indonesia will be unchanged during the period of PJP II, target production amount of paddy is set at 66.2 million tons, which are equivalent to the paddy demand as of 2018 projected in this study (refer to Chapter 4).

Production at 1990, setting as the base year, was 45.2 million ton. We, therefore, have to increase paddy production by 21 million ton in 30 years.

No particular target has set for the amount of stock for food security purpose or price stabilization in the Study. At present, BULOG has a storing capacity of about 2 million tons of rice at maximum for the purpose of price stabilization and distribution of rice to civil servants. It is not conceived that this storing capacity will change drastically. It is also not announced that the governmental policy will be changed to admit positive export or import of paddy.

Past actual production of lowland paddy last 13 years fluctuates ranging $\pm 3\%$ from the theoretical values obtained by regression analysis. This range is equivalent to about 300 million tons. In 1991, a serious drought year produced 42.3 million tons of lowland paddy which is 3% less than the theoretical values while in 1992 recorded 45.4 million tons, being 3% more than the theoretical values. Paddy production in future is expected also to fluctuate due mainly to the change in climatic condition. In case a certain year experience the favorable climate, paddy production may surpass the demand, and the surplus amount will be stored under BULOG's. On the other hand, paddy production may not meet the demand under unfavorable climate such as drought or flood, and the deficit amount will be compensated from BULOG's stock.

9.2.2 Socio-economic Development Framework

A socio-economic framework or macro frame for irrigation development planning specifies development targets or the level of development in some target year by selected socio-economic indices projected in a mutually consistent way. The indices used are production amount, value-added, and employment. The base year for projection is taken to be 1990. The effect of on-going projects will be added evenly to all Alternatives.

(1) Projection method

A socio-economic framework is worked out for each alternative presented above by projecting the selected socio-economic indices in a mutually consistent way. The following summarizes the projection method.

- i) Production amount through the implementation of projects is projected for each of Alternatives by using area of proposed projects, cropping intensity and yield.
- ii) The value-added is estimated at Rp.240,000/ha by using production cost data by CBS and anticipated incremental paddy production through the implementation of projects for each Alternatives.
- iii) Employment is projected by using incremental paddy area. Labour requirement is estimated at 190 man-days/ha based on the production cost data by CBS, and incremental labor requirement from non-irrigated paddy cultivation to irrigated condition through rehabilitation works is estimated at 60 man-days/ha.

(2) Projection results

Projection results are summarized below:

<u>Production Amount</u>								
Unit:10 ⁶ ton; % share in parenthesis								
	Estimate		Projection				Growth rate (% p.a.)	
	1990	1998	2008	2018	'90-'98	1998-'2008	2008-'18	1990-2018
Alternative I	45.2	53.1	57.7	56.8	2.05	0.83	-0.15	0.83
Alternative II	45.2	53.7	61.9	66.2	2.25	1.45	0.65	1.39
Alternative III	45.2	53.7	61.9	66.2	2.25	1.45	0.65	1.39

<u>Value-Added and its Projection</u>								
Unit:Rp.10 ¹² ; % share in parenthesis								
	Estimate		Projection				Growth rate (% p.a.)	
	1990	1998	2008	2018	'90-'98	1998-'2008	2008-'18	1990-2018
Alternative I	10.8	12.7	13.8	13.6	2.03	0.83	0.16	0.82
Alternative II	10.8	12.9	14.9	15.9	2.18	1.43	0.67	1.37
Alternative III	10.8	12.9	14.9	15.9	2.18	1.43	0.67	1.37

Employment and its Projection

	Unit: 10 ⁶ man-days; % share in parenthesis							
	Estimate	Projection			Growth rate (% p.a.)			
	1990	1998	2008	2018	'90-'98	1998-'2008	2008-'18	1990-2018
Alternative I	1,877	2,100	2,230	2,170	1.41	0.60	-0.27	0.52
Alternative II	1,877	2,218	2,557	2,734	2.11	1.43	0.67	1.35
Alternative III	1,877	2,125	2,403	2,558	1.56	1.24	0.63	1.11

Under the Alternative I paddy production will increase so as to meet the increased demand up to year 1998. However, the production increase will be slowed and even decrease later mainly due to land conversion effect. As a result, production will be 4 million tons less than the total demand in 2008, and 10 million tons less in 2018. On the other hand, paddy production under Alternative II and Alternative III will be able to catch up with the demand increase. The paddy production growth rate will decrease in the future with the decelerated demand growth rate, and overall growth rate in 28 years will be 0.83% under Alternative I and 1.39 % under Alternative II and III, respectively.

Value-added under Alternative I will increase little after 1998 and even decrease after 2008 because all rehabilitation projects will be finished until year 1998, and production increase is expected only by yield increase through improvement of agricultural measures. While under Alternatives II and III, value added will increase to 15.9×10^{12} in 2018 from 10.8×10^{12} in 1990, with the increase of production.

Employment will not increase much under Alternative I because the paddy area itself will not be expanded. Alternative II will increase employment opportunity through expansion of new paddy area. Incremental opportunity will be 857×10^6 man-days in 2018, which is 46% more than 1990 level. Under alternative III, increase of employment opportunity will be between Alternative I and III.

9.2.3 Spatial Development Framework

(1) Basic elements of spatial framework

Spatial development is affected by land and water resources, existing infrastructure facilities, human resources, etc.

Potential for further irrigation development

The results of land and water potential study reveals that most provinces in Jawa are of critical water condition. Major potential areas for future irrigation development from the land and water resources condition are Sumatera, Kalimantan and Irian Jaya as shown below (also refer to Table 9.1):

Irrigation Development Potential by Region

Unit: 1,000 ha

Region	1990	2020
Sumatera	4,009	3,972
Jawa	83	62
Bali & NT	98	90
Kalimantan	3,693	3,693
Sulawesi	535	524
Maluku & IJ	2,524	2,524
Indonesia	10,944	10,865

Source: JICA-FIDP team estimate. For details see Table 9.1

Sumatera Selatan, Kalimantan Timur and Irian Jaya provinces have more than one million ha of irrigation development potential. Other important provinces are Kalimantan Tengah, Jambi, etc. As mentioned later, however, many of these provinces have scarce population with poor infrastructure condition.

Existing infrastructure facilities

According to the results of inventory survey, some 3.5 million ha of irrigated area under the responsibility of PU exists in Indonesia, of which 58% or 2.0 million ha is concentrated in Jawa, followed by Sumatera with the share of 23% or 0.8 million ha. On the other hand, Kalimantan and Maluku and Irian Jaya have only less than 0.05 million ha in total which account for as low as 1.1%, as shown below:

Total Paddy Field Area of On-going and Proposed Rehabilitation Schemes

Unit: 1,000 ha

Islands	Rehabilitation schemes			Total Existing Schemes
	On-going	Proposed	Total	
Sumatera	161	192	353	792
Jawa	209	221	430	2,025
Bali & Nusa Tenggara	44	43	87	261
Kalimantan	0	5	5	29
Sulawesi	60	166	226	381
Maluku & Irian Jaya	8	9	17	11
Indonesia	482	636	1,118	3,499

Source: Inventory Survey by JICA-FIDP team.

Rehabilitation schemes which are on-going or proposed totals as wide as 1.1 million ha or 32 % of total irrigation area. More than 62% of existing irrigation area or 0.2 million ha in Sulawesi needs rehabilitation while Jawa require rehabilitation works for only 27% of total existing irrigation area or 0.43 million ha.

As for road condition, as an indicator of accessibility, there are much difference in road density among provinces as well as island groups as shown below (also see Table 9.2):

Length of Road and Road Density by Province/Island as of 1989

Province	Total Road Length (1,000 km)	Road Density (m/km ²)
Sumatera	84.6	179
Jawa*	71.7	542
Bali & Nusa Tenggara	26.1	295
Kalimantan	28.3	52
Sulawesi	42.4	224
Maluku & Irian Jaya	13.2	27
Indonesia	266.3	139

Note: *: D.K.I Jakarta is excluded.

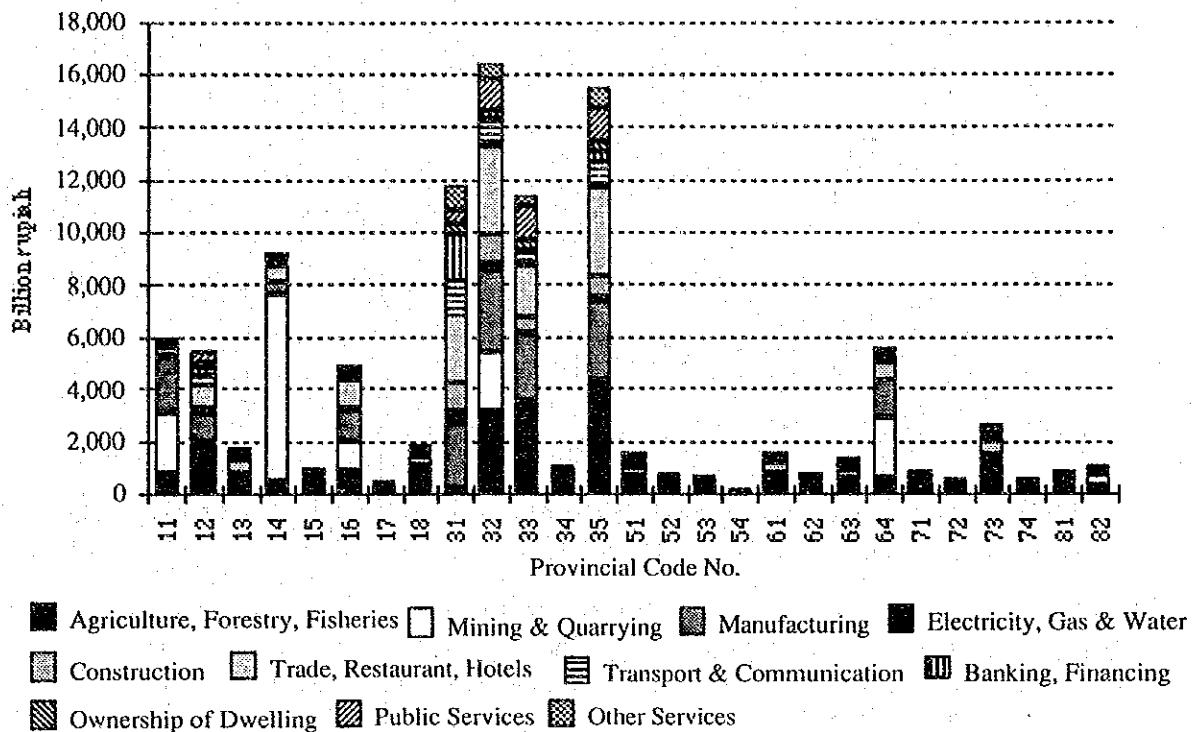
Source: Statistical Year Book of Indonesia 1991, Central Bureau of Statistics.

Jawa seems the most accessible region with road density of 542 m/km² while Kalimantan, Maluku & Irian Jaya the worst with road density of 20 to 50 m/km². For Provincial wise, all provinces in Jawa have dense road network with more than 500 m/km², reflecting large population, while Irian Jaya has only 19 m/km² due to scarce people.

From infrastructural point of view, Kalimantan and Maluku & Irian Jaya are not developed well, Sumatera and Sulawesi, moderate, and Jawa, Bali are well developed.

Economic structure

The following figure shows GRDP by province and by economic sectors as of 1989:



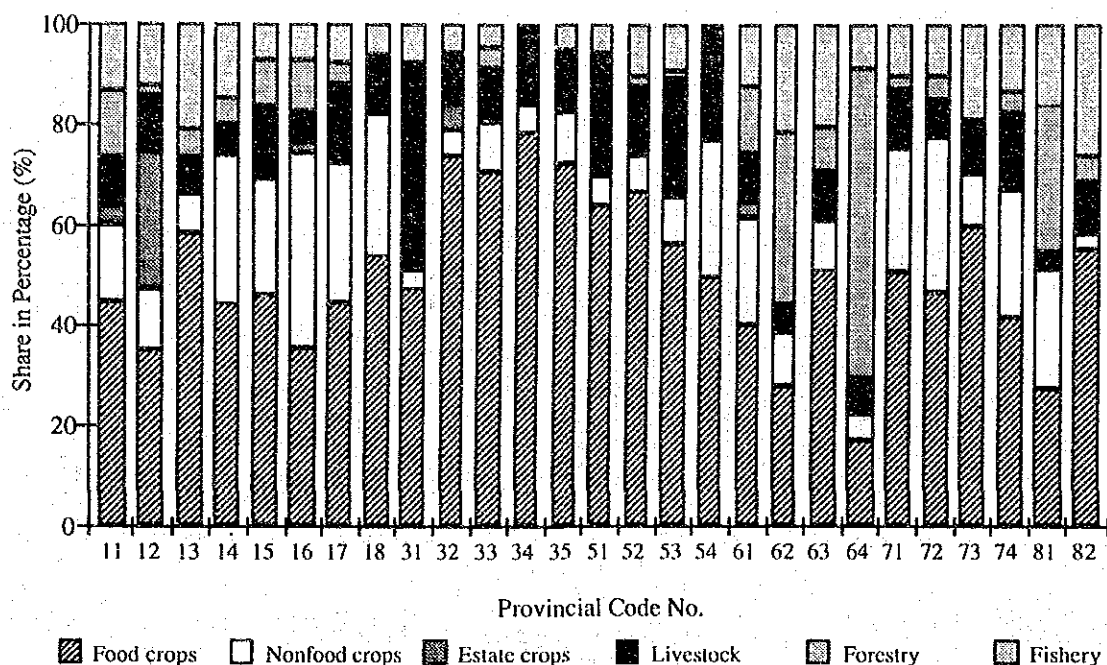
Source: *Regional Income of Provinces in Indonesia by Industrial Origin 1983-1989*, CBS, 1991

GRDP by Sector and Province as of 1989

From the figure, it is obvious that economy in Indonesia totally depends upon Jawa. Except oil and gas related industry, all province other than those in Jawa has only a little share in GRDP.

In most provinces in Jawa, not only industry and service sectors, but also agriculture sector has considerable share in total GRDP. Other remarkable provinces are: D.I. Aceh, Sumatera Utara, Riau, Sumatera Selatan and Kalimantan Timur. Production in Riau mostly comes from oil, gas and their related industries. In Kalimantan Timur, forest based industry has rather big share as well as oil products. In Sumatera Selatan, all industries share production relatively even.

Within agriculture sector, food crop sub-sector shares the most significant portion in many provinces as shown below:



Source: Prepared by JICA-FIDP team based on "Regional Income of Provinces in Indonesia by Industrial Origin 1983-1989", CBS 1991

Share of Each Sub-sector in Agricultural Sector Value-added by Province as of 1989

In Jawa, Bali and Nusa Tenggara, food crops sub-sector shares more than 60% of total agricultural products. In Sumatera and Sulawesi non-food crops sub-sector has relatively high share. While livestock sub-sector is relatively active in Bali, Nusa Tenggara and Timor Timur aside from Jawa, fishery sub-sector has higher share in Sumatera, Kalimantan and Maluku & Irian Jaya. Remarkable share of estate crops sub-sector is seen in Sumatera Utara, and Kalimantan Timur is specialized in forestry sub-sector.

As the comparison of GRDP values among provinces can not reflect productivity due to imbalance of population, it may be interesting to compare per worker agricultural productivity and per worker GRDP in each province to know the relative productivity of agricultural sector relative to other sector. They are shown on Table 9.3 and Table 9.4, and summarized below:

Comparison of per worker productivity in agriculture sector and per capita GRDP among highest and lowest seven provinces as of 1988 - 1990

per worker agricultural productivity			per capita GRDP(without oil and gas)		
No.	Province	Rp.10 ³ /worker	No.	Province	Rp.10 ³ /worker
The <u>lowest</u> seven provinces			The <u>lowest</u> seven provinces		
1.	Timor Timur	145	1.	Timor Timur	355
2.	Nusa Tenggara Timur	254	2.	Nusa Tenggara Timur	400
3.	Lampung	368	3.	Nusa Tenggara Barat	534
4.	D.I.Yogyakarta	392	4.	Lampung	613
5.	Bengkulu	399	5.	D.I.Yogyakarta	677
6.	Nusa Tenggara Barat	419	6.	Sulawesi Tengah	759
7.	Sulawesi Tengah	420	7.	Jawa Tengah	778
Indonesia		535	Indonesia		1,150

per worker agricultural productivity			per capita GRDP(without oil and gas)		
No.	Province	Rp.10 ³ /worker	No.	Province	Rp.10 ³ /worker
The <u>highest</u> seven provinces			The <u>highest</u> seven provinces		
1.	DKI Jakarta	4,599	1.	DKI Jakarta	4,664
2.	Kalimantan Timur	1,702	2.	Kalimantan Timur	3,175
3.	D.I.Aceh	804	3.	Sumatera Selatan	1,624
4.	Riau	721	4.	Riau	1,570
5.	Sulawesi Selatan	706	5.	Maluku	1,344
6.	Maluku	691	6.	Kalimantan Tengah	1,308
7.	Sumatera Utara	690	7.	Sumatera Utara	1,284
Indonesia		535	Indonesia		1,150

Source: per worker agricultural productivity: Consultant's calculation based on *Statistik Indonesia 1991*, CBS and *Regional Income of Provinces in Indonesia by Industrial Origin 1983-1989*, CBS; per capita GRDP: *Statistik Indonesia 1991*, CBS

From the above table, it can be said that per worker productivity in agriculture sector is generally quite smaller compared to other sectors. The productivity differs among provinces. There is a tendency that if total per worker GRDP is lower in value, per worker agricultural GRDP is also low. There is no relation between per worker agricultural GRDP and the ratio of agricultural GRDP to total GRDP.

Human resources

According to the results of the recent population census, population in Indonesia as of 1990 amounted to 179 million. Jawa accounts for 107 million or 60% of total population, followed by Sumatera with 36 million or 20% of total and Sulawesi with 13 million or 7%.

Reflecting the imbalance of population distribution pattern, population density is very high in Jawa with average density of 813 person/km², followed by Bali, Lampung, Nusa Tenggara

Barat, Sumatera Utara, Sulawesi Utara, etc. Kalimantan and Maluku & Irian Jaya hold only scarce population at present (refer to Table 9.5).

As of 1990, total working population is estimated at 72 million, of which 36 million or 50% are engaged in agriculture sector¹. Jawa accounts for 18.9 million or 52% of agricultural employment. Past trend on employment suggests while the number of agricultural employment in Jawa has decreased over the years, that in off-Jawa area has increased steadily.

(2) Spatial Implication of development alternatives

The development alternatives presented in Section 9.1 are looked at in the light of spatial framework prescribing to some extent relationship of Irrigation Development with target production increase.

Alternative 1: Rehabilitation and efficient O&M

Spatial irrigation development pattern will be centralized under this alternative to Jawa and Sumatera where existing irrigation networks are concentrated. Degree of production increase is relatively low with small area expansion of irrigated area which will result in increase of yield and cropping intensity. As a result, paddy production areas will not be dispersed, and beneficiaries will not increase much, both of which will not contribute to equitable development.

Alternative 2: New development

Spatial irrigation development pattern will be more dispersed under this alternative, as it emphasizes the new reclamation. Degree of production increase will be high with the expansion of newly irrigated area. This will create large number of beneficiaries. Conversion from rainfed area into irrigated area will proceed which will contribute to the stability of paddy production. As a result, existing irrigation systems may be comparatively neglected.

Alternative 3: Harmonious and Integrated development

Under this alternative, while new irrigation development will be directed to selected strategic areas, existing irrigation systems will properly be maintained. Paddy production will be comparatively balanced towards the loose self-sufficiency in each region. This will call for more deliberate efforts by public sector in development planning and locational policies.

¹ L. Fletcher and T. Kesavan. *Planning Indonesia's Agricultural Future: An Analytical Approach*; Bureau of Agriculture and Irrigation, BAPPENAS, December 1992

9.2.4 Evaluation of Alternatives

The irrigation development alternatives may be evaluated from several points of view. The irrigation development objectives naturally provide a set of evaluation criteria: viz. economic growth, equity, social aspects and environment. Another important criterion is public sector resource requirements, including not only investment expenditure but also institutional supports. Evaluation by these criteria is summarized below:

Evaluation of Three Development Alternatives

	Alternative 1 Rehabilitation & EOM	Alternative 2 New development	Alternative 3 Harmonious & Integrated
(1) Definition	Emphasis on maintenance of existing facilities	Emphasis on new reclamation of land	Balance between Alternative 1 and Alternative 2
(2) Spatial development pattern	Polarized	Dispersed	Decentralized
(3) Impact of production increase	Low, quick yielding	High, needs long time for realization	Moderate
(4) Social and environmental problems	likely to be small but increase in inequity.	Equitable development, stress on environment.	More manageable
(5) Public sector resource costs	Smallest investment costs, increase in costs for institution, training, etc.	High costs for infrastructure, utilities and social services.	Larger public sector resource requirements for selective/strategic improvement of infrastructure, etc. and for institutional development
(6) Other implications	Unlikely to keep self-sufficiency.	Most likely to keep self-sufficiency.	Likely to keep self-sufficiency.

Alternative 1 will involve the smallest investment costs. Negative environmental effects will be minimal. Production increase will be small and unlikely to keep self-sufficiency. Existing irrigation networks will be more efficiently functioned with farmers' training on water management as well as farming practices. As production areas will not be dispersed, attainment of equity may be low or none.

Alternative 2 will be able to keep self-sufficiency in rice through combination of large and small-scale new development which makes drastic increase in paddy production possible. Development areas will be spread over the Indonesia, especially outer Jawa. It may be the most effective option from the 'equitable development' point of view. However, the public

sector resource costs will become increasingly high to facilitate other infrastructure and utilities to meet the settlers/transmigrants' needs.

Costs involved in Alternative 3 will be intermediate with respect to public investment for infrastructure and utilities, social costs and negative environmental effects. This alternative calls for more deliberate efforts in the public sector to lead the development in more desirable degree and locations. They include selective and strategic development according to careful planning and locational policies.

Alternative 1 for rehabilitation and EOM and Alternative 2 for new development are two extremes, presented to clarify the range of choice for irrigation development. The irrigation development program will be worked out for Alternative 3, as it represents the best and most practicable alternative on the balance between Jawa and outer Jawa and between existing and potential irrigation areas.

9.3 Development Phasing

Irrigation development has to be planned in phases, as the various kinds of development efforts like identification, design and implementation will take place over time. The planning period is broadly divided into three phases: Phase I upto 2000, Phase II for 2001-2010, and Phase III for 2011-2020. Expected performance of the irrigation development is described below for Alternative 3.

Phase I : Trend development (1994 - 2000)

Currently proposed projects including new, rehabilitation, SM/EOM, groundwater development, etc. will be implemented. Paddy production will be sufficient enough to keep self-sufficiency through implementation of those programs. However, Jawa may not be a exporter of paddy as a result of demand increase and land loss by conversion. Production increase in outer Jawa area will proceed to compensate the decrease in import amount from Jawa.

In Sumatera, continuous efforts of irrigation development will proceed together with rehabilitation of existing irrigation facilities which are not functioning. Implementation of projects will be concentrated on the northern part of islands: Aceh, Sumatera Utara, Sumatera Barat and Riau, all of which have most proposed projects in the island. Upgrading of swamp schemes will also be implemented to increase production and to make stable production

environment. While implementing proposed projects, identification study and design of new projects will be made to cope with the increasing demand of paddy in future. Such study will be intensely conducted in the southern part of the island: Jambi, Sumatera Selatan, Bengkulu and Lampung in light with large potential for development. Such planning will be well-coordinated with integrated regional planning. Coordination with transmigration program and environmental consideration may also be necessary for project planning.

In Jawa and Bali, conversion of currently irrigated land into other purposes such as for residence and industry will proceed while sugarcane and tobacco area will be converted back into irrigated paddy field. Water use efficiency will be maximized through rehabilitation and EOM of existing systems with training of farmers on water management, in order to increase productivity as well as to cope with critical water condition. Groundwater development will likely to contribute to the creation of stable production environment. Small schemes with command area of less than 150 ha, will be all handed over to farmers (WUAs) with careful guidance and training by PU staffs. Evaluation and monitoring system (PBME) will be established, the evaluation results will be reflected into the further step of development for production increase and/or for improvement of farm economy. In order to prevent a big scale flood, integrated basin development may be reconsidered including dam and reservoir plan, water allocation, reforestation measures for major river basins as a part of regional planning.

In NTB, NTT and Timor Timur, proposed projects including groundwater development and small water impoundments development will be implemented to increase crop production as well as to supply rural water. The rehabilitation measures for damaged irrigation facilities as well as other infrastructure by recent earthquake will urgently be undertaken. In light with small amount of rainfall with long dry spell, and with porous soil structures, careful and limited development will be made including crop selection.

In Kalimantan, aside from proposed projects, not many development projects will be identified. Implementation of projects include rather big scale one which will contribute to economic development as well as ones to support subsistence level farmers residing in swamp areas. Also research and extension program will be continued for sustainable swamp development. Further development plan may be formulated as a part of integrated regional planning including infrastructure development and transmigration program.

In Sulawesi, presently proposed projects including rehabilitation of existing schemes as well as new development will be developed. Through the implementation of projects together with training of farmers, water use efficiency will be maximized. The remaining potential area will be studied and

In Maluku & Irian Jaya, paddy production will increase drastically through implementing proposed development projects, which will contribute to increase of economic activity and also to increase of farm income. People will be familiar with rice with the increased paddy production and per capita consumption will also increase.

Phase II : Trend and new development (2001-2010)

Most proposed projects will be implemented in the first half of this phase, and O&M of the system will be of important in this phase. Newly identified irrigation projects in the phase I will start implementation to meet the increasing demand for rice.

In Sumatera, center of development will shift from Northern Sumatera zone to Southern Sumatera zone. Newly identified projects in the phase I will start implementation in Southern Sumatera zone. Re-settlement program and/or transmigration program may be arranged with the design and implementation of new development projects. In Northern Sumatera zone where development will have been completed, efficient O&M involving beneficiary farmers will start and continue to keep the systems in good condition. Paddy production will become stable through those efforts.

In Jawa and Bali, paddy production will not meet with the demand within the region, deficit amount will be supplied from Sumatera and Sulawesi. EOM will be a main concern after the completion of all rehabilitation projects. Farmers may diversify crops from paddy to other water-saving crops in dry season. Handed over projects to farmers will extend to the schemes having less than 500 ha. Established PBME will be applied to all completed projects, and contribute to the improvement of farm economy through constraints identification and their resolution. Implementation of improvement measures against flood or drought will continuously conducted through reforestation, soil conservation, river control works, etc., to minimize flood and/or drought problem.

In NTB, NTT and Timor Timur, most water resources will be developed by this phase. Efficient O&M with training of farmers will be the main concern to maximize water value and increase crop production. Water saving irrigation method including sprinkler and/or trickle (or drip) irrigation may be introduced, especially for tree crops.

In Kalimantan, based upon the formulated regional development plan, irrigation development projects including swamp development may be newly identified. Infrastructure development

such as road and electricity to improve living standard will be implemented towards hinterland within established conversion forest area.

In Sulawesi, water resources will almost be fully developed. Efficient O&M and training of farmers will be extended to all schemes. Paddy production will reach to the maximum level. Surplus products will be sent to eastern deficit regions as well as Kalimantan and Jawa. Competition of water among production sectors will be occurred in some areas. Like Jawa and Bali, water resources conservation measures will be planned and start implementation. Soil conservation measures such as reforestation, agro-forestry, terracing, etc., will be undertaken for conservation of catchment area.

In Maluku and Irian Jaya, new irrigation development will continue in a limited area. Constructed irrigated paddy field will be well-established, and farmers will be familiar with the farming practice through extension efforts.

Phase III : New development (2011-2020)

Newly identified projects will be continuously implemented. Self-sufficiency in rice will be maintained. EOM and periodical rehabilitation will be main task during this phase.

In Sumatera, development will continue centering Southern Sumatera region. Production will already be surplus, and the region will be established as paddy supply base to Jawa. Land and water resources will be well-utilized, and regional economy will increase integratedly as a result of balanced development among sectors. Through the efforts of EOM and extension services, paddy yield will increase steadily.

In Jawa and Bali, paddy yield will reach at maximum level as a result of improvement of farming practice. All small schemes with an area of less than 500 ha will have already been handed over to farmers. However, continuous land conversion from paddy field to other purposes decrease the production capacity while demand will increase as a result of population increase, which will result in the increase of deficit year by year. Water resources will be well-conserved by the continuous efforts on reforestation, soil conservation, upland farming improvement. Crop diversification will further proceed towards high value crops according to consumers' tastes.

In NTB, NTT and Timor Timur, diversification of agriculture production will proceed through crop selection more adapted to dry climate as well as introduction of new water-saving irrigation method. Such products may be sent to Jawa or even foreign markets.

In Kalimantan, basic infrastructure will be facilitated and urban areas may be established, based on the regional planning results. Accordingly population will increase by inflow of immigrants, which will increase paddy demand. Irrigation development may be further developed to supply basic foods.

In Sulawesi, land and water resources will be fully developed. While paddy yield will reach almost to maximum potential level, diversification of crops will proceed from paddy to other high value crops including non-food crops like coffee, cocoa, etc. Surplus of paddy products will continuously sent to deficit regions including eastern areas, Kalimantan and Jawa.

In Maluku and Irian Jaya, like the case of Kalimantan, urbanization will proceed with the increase of infrastructure development. Demand for paddy will increase accordingly, and new irrigation development may further be formulated.

Table 9.1 Irrigation Development Potential Area by Province (1990-2020)

Unit: 1,000 ha

Code No.	Province	Year						
		1990	1995	2000	2005	2010	2015	2020
11	D.I.Aceh	275	274	272	270	268	266	263
12	Sumatera Utara	380	378	375	373	370	369	367
13	Sumatera Barat	284	284	284	284	284	284	284
14	Riau	876	876	876	876	876	876	876
15	Jambi	500	500	500	500	500	500	500
16	Sumatera Selatan	1,275	1,275	1,275	1,275	1,274	1,274	1,274
17	Bengkulu	118	118	118	118	118	118	118
18	Lampung	303	301	297	295	293	293	291
31	D.K.I.Jakarta	0	0	0	0	0	0	0
32	Jawa Barat	79	77	72	69	67	65	62
33	Jawa Tengah	4	3	0	0	0	0	0
34	D.I.Yogyakarta	0	0	0	0	0	0	0
35	Jawa Timur	0	0	0	0	0	0	0
51	Bali	0	0	0	0	0	0	0
52	Nusa Tenggara Barat	9	8	8	7	7	7	6
53	Nusa Tenggara Timur	55	55	53	53	52	51	50
54	Timor Timur	35	35	34	34	34	34	34
61	Kalimantan Barat	1,136	1,136	1,136	1,136	1,136	1,136	1,136
62	Kalimantan Tengah	821	821	821	821	821	821	821
63	Kalimantan Selatan	478	478	478	478	478	478	478
64	Kalimantan Timur	1,257	1,257	1,257	1,257	1,257	1,257	1,257
71	Sulawesi Utara	70	69	69	69	69	68	68
72	Sulawesi Tengah	137	136	136	136	136	136	135
73	Sulawesi Selatan	174	174	174	174	174	174	174
74	Sulawesi Tenggara	155	154	153	151	150	148	147
81	Maluku	365	365	364	364	364	364	364
82	Irian Jaya	2,160	2,160	2,160	2,160	2,160	2,160	2,160
	Sumatera	4,009	4,006	3,997	3,991	3,983	3,980	3,972
	Jawa	83	80	72	69	67	65	62
	Bali, NTB, NTT, TImtim	98	97	95	94	93	92	90
	Kalimantan	3,693	3,693	3,693	3,693	3,693	3,693	3,693
	Sulawesi	535	534	532	530	528	526	524
	Maluku & IJ	2,525	2,525	2,525	2,525	2,524	2,524	2,524
	INDONESIA	10,944	10,934	10,913	10,901	10,887	10,879	10,865

Source: JICA-FIDP team estimates.

Table 9.2 Length of Roads under State, Province, Regency and Municipality Responsibilities by Province at the End of Year 1989

Province	State	Provincial	Regency/ Municipality	Total length (km)	Land area (km ²)	Road Density (m/km ²)
1. D.I. Aceh	492	2,065	7,736	10,293	55,392	186
2. Sumatera Utara	846	2,611	20,621	24,078	70,787	340
3. Sumatera Barat	802	1,131	9,278	11,211	49,778	225
4. Riau	103	2,545	8,012	10,660	94,561	113
5. Jambi	707	1,399	4,046	6,152	44,800	137
6. Sumatera Selatan	1,018	2,758	7,651	11,427	103,688	110
7. Bengkulu	249	1,099	2,551	3,899	21,168	184
8. Lampung	453	1,614	4,835	6,902	33,307	207
Sumatera	4,670	15,222	64,730	84,622	473,481	179
9. D.K.I. Jakarta	-	-	-	-	590	-
10. Jawa Barat	677	1,987	16,998	19,662	46,300	425
11. Jawa Tengah	453	1,838	17,719	20,010	34,206	585
12. D.I. Yogyakarta	91	731	6,036	6,858	3,169	2,164
13. Jawa Timur	1,053	2,476	21,633	25,162	47,921	525
Jawa	2,274	7,032	62,386	71,692	132,186	542
14. Bali	430	536	5,328	6,294	5,561	1,132
15. Nusa Tenggara Barat	486	429	3,355	4,270	20,177	212
16. Nusa Tenggara Timur	1,116	1,781	11,015	13,912	47,876	291
17. Timor Timur	661	984	-	1,645	14,874	111
Bali & Nusa Tenggara	2,693	3,730	19,698	26,121	88,488	295
18. Kalimantan Barat	1,248	1,704	5,644	8,596	146,760	59
19. Kalimantan Tengah	142	914	7,453	8,509	152,600	56
20. Kalimantan Selatan	567	991	4,778	6,336	37,660	168
21. Kalimantan Timur	657	1,151	3,015	4,823	202,440	24
Kalimantan	2,614	4,760	20,890	28,264	539,460	52
22. Sulawesi Utara	820	1,353	5,062	7,235	19,023	380
23. Sulawesi Tengah	861	2,422	4,511	7,794	69,726	112
24. Sulawesi Selatan	921	1,690	19,423	22,034	72,781	303
25. Sulawesi Tenggara	337	1,091	3,955	5,383	27,686	194
Sulawesi	2,939	6,556	32,951	42,446	189,216	224
26. Maluku	381	2,083	2,619	5,083	74,505	68
27. Irian Jaya	1,614	1,321	5,163	8,098	421,981	19
Maluku & Irian Jaya	1,995	3,404	7,782	13,181	496,486	27
INDONESIA	17,185	40,704	208,437	266,326	1,919,317	139

Source: JICA-FIDP team calculation based on Statistical Year Book of Indonesia 1991; CBS

Table 9.3 Per Worker Agricultural Gross Regional Domestic Product at Constant 1983 Prices, by Province

Province	1988				1989				1990				1988-1990 average			
	Agr. GRDP (million Rp.)	Agr. Worker population	Worker Agr. GRDP('000Rp.)	Worker Agr. GRDP('000Rp.)	Agr. GRDP (million Rp.)	Agr. Worker population	Worker Agr. GRDP('000Rp.)	Worker Agr. GRDP('000Rp.)	Agr. GRDP (million Rp.)	Agr. Worker population	Worker Agr. GRDP('000Rp.)	Worker Agr. GRDP('000Rp.)	Agr. GRDP (million Rp.)	Agr. Worker population	Worker Agr. GRDP('000Rp.)	Worker Agr. GRDP('000Rp.)
11. Daerah Istimewa Aceh	703,390	919,495	765	867,001	745,085	867,001	859	993,318	786,872	993,318	792	745,116	926,605	804	804	804
12. Sumatera Utara	1,706,782	2,677,096	638	2,513,086	1,820,046	2,513,086	724	2,746,152	1,951,908	2,746,152	711	1,826,245	2,645,445	690	690	690
13. Sumatera Barat	495,444	809,301	612	964,931	516,094	964,931	535	950,854	542,038	950,854	570	517,859	908,362	570	570	570
14. Riau	378,449	514,401	736	588,399	419,504	588,399	713	664,392	476,679	664,392	717	424,877	589,064	721	721	721
15. Jambi	263,913	504,616	523	498,329	277,293	498,329	556	636,374	286,198	636,374	450	275,801	546,440	505	505	505
16. Sumatera Selatan	841,608	1,353,351	622	886,075	886,075	1,381,802	641	1,650,407	918,200	1,650,407	556	881,961	1,461,853	603	603	603
17. Bengkulu	165,731	447,931	370	433,470	170,039	433,470	392	416,283	181,926	416,283	437	172,565	432,568	399	399	399
18. Lampung	751,205	1,978,972	380	802,266	802,266	2,207,723	363	836,981	836,981	2,306,739	363	796,817	2,164,478	368	368	368
31. D.K.I. Jakarta	143,277	39,389	3,637	143,252	143,252	19,157	7,478	31,634	128,220	31,634	4,053	138,250	30,060	4,599	4,599	4,599
32. Jawa Barat	2,987,148	5,894,433	507	5,876,394	3,135,351	5,876,394	534	5,576,083	3,328,748	5,576,083	597	3,150,416	5,782,303	545	545	545
33. Jawa Tengah	3,240,313	6,227,459	520	7,064,738	3,432,105	7,064,738	486	6,996,511	3,534,999	6,996,511	505	3,402,472	6,762,903	503	503	503
34. D.I. Yogyakarta	280,975	769,879	365	733,941	299,485	733,941	408	727,722	293,697	727,722	404	291,386	743,847	392	392	392
35. Jawa Timur	4,144,646	8,790,747	471	8,490,489	4,278,197	8,490,489	504	8,747,079	4,476,478	8,747,079	512	4,299,774	8,676,105	496	496	496
51. Bali	504,816	769,585	656	702,518	523,903	702,518	746	811,532	521,754	811,532	643	516,824	761,212	679	679	679
52. Nusa Tenggara Barat	357,690	864,327	414	997,561	385,287	997,561	386	859,888	396,805	859,888	461	379,927	907,252	419	419	419
53. Nusa Tenggara Timur	325,218	1,464,514	222	1,369,347	340,459	1,369,347	249	3,569,871	356,987	3,569,871	266	340,888	1,391,787	245	245	245
54. Timor Timur	452,18	366,896	123	327,551	468,94	327,551	143	515,64	515,64	515,64	175	47,892	329,941	145	145	145
61. Kalimantan Barat	393,379	923,923	426	914,146	420,954	914,146	460	1,022,645	437,476	1,022,645	428	417,270	953,571	438	438	438
62. Kalimantan Tengah	217,690	292,444	744	335,890	228,193	335,890	679	402,076	241,543	402,076	601	229,142	343,470	667	667	667
63. Kalimantan Selatan	329,217	565,948	582	640,482	351,247	640,482	548	362,581	362,581	362,581	555	347,682	619,821	561	561	561
64. Kalimantan Timur	520,061	308,540	1,686	535,217	535,217	271,325	1,973	355,269	535,860	355,269	1,508	530,379	311,711	1,702	1,702	1,702
71. Sulawesi Utara	292,095	614,537	475	660,766	307,570	660,766	465	660,067	354,018	660,067	536	317,894	645,123	493	493	493
72. Sulawesi Tengah	1,995,81	532,676	375	531,483	2,298,12	531,483	432	553,991	2,502,02	553,991	452	226,532	539,383	420	420	420
73. Sulawesi Selatan	1,026,997	1,547,602	664	1,515,978	1,101,252	1,515,978	726	1,627,832	1,184,938	1,627,832	728	1,104,396	1,563,804	706	706	706
74. Sulawesi Tenggara	179,024	363,515	492	338,864	197,806	338,864	584	231,887	231,887	231,887	558	202,906	372,649	544	544	544
81. Maluku	274,645	386,207	711	282,880	282,880	425,117	665	297,311	297,311	297,311	698	284,945	412,472	691	691	691
82. Irian Jaya	220,199	528,492	417	426,893	238,723	426,893	559	509,911	230,679	509,911	452	229,857	488,432	471	471	471
INDONESIA	20,988,711	40,456,296	519	22,114,989	20,988,711	40,456,296	538	42,378,309	23,196,549	42,378,309	547	22,100,083	41,310,662	535	535	535

Remarks: GRDP values are expressed at 1983 constant price.

Source: GRDP: Regional Income of Provinces in Indonesia by Industrial Origin, 1983-1990, CBS, 1992
Worker: Statistical Yearbook of Indonesia 1989, 1990 and 1991, CBS

Table 9.4 Per Worker Gross Regional Product Without Oil, Gas and Their Products
Constant 1983 Prices, By Province during 1988-1990

Province	1988			1989			1990			1988-1990 average		
	GRDP (million Rp.)	Worker population	Worker GRDP (000Rp.)	GRDP (million Rp.)	Worker population	Worker GRDP (000Rp.)	GRDP (million Rp.)	Worker population	Worker GRDP (000Rp.)	GRDP (million Rp.)	Worker population	Worker GRDP (000Rp.)
11. Daerah Istimewa Aceh *	1,534,684	1,279,544	1,199	1,652,287	1,283,057	1,288	1,762,374	1,365,668	1,290	1,649,782	1,309,423	1,260
12. Sumatera Utara *	4,824,743	4,207,640	1,147	5,297,501	4,022,502	1,317	5,742,588	4,127,687	1,391	5,288,277	4,119,276	1,284
13. Sumatera Barat	1,596,840	1,418,883	1,125	1,712,067	1,526,321	1,122	1,832,855	1,525,601	1,201	1,713,921	1,490,268	1,150
14. Riau *	1,398,088	916,097	1,526	1,549,542	992,642	1,561	1,676,286	1,036,194	1,618	1,541,305	981,644	1,570
15. Jambi *	683,267	719,330	950	753,781	732,034	1,030	819,713	826,936	991	752,254	759,433	991
16. Sumatera Selatan *	3,397,754	2,209,373	1,538	3,707,960	2,198,164	1,687	4,003,736	2,433,046	1,646	3,703,150	2,280,194	1,624
17. Bengkulu	396,627	547,774	724	426,049	512,053	832	454,999	540,165	842	425,892	533,331	799
18. Lampung	1,644,969	2,739,415	600	1,780,365	2,963,648	601	1,918,146	3,013,567	637	1,781,160	2,905,543	613
31. D.K.I. Jakarta	11,469,201	2,673,922	4,289	12,586,088	2,478,983	5,077	13,681,114	2,938,549	4,656	12,578,801	2,697,151	4,664
32. Jawa Barat *	13,141,869	12,528,099	1,049	14,236,335	11,948,050	1,192	15,481,401	12,718,594	1,217	14,286,535	12,398,248	1,152
33. Jawa Tengah *	9,685,895	12,504,593	775	10,297,072	13,955,735	738	11,042,572	13,424,784	823	10,341,846	13,295,037	778
34. D.I. Yogyakarta	976,436	1,517,995	643	1,037,669	1,557,011	666	1,085,093	1,502,690	722	1,033,066	1,525,899	677
35. Jawa Timur *	14,408,098	15,294,576	942	15,482,651	15,328,233	1,010	16,729,517	15,432,144	1,084	15,540,089	15,351,651	1,012
51. Bali	1,354,561	1,547,776	875	1,473,296	1,486,006	991	1,603,867	1,510,394	1,062	1,477,241	1,514,725	975
52. Nusa Tenggara Barat	690,904	1,341,191	515	749,950	1,424,667	526	802,140	1,433,805	559	747,665	1,399,888	534
53. Nusa Tenggara Timur	632,015	1,698,994	372	666,220	1,679,701	397	712,397	1,647,274	432	670,211	1,675,523	400
54. Timor Timur	116,904	378,138	309	125,409	344,426	364	140,001	353,799	396	127,438	358,788	355
61. Kalimantan Barat	1,404,183	1,228,286	1,143	1,470,356	1,258,411	1,168	1,574,792	1,377,910	1,143	1,483,110	1,288,202	1,151
62. Kalimantan Tengah	686,569	513,470	1,337	718,442	555,209	1,294	767,920	593,150	1,295	724,310	553,943	1,308
63. Kalimantan Selatan	1,173,347	1,043,195	1,125	1,256,053	1,109,673	1,132	1,338,335	1,130,193	1,184	1,255,912	1,094,354	1,148
64. Kalimantan Timur *	2,071,474	728,959	2,842	2,203,832	635,165	3,470	2,375,034	730,384	3,252	2,216,780	698,169	3,175
71. Sulawesi Utara	825,027	1,053,756	783	873,287	1,034,795	844	957,480	1,037,430	923	885,265	1,041,994	850
72. Sulawesi Tengah	487,775	696,930	700	535,157	682,705	784	581,351	733,336	793	534,761	704,324	759
73. Sulawesi Selatan	2,363,160	2,359,054	1,002	2,523,081	2,503,799	1,008	2,711,252	2,556,736	1,060	2,532,498	2,473,196	1,024
74. Sulawesi Tenggara	420,778	459,046	917	465,094	472,515	984	525,636	539,542	974	470,503	490,368	959
81. Maluku *	722,821	520,373	1,389	770,914	590,474	1,306	834,304	620,995	1,343	776,013	577,281	1,344
82. Irian Jaya *	680,216	690,425	985	829,021	632,225	1,311	871,448	680,007	1,282	793,562	667,552	1,189
INDONESIA *	78,788,205	72,816,834	1,082	85,179,479	73,908,204	1,153	92,026,351	75,830,580	1,214	85,351,345	74,185,206	1,150

Note: GRDP values are expressed as 1983 constant price

Remarks: *) Without oil, gas and their products. Oil, gas, and their products consist of: crude petroleum, natural gas, L.N.G. and refined petroleum

Source: for GRDP: Regional Income of Provinces in Indonesia by Industrial Origin 1983-1990, CBS, 1992; Worker: Statistical Year Book of Indonesia 1989, 1990 and 1991, CB

Table 9.5 Area and Population by Province

Province	Area (km ²)	Areal Percentage (%)	Population			Urbanization Percentage (%)	Population Percentage (%)	Population Density (person/km ²)
			Urban	Rural	Total			
11 D.I.Acch	55,392	2.89	539,740	2,875,653	3,415,393	15.80	1.91	61.7
12 Sumatera Utara	70,787	3.69	3,638,832	6,613,479	10,252,311	35.49	5.72	144.8
13 Sumatera Barat	49,778	2.59	807,983	3,190,694	3,998,677	20.21	2.23	80.3
14 Riau	94,561	4.93	1,047,454	2,233,592	3,281,046	31.92	1.83	34.7
15 Jambi	44,800	2.33	432,727	1,581,327	2,014,054	21.49	1.12	45.0
16 Sumatera Selatan	103,688	5.40	1,837,492	4,438,453	6,275,945	29.28	3.50	60.5
17 Bengkulu	21,168	1.10	240,192	938,759	1,178,951	20.37	0.66	55.7
18 Lampung	33,307	1.74	747,327	5,256,782	6,004,109	12.45	3.35	180.3
Sumatera	473,481	24.67	9,291,747	27,128,739	36,420,486	25.51	20.32	76.9
31 D.K.I.Jakarta	590	0.03	8,222,515	0	8,222,515	100.00	4.59	13936.5
32 Jawa Barat	46,300	2.41	12,208,176	23,170,307	35,378,483	34.51	19.74	764.1
33 Jawa Tengah	34,206	1.78	7,694,539	20,822,247	28,516,786	26.98	15.91	833.7
34 D.I.Yogyakarta	3,169	0.17	1,294,056	1,618,555	2,912,611	44.43	1.63	919.1
35 Jawa Timur	47,921	2.50	8,916,011	23,571,557	32,487,568	27.44	18.13	677.9
Jawa	132,186	6.89	38,335,297	69,182,666	107,517,963	35.65	60.00	813.4
51 Bali	5,561	0.29	734,237	2,043,119	2,777,356	26.44	1.55	499.4
52 Nusa Tenggara Barat	20,177	1.05	582,180	2,786,519	3,368,699	17.28	1.88	167.0
53 Nusa Tenggara Timur	47,876	2.49	372,242	2,895,677	3,267,919	11.39	1.82	68.3
54 Timor Timur	14,874	0.77	58,221	689,336	747,557	7.79	0.42	50.3
Bali, Nusa Tenggara & Timor Tir	88,488	4.61	1,746,880	8,414,651	10,161,531	17.19	5.67	114.8
61 Kalimantan Barat	146,760	7.65	642,989	2,592,377	3,235,366	19.87	1.81	22.0
62 Kalimantan Tengah	152,600	7.95	245,249	1,150,612	1,395,861	17.57	0.78	9.1
63 Kalimantan Selatan	37,660	1.96	702,950	1,893,697	2,596,647	27.07	1.45	68.9
64 Kalimantan Timur	202,440	10.55	915,469	959,563	1,875,032	48.82	1.05	9.3
Kalimantan	539,460	28.11	2,506,657	6,596,249	9,102,906	27.54	5.08	16.9
71 Sulawesi Utara	19,023	0.99	564,795	1,913,151	2,477,946	22.79	1.38	130.3
72 Sulawesi Tengah	69,726	3.63	281,134	1,422,196	1,703,330	16.50	0.95	24.4
73 Sulawesi Selatan	72,781	3.79	1,685,443	5,295,146	6,980,589	24.14	3.90	95.9
74 Sulawesi Tenggara	27,686	1.44	229,649	1,119,649	1,349,298	17.02	0.75	48.7
Sulawesi	189,216	9.86	2,761,021	9,750,142	12,511,163	22.07	6.98	66.1
81 Maluku	74,505	3.88	352,438	1,498,649	1,851,087	19.04	1.03	24.8
82 Irian Jaya	421,981	21.99	395,131	1,233,956	1,629,087	24.25	0.91	3.9
Maluku & Irian Jaya	496,486	25.87	747,569	2,732,605	3,480,174	21.48	1.94	7.0
INDONESIA	1,919,317	100.00	55,389,171	123,805,052	179,194,223	30.91	100.00	93.4

Source: Punduduk Indonesia, Hasil Sensus Penduduk 1990; Biro Pusat Statistik
Statistik Indonesia 1991; Biro Pusat Statistik

Chapter 10

10. FORMULATION OF IRRIGATION DEVELOPMENT PROGRAM

10.1 Flow of Program Formulation

Irrigation Development Program is formulated aiming at maintaining self-sufficiency in rice during the period of PJPT II. The program is formulated in the following steps:

- Step-1 estimation of demand and supply balance of paddy,
- Step-2 selection of strategic zones,
- Step-3 allocation of target production and area to each zone,
- Step-4 selection of priority projects,
- Step-5 preparation of implementation plan, and
- Step-6 cost estimates

Step-1 : Paddy production in year of 2020 is estimated taking all program projects into account and compare with the demand in that year to know the volume of deficit paddy amount.

Step-2 : After deficit amount is calculated, our concern here is how to allocate new projects which will produce same amount of paddy deficit. We will, therefore, select strategic zones or important zones for further development considering land and water resources .

Step-3 : Target production, then, will be allocated to each zone setting target self-sufficiency rate considering past irrigation development, human resources, infrastructure, etc. The target production allocated to each zone is further allocated to each province in a same manner as the case of the allocation to each zone. After allocated to each province, target production are translated into target development area using assumed increased production effect (refer to the sub-section 6.4.1).

Step-4 : In accordance with the criteria set by DGWRD, priority projects will be selected for implementation in each province.

Step-5 : Overall irrigation development program, putting on-going and proposed projects, and to-be-identified area together, is scheduled for implementation in 25 years from 1994 to 2019 by province, so as to keep self-sufficiency in rice in Indonesia. Certain assumption is made on making schedule. As for to-be-

developed areas as well as proposed projects for which feasibility study has not been conducted, study schedule is also made based on the implementation schedule.

Step-6 : Total costs required for development are estimated by year and by province. Costs are broadly divided into some categories; New construction, Extension, Rehabilitation & special maintenance, Groundwater development, O&M and Others. Cost for each category is estimated by applying certain unit costs or certain rate of total costs.

Each step for program formulation will be explained more in detail in the following sections. As for Step-4, however, was skipped in the study since information of projects for priority ranking was not collected sufficiently. Only the selection criteria is presented here.

10.2 Estimation of Demand and Supply Balance

According to the inventory survey (see Section 6.2), proposed irrigation development area amounts to about 2.2 million ha of which 1.3 million or 60 % are new construction projects. The rest or 0.9 million ha is rehabilitation/extension projects. These rehabilitation/extension projects are put priority for its economic advantage in general.

The area for which land development works are required is reported at some 300,000 ha. The Ministry of Agriculture, being responsible for land development works, put priority on implementing all incomplete land development works.

Rehabilitation of small scale irrigation schemes including village irrigation have also been put priority since those projects are generally located in remote areas where economic situation of farmers are low. In demand supply balance calculation, therefore following all rehabilitation and/or extension projects and land development and small scale irrigation are counted.

- | | | |
|---|---|---------------------------|
| (1) Land development projects | : | 300,000 ha |
| (2) Rehabilitation/special maintenance projects | : | 407,000 ha (all proposed) |
| (3) Extension projects | : | 105,000 ha (all proposed) |
| (4) Small scale irrigation (irrigasi desa) projects | : | 600,000 ha |

Implementation schedule for those rehabilitation and/or extension is assumed that :

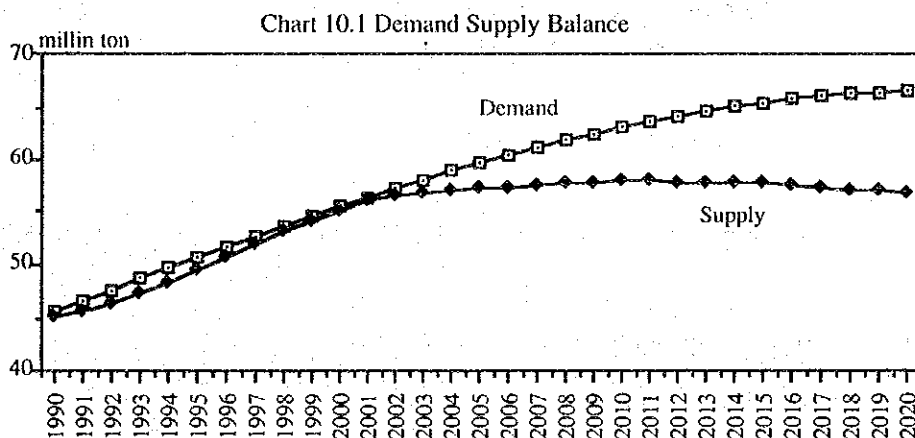
- all projects except small scale irrigation shall be completed within Repelita VI
- small scale irrigation projects shall be accomplished within Repelitas VI & VII
- existing implementation schedule is adopted for the projects if they have it
- for build up period, assumption described in Section 6.6 is applied

All above projects and on-going projects are allocated to each year keeping above conditions in mind. The result is shown in Table 10.1 ~ Table 10.3 and summarized below.

	Implementation Program					
	Unit:1,000ha					
	1991 1995	1996 2000	2001 2005	2006 2010	2011 2015	2016 2020
Zone 1	256	89	32	0	0	0
Zone 2	81	78	24	0	0	0
Zone 3	622	115	63	0	0	0
Zone 4	54	13	8	0	0	0
Zone 5	131	82	31	0	0	0
Zone 6	96	49	23	0	0	0
Indonesia	1,242	425	180	0	0	0

Category	Implementation Program by Category					Total
	Repelita VI	Repelita VII	Repelita VIII	Repelita IX	Repelita X	
New Construction	26.4	0	0	0	0	26.4
Extension	94.0	11	0	0	0	105.0
Rehabilitation	406.9	0	0	0	0	406.9
GW	0.0	0	0	0	0	0.0
Small scale	296.0	296	0	0	0	592.0
Land Development	322.2	3	0	0	0	325.4

Based on the above implementation schedule, cropping intensity and yield, expected paddy production amount is calculated and balance between demand and supply is also calculated as presented in Table 10.4. Following summary table and Chart shows that paddy supply may balance until around 2003 and after deficit amount increase.



	Demand Supply Balance					
	1995	2000	2005	2010	2015	2020
	Unit: 1,000tons					
Zone 1	-278	227	26	-256	-357	-347
Zone 2	-1,160	-1,158	-1,588	-2,173	-2,584	-2,834
Zone 3	1,071	1,106	-192	-1,931	-3,214	-4,796
Zone 4	-631	-890	-1,194	-1,492	-1,649	-1,699
Zone 5	760	1,246	1,375	1,294	1,227	1,209
Zone 6	-858	-786	-923	-1,108	-1,188	-1,201
Indonesia	-1,097	-255	-2,497	-5,665	-7,766	-9,668

In year of 2020, about 9.7 million ton of paddy may deficit if all program project (on-going, rehabilitation, extension and land development) only implemented and no other new schemes.

Consequently, deficit amount of 9.7 million tons of paddy should be produced through implementation of new irrigation projects to keep the 100 % of self-sufficiency.

10.3 Selection of Strategic Zones

As defined in the Section 8.3, the whole Indonesia is divided into six zones for the convenience of program formulation as shown below:

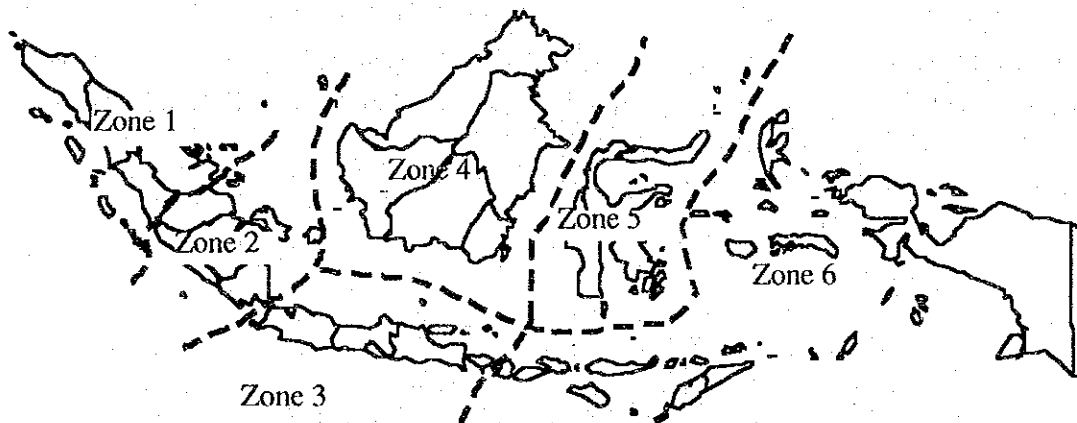


Chart 10.2 Macro Zoning for Formulation of Irrigation Development Program

The following five items were simply examined for each zone to select strategic zones.

- (i) present paddy yield
- (ii) future paddy supply and demand balance
- (iii) irrigation development potential
- (iv) human resources
- (v) infrastructure development situation

The results are summarized as below:

Zone	Productivity	Future paddy balance	Dev.potential	Human res.	Infrastruct.	Evaluation
Zone 1	high	surplus	big	moderate	moderate	Full development
Zone 2	moderate	deficit	big	moderate	moderate	Full development
Zone 3	very high	deficit	none	high	high	Rehabilitation
Zone 4	low	deficit	big	scarce	scarce	Limited development
Zone 5	high	surplus	small	moderate	moderate	Limited development & Rehabilitation
Zone 6	low	deficit	big	scarce	scarce	Limited development

From the above analysis, Zone 1 and Zone 2 (Sumatera) will be strategic zones for further development as having big potential for development with moderate level of human resources and infrastructure. Zone 5 (Sulawesi) already has many proposed projects for development, and further room for development is limited. Zone 4 (Kalimantan) and Zone 6 (Eastern region) will not be able to develop fast despite of big development potential due to lack of human resources and infrastructure. Only limited development will be expected. Zone 3 (Jawa) has already been fully developed and almost no room for further development, although large deficit of rice is anticipated in future.

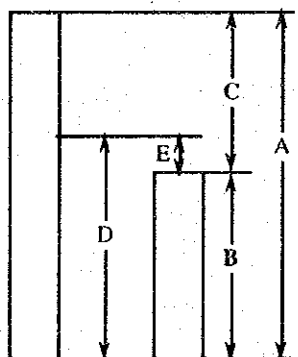
10.4 Target Paddy Production and Irrigation Development Area by Province

As discussed in aforesession, Indonesia should have to product another 9.7 million ton of paddy adding to present irrigation development program to keep self sufficiency rate of 100%. Future irrigation development program then encounter this fact and formulate to meet the paddy production demand considering various factors such as regional characteristics, paddy yield trend, land conversion, potential area etc.

10.4.1 Development Condition of Each Zone and Province

For further discussion, following terms and abbreviations are utilized as defined herein.

Chart 10.3 Relation of Demand, Potential and Production



A = Maximum paddy production amount (+ Table 10.5)

B = Production by all programmed schemes

C = Development potential

D = Demand

E = $\begin{cases} \text{if negative Deficit} \\ \text{if positive Surplus} \end{cases}$

SS-Rate (self-sufficiency rate) = $\frac{B}{D}$ (%) a ratio of supply amount to demand amount

Dev-Rate (development ratio) = $\frac{B}{A}$ (%) a ratio of developed amount to maximum production amount

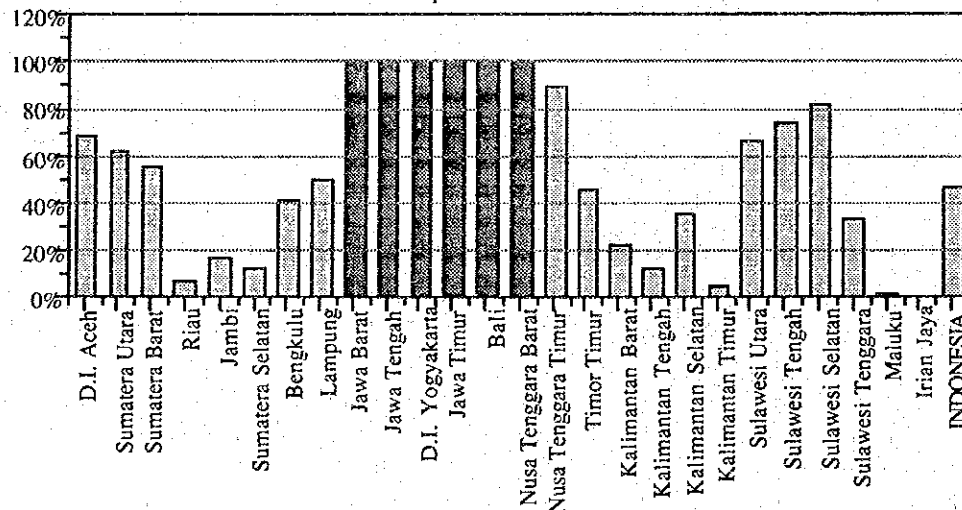
Upon completion of all program and on-going irrigation projects, self sufficiency rate and development ratio of Indonesia will be 86 % and 47 % respectively. Table 10.6 shows those figures of each province and summarized below.

Self sufficiency and development ratio by zone

Zone	Maximum Paddy Production A 1000 ton	All Irrigation Schemes B 1000 ton	Demand D 1000 ton	Deficit B-D 1000 ton	Self sufficiency B/D %	Development Ratio B/A %	Required Development Ratio D/A %
Zone 1	22,834	9,038	9,385	-347	96.3%	39.6%	41.1%
Zone 2	24,901	5,245	8,079	-2,834	64.9%	21.1%	32.4%
Zone 3	30,351	30,351	35,147	-4,796	86.4%	100.0%	115.8%
Zone 4	16,837	3,008	4,708	-1,699	63.9%	17.9%	28.0%
Zone 5	9,101	6,533	5,324	1,209	122.7%	71.8%	58.5%
Zone 6	17,441	2,642	3,842	-1,201	68.8%	15.1%	22.0%
Indonesia	121,464	56,816	66,485	-9,668	85.5%	46.8%	54.7%

Zone 3 has 100 % of development ratio, therefore this zone has maximum irrigation program and no more expandable area at all. Other than Zone 3, NTB has 100 % development ratio (+ Table 10.6 and below chart).

Chart 10.4 Development Ratio of each Province



Namely all deficit amount of 9.7 million ton of paddy should be produced by all Zones except Zone3 and NTB.

10.4.2 Target Production and Development Area

It is not so easy to determine the target area or production amount in each province, since so many factors should be taking into account. In this study mathematical solution method so called *linear programming* was employed to seek the target value of production and development area of each Province under following conditions.

Applied condition

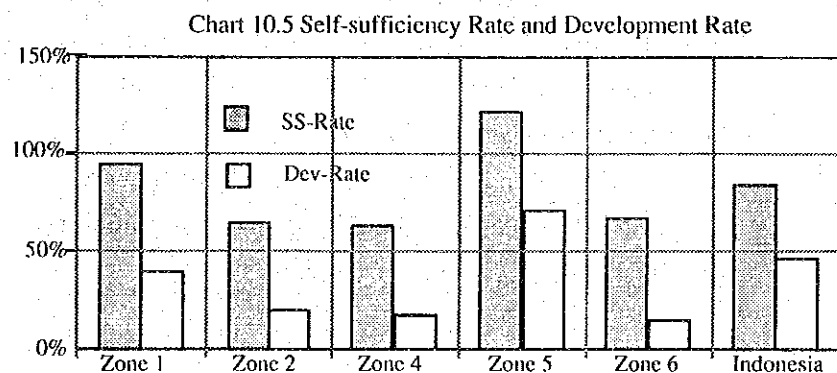
Two levels of conditions are applied as the constraints for this calculation i.e.. Zonal level condition and Provincial level condition. Zonal condition will determine the target production of each zone and Provincial condition will determine the target development area of each province. Detail condition of two levels are described below.

1) Condition at Zonal level

Two sub-level conditions are set. Firstly, whole Indonesia is divided into two areas one is Western Area including Zone 1, Zone 2 and Zone 3 and the other area of Eastern Area including Zone 4, Zone 5 and Zone 6. A condition is set for those two Areas. Next step, a condition of each zone is determined.

For two Areas, 110 % of SS-Rate is given to Eastern Area considering future paddy marketing flow direction. We assumed about 10 % of paddy production in Eastern Area will export to Western Area (Jawa & Bali). Then two Area's condition is as follows

Target Self-sufficiency Rate	
Western Area	Eastern Area
none	110%



Above chart shows the SS-Rate and Dev-Rate after accomplish all program and on-going irrigation schemes in year of 2020. Zone 1 & 5 have high SS-Rate and other zones have around 60 % SS-Rate. Target SS-Rate for those less SS-Rate zone is determined at 80 %. Zone 2 is expected as a big supplier to Zone 3 (Jawa) in future because of the least utilization of development potential at present except Zone 4 and Zone 6. Then Zone 2 should have unlimited SS-Rate. Then limit of SS-Rate for each Zone are determined as follows.

Target Self-sufficiency Rate				
Zone1	Zone2	Zone4	Zone5	Zone6
none	none	80%	none	80%

For those Zones where SS-Rate is high, Dev-Rate limitation is given. All programmed schemes give Dev-Rate of 40 % for Zone 1 and 72 % for Zone 5 (+ Table 10.6). And demand amount of 66.5 million of paddy require about 55 % of Dev-Rate on an average for whole Indonesia. Target Dev-Rate of 50 % is given to less average zone of Zone 1 and 90 % of Dev-Rate is given to Zone 5 to expect more paddy production. Then limit of Dev-Rate for each Zone are determined as follows.

Target Development Rate				
Zone1	Zone2	Zone4	Zone5	Zone6
50%	none	none	90%	none

2) Condition at Provincial level

Zone 1 : Target development area should keep the proportion of development potential area (D/P-Area)^{*1} (+ Table 10.7) . Area adjusting to meet the requirement of Dev-Rate 50 % should be made in Riau which has biggest D/P-Area among Zone 1.

Zone 2 : Same as Zone 1 and Sumatera Selatan is adjusting area.

Zone 4 : Target development area should keep the proportion of irrigation area at 2020 including all programmed schemes

^{*1} Development Potential Area = Irrigation Potential Area - Area of all program and on-going schemes

Zone 5 : Same as Zone 1 and Sulawesi Utara is adjusting area. Sulawesi Selatan has more than 100% of SS-Rate then Dev-Rate of 100% is given.

Zone 6 : Same as Zone 4 and adjusting area is NTT and Timor Timur.

Adding above two conditions, calculation was performed with following assumptions.

- at year of 2020 all irrigation area are full developed and functioned
- new irrigation area may consist of 30% of converted land from rainfed area and 70% of virgin land.

Target production and irrigation development area

Try and Error calculation was carried out by adjusting new development area in each Province under condition of aforementioned to seek the production amount which should equal to deficit amount of 9.7 million ton. The results of calculation is shown below.

Required New Development Area and Production by its New Area

	SS-Rate	Dev-Rate	New Area 1,000 ha	Production 1,000 ton
Zone1	122%	50%	282	2,379
Zone2	120%	39%	481	4,441
Zone3	86%	100%		
Zone4	78%	22%	188	675
Zone5	155%	91%	218	1,741
Zone6	80%	18%	93	432
Western Area	98%	66%	762	6,820
Eastern Area	108%	35%	498	2,849
Indonesia	100%	55%	1,260	9,669

About 1.3 million ha of new irrigation area is required adding to the area of all program and on-going irrigation schemes to product 66.5 million tons of paddy in 2020. This calculation however disregarded next Repelita XI, then there are few irrigation project during Repelita X. Because the new scheme within Repelita X may contribute to demand of Repelita XI. If we take the demand of Repelita XI, XII and so on, into consideration, above results may change.

In the next section, estimated required new irrigation area are allocated to each year and each province disregarding succeeding Repelitas.

10.4.3 Annual Target Development Area by Province

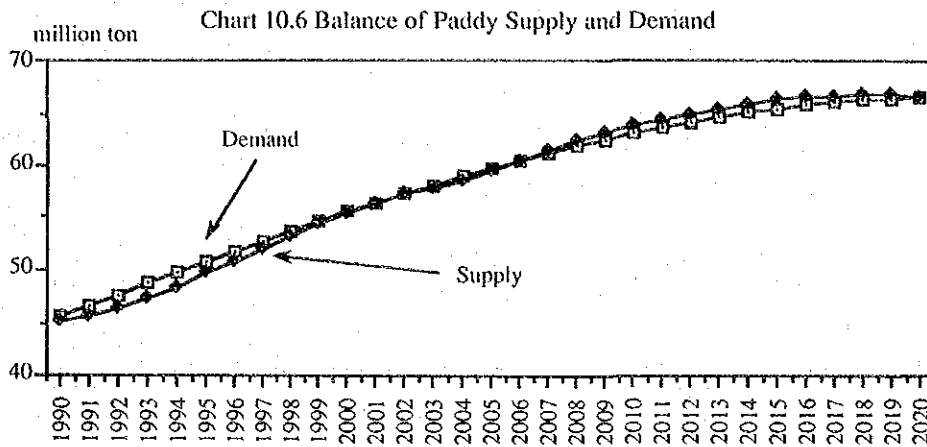
New irrigation area estimated at about 1.3 million ha is allocated so as to eliminated deficit amount as much as possible. Apportionment procedure is simple. If Province has proposed new irrigation project then those area are allocated. If they have no proposal or not enough to cover the required area then new irrigation area is assigned to every year evenly from end of completion year of all proposed schemes to year of 2015. After allocation of newly development area, target development area including rehabilitation, extension, on-going and new construction project of each province is estimated as shown in Table 10.8 and summarized below. Provincial level and Zonal level breakdown of target irrigation development area are shown in Figure 10.1 ~ Figure 10.7.

Target Irrigation Development Area							Unit:1,000ha
	1991	1996	2001	2006	2011	2016	
	1995	2000	2005	2010	2015	2020	
Zone1	257.1	143.3	254.4	38.8	13.0	3.0	
Zone2	81.9	88.4	162.4	189.5	143.8	0.0	
Zone3	633.3	143.7	90.3	20.0	14.8	9.6	
Zone4	54.3	19.7	65.5	67.2	54.9	0.0	
Zone5	133.4	127.4	162.5	31.5	23.0	1.2	
Zone6	98.6	63.8	58.1	33.3	11.8	2.4	
Indonesia	1,258.6	586.3	793.2	380.3	261.3	16.2	

Land development area are calculated based on the above development area as follows. Annual land development area in each Zone and Indonesia are shown in Figure 10.8.

Target Land Development Area							Unit:1,000ha
	1991	1996	2001	2006	2011	2016	
	1995	2000	2005	2010	2015	2020	
Zone1	81.6	85.2	150.2	44.8	7.4	0.0	
Zone2	40.8	58.0	104.8	159.4	126.7	6.4	
Zone3	47.6	17.3	0.0	0.0	0.0	0.0	
Zone4	21.8	18.1	44.9	56.1	45.9	5.3	
Zone5	48.9	86.9	53.3	23.1	15.4	1.4	
Zone6	46.3	44.6	26.6	23.7	9.1	0.0	
Indonesia	286.9	310.2	379.9	307.1	204.5	13.2	

Total paddy production of each year is estimated based on the allocated development area and yield. Figure 10.9 shows estimated annual production curve and demand projection towards 2020 together with projection of paddy area. Following Chart shows supply and demand curve towards 2020 cited from Figure 10.9.



As can be seen above Chart, supply is almost balanced with demand upto year of 2020 and some deficit will occur during 1995~2000. (+ Table 10.9) This deficit amount is not greater than of reliable range or 3% of supply amount as shown in Figure 10.10.

Then determined annual target irrigation development area is confirmed to be a long term irrigation development program and balanced program.

10.5 Selection of Priority Project

In order to prepare an implementation schedule, specific projects will be selected from the list of proposed projects by prioritizing them according to a certain criteria. DGWRD has a selection criteria of water resources development projects which include irrigation projects.

General criteria for water resources development has ten items as below:

- (1) Proposed projects should be planned in line with goals of national and regional development and promoted as priority by the corresponding local government.
- (2) Proposed projects should be planned in line with the concept of river basin development and/or water resources development plan which should always be available along with its feasibility study.
- (3) Planning of water resources should comply with prevailing technical regulations related with water resources development.
- (4) Technically, the proposed projects should not be difficult to develop, and be as best alternative based upon the technical conditions and existing constraint in the said area.

- (5) Proposed projects should accomplish their purposes and be economically viable. The implementation of the projects should bring financial benefit to the beneficiaries.
- (6) The benefit derived from water resources development is not only to increase the national and regional income, but also to reduce the number of poverty in the nation.
- (7) Proposed projects should not contradict with social and culture of local people and should receive the good responses from the people during the implementation.
- (8) Administratively, there should not be any constraint during the implementation and operation after construction. Special attention is paid necessary to the reallocation of the people or other matters related with them.
- (9) Result of Environmental Impact Assessment (AMDAL; see ANNEX H) should not indicate any constraint which could arise during the construction or suggest a necessary effort to deal with.
- (10) Administratively, preliminary preparations have been done in the form of organization or institutions, and the method of operation and maintenance.

As a part of water resources development, irrigation development projects are classified into three programs; (i) rehabilitation and maintenance program, (ii) construction of irrigation network program and (iii) swamp development program. Each program has its own selection criteria in which technical, economical, social and environmental aspects are included. They are summarized in Table 10.10.

10.6 Irrigation Development Target in Next Five Repelitas

Assuming fiscal year of 1994/95 equal to calendar year of 1994 for example, annual target development irrigation area in every province is summed up to know the target development area in each Repelita. Table 10.11 ~10.15 present target development area for next five Repelitas by province and by category. Table 10.16 shows the total development target area of all province in each Repelita and zonal summary is shown below.

Zone	Development Target					Total
	Repelita VI	Repelita VII	Repelita VIII	Repelita IX	Repelita X	
Zone 1	204.1	245.1	113.2	19.0	5.0	586.4
Zone 2	104.8	112.2	186.4	189.5	33.3	626.2
Zone 3	344.3	134.5	24.0	14.0	16.0	532.8
Zone 4	16.1	48.4	73.0	58.0	20.1	215.5
Zone 5	136.4	164.4	77.6	27.5	8.6	414.4
Zone 6	70.8	80.2	30.0	19.0	4.0	204.1
Indonesia	876.5	784.7	504.2	326.9	87.0	2,579.4

So far target development area is programmed so as to balance paddy production and demand at every year as much as possible and annual target development area is determined. Those target area consists of five categories of schemes i.e.. new construction, extension, rehabilitation, ground water and small scale irrigation. Out of 2.6 million ha of total development target, 50% or 1.3 million ha are new construction schemes, 4% or 0.1 million ha are extension, 16% or 0.4 million ha are rehabilitation and 7% or 0.2 million ha are groundwater and 23% or 0.6 million ha are small scale irrigation schemes. Table 10.17 ~ Table 10.20 show the target development area of each category by province in each Repelita. Summary of those table is shown in following table.

Category	Repelita VI	Repelita VII	Repelita VIII	Repelita IX	Repelita X	Total
New Construction	36.4	434.8	465.2	299.9	60.0	1,296.3
Extension	94.0	11.0	0.0	0.0	0.0	105.0
Rehabilitation	406.9	0.0	0.0	0.0	0.0	406.9
GW	43.2	43.0	39.0	27.0	27.0	179.2
Small scale	296.0	296.0	0.0	0.0	0.0	592.0
Indonesia	876.5	784.7	504.2	326.9	87.0	2,579.4

For the land development, Table 10.21 shows the land development target area of each Province for each Repelita. Zonal summary is shown bellow.

Zone	Repelita VI	Repelita VII	Repelita VIII	Repelita IX	Repelita X	Total
Zone 1	89.5	99.6	76.3	9.5	0.0	274.9
Zone 2	59.6	54.2	131.4	130.7	21.6	397.4
Zone 3	28.2	0.0	0.0	0.0	0.0	28.2
Zone 4	15.4	26.8	50.6	40.6	13.4	146.8
Zone 5	83.4	47.9	25.4	15.1	4.2	175.9
Zone 6	50.3	29.8	19.6	11.9	0.0	111.6
Indonesia	326.4	258.2	303.3	207.7	39.2	1,134.8

10.7 Preparation Study

About 1.3 million ha of new construction area include 26 thousand ha of on-going schemes, 0.73 million ha of nominated schemes and 0.54 million ha of newly programmed by this study. Breakdown of nominated area and newly programmed area is shown in Table 10.22. Out of 20 Province which needs new irrigation project, seven provinces has more nominated project than required area. Remaining 13 provinces should need newly programmed project having total area of 0.54 million ha. At present no information of 1.3 million ha of new area is available at all for further study and/or design so on. All preparatory works including

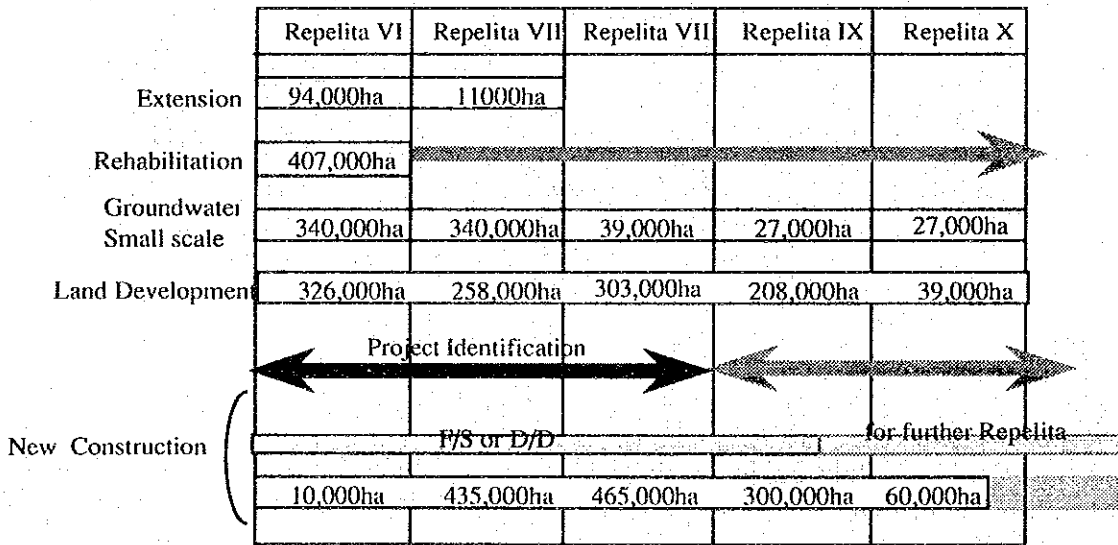
project identification, feasibility study and detailed design are required prior to commencement construction works. And construction works may not complete within one or two years for new reclamation scheme in general. Suggested program of each Repelita has about 1,275,000 ha of new irrigation schemes as shown below.

New Construction Area within PJPT II Unit:1,000 ha

New Project	Repelita VI	Repelita VII	Repelita VIII	Repelita IX	Repelita X	Total
Nominated	10	435	270	11	0	726
To be identified	0	0	195	289	60	544
Total	10	435	465	300	60	1,270

Above area is required paddy field and is not construction area. For example, 435,000 ha of technical level irrigation paddy field should be constructed and operated during Repelita VII. To do so, detailed design work and feasibility study for these area must be carried out within Repelita VI not VII. To carry out feasibility study, financial and administrative arrangement works should be performed 2 or 3 years ahead to feasibility study. Then 435,000 ha of newly reclaimed paddy field in Repelita VII forced us to do those preparatory works as soon as possible. Scheduling for this preparatory works may need quick action as can be seen in following chart

Chart 10.7 Development Schedule



10.8 Cost Estimates

The costs necessary for the irrigation development in PJPT II is estimated based on the previous implementation schedule. Cost estimates are made according to the following categories.

- New construction
- Extension
- Rehabilitation and special maintenance
- Groundwater development
- O&M Surface Irrigation (incl. Efficient O&M)
- Swamp (incl. O&M, EOM and upgrading)
- Handing over Small Schemes
- Small scale irrigation
- Land Development
- Survey, Design, etc.

Costs for each category are estimated separately, and total costs are obtained by summing up the each category. Although costs for fish pond development are not included, estimated costs cover almost all development costs for irrigation sub-sector.

10.8.1 Condition of Estimates

Cost estimates here is made basically by multiplying unit costs per hectare basis with development area. Only costs for survey and design are estimated to be certain ratio of new construction cost. Hereunder, basic condition of estimates will be explained.

(1) Unit Costs

Unit costs used are expressed at 1992 constant price, based on the recent three years (1989/90, 1990/91 and 1991/92) actual average unit costs. Actual unit costs in each year are first unified to 1991 constant prices using the official whole sale price index of construction materials for public works in agriculture¹, and three years average unit costs at 1991 constant price is obtained. The unit costs in 1992 are then estimated by escalating 9%, assumed inflation rate, from those at 1991 constant price. As for unit cost for small scale irrigation, an estimated cost is applied on the basis of the information from BPP. Also an estimated cost is applied for swamp development (including reclamation and upgrading) based on information from BPP and Directorate of swamp.

¹ : *Monthly Statistical Bulletin, Indikator Ekonomi*, December 1992, CBS

Those unit costs applied are presented on Table 10.23, and summarized as below:

Estimated Unit Costs by Development Type at 1992 constant price

Type of Development	Unit Costs(Rp./ha)
New development	7,500,000
Extension	4,200,000
Groundwater development	6,300,000
Rehabilitation	3,000,000
Handing over small schemes	200,000
Regular O&M (surface irrig.)	17,300
Regular O&M (swamp)	11,700
EOM (surface irrig.)	31,300
EOM (swamp)	33,600
Swamp development	2,000,000
Land Development	500,000
Small scale irrigation (Irigasi Desa)	500,000

Note : All costs are tentative.
Source: see Table 10.23

The unit cost for survey and design is estimated at 10 % of the unit cost of new construction.

(2) Development area

Development area is not necessarily the same as the beneficial area which are used in the previous section to estimate production change. Development areas for extension and rehabilitation works are different from beneficial area, because of the following reasons.

As for swamp development, 520 thousand ha is planned to be reclaimed and/or up-graded. This development is mainly towards for estate crops and limited extent for staple food like paddy. Since no breakdown is available for areas by objective crops, all development area is applied for the cost estimate. Development area for paddy may be not more than 30% of the total target area.

Extension works

Extension area can be divided broadly into two parts whether canal construction is necessary. For the area where only land development is required will be developed under the responsibility of the Ministry of Agriculture. The areas where canal construction is necessary are , therefore, adopted for cost estimates. The area is estimated to be 105 thousand ha according to the Inventory Survey results (+ Table 10.25).

Rehabilitation works

Beneficial area of rehabilitation works is estimated to be 30% of total area which is assumed to be rainfed area due to the damage of system. Then the development area for rehabilitation works with 407 thousand ha corresponds to the whole objective system area which is 3.3 times larger than beneficiary area, as shown on Table 10.26. Rehabilitation works may be required in future with the aging of existing structure or due to unexpected damage by natural disaster. However, area for future rehabilitation works are not able to be determined. No rehabilitation works is considered after completion of the proposed works.

As for new development (1.3 million ha), groundwater development (179 thousand ha), and upgrading of small scale irrigation (592 thousand ha), beneficial areas coincide with development area, as shown on Table 10.24 for new development, Table 10.27 for groundwater development, and Table 10.34 for small scale irrigation, respectively.

Areas for handing over small schemes, of which production increase effect is not considered, are estimated to increase at constant rate, and all objective schemes having less than 500 ha is estimated to be handed over to farmers in the year of 2010, despite of the government schedule of the target year of 2003, in light with slower progress. Total target area is 1.6 million ha as shown on Table 10.32. For convenience, it is considered that no more small schemes than those existing at present will be constructed.

Operation and maintenance of surface irrigation systems has been carried out with the combination of current O&M (O&M), efficient O&M (EOM), handing over small schemes (PIK) and collection of irrigation service fee (ISF). Area for O&M under the responsibility of PU will expand with the expansion of new irrigated area through new development as well as extension works while decrease with the progress of PIK and ISF. Net area for O&M will, therefore, is obtained as the combined results of adding new development and extension areas and of deducting areas for PIK and ISF. Area for ISF, however, will not be counted due to very slow progress and to unclear future.

In accordance with the government policy, even after the completion of EOM program, costs for O&M will remain equivalent to cost for EOM. In cost terms, O&M cost will increase to EOM level upto the year of 2003. The consecutive change in O&M and EOM areas are schematized in Figure 10.10 and tabulated on Table 10.37. Annual O&M area for surface irrigation in 2020 is estimated at almost 4.3 million ha.

As for the operation and maintenance of swamp systems, cost for O&M will also increase upto present EOM level. Total area will, however, be constant as no new development nor