Estimated Water Potential

Unit: 1,000 ha

Region	1990	1995	2000	2005	2010	2015	2020
Sumatera	10,398	10,378	10,341	10,315	10,283	10,264	10,228
Jawa	83	80	72	69	67	65	62
Bali & NT	98	97	95	94	93	92	90
Kalimantan	16,506	16,502	16,494	16,488	16,479	16,472	16,464
Sulawesi	1,249	1,247	1,242	1,239	1,235	1,232	1,228
Maluku & IJ	13,813	13,812	13,809	13,807	13,804	13,803	13,800
INDONESIA	42,148	42,115	42,053	42,012	41,960	41,928	41,872

Source: JICA-FIDP team estimate.

In the year 2020, almost river basins in Jawa, Bali Nusa tenggara Barat, Sulawesi Selatan, and part of Sumatera Utara will not have water potential, but part of Sumatera, Kalimantan, part of Sulawesi and Irian Jaya will have water potential to develop new irrigation area.

3.2.6 Irrigation Development Potential

Potential area for irrigation development is estimated by overlaying the results of water potential study with those of land potential study.

At first, potential area for irrigation development in each river basin is calculated (see Table 3.11). Then the area is allotted to the provinces which extend over the basin, in proportion to area. Table 3.12 shows the estimated irrigation development potential area in each Province and summarized below. Figure 3.7 shows river basin wise areal distribution of irrigation potential area.

Irrigation Development Potential by Region

Unit: 1,000 ha

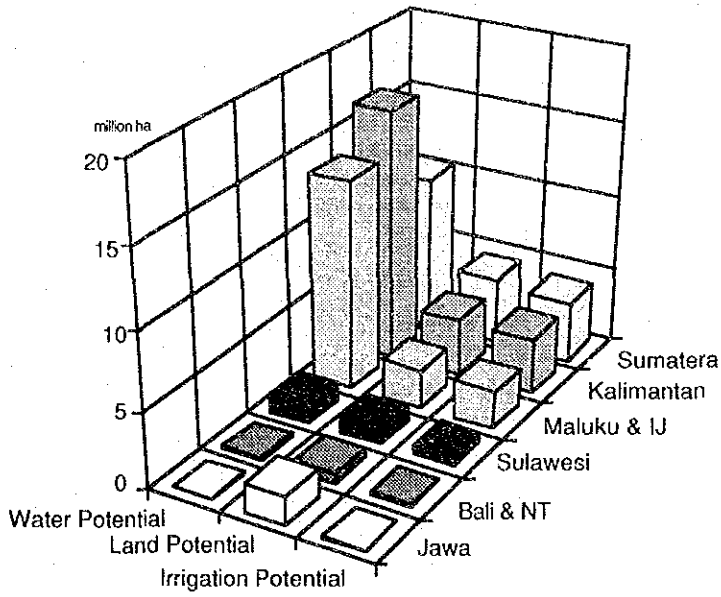
Region	1990	1995	2000	2005	2010	2015	2020
Sumatera	4,009	4,006	3,997	3,991	3,983	3,980	3,972
Jawa	83	80	72	69	67	65	62
Bali & NT	98	97	95	94	93	92	90
Kalimantan	3,693	3,693	3,693	3,693	3,693	3,693	3,693
Sulawesi	535	534	532	530	528	526	524
Maluku & IJ	2,525	2,525	2,525	2,525	2,524	2,524	2,524
Indonesia	10,944	10,934	10,913	10,901	10,887	10,879	10,865

Source: JICA-FIDP team estimate.

Comparing above table with previous page of Table "Estimated Water Potential" all region except Jawa, Bali and Nusa Tenggara are smaller area than water potential. This means that Jawa, Bali and Nusa Tenggara are limited by water and other regions are limited by land.

Following figure shows three potential area, land water and irrigation, by region.

Potential Area of Water, Land, and Irrigation Development



Irrigation development potential for whole Indonesia is estimated at about 11 million ha in 1990, and keep this potential area until 2020. About 93% of potential area are distributed in those island of Sumatera (36%), Kalimantan (34%) and Maluku/Irian Jaya (23%). Irian Jaya has most large potential area of 2.1 million ha followed by Sumatera selatan (1,274,000 ha), Kalimantan Timur(1,257,000ha) and Kalimantan Barat (1,136,000 ha) so on (see Table 3.12).

Irrigation development potential so far assessed should be discussion material for the regional level or nation wide irrigation development planning. For other purpose, detailed survey and/or study work will be required.

Table 3.1 Land Suitability Criteria for Wetland Agriculture Development

Criteria Sub-criteria	Suitable (S)	Conditioanlly Suitable ($)	Unsuitable (N)
Groudwater Quality (g)	Fresh		Brackish/Sulphurous, Saline
Inundation (i)			
Flood water risk only	None - High		
Sedimentation	Low		Medium - High
Inundation	None - Seasonal		Parmanent - Tidal
Climate (c)			
Annual Rainfall	1000 - 5000 mm		< 1000 mm, > 5000 mm
Wet month (>200 mm)	>= 4 months		< 4 months
Dry month (< 100 mm)	< 7 months		>= 7 months
Dry month (< 60 mm)	<= 3 months		> 3 months
Growing days (food crops)	>= 100 days		< 100 days
Mean temperature	15 - 34 C°		< 15 C°, > 34 C°
Soil Texture (t) (top 25 cm)	Fine - Moderately coarse, Organic		Coarse
Soil Depth (d)			
Peat	0 - 75 cm		>= 75 cm
Mineral soil	> 25 cm		<= 25 cm
Soil Drainage (w)	Imperfect Very poor	Well - Moderately well	Excessive
Soil Nutritions (n)			
Exchangeable K (meq/100g)	>= 0.1	< 0.1	
Available P (ppm P2O5) (Bray I)	>= 10	< 10	
Total P (mg/100g P2O5)	>= 10	< 10	
CEC (meq/100g)	>= 5		< 5
pH(H2O)	< 7.8		> 7.9
Al Saturation (%)	< 40	> 41	
Exchangeable Al (meq/100g)	<= 2	> 2	
Depth to acid Sulphate (cm)	>26		<25
Salinity (EC mS/cm)	<= 4.0		> 4.0
Parent material			Quartzic or ultrabasic
Elevation (l)	< 1500 m		> 1500 m
Slope (s)	< 2 %	2 - 25 % *	> 25 % *

Remark: * For volcanic soils in Jawa, 2 - 60 % is conditionally suitable and > 60 % is unsuitable.
Source: RePPProT National Overview.

Table 3.2 Land Suitability for Wetland Agriculture Development by Province

('000 ha)

Province	Area by Land Suitability Class						Subdivision of Conditionally Suitable Land			
	Total	S	$	$$	N	Unclassified	$i	$w	$n	$s
D.I. Aceh	5,675	217	393	592	4,440	33	11	6	310	67
Sumatera Utara	7,250	246	862	1,368	4,596	179	16	1	557	287
Sumatera Barat	4,169	105	388	384	3,264	27	174	0	91	123
Riau	9,860	879	1,189	2,479	4,720	593	0	181	998	10
Jambi	4,874	279	452	2,042	2,055	47	9	108	323	12
Sumatera Selatan	10,226	359	1,775	4,177	3,659	256	29	22	1,661	63
Bengkulu	2,090	60	64	296	1,668	2	20	1	8	34
Lampung	3,387	49	234	1,637	1,455	12	20	6	189	20
Sumatera	**47,531**	**2,195**	**5,355**	**12,976**	**25,856**	**1,148**	**278**	**324**	**4,137**	**616**
D.K.I. Jakarta	66	30	0	33	2	0	0	0	0	0
Jawa Barat	4,645	779	299	2,891	654	22	0	0	0	299
Jawa Tengah	3,413	743	385	1,683	582	20	0	0	0	385
D.I. Yogyakarta	315	14	86	105	103	6	0	0	0	86
Jawa Timur	4,818	454	1,162	2,598	513	92	0	0	0	1,162
Jawa	**13,257**	**2,019**	**1,932**	**7,310**	**1,855**	**140**	**0**	**0**	**0**	**1,932**
Bali	564	4	127	396	31	6	0	0	0	127
Nusa Tenggara Barat	1,954	153	82	209	1,508	1	0	0	0	82
Nusa Tenggara Timur	4,633	159	100	765	3,599	10	0	0	20	80
Timor Timur	1,507	75	0	282	1,137	13	0	0	0	0
Bali & NT	**8,657**	**392**	**309**	**1,652**	**6,275**	**29**	**0**	**0**	**20**	**290**
Kalimantan Barat	14,753	701	132	3,892	9,872	156	0	0	100	32
Kalimantan Tengah	15,360	1,001	276	2,037	12,008	38	0	0	276	0
Kalimantan Selatan	3,749	848	0	1,345	1,475	81	0	0	0	0
Kalimantan Timur	19,721	517	268	5,644	13,000	292	0	0	100	168
Kalimantan	**53,583**	**3,067**	**676**	**12,918**	**36,355**	**568**	**0**	**0**	**476**	**200**
Sulawesi Utara	2,655	60	183	211	2,192	8	0	1	0	182
Sulawesi Tengah	6,053	229	302	150	5,313	60	0	6	0	296
Sulawesi Selatan	6,229	747	330	539	4,513	101	0	4	0	326
Sulawesi Tenggara	3,678	164	106	703	2,704	1	0	0	0	106
Sulawesi	**18,615**	**1,200**	**920**	**1,602**	**14,723**	**170**	**0**	**10**	**0**	**910**
Maluku	7,783	507	270	1,358	5,560	88	0	0	26	244
Irian Jaya	41,480	4,210	2,931	2,386	31,583	370	0	0	674	2,257
Maluku & IJ	**49,263**	**4,717**	**3,201**	**3,744**	**37,143**	**458**	**0**	**0**	**700**	**2,502**
Indonesia	**190,905**	**13,590**	**12,394**	**40,202**	**122,207**	**2,513**	**278**	**334**	**5,333**	**6,449**

Note: S = Fully suitable; $ = Conditionally suitable; $$ = Marginally suitable; N = Unsuitable; and Unclassified = Lakes, rivers, no data areas, etc.
$i = Conditionally suitable by inundation; $w = Conditionally suitable by soil drainage;
$n = Conditionally suitable by soil nutritions; and $s = Conditionally suitable by slope.

Source: JICA-FIDP Team calculation based on RePPProT

Table 3.3 Land Availability for Wetland Agriculture Development by Province

Province	Gross total area ('000 ha)	Actually used area for Sawah ('000 ha)	(%)	Actually used area for other purposes ('000 ha)	(%)	Gross available area for wetland development ('000 ha)	(%)	Net available area ('000 ha)
D.I. Aceh	5,674.8	215.2	4%	3,774.6	67%	1,685.0	30%	606.6
Sumatera Utara	7,250.1	341.0	5%	4,087.9	56%	2,821.2	39%	1,015.6
Sumatera Barat	4,169.0	210.0	5%	2,647.2	63%	1,311.8	31%	472.2
Riau	9,859.5	384.5	4%	5,083.2	52%	4,391.8	45%	1,581.0
Jambi	4,873.9	194.6	4%	2,427.9	50%	2,251.4	46%	810.5
Sumatera Selatan	10,226.3	585.5	6%	4,299.2	42%	5,341.6	52%	1,923.0
Bengkulu	2,090.4	47.6	2%	1,224.4	59%	818.4	39%	294.6
Lampung	3,386.7	110.5	3%	1,379.8	41%	1,896.4	56%	682.7
Sumatera	**47,530.7**	**2,088.9**	**4%**	**24,924.2**	**52%**	**20,517.6**	**43%**	**7,386.3**
D.K.I. Jakarta	65.8	26.7	41%	33.4	51%	5.7	9%	2.1
Jawa Barat	4,644.6	923.5	20%	2,078.5	45%	1,642.6	35%	591.3
Jawa Tengah	3,412.8	877.5	26%	1,467.5	43%	1,067.8	31%	384.4
D.I. Yogyakarta	315.1	81.0	26%	121.5	39%	112.6	36%	40.5
Jawa Timur	4,818.2	1,222.9	25%	2,303.2	48%	1,292.1	27%	465.2
Jawa	**13,256.5**	**3,131.6**	**24%**	**6,004.1**	**45%**	**4,120.8**	**31%**	**1,483.5**
Bali	563.9	104.3	18%	252.9	45%	206.7	37%	74.4
Nusa Tenggara Barat	1,953.7	181.7	9%	893.5	46%	878.5	45%	316.3
Nusa Tenggara Timur	4,632.5	141.7	3%	1,757.1	38%	2,733.7	59%	984.1
Timor Timur	1,506.8	16.8	1%	692.6	46%	797.4	53%	287.1
Bali & NT	**8,656.9**	**444.5**	**5%**	**3,596.1**	**42%**	**4,616.3**	**53%**	**1,661.9**
Kalimantan Barat	14,753.0	279.2	2%	8,926.8	61%	5,547.0	38%	1,996.9
Kalimantan Tengah	15,360.4	363.2	2%	8,393.8	55%	6,603.4	43%	2,377.2
Kalimantan Selatan	3,749.0	296.0	8%	1,816.4	48%	1,636.6	44%	589.2
Kalimantan Timur	19,721.0	204.1	1%	14,596.1	74%	4,920.8	25%	1,771.5
Kalimantan	**53,583.4**	**1,142.5**	**2%**	**33,733.1**	**63%**	**18,707.8**	**35%**	**6,734.8**
Sulawesi Utara	2,654.5	86.5	3%	1,657.5	62%	910.5	34%	327.8
Sulawesi Tengah	6,053.2	188.9	3%	4,432.4	73%	1,431.9	24%	515.5
Sulawesi Selatan	6,229.1	460.0	7%	3,775.3	61%	1,993.8	32%	717.8
Sulawesi Teaggara	3,677.7	95.9	3%	2,317.0	63%	1,264.8	34%	455.3
Sulawesi	**18,614.5**	**831.3**	**4%**	**12,182.2**	**65%**	**5,601.0**	**30%**	**2,016.4**
Maluku	7,782.9	56.5	1%	5,294.5	68%	2,431.9	31%	875.5
Irian Jaya	41,480.0	66.2	0%	28,099.9	68%	13,313.9	32%	4,793.0
Maluku & IJ	**49,262.9**	**122.7**	**0%**	**33,394.4**	**68%**	**15,745.8**	**32%**	**5,668.5**
Indonesia	**190,904.9**	**7,761.5**	**4%**	**113,834.1**	**60%**	**69,309.3**	**36%**	**24,951.3**

Note: Actually used area for other purposes includes water-covered area and no data area.
Source: JICA-FIDP Team calculation based on RePPProT

Table 3.4 Land Potential for Wetland Agriculture Development by Province

('000 ha)

Province	Net potential area				
	Total	Fully suitable	Conditionally suitable	Marginally suitable	Unsuitable
D.I. Aceh	606.6	32.7	55.8	109.2	409.0
Sumatera Utara	1,015.6	40.5	93.5	242.9	638.8
Sumatera Barat	472.2	18.8	47.3	64.1	342.1
Riau	1,581.0	145.8	166.4	572.9	695.9
Jambi	810.5	36.4	67.0	448.3	258.8
Sumatera Selatan	1,923.0	49.6	214.5	1,015.2	643.7
Bengkulu	294.6	11.4	11.3	55.1	216.8
Lampung	682.7	6.7	25.5	424.2	226.4
Sumatera	**7,386.3**	**341.9**	**681.2**	**2,931.8**	**3,431.4**
D.K.I. Jakarta	2.1	0.0	0.0	2.1	0.0
Jawa Barat	591.3	8.0	16.6	435.7	131.0
Jawa Tengah	384.4	18.8	12.3	257.2	96.1
D.I. Yogyakarta	40.5	0.3	1.6	13.4	25.3
Jawa Timur	465.2	0.0	24.2	377.6	63.4
Jawa	**1,483.5**	**27.0**	**54.7**	**1,086.0**	**315.8**
Bali	74.4	0.0	5.3	67.3	1.8
Nusa Tenggara Barat	316.3	15.9	8.5	56.8	235.0
Nusa Tenggara Timur	984.1	35.1	26.4	218.9	703.8
Timor Timur	287.1	19.1	0.1	76.8	191.1
Bali & NT	**1,661.9**	**70.2**	**40.2**	**419.8**	**1,131.7**
Kalimantan Barat	1,996.9	119.0	31.5	897.7	948.7
Kalimantan Tengah	2,377.2	179.3	62.4	410.7	1,724.8
Kalimantan Selatan	589.2	139.5	0.0	363.1	86.7
Kalimantan Timur	1,771.5	91.6	72.0	1,068.5	539.4
Kalimantan	**6,734.8**	**529.3**	**166.0**	**2,740.0**	**3,299.5**
Sulawesi Utara	327.8	10.4	18.9	40.2	258.2
Sulawesi Tengah	515.5	37.7	41.4	36.1	400.2
Sulawesi Selatan	717.8	96.6	47.4	127.0	446.8
Sulawesi Tenggara	455.3	26.1	15.8	171.2	242.2
Sulawesi	**2,016.4**	**170.8**	**123.6**	**374.5**	**1,347.4**
Maluku	875.5	131.3	64.2	227.8	452.2
Irian Jaya	4,793.0	1,161.9	661.1	337.2	2,632.8
Maluku & IJ	**5,668.5**	**1,293.2**	**725.3**	**565.1**	**3,084.9**
Indonesia	**24,951.3**	**2,432.4**	**1,790.9**	**8,117.2**	**12,610.8**

Source: JICA-FIDP Team calculation based on RePPProT

Table 3.5 Irrigation Development Potential Area by Province in 1990

('000 ha)

Province	Irrigable Rainfed <1>	Fully suitable <2>	Conditionally suitable <3>	Marginally suitable <4>	Total
D.I. Aceh	80	33	56	109	277
Sumatera Utara	128	40	93	243	505
Sumatera Barat	45	19	47	64	175
Riau	36	146	166	573	922
Jambi	22	36	67	448	574
Sumatera Selatan	35	50	214	1,015	1,314
Bengkulu	7	11	11	55	85
Lampung	34	7	25	424	490
Sumatera	388	342	681	2,932	4,342
D.K.I. Jakarta	1	0	0	2	3
Jawa Barat	176	8	17	436	636
Jawa Tengah	229	19	12	257	517
D.I. Yogyakarta	7	0	2	13	22
Jawa Timur	189	0	24	378	591
Jawa	602	27	55	1,086	1,769
Bali	0	0	5	67	73
Nusa Tenggara Barat	19	16	8	57	101
Nusa Tenggara Timur	9	35	26	219	289
Timor Timur	0	19	0	77	96
Bali & NT	29	70	40	420	559
Kalimantan Barat	106	119	32	898	1,155
Kalimantan Selatan	29	179	62	411	681
Kalimantan Tengah	100	139	0	363	602
Kalimantan Timur	23	92	72	1,069	1,255
Kalimantan	258	529	166	2,740	3,693
Sulawesi Utara	8	10	19	40	78
Sulawesi Tengah	7	38	41	36	122
Sulawesi Tenggara	202	97	47	127	473
Sulawesi Selatan	3	26	16	171	216
Sulawesi	220	171	124	375	889
Maluku	0	131	64	228	423
Irian Jaya	0	1,162	661	337	2,160
Maluku & IJ	0	1,293	725	565	2,584
Indonesia	1,496	2,432	1,791	8,117	13,836

Notes:
(1): Estimated irrigable area within present rainfed paddy field, based on CBS data and FIDP land suitability study.
(2), (3), (4): Paddy field extension potential by FIDP land potential study.

Source: JICA-FIDP Team calculation.

Table 3.6 SWS and River Basin (1/3)

No.	Representative Province	SWS Code	Name of SWS	Code of River Basin	Name of River Basin
	SUMATERA				
1	D.I.Aceh	101	Krueng Aceh	1010	Krueng Aceh
2	D.I.Aceh	102	Meureudu ureun	1020	Meureudu ureun
3	D.I.Aceh	103	Pase Peusangan	1030	Pase Peusangan
4	D.I.Aceh	104	Jambu Aye	1040	Jambu Aye
5	D.I.Aceh	105	Tamiyang Langsa	1050	Tamiyang Langsa
6	D.I.Aceh	106	Woyla Wambesi	1060	Woyla Wambesi
7	D.I.Aceh	107	Singkulat Tripa	1071	Singkulat Tripa
8				1072	Simeulue
9	Sumatera Utara	108	Singkil	1080	Singkil
10	Sumatera Utara	109	Wampu Besitang	1090	Wampu Besitang
11	Sumatera Utara	110	Belawan Belumai	1100	Belawan Belumai
12	Sumatera Utara	111	S.Pagurawan S.Bahbolan	1110	S.Pagurawan S.Bahbolan
13	Sumatera Utara	112	Asahan	1121	Asahan
14				1122	Silau
15	Sumatera Utara	113	Barumun Kualuh	1131	Kualuh
16				1132	Barumun
17	Sumatera Utara	114	Bt.Gadis	1141	Bt.Gadis
18				1142	Nias Tanahmasa
19	Riau	115	Rokan	1150	Rokan
20	Riau	116	Siak	1161	Siak
21				1162	Bengkalis Rupat
22	Riau	117	Kampar	1171	Kampar
23				1172	Batam Bintan
24	Riau	118	Indragiri	1181	Indragiri
25				1182	Singkep Lingga
26	Sumatera Barat	119	Silaut	1191	Silaut
27				1192	Pagai
28	Sumatera Barat	120	Anai Sualang	1201	Anai Sualang
29				1202	Siberut
30	Jambi	121	Bt Hari	1210	Bt Hari
31	Sumatera Selatan	122	Sugihan	1220	Sugihan
32	Sumatera Selatan	123	Baturusa Cerucut	1230	Baturusa Cerucut
33	Sumatera Selatan	124	Musi	1241	Musi
34				1242	Lalang
35	Lampung	125	Mesuji Tl.Bawang	1250	Mesuji Tl.Bawang
36	Lampung	126	Seputih Sekampung	1261	Seputih
37				1262	Sekampung
38	Lampung	127	Semangko	1270	Semangko
39	Bengkulu	128	Kanal-Alas Talo	1280	Kanal-Alas Talo
40	Bengkulu	129	Lais-Bintunan	1290	Lais-Bintunan
41	Bengkulu	130	Ipuy-Temarang	1300	Ipuy-Temarang
	Total Unit	30		41	

Table 3.6 SWS and River Basin (2/3)

No.	Representative Province	SWS Code	Name of SWS	Code of River Basin	Name of River Basin
	JAWA				
42	Jawa Barat	201	Ciujung-Cilimin	2011	Labuhan Merak
43				2012	Ciujung
44	DKI.Jakarta	202	Cisadane-Ciliwung	2020	Cisadane-Ciliwung
45	Jawa Barat	203	Cisadeg-Cikuningan	2030	Cisadeg-Cikuningan
46	Jawa Barat	204	Citarum	2041	Citarum Hulu
47				2042	Citarum Hilir
48	Jawa Barat	205	Cimanuk	2051	Cimanuk
49				2052	Cisanggarung
50	Jawa Barat	206	Ciwulan	2060	Ciwulan
51	Jawa Tengah	207	Citanduy	2070	Citanduy
52	Jawa Tengah	208	Pemali Comal	2080	Pemali Comal
53	Jawa Tengah	209	Serayu	2091	Serayu
54				2092	Lukulo Dulang
55	Jawa Tengah	210	Jratun Seluna	2101	Buyaran
56				2102	Serang Lusi
57				2103	Geris Juana
58	Jawa Tengah	211	Progo-Opak-Oyo	2111	Progo
59				2112	Opak-Oyo
60	Jawa Tengah	212	Bengawan Solo	2121	Bengawan Solo-hulu
61	Jawa Tengah			2122	Bengawan Solo-hilir
62	Jawa Timur			2123	Grindulu Panggul
63	Jawa Timur	213	K.Brantas	2131	K.Brantas-hilir
64	Jawa Timur			2132	K.Brantas-hulu
65	Jawa Timur			2133	Luminu Penguluran
66	Jawa Timur	214	Pekalen Sampean	2141	Pekalen Sampean
67	Jawa Timur			2142	Bedadung
68	Jawa Timur			2143	Bajulputih
69	Jawa Timur	215	Madura	2150	Madura
	Total Unit	15		28	
	BALI				
70	Bali	301	Bali	3011	Bali-Singaraja
71	Bali			3012	Bali-denpasa
72	Nusa Tenggara Barat	302	Lombok	3020	Lombok
73	Nusa Tenggara Barat	303	Sumbawa	3030	Sumbawa
74	Nusa Tenggara Timur	304	Sumbawa	3040	Sumbawa
75	Nusa Tenggara Timur	305	Flores	3050	Flores
76	Nusa Tenggara Timur	306	Westt Timor	3060	Westt Timor
77	Timor Timur	307	East Timor	3070	East Timor
	Total Unit	7		8	
	KALIMATAN				
78	Kalimantan Selatan	401	Cengal-Batulicin	4010	Cengal-Batulicin
79	Kalimantan Tengah	402	Barito	4021	Barito-hulu
80	Kalimantan Selatan			4022	Barito-hilir
81	Kalimantan Tengah	403	Kahayan	4030	Kahayan
82	Kalimantan Tengah	404	Mendawi	4040	Mendawi
83	Kalimantan Tengah	405	Sampit	4050	Sampit
84	Kalimantan Tengah	406	Pembuang	4061	Pembuang
85	Kalimantan Tengah			4062	Lamandau Arut
86	Kalimantan Barat	407	Pawan	4070	Pawan
87	Kalimantan Barat	408	Kapuas	4080	Kapuas
88	Kalimantan Barat	409	Mempawah,Sambas	4090	Mempawah,Sambas
89	Kalimantan Timur	410	Sesayap	4100	Sesayap
90	Kalimantan Timur	411	Kayan	4110	Kayan
91	Kalimantan Timur	412	Berau-Kelai	4120	Berau-Kelai
92	Kalimantan Timur	413	Karangan	4130	Karangan
93	Kalimantan Timur	414	Mahakam	4141	Mahakam
94	Kalimantan Timur			4142	Balikpapan
	Total Unit	14		17	

Table 3.6 SWS and River Basin (3/3)

No.	Representative Province	SWS Code	Name of SWS	Code of River Basin	Name of River Basin
	SULAWESI				
95	Sulawesi Utara	501	Ranowangko Tondano	5011	Manado
96	Sulawesi Utara			5012	Onggak Dumaga
97	Sulawesi Utara	501	Ranowangko Tondano	5013	Sangir
98	Sulawesi Utara	502	Limboto,Bone	5021	Sangkup
99	Sulawesi Utara			5022	Limboto
100	Sulawesi Utara	503	Paguyaman,Randangan	5031	Paleleh
101	Sulawesi Utara			5032	Paguyaman,Randangan
102	Sulawesi Tengah	504	Lambunu Bual	5041	Bual
103	Sulawesi Tengah			5042	Lambunu
104	Sulawesi Tengah	505	Parigi Poso	5050	Parigi Poso
105	Sulawesi Tengah	506	Bongka Malik	5061	Bongka
106	Sulawesi Tengah			5062	Bunta
107	Sulawesi Tengah	507	Lombak,Mantawa	5070	Lombak,Mantawa
108	Sulawesi Tengah	508	Laa-Tambalako	5080	Laa-Tambalako
109	Sulawesi Tengah	509	Palu-Lariang	5091	Palu
110	Sulawesi Tengah			5092	Lariang
111	Sulawesi Tenggara	510	Lasolo-Sumpara	5101	Sumpara
112	Sulawesi Tenggara			5102	Lasolo
113	Sulawesi Tenggara	511	Paleang-Roraya	5111	Roraja
114	Sulawesi Tenggara			5112	Muna Buton
115	Sulawesi Tenggara	512	Tosari-Susua	5120	Tosari-Susua
116	Sulawesi Selatan	513	Kaluku-Karama	5131	Budung-budung
117	Sulawesi Selatan			5132	Karama
118	Sulawesi Selatan			5133	Mamuju
119	Sulawesi Selatan	514	Pompengan-Kalaena Larom	5141	Rongkong
120	Sulawesi Selatan			5142	Balease
121	Sulawesi Selatan			5143	Kalaena
122	Sulawesi Selatan			5144	Laroma
123	Sulawesi Selatan	515	Sadang	5151	Mapili
124	Sulawesi Selatan			5152	Sadang
125	Sulawesi Selatan			5153	Supa Lipukasi
126	Sulawesi Selatan	516	Walanae-Cenranae	5161	Paremang Gilirang
127	Sulawesi Selatan			5162	Walanae
128	Sulawesi Selatan	517	Jeneberang	5171	Jeneberang
129	Sulawesi Selatan			5172	Selayar
	Total Unit	17		25	
	MALUKU & IRIAN JAYA				
130	Maluku	601	Southeast Maluku	6010	Maluku Tenggara
131	Maluku	602	Central Maluku	6020	Maluku Tengah
132	Maluku	603	North Maluku	6030	Maluku Utara
133	Irian Jaya	701	Wasi-Kias Omba	7010	Wasi-Kias Omba
134	Irian Jaya	702	Mamberamo	7020	Mamberamo
135	Irian Jaya	703	Eilanden Edera	7030	Eilanden Edera
136	Irian Jaya	704	Digul Bikuma	7040	Digul Bikuma
	Total Unit	7		7	

Note : SWS are sub-divided into 136 River basin

Source : Regulation of Minister of Public Works No. 39/1989

Table 3.7 Estimated River Basin Discharge (1/3)

(Unit '000,000 m3)

River Basin Code	Representative Province	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1010	D.I.Aceh	243	130	134	190	122	37	32	61	109	219	340	280	1,896
1020	D.I.Aceh	226	109	134	134	75	25	22	47	75	159	251	226	1,484
1030	D.I.Aceh	426	162	276	300	324	96	72	156	306	456	444	473	3,488
1040	D.I.Aceh	546	156	248	276	347	170	177	241	454	546	617	730	4,507
1050	D.I.Aceh	523	122	272	414	557	360	380	543	740	971	801	713	6,393
1060	D.I.Aceh	824	509	1,047	1,226	781	495	473	774	738	1,068	1,420	860	10,216
1071	D.I.Aceh	954	707	1,313	1,515	954	685	606	1,033	1,055	1,470	1,684	1,145	13,120
1072	D.I.Aceh	143	108	183	198	157	147	161	232	204	267	310	218	2,326
1080	Sumatera Utara	1,174	868	1,608	1,978	1,318	659	804	1,142	1,318	1,897	2,154	1,688	16,608
1090	Sumatera Utara	455	93	216	347	686	393	324	571	733	987	686	725	6,216
1100	Sumatera Utara	359	176	264	379	521	372	372	501	663	852	643	467	5,568
1110	Sumatera Utara	200	98	162	203	240	166	196	274	348	484	325	237	2,932
1121	Sumatera Utara	58	37	70	78	67	27	29	53	82	114	111	82	807
1122	Sumatera Utara	312	196	373	416	361	147	153	281	441	612	593	441	4,325
1131	Sumatera Utara	590	253	388	531	573	363	430	573	886	1,172	945	666	7,370
1132	Sumatera Utara	1,000	600	864	782	546	200	109	436	582	900	1,018	1,018	8,055
1141	Sumatera Utara	1,400	1,174	1,731	1,957	1,235	723	798	1,310	1,536	2,198	2,364	2,017	18,442
1142	Sumatera Utara	472	366	541	700	477	445	429	710	716	981	1,044	784	7,664
1150	Riau	2,429	1,385	2,134	2,043	1,408	931	500	1,249	1,680	2,770	2,838	2,997	22,363
1161	Riau	1,293	1,031	1,555	1,555	1,206	612	612	1,014	1,380	1,957	1,905	1,625	15,744
1162	Riau	380	235	489	591	459	229	205	326	374	585	742	646	5,262
1171	Riau	3,498	2,374	3,248	3,092	2,686	1,312	1,187	1,718	2,342	3,436	4,185	4,154	33,231
1172	Riau	333	142	221	303	292	221	221	228	228	341	397	352	3,279
1181	Riau	3,223	2,401	3,159	3,349	2,180	979	758	1,453	2,275	3,349	3,633	3,855	30,615
1182	Riau	347	165	343	393	393	275	271	313	288	398	457	512	4,154
1191	Sumatera Barat	1,186	834	994	1,132	903	635	581	857	1,201	1,568	1,606	1,545	13,042
1192	Sumatera Barat	195	189	197	224	168	138	146	267	204	293	326	312	2,658
1201	Sumatera Barat	883	695	1,088	1,364	856	517	544	865	1,096	1,462	1,578	1,444	12,391
1202	Sumatera Barat	385	235	343	447	328	351	289	393	470	574	617	551	4,983
1210	Jambi	5,391	4,322	4,990	4,856	3,386	2,005	1,649	2,183	2,807	4,144	5,035	6,059	46,826
1220	Sumatera Selatan	1,285	1,030	1,189	1,158	807	478	393	520	669	988	1,200	1,444	11,161
1230	Sumatera Selatan	2,359	1,188	1,505	1,606	1,505	987	803	585	636	1,255	1,924	2,710	17,061
1241	Sumatera Selatan	8,242	6,430	7,483	6,430	4,150	2,163	1,637	2,631	2,572	4,501	6,489	8,126	60,854
1242	Sumatera Selatan	1,821	1,277	2,235	1,803	1,634	789	469	695	695	1,540	1,821	2,629	17,406
1250	Lampung	2,176	1,761	1,960	1,611	947	498	332	233	449	631	1,395	2,176	14,168
1261	Lampung	1,208	880	915	561	380	302	207	130	164	285	768	1,131	6,931
1262	Lampung	647	568	574	473	298	225	135	96	124	270	411	619	4,440
1270	Lampung	614	544	501	579	431	332	353	445	544	996	854	699	6,891
1280	Bengkulu	1,046	839	958	998	615	503	431	599	823	1,190	1,438	1,254	10,693
1290	Bengkulu	965	816	920	978	725	453	395	609	829	1,204	1,179	1,140	10,211
1300	Bengkulu	582	390	481	516	405	248	268	400	597	906	795	805	6,393
	Sumatera												Total	482,173

Table 3.7 Estimated River Basin Discharge (2/3)

(Unit '000,000 m3)

River Basin Code	Representative Province	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2011	Jawa Barat	438	329	329	247	205	99	79	72	101	203	285	386	2,773
2012	Jawa Barat	360	315	317	330	250	152	120	137	145	227	250	292	2,896
2020	DKI Jakarta	586	506	393	317	277	136	88	84	144	245	301	329	3,406
2030	Jawa Barat	1,781	1,437	1,670	1,366	901	506	385	304	405	1,225	1,903	1,893	13,775
2041	Jawa Barat	688	582	521	371	269	102	45	33	33	155	371	497	3,666
2042	Jawa Barat	879	751	919	775	512	152	88	72	176	488	879	927	6,619
2051	Jawa Barat	512	412	504	412	352	234	243	143	243	629	712	603	5,001
2052	Jawa Barat	185	165	208	288	368	358	401	252	250	582	530	309	3,896
2060	Jawa Barat	1,328	1,113	1,159	664	410	124	52	52	52	176	579	1,035	6,744
2070	Jawa Tengah	852	721	821	538	402	188	162	63	110	397	627	794	5,675
2080	Jawa Tengah	1,140	923	711	390	296	123	64	40	40	173	346	661	4,906
2091	Jawa Tengah	697	573	709	558	403	155	143	94	166	464	716	765	5,442
2092	Jawa Tengah	560	460	508	328	206	118	74	29	29	331	545	545	3,732
2101	Jawa Tengah	501	377	355	249	168	47	25	25	25	103	209	339	2,422
2102	Jawa Tengah	471	368	364	209	121	30	30	30	30	133	269	429	2,485
2103	Jawa Tengah	648	463	352	196	128	53	29	29	29	64	192	345	2,526
2111	Jawa Tengah	434	376	412	254	155	47	22	22	22	119	271	387	2,519
2112	Yogyakarta	388	367	325	144	76	21	21	21	21	55	186	309	1,935
2121	Jawa Tengah	1,462	1,361	1,431	901	521	120	80	80	80	300	911	1,231	8,479
2122	Jawa Tengah	919	823	919	439	232	64	64	64	64	136	471	807	5,001
2123	Jawa Timur	196	172	161	74	85	23	50	13	27	127	177	207	1,311
2131	Jawa Timur	966	879	835	433	251	50	50	50	50	63	333	678	4,637
2132	Jawa Timur	880	805	834	560	385	122	64	47	47	292	659	898	5,591
2133	Jawa Timur	400	292	320	212	154	138	129	37	40	249	320	387	2,677
2141	Jawa Timur	714	633	538	252	152	38	38	38	38	38	238	481	3,198
2142	Jawa Timur	761	648	679	417	288	113	82	41	62	303	591	776	4,761
2143	Jawa Timur	603	593	573	233	243	167	152	41	41	137	274	512	3,568
2150	Jawa Timur	612	465	493	340	210	51	45	45	45	45	215	488	3,056
	Jawa												Total	122,699
3011	Bali	203	184	154	62	27	12	12	12	12	12	42	126	858
3012	Bali	557	456	347	142	117	113	159	34	38	176	289	469	2,896
3020	Nusa Tenggara Barat	524	415	348	104	63	36	36	36	36	36	172	402	2,208
3030	Nusa Tenggara Barat	1,646	1,448	1,174	412	122	122	122	122	122	122	518	1,356	7,285
3040	Nusa Tenggara Timur	1,355	1,192	1,062	585	249	87	87	87	87	152	499	1,094	6,534
3050	Nusa Tenggara Timur	1,851	1,553	1,329	672	254	119	119	119	119	149	687	1,493	8,466
3060	Nusa Tenggara Timur	1,919	1,818	1,313	404	263	162	162	162	162	162	424	1,434	8,383
3070	Timor Timur	1,672	1,627	1,356	753	904	482	121	121	121	121	618	1,386	9,280
	Bali & Nusa Tenggara												Total	45,909
4010	Kalimantan Selatar	1,671	1,557	1,768	1,233	1,249	1,411	1,200	697	568	406	762	1,249	13,770
4021	Kalimantan Tengah	5,510	4,698	5,680	5,979	4,484	3,032	1,922	2,093	2,477	3,844	5,552	6,321	51,592
4022	Kalimantan Selatar	4,955	4,275	4,577	3,329	2,459	1,589	1,021	643	757	1,589	3,253	4,955	33,401
4030	Kalimantan Tengah	2,249	1,869	1,990	2,215	2,007	1,713	986	865	1,765	1,557	2,578	2,457	22,252
4040	Kalimantan Tengah	2,056	2,174	2,292	2,481	2,008	1,512	969	780	1,394	2,174	2,174	3,142	23,154
4050	Kalimantan Tengah	1,488	1,455	1,989	1,859	1,294	1,100	711	792	986	1,310	1,617	1,617	16,217
4061	Kalimantan Tengah	1,339	1,277	1,542	1,526	1,464	1,137	763	561	670	1,230	1,417	1,635	14,559
4062	Kalimantan Tengah	2,187	2,085	2,518	2,492	2,390	1,856	1,246	915	1,093	2,009	2,314	2,670	23,776
4070	Kalimantan Barat	3,936	2,893	3,398	3,869	3,431	2,389	1,548	1,480	2,220	3,801	4,743	4,609	38,317
4080	Kalimantan Barat	12,231	9,938	11,180	11,180	9,556	6,976	5,542	6,689	9,365	12,518	14,047	12,422	121,644
4090	Kalimantan Barat	1,768	976	820	934	1,004	750	594	750	962	1,584	1,952	1,952	14,046
4100	Kalimantan Timur	2,020	1,831	2,399	2,999	3,630	3,315	3,220	3,630	3,536	3,125	4,199	2,904	36,808
4110	Kalimantan Timur	3,433	3,070	3,532	3,466	3,367	2,574	2,541	2,871	3,400	3,664	4,192	3,433	39,540
4120	Kalimantan Timur	1,453	1,223	1,090	1,109	1,051	516	688	612	765	898	1,529	1,491	12,425
4130	Kalimantan Timur	1,138	975	1,321	1,280	1,199	975	589	853	752	874	1,199	1,646	12,798
4141	Kalimantan Timur	6,743	5,968	7,441	8,371	7,131	4,883	3,333	2,945	3,643	5,116	7,441	8,294	71,309
4142	Kalimantan Timur	1,150	893	1,301	1,120	1,120	953	832	696	560	363	878	1,226	11,091
	Kalimantan												Total	556,700

Table 3.7 Estimated River Basin Discharge (3/3)

(Unit '000,000 m3)

River Basin Code	Representative Province	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
5011	Sulawesi Utara	532	407	359	351	340	259	185	126	133	200	359	458	3,708
5012	Sulawesi Utara	317	242	244	205	178	130	100	64	78	107	203	262	2,130
5013	Sulawesi Utara	704	488	488	545	583	628	501	330	273	323	583	621	6,067
5021	Sulawesi Utara	491	381	290	260	309	234	146	101	107	231	322	348	3,220
5022	Sulawesi Utara	141	126	141	171	145	141	93	56	30	56	122	160	1,380
5031	Sulawesi Utara	158	122	93	84	99	75	47	32	34	74	103	112	1,034
5032	Sulawesi Utara	247	221	247	299	254	247	163	98	52	98	215	280	2,421
5041	Sulawesi Tengah	980	789	662	526	517	553	399	336	299	308	671	816	6,857
5042	Sulawesi Tengah	33	33	58	137	208	249	233	154	83	33	54	33	1,309
5050	Sulawesi Tengah	495	592	776	1,280	1,164	854	563	369	349	446	631	592	8,109
5061	Sulawesi Tengah	250	184	267	347	478	444	489	482	284	153	166	191	3,734
5062	Sulawesi Tengah	399	293	426	554	764	709	781	770	454	244	266	305	5,962
5070	Sulawesi Tengah	125	156	297	398	640	1,000	882	406	219	70	63	187	4,443
5080	Sulawesi Tengah	937	918	1,164	1,363	1,164	975	814	606	256	237	596	890	9,917
5091	Sulawesi Tengah	383	315	375	443	426	349	273	247	239	204	315	341	3,910
5092	Sulawesi Tengah	284	234	278	329	316	259	202	183	177	152	234	253	2,900
5101	Sulawesi Tenggara	353	390	434	471	677	537	397	221	96	59	221	250	4,106
5102	Sulawesi Tenggara	356	394	438	475	683	542	401	223	97	59	223	253	4,144
5111	Sulawesi Tenggara	446	452	518	393	583	603	334	92	59	52	105	328	3,964
5112	Sulawesi Tenggara	670	679	642	651	774	623	255	76	76	76	170	594	5,283
5120	Sulawesi Tenggara	491	479	622	665	727	460	348	230	155	205	280	330	4,992
5131	Sulawesi Selatan	301	325	427	499	393	270	157	103	120	144	304	321	3,365
5132	Sulawesi Selatan	499	539	709	828	652	448	261	170	198	238	505	533	5,578
5133	Sulawesi Selatan	306	174	184	207	220	194	92	62	89	145	237	296	2,204
5141	Sulawesi Selatan	336	362	431	455	397	295	159	84	64	125	290	376	3,373
5142	Sulawesi Selatan	357	330	424	460	443	376	235	195	130	122	187	365	3,622
5143	Sulawesi Selatan	369	356	497	535	480	352	273	204	124	114	245	335	3,882
5144	Sulawesi Selatan	378	354	547	612	495	399	294	185	161	129	290	330	4,174
5151	Sulawesi Selatan	158	133	166	253	237	161	109	65	101	136	142	174	1,835
5152	Sulawesi Selatan	513	576	751	877	670	445	269	125	125	257	495	639	5,741
5153	Sulawesi Selatan	778	540	468	299	198	75	26	26	26	81	335	719	3,572
5161	Sulawesi Selatan	94	47	168	360	701	556	447	259	286	176	118	78	3,290
5162	Sulawesi Selatan	348	290	385	588	813	588	348	131	58	131	276	305	4,259
5171	Sulawesi Selatan	958	659	509	288	195	101	30	30	30	30	270	719	3,818
5172	Sulawesi Selatan	335	322	440	700	1,103	911	483	130	50	50	155	360	5,039
	Sulawesi												Total	143,343
6010	Maluku	2,066	1,531	1,475	1,457	1,549	848	184	148	148	148	332	1,605	11,490
6020	Maluku	1,276	1,138	1,498	2,303	3,773	4,356	4,356	3,024	1,748	832	638	1,248	26,190
6030	Maluku	1,873	1,619	1,746	2,445	3,048	2,857	2,349	1,778	1,460	1,206	1,683	2,032	24,096
7010	Irian Jaya	10,433	10,123	11,156	10,743	11,156	9,916	8,470	8,160	7,747	6,611	6,817	9,400	110,730
7020	Irian Jaya	14,304	14,166	15,693	12,638	11,249	9,999	9,721	10,277	10,277	9,860	10,416	12,638	141,238
7030	Irian Jaya	7,500	8,084	9,545	9,350	9,934	11,201	11,395	11,493	9,447	6,136	6,233	7,110	107,428
7040	Irian Jaya	9,009	8,479	10,220	7,646	6,511	3,785	3,407	3,407	3,937	4,391	5,451	9,009	75,251
	Maluku & Irian Jaya												Total	496,422

Source: JICA-FIDP Team calculation

Table 3.8 Parameter Assumption on Irrigation Water Requirement

Parameter	Method/Source
Evapotranspiration	The available data by Penman method by RePPProT.
Effective Rainfall	by multiplying proportion by monthly probable rainfall Proportion = Table 8, EFFECTIVE RAINFALL, No.25 by FAO For paddy = 84% ~ 62%, Max. = 175 mm/month For palawija = 72% ~ 63%, Max. = 100 mm/month
Percolation	Paddy Land = 2 mm/day *)
Water Requirement of Land Preparatio	The land preparation period = 30 days. *) Water Requirement = 250 mm *) Van de Goor and Zijlstra's formula is used: **) $IR = Me^{k} / (e^{k}-1)$ Where; IR : Irrigation requirement at field level (mm/day) M : Water requirements to compensate for evaporation and percolation of the fields already saturated (mm/day M=Eo+p Eo is open water evaporation taken at 1.1 ETo during land preparation (mm/day) K : MT/S T : land preparation period (days) S : presaturation requirements
Water Layer Replacement	50 mm at about 1 month and 2 months after transplanting. **)
Consumptive Use	The consumptive use is calculated as **) Etc = kc x Eto Where : Etc : crop evapotranspiration (mm/day) Eto : reference crop evapotranspiration (mm/day) kc : crop coefficient
Crop Coefficients **)	Growth — Crop Coefficient (kc): Paddy / Palawija First month 1.10 / 0.67 Second month 1.05 / 1.00 Third month 0.95 / 0.75
Irrigation Efficiency	55% for paddy field *) 50% for palawija field. *)

Remarks : *)Assumed by JICA-FIDP Team
**)Source by Irrigation Design Standards published by DGWRD, Ministry of Public Works

Table 3.9 Annual Water Demand by Basin in 2020 (1/3)

(Unit MCM m3)

River Basin Code	Representative Province	DMI	River Maintenance	Irrigation	Fishpond	Livestock	Total
1010	D.I.Aceh	56.0	84.5	209.5	19.7	1.0	370.7
1020	D.I.Aceh	12.7	13.3	339.8	17.6	0.7	384.1
1030	D.I.Aceh	51.9	68.7	529.4	23.7	1.4	675.0
1040	D.I.Aceh	23.9	31.6	251.9	11.7	1.7	320.8
1050	D.I.Aceh	23.9	31.5	223.3	11.2	1.7	291.7
1060	D.I.Aceh	12.3	10.9	208.5	14.8	1.7	248.2
1071	D.I.Aceh	13.9	14.0	268.5	6.9	2.7	306.0
1072	D.I.Aceh	2.6	2.5	28.6	1.6	0.5	35.8
1080	Sumatera Utara	22.1	17.6	938.5	17.6	5.3	1,001.1
1090	Sumatera Utara	165.7	161.4	478.3	13.0	3.6	821.9
1100	Sumatera Utara	471.6	492.4	1,435.8	21.5	3.2	2,424.6
1110	Sumatera Utara	31.1	38.7	591.7	6.4	1.6	669.4
1121	Sumatera Utara	38.7	60.5	97.9	2.7	0.5	200.3
1122	Sumatera Utara	38.7	52.7	496.2	15.7	2.4	605.7
1131	Sumatera Utara	37.5	51.7	400.9	14.6	4.0	508.7
1132	Sumatera Utara	27.2	33.8	352.9	15.7	4.2	433.9
1141	Sumatera Utara	31.9	29.4	915.4	45.3	7.2	1,029.3
1142	Sumatera Utara	17.7	13.0	65.7	1.2	2.5	100.2
1150	Riau	34.9	32.1	311.9	34.9	4.8	418.6
1161	Riau	62.5	86.7	31.2	8.5	1.7	190.6
1162	Riau	10.3	11.0	0.0	1.8	0.6	23.7
1171	Riau	135.6	123.9	307.1	40.9	4.0	611.4
1172	Riau	49.4	78.4	2.5	1.3	0.4	132.0
1181	Riau	73.4	81.2	890.7	77.9	6.9	1,130.1
1182	Riau	14.5	21.7	0.8	0.8	0.4	38.2
1191	Sumatera Barat	16.5	14.6	323.5	6.1	3.8	364.5
1192	Sumatera Barat	3.8	4.4	45.6	3.6	0.8	58.2
1201	Sumatera Barat	135.0	131.9	945.0	57.7	4.6	1,274.3
1202	Sumatera Barat	9.7	11.3	152.8	9.3	2.0	185.0
1210	Jambi	186.3	165.4	846.4	137.2	12.3	1,347.6
1220	Sumatera Selatan	19.8	19.0	97.6	11.2	2.9	150.6
1230	Sumatera Selatan	44.6	57.3	18.6	78.3	4.6	203.5
1241	Sumatera Selatan	403.0	357.2	1,299.4	136.1	16.8	2,212.5
1242	Sumatera Selatan	35.8	37.2	53.8	41.2	4.9	172.8
1250	Lampung	46.2	15.7	308.9	118.3	10.6	499.7
1261	Lampung	44.5	24.6	1,232.9	37.0	6.7	1,345.7
1262	Lampung	85.9	95.9	584.2	34.3	4.3	804.6
1270	Lampung	46.2	34.7	266.4	60.0	5.4	412.7
1280	Bengkulu	70.4	108.4	195.6	50.1	4.4	428.9
1290	Bengkulu	13.7	8.8	151.5	30.9	3.6	208.5
1300	Bengkulu	8.4	3.6	92.8	18.3	2.4	125.6
	Sumatera	2,629.5	2,733.3	15,992.0	1,256.6	154.8	22,766.3

Table 3.9 Annual Water Demand by Basin in 2020 (2/3)

(Unit MCM m3)

River Basin Code	Representative Province	DMI	River Maintenance	Irrigation	Fishpond	Livestock	Total
2011	Jawa Barat	47.0	48.1	696.5	11.0	3.5	806.0
2012	Jawa Barat	64.3	79.2	659.8	8.5	3.5	815.3
2020	DKI.Jakarta	2,526.5	2,688.8	1,460.2	34.2	5.3	6,715.0
2030	Jawa Barat	288.0	245.7	1,833.5	84.7	14.3	2,466.2
2041	Jawa Barat	684.7	708.0	1,514.6	83.4	5.8	2,996.4
2042	Jawa Barat	1,038.8	1,058.4	6,646.6	70.9	11.1	8,825.8
2051	Jawa Barat	162.2	137.6	2,665.0	52.9	6.1	3,023.8
2052	Jawa Barat	316.1	320.6	1,781.2	79.3	3.9	2,501.0
2060	Jawa Barat	201.6	164.9	1,894.2	186.5	9.2	2,456.5
2070	Jawa Tengah	164.2	134.0	1,570.3	99.3	9.0	1,976.9
2080	Jawa Tengah	515.6	517.6	2,616.3	1.4	10.4	3,661.3
2091	Jawa Tengah	159.6	133.8	919.8	18.2	7.9	1,239.2
2092	Jawa Tengah	83.6	83.7	1,180.6	10.1	7.8	1,365.8
2101	Jawa Tengah	297.0	290.5	1,308.6	0.5	6.6	1,903.2
2102	Jawa Tengah	153.7	138.9	996.0	2.0	8.0	1,298.6
2103	Jawa Tengah	212.4	207.5	1,504.1	1.1	7.5	1,932.6
2111	Jawa Tengah	89.2	109.3	1,149.7	25.9	6.2	1,380.3
2112	Yogyakarta	197.0	196.3	842.4	6.4	6.7	1,248.8
2121	Jawa Tengah	450.9	404.0	4,989.2	3.3	19.8	5,867.2
2122	Jawa Tengah	189.5	145.2	2,381.8	9.5	15.1	2,741.2
2123	Jawa Timur	12.2	7.3	216.9	0.1	3.0	239.5
2131	Jawa Timur	863.8	885.4	3,758.1	3.0	11.6	5,521.9
2132	Jawa Timur	353.1	341.3	1,743.9	1.9	10.8	2,451.0
2133	Jawa Timur	67.1	82.5	800.7	0.8	5.7	956.8
2141	Jawa Timur	210.2	190.6	2,345.5	0.2	8.8	2,755.3
2142	Jawa Timur	95.6	106.6	2,186.4	2.0	9.5	2,400.1
2143	Jawa Timur	69.9	75.5	2,192.5	0.9	9.4	2,348.2
2150	Jawa Timur	93.2	83.9	686.3	7.3	10.5	881.2
	Jawa	9,607.0	9,585.4	52,540.7	805.4	237.0	72,775.4
3011	Bali	20.9	22.0	364.9	0.3	5.5	413.5
3012	Bali	176.8	171.8	2,012.7	3.4	15.2	2,379.9
3020	Nusa Tenggara Barat	100.0	106.9	2,052.4	5.2	5.0	2,269.4
3030	Nusa Tenggara Barat	38.6	37.1	1,126.6	10.9	16.9	1,230.1
3040	Nusa Tenggara Timur	21.6	25.8	406.6	6.6	8.0	468.6
3050	Nusa Tenggara Timur	43.9	43.4	861.1	2.6	11.0	961.9
3060	Nusa Tenggara Timur	55.6	53.7	750.3	14.2	14.6	888.3
3070	Timor Timur	28.2	19.0	195.0	0.4	7.2	249.7
	Bali & NT	485.5	479.6	7,769.6	43.5	83.4	8,861.6
4010	Kalimantan Selatan	36.2	46.0	122.7	26.0	5.3	236.3
4021	Kalimantan Tengah	11.3	10.7	854.4	75.3	0.9	952.6
4022	Kalimantan Selatan	163.2	143.8	720.0	292.2	6.6	1,325.8
4030	Kalimantan Tengah	19.5	25.0	215.5	21.1	0.3	281.4
4040	Kalimantan Tengah	21.7	29.8	125.3	10.2	0.5	187.5
4050	Kalimantan Tengah	9.1	11.5	48.7	3.5	0.3	73.1
4061	Kalimantan Tengah	9.6	12.6	49.2	3.4	0.3	75.1
4062	Kalimantan Tengah	27.7	42.4	91.4	2.7	0.7	164.8
4070	Kalimantan Barat	18.1	17.8	164.2	10.8	2.0	212.9
4080	Kalimantan Barat	156.8	137.7	803.8	184.1	5.6	1,288.1
4090	Kalimantan Barat	32.0	28.5	210.3	5.2	0.8	276.8
4100	Kalimantan Timur	8.2	13.0	26.4	2.7	0.9	51.3
4110	Kalimantan Timur	8.6	13.7	26.1	2.8	0.9	52.1
4120	Kalimantan Timur	4.7	7.2	11.6	0.5	0.5	24.5
4130	Kalimantan Timur	18.1	29.9	22.6	2.8	0.6	74.0
4141	Kalimantan Timur	149.8	159.0	110.4	16.5	2.2	437.8
4142	Kalimantan Timur	74.0	91.8	40.6	93.1	0.6	300.0
	Kalimantan	768.4	820.4	3,643.2	752.9	29	6,013.9

Table 3.9 Annual Water Demand by Basin in 2020 (3/3)

(Unit MCM m3)

River Basin Code	Representative Province	DMI	River Maintenance	Irrigation	Fishpond	Livestock	Total
5011	Sulawesi Utara	57.0	83.7	235.9	24.2	1.9	402.7
5012	Sulawesi Utara	4.8	5.6	120.3	3.2	1.2	135.1
5013	Sulawesi Utara	18.4	15.3	256.4	17.0	3.3	310.4
5021	Sulawesi Utara	6.5	7.2	149.7	4.5	1.7	169.5
5022	Sulawesi Utara	16.8	23.2	177.4	4.8	1.9	224.1
5031	Sulawesi Utara	1.7	1.5	28.6	1.2	0.6	33.6
5032	Sulawesi Utara	10.8	9.8	234.3	8.5	3.4	266.8
5041	Sulawesi Tengah	16.0	17.7	532.4	6.7	6.0	578.7
5042	Sulawesi Tengah	13.9	19.2	495.0	6.7	2.8	537.6
5050	Sulawesi Tengah	13.6	18.8	315.6	5.0	6.3	359.3
5061	Sulawesi Tengah	3.5	4.8	52.6	0.8	2.3	63.9
5062	Sulawesi Tengah	8.3	10.9	122.2	1.4	3.7	146.5
5070	Sulawesi Tengah	13.4	17.3	247.3	2.1	5.3	285.4
5080	Sulawesi Tengah	8.8	12.1	137.7	2.1	6.4	167.1
5091	Sulawesi Tengah	23.1	31.2	856.8	12.0	5.6	928.6
5092	Sulawesi Tengah	13.0	15.6	413.6	4.9	4.0	451.1
5101	Sulawesi Tenggara	17.2	22.7	224.8	5.1	4.0	273.9
5102	Sulawesi Tenggara	17.5	20.7	264.4	20.9	3.8	327.3
5111	Sulawesi Tenggara	21.3	29.9	182.0	16.5	3.4	253.0
5112	Sulawesi Tenggara	30.9	42.7	102.1	22.3	4.8	202.9
5120	Sulawesi Tenggara	10.6	9.1	221.6	39.1	3.2	283.6
5131	Sulawesi Selatan	3.0	1.7	53.4	0.3	2.0	60.4
5132	Sulawesi Selatan	7.3	5.7	287.0	4.8	3.4	308.2
5133	Sulawesi Selatan	6.9	7.4	97.1	0.6	2.0	114.0
5141	Sulawesi Selatan	3.6	2.5	192.0	4.6	1.7	204.4
5142	Sulawesi Selatan	3.4	2.3	159.8	4.3	1.6	171.4
5143	Sulawesi Selatan	4.3	3.0	221.4	5.4	2.1	236.2
5144	Sulawesi Selatan	4.4	3.7	186.5	5.8	2.0	202.4
5151	Sulawesi Selatan	11.8	15.2	485.0	3.1	1.6	516.7
5152	Sulawesi Selatan	17.6	14.9	963.1	4.6	3.7	1,004.0
5153	Sulawesi Selatan	23.1	24.4	949.1	2.8	1.9	1,001.3
5161	Sulawesi Selatan	11.0	11.1	638.7	22.5	2.3	685.6
5162	Sulawesi Selatan	25.8	24.8	2,100.4	21.9	4.2	2,177.1
5171	Sulawesi Selatan	203.8	204.9	1,089.2	59.7	2.2	1,559.8
5172	Sulawesi Selatan	32.9	28.7	1,449.5	4.6	3.7	1,519.4
	Sulawesi	685.7	769.3	14,242.9	354.2	110	16,162.2
6010	Maluku	15.2	20.6	0.0	0.0	1.5	37.4
6020	Maluku	59.0	80.7	127.3	0.0	2.2	269.1
6030	Maluku	44.5	56.7	6.2	0.0	2.5	109.9
7010	Irian Jaya	29.8	38.3	12.8	0.0	0.5	81.5
7020	Irian Jaya	48.7	56.1	10.6	0.0	0.7	116.1
7030	Irian Jaya	16.4	15.3	9.0	0.0	0.5	41.3
7040	Irian Jaya	11.6	14.4	15.9	0.0	0.4	42.3
	Maluku & IJ	225.3	282.2	181.8	0.0	8.3	697.6
	INDOONESIA	14,401	14,670	94,370	3,213	623	127,277

Source: JICA-FIDP Team Calculation.

Table 3.10 Estimation of Water Potential Area by River Basin (1/3)

('000 ha)

River Basin Code	Representative Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
1010	D.I.Aceh	21.3	20.2	18.2	16.4	14.3	12.7	10.2
1020	D.I.Aceh	2.4	2.2	1.8	1.5	1.2	0.9	0.6
1030	D.I.Aceh	48.6	47.6	45.8	44.4	42.6	41.3	39.3
1040	D.I.Aceh	76.3	76.1	75.7	75.4	75.0	74.8	74.3
1050	D.I.Aceh	55.5	55.3	54.9	54.6	54.3	54.0	53.6
1060	D.I.Aceh	393.5	393.4	393.2	393.0	392.8	392.7	392.5
1071	D.I.Aceh	495.6	495.5	495.3	495.2	495.0	494.9	494.7
1072	D.I.Aceh	79.6	79.6	79.6	79.5	79.5	79.5	79.4
1080	Sumatera Utara	326.3	326.2	325.9	325.7	325.5	325.4	325.2
1090	Sumatera Utara	14.2	13.3	11.7	10.8	8.2	7.7	6.3
1100	Sumatera Utara	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1110	Sumatera Utara	16.3	16.1	15.7	15.5	15.2	15.1	14.9
1121	Sumatera Utara	8.4	8.0	7.3	6.9	6.4	6.3	5.8
1122	Sumatera Utara	54.4	54.1	53.4	53.1	52.7	52.5	52.1
1131	Sumatera Utara	98.9	98.6	98.1	97.8	97.5	97.3	97.0
1132	Sumatera Utara	36.4	36.2	35.7	35.5	35.2	35.1	34.8
1141	Sumatera Utara	373.6	373.4	372.8	372.6	372.3	372.2	371.9
1142	Sumatera Utara	263.7	263.6	263.3	263.2	263.1	263.0	262.9
1150	Riau	405.9	405.4	404.6	404.1	403.6	403.3	402.7
1161	Riau	424.6	424.2	423.5	422.9	422.3	421.9	421.2
1162	Riau	87.8	87.8	87.7	87.6	87.5	87.5	87.4
1171	Riau	1,076.4	1,074.9	1,072.4	1,070.5	1,068.3	1,067.0	1,061.3
1172	Riau	53.8	53.5	52.9	52.5	52.0	51.7	51.1
1181	Riau	620.8	619.8	618.0	616.7	615.4	614.7	613.3
1182	Riau	62.8	62.7	62.6	62.4	62.3	62.2	62.0
1191	Sumatera Barat	323.6	323.5	323.2	323.1	322.9	322.8	322.7
1192	Sumatera Barat	103.8	103.7	103.6	103.6	103.5	103.5	103.5
1201	Sumatera Barat	227.8	227.0	225.6	224.6	223.5	221.4	219.9
1202	Sumatera Barat	102.4	102.4	102.2	102.2	102.1	102.0	102.0
1210	Jambi	1,199.5	1,197.8	1,194.9	1,192.7	1,187.7	1,185.7	1,182.3
1220	Sumatera Selatan	220.5	220.3	220.0	219.8	219.6	219.5	219.3
1230	Sumatera Selatan	370.9	370.4	369.6	369.0	368.5	368.2	367.6
1241	Sumatera Selatan	783.8	781.1	776.5	773.2	769.7	767.9	763.8
1242	Sumatera Selatan	245.3	245.0	244.5	244.2	243.8	243.6	243.2
1250	Lampung	172.0	171.6	170.6	170.2	169.8	169.4	169.1
1261	Lampung	35.9	35.5	34.5	34.1	33.6	33.4	33.0
1262	Lampung	41.1	40.0	37.9	36.8	35.6	35.4	34.1
1270	Lampung	233.3	232.9	232.0	231.6	231.2	231.0	230.5
1280	Bengkulu	534.0	532.2	529.1	526.7	523.7	521.7	518.2
1290	Bengkulu	509.4	509.1	508.6	508.3	508.0	507.7	507.4
1300	Bengkulu	197.7	197.6	197.5	197.5	197.4	197.4	197.3
	Sumatera	10,398	10,378	10,341	10,315	10,283	10,264	10,228

Table 3.10 Estimation of Water Potential Area by River Basin (2/3)

('000 ha)

River Basin Code	Representative Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
2011	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	Jawa Barat	19.0	18.5	17.6	17.1	16.6	16.4	15.8
2020	DKI.Jakarta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2030	Jawa Barat	60.2	58.6	54.0	52.1	50.0	48.9	46.6
2041	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2042	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2051	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2052	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2060	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2070	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2080	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2091	Jawa Tengah	4.2	2.8	0.0	0.0	0.0	0.0	0.0
2092	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2101	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2102	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2103	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2111	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2112	Yogyakarta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2121	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2122	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2123	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2131	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2132	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2133	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2141	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2142	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2143	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2150	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Jawa	83	80	72	69	67	65	62
3011	Bali	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3012	Bali	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3020	Nusa Tenggara Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3030	Nusa Tenggara Barat	8.6	8.3	7.7	7.3	6.9	6.8	6.4
3040	Nusa Tenggara Timur	15.2	15.1	14.8	14.7	14.5	14.4	14.2
3050	Nusa Tenggara Timur	10.3	10.1	9.7	9.4	9.1	8.9	8.6
3060	Nusa Tenggara Timur	28.2	28.0	27.5	27.2	26.8	26.6	26.2
3070	Timor Timur	35.9	35.8	35.5	35.4	35.2	35.1	34.9
	Bali & NT	98	97	95	94	93	92	90
4010	Kalimantan Selatan	353.9	353.4	352.4	351.8	351.1	350.8	350.1
4021	Kalimantan Tengah	1,208.6	1,208.5	1,208.3	1,208.2	1,208.0	1,207.9	1,207.7
4022	Kalimantan Selatan	2,540.8	2,540.2	2,538.8	2,538.0	2,537.0	2,535.2	2,533.9
4030	Kalimantan Tengah	642.9	642.9	642.7	642.5	642.4	642.2	642.0
4040	Kalimantan Tengah	618.0	617.8	617.5	617.1	616.7	616.4	615.8
4050	Kalimantan Tengah	452.8	452.8	452.6	452.5	452.3	452.2	452.0
4061	Kalimantan Tengah	386.6	386.5	386.5	386.4	386.3	386.3	386.2
4062	Kalimantan Tengah	630.7	630.6	630.4	630.2	629.9	629.7	629.4
4070	Kalimantan Barat	786.1	786.0	785.9	785.8	785.6	785.6	785.5
4080	Kalimantan Barat	3,907.2	3,906.6	3,905.4	3,904.5	3,903.5	3,901.6	3,900.3
4090	Kalimantan Barat	337.9	337.8	337.5	337.3	337.1	337.0	336.8
4100	Kalimantan Timur	778.1	778.1	778.0	777.9	777.8	777.7	777.6
4110	Kalimantan Timur	1,501.8	1,501.7	1,501.6	1,501.5	1,501.4	1,501.3	1,501.2
4120	Kalimantan Timur	313.9	313.9	313.8	313.8	313.7	313.7	313.7
4130	Kalimantan Timur	292.4	292.3	292.1	291.9	291.8	291.7	291.5
4141	Kalimantan Timur	1,643.4	1,642.3	1,640.7	1,639.2	1,635.9	1,634.8	1,632.5
4142	Kalimantan Timur	110.9	110.5	109.8	109.3	108.8	108.5	107.9
	Kalimantan	16,506	16,502	16,494	16,488	16,479	16,472	16,464

Table 3.10 Estimation of Water Potential Area by River Basin (3/3)

('000 ha)

River Basin Code	Representative Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
5011	Sulawesi Utara	43.3	42.8	42.0	41.5	41.0	40.8	40.1
5012	Sulawesi Utara	22.4	22.4	22.3	22.3	22.2	22.2	22.2
5013	Sulawesi Utara	129.1	129.0	128.7	128.6	128.5	128.4	128.3
5021	Sulawesi Utara	36.3	36.2	36.2	36.1	36.1	36.0	36.0
5022	Sulawesi Utara	6.6	6.5	6.3	6.2	6.0	5.9	5.8
5031	Sulawesi Utara	12.5	12.5	12.5	12.5	12.5	12.5	12.5
5032	Sulawesi Utara	15.0	14.9	14.8	14.7	14.6	14.6	14.5
5041	Sulawesi Tengah	88.7	88.6	88.4	88.3	88.1	88.0	87.8
5042	Sulawesi Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5050	Sulawesi Tengah	110.7	110.6	110.4	110.3	110.2	110.0	109.9
5061	Sulawesi Tengah	61.8	61.8	61.7	61.7	61.6	61.6	61.5
5062	Sulawesi Tengah	97.0	97.0	96.9	96.8	96.7	96.6	96.4
5070	Sulawesi Tengah	14.9	14.8	14.7	14.5	14.4	14.3	14.1
5080	Sulawesi Tengah	85.1	85.0	84.9	84.8	84.7	84.6	84.5
5091	Sulawesi Tengah	50.4	50.2	50.0	49.8	49.6	49.5	49.2
5092	Sulawesi Tengah	44.0	43.9	43.8	43.7	43.6	43.5	43.4
5101	Sulawesi Tenggara	34.7	34.5	34.1	33.8	33.4	33.1	32.7
5102	Sulawesi Tenggara	32.8	32.6	32.2	31.9	31.6	31.3	30.9
5111	Sulawesi Tenggara	30.3	30.1	29.6	29.2	28.7	28.3	27.7
5112	Sulawesi Tenggara	25.9	25.7	25.4	25.0	24.6	24.3	23.9
5120	Sulawesi Tenggara	86.5	86.5	86.4	86.3	86.2	86.2	86.1
5131	Sulawesi Selatan	26.9	26.8	26.8	26.8	26.8	26.8	26.8
5132	Sulawesi Selatan	36.7	36.7	36.6	36.6	36.6	36.6	36.5
5133	Sulawesi Selatan	13.6	13.5	13.5	13.5	13.4	13.4	13.4
5141	Sulawesi Selatan	12.4	12.4	12.3	12.3	12.3	12.3	12.3
5142	Sulawesi Selatan	43.4	43.4	43.4	43.4	43.3	43.3	43.3
5143	Sulawesi Selatan	34.7	34.7	34.7	34.7	34.7	34.7	34.6
5144	Sulawesi Selatan	52.3	52.3	52.3	52.3	52.2	52.2	52.2
5151	Sulawesi Selatan	1.3	1.2	1.1	1.1	1.0	1.0	1.0
5152	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5153	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5161	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5162	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5171	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5172	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sulawesi	1,249	1,247	1,242	1,239	1,235	1,232	1,228
6010	Maluku	41.6	41.5	41.4	41.3	41.1	41.1	40.9
6020	Maluku	506.3	505.7	504.7	503.8	502.8	502.1	500.9
6030	Maluku	677.0	676.7	676.2	675.9	675.4	675.1	674.6
7010	Irian Jaya	3,154.0	3,153.8	3,153.5	3,153.2	3,153.0	3,152.9	3,152.6
7020	Irian Jaya	3,559.1	3,558.9	3,558.4	3,558.0	3,557.7	3,557.5	3,557.0
7030	Irian Jaya	4,766.3	4,766.2	4,766.0	4,765.9	4,765.7	4,765.6	4,765.5
7040	Irian Jaya	1,108.8	1,108.7	1,108.6	1,108.5	1,108.4	1,108.4	1,108.3
	Maluku & Irian Jaya	13,813	13,812	13,809	13,807	13,804	13,803	13,800
	Indonesia	42,148	42,115	42,052	42,012	41,960	41,928	41,872

Source: JICA-FIDP Team calculation

Table 3.11 Irrigation Potential Area by River Basin (1/3)

River Basin Code	Representative Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
1010	D.I.Aceh	19.6	19.6	18.2	16.4	14.3	12.7	10.2
1020	D.I.Aceh	2.4	2.2	1.8	1.5	1.2	0.9	0.6
1030	D.I.Aceh	29.0	29.0	29.0	29.0	29.0	29.0	29.0
1040	D.I.Aceh	34.4	34.4	34.4	34.4	34.4	34.4	34.4
1050	D.I.Aceh	33.6	33.6	33.6	33.6	33.6	33.6	33.6
1060	D.I.Aceh	34.8	34.8	34.8	34.8	34.8	34.8	34.8
1071	D.I.Aceh	54.3	54.3	54.3	54.3	54.3	54.3	54.3
1072	D.I.Aceh	9.9	9.9	9.9	9.9	9.9	9.9	9.9
1080	Sumatera Utara	91.0	91.0	91.0	91.0	91.0	91.0	91.0
1090	Sumatera Utara	14.2	13.3	11.7	10.8	8.2	7.7	6.3
1100	Sumatera Utara	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1110	Sumatera Utara	16.3	16.1	15.7	15.5	15.2	15.1	14.9
1121	Sumatera Utara	8.1	8.0	7.3	6.9	6.4	6.3	5.8
1122	Sumatera Utara	35.1	35.1	35.1	35.1	35.1	35.1	35.1
1131	Sumatera Utara	59.6	59.6	59.6	59.6	59.6	59.6	59.6
1132	Sumatera Utara	36.4	36.2	35.7	35.5	35.2	35.1	34.8
1141	Sumatera Utara	105.4	105.4	105.4	105.4	105.4	105.4	105.4
1142	Sumatera Utara	37.4	37.4	37.4	37.4	37.4	37.4	37.4
1150	Riau	195.4	195.4	195.4	195.4	195.4	195.4	195.4
1161	Riau	166.2	166.2	166.2	166.2	166.2	166.2	166.2
1162	Riau	57.7	57.7	57.7	57.7	57.7	57.7	57.7
1171	Riau	287.6	287.6	287.6	287.6	287.6	287.6	287.6
1172	Riau	35.9	35.9	35.9	35.9	35.9	35.9	35.9
1181	Riau	273.7	273.7	273.7	273.7	273.7	273.7	273.7
1182	Riau	40.5	40.5	40.5	40.5	40.5	40.5	40.5
1191	Sumatera Barat	36.7	36.7	36.7	36.7	36.7	36.7	36.7
1192	Sumatera Barat	6.3	6.3	6.3	6.3	6.3	6.3	6.3
1201	Sumatera Barat	37.3	37.3	37.3	37.3	37.3	37.3	37.3
1202	Sumatera Barat	16.2	16.2	16.2	16.2	16.2	16.2	16.2
1210	Jambi	464.9	464.9	464.9	464.9	464.9	464.9	464.9
1220	Sumatera Selatan	138.0	138.0	138.0	138.0	138.0	138.0	138.0
1230	Sumatera Selatan	217.4	217.4	217.4	217.4	217.4	217.4	217.4
1241	Sumatera Selatan	735.0	735.0	735.0	735.0	735.0	735.0	735.0
1242	Sumatera Selatan	238.9	238.9	238.9	238.9	238.9	238.9	238.9
1250	Lampung	172.0	171.6	170.6	170.2	169.8	169.4	169.1
1261	Lampung	35.9	35.5	34.5	34.1	33.6	33.4	33.0
1262	Lampung	41.1	40.0	37.9	36.8	35.6	35.4	34.1
1270	Lampung	101.0	101.0	101.0	101.0	101.0	101.0	101.0
1280	Bengkulu	33.9	33.9	33.9	33.9	33.9	33.9	33.9
1290	Bengkulu	26.8	26.8	26.8	26.8	26.8	26.8	26.8
1300	Bengkulu	29.6	29.6	29.6	29.6	29.6	29.6	29.6

Table 3.11 Irrigation Potential Area by River Basin (2/3)

River Basin Code	Representative Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
2011	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	Jawa Barat	19.0	18.5	17.6	17.1	16.6	16.4	15.8
2020	DKI.Jakarta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2030	Jawa Barat	60.2	58.6	54.0	52.1	50.0	48.9	46.6
2041	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2042	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2051	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2052	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2060	Jawa Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2070	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2080	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2091	Jawa Tengah	4.2	2.8	0.0	0.0	0.0	0.0	0.0
2092	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2101	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2102	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2103	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2111	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2112	Yogyakarta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2121	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2122	Jawa Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2123	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2131	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2132	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2133	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2141	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2142	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2143	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2150	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3011	Bali	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3012	Bali	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3020	Nusa Tenggara Barat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3030	Nusa Tenggara Barat	8.6	8.3	7.7	7.3	6.9	6.8	6.4
3040	Nusa Tenggara Timur	15.2	15.1	14.8	14.7	14.5	14.4	14.2
3050	Nusa Tenggara Timur	10.3	10.1	9.7	9.4	9.1	8.9	8.6
3060	Nusa Tenggara Timur	28.2	28.0	27.5	27.2	26.8	26.6	26.2
3070	Timor Timur	35.9	35.8	35.5	35.4	35.2	35.1	34.9
4010	Kalimantan Selatar	270.7	270.7	270.7	270.7	270.7	270.7	270.7
4021	Kalimantan Tengah	192.6	192.6	192.6	192.6	192.6	192.6	192.6
4022	Kalimantan Selatar	401.6	401.6	401.6	401.6	401.6	401.6	401.6
4030	Kalimantan Tengah	76.1	76.1	76.1	76.1	76.1	76.1	76.1
4040	Kalimantan Tengah	104.1	104.1	104.1	104.1	104.1	104.1	104.1
4050	Kalimantan Tengah	71.1	71.1	71.1	71.1	71.1	71.1	71.1
4061	Kalimantan Tengah	68.7	68.7	68.7	68.7	68.7	68.7	68.7
4062	Kalimantan Tengah	129.9	129.9	129.9	129.9	129.9	129.9	129.9
4070	Kalimantan Barat	263.8	263.8	263.8	263.8	263.8	263.8	263.8
4080	Kalimantan Barat	742.8	742.8	742.8	742.8	742.8	742.8	742.8
4090	Kalimantan Barat	110.9	110.9	110.9	110.9	110.9	110.9	110.9
4100	Kalimantan Timur	202.3	202.3	202.3	202.3	202.3	202.3	202.3
4110	Kalimantan Timur	211.3	211.3	211.3	211.3	211.3	211.3	211.3
4120	Kalimantan Timur	122.4	122.4	122.4	122.4	122.4	122.4	122.4
4130	Kalimantan Timur	130.2	130.2	130.2	130.2	130.2	130.2	130.2
4141	Kalimantan Timur	492.5	492.5	492.5	492.5	492.5	492.5	492.5
4142	Kalimantan Timur	101.6	101.6	101.6	101.6	101.6	101.6	101.6

Table 3.11 Irrigation Potential Area by River Basin (3/3)

River Basin Code	Representative Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
5011	Sulawesi Utara	10.5	10.5	10.5	10.5	10.5	10.5	10.5
5012	Sulawesi Utara	6.6	6.6	6.6	6.6	6.6	6.6	6.6
5013	Sulawesi Utara	18.2	18.2	18.2	18.2	18.2	18.2	18.2
5021	Sulawesi Utara	9.4	9.4	9.4	9.4	9.4	9.4	9.4
5022	Sulawesi Utara	6.6	6.5	6.3	6.2	6.0	5.9	5.8
5031	Sulawesi Utara	2.8	2.8	2.8	2.8	2.8	2.8	2.8
5032	Sulawesi Utara	15.0	14.9	14.8	14.7	14.6	14.6	14.5
5041	Sulawesi Tengah	18.6	18.6	18.6	18.6	18.6	18.6	18.6
5042	Sulawesi Tengah	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5050	Sulawesi Tengah	19.3	19.3	19.3	19.3	19.3	19.3	19.3
5061	Sulawesi Tengah	6.9	6.9	6.9	6.9	6.9	6.9	6.9
5062	Sulawesi Tengah	11.1	11.1	11.1	11.1	11.1	11.1	11.1
5070	Sulawesi Tengah	14.9	14.8	14.7	14.5	14.4	14.3	14.1
5080	Sulawesi Tengah	19.3	19.3	19.3	19.3	19.3	19.3	19.3
5091	Sulawesi Tengah	23.1	23.1	23.1	23.1	23.1	23.1	23.1
5092	Sulawesi Tengah	31.8	31.8	31.8	31.8	31.8	31.8	31.8
5101	Sulawesi Tenggara	34.7	34.5	34.1	33.8	33.4	33.1	32.7
5102	Sulawesi Tenggara	32.8	32.6	32.2	31.9	31.6	31.3	30.9
5111	Sulawesi Tenggara	30.3	30.1	29.6	29.2	28.7	28.3	27.7
5112	Sulawesi Tenggara	25.9	25.7	25.4	25.0	24.6	24.3	23.9
5120	Sulawesi Tenggara	38.4	38.4	38.4	38.4	38.4	38.4	38.4
5131	Sulawesi Selatan	25.9	25.9	25.9	25.9	25.9	25.9	25.9
5132	Sulawesi Selatan	36.7	36.7	36.6	36.6	36.6	36.6	36.5
5133	Sulawesi Selatan	13.6	13.5	13.5	13.5	13.4	13.4	13.4
5141	Sulawesi Selatan	12.4	12.4	12.3	12.3	12.3	12.3	12.3
5142	Sulawesi Selatan	20.6	20.6	20.6	20.6	20.6	20.6	20.6
5143	Sulawesi Selatan	25.9	25.9	25.9	25.9	25.9	25.9	25.9
5144	Sulawesi Selatan	22.5	22.5	22.5	22.5	22.5	22.5	22.5
5151	Sulawesi Selatan	1.3	1.2	1.1	1.1	1.0	1.0	1.0
5152	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5153	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5161	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5162	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5171	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5172	Sulawesi Selatan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6010	Maluku	41.6	41.5	41.4	41.3	41.1	41.1	40.9
6020	Maluku	150.6	150.6	150.6	150.6	150.6	150.6	150.6
6030	Maluku	172.4	172.4	172.4	172.4	172.4	172.4	172.4
7010	Irian Jaya	537.9	537.9	537.9	537.9	537.9	537.9	537.9
7020	Irian Jaya	722.8	722.8	722.8	722.8	722.8	722.8	722.8
7030	Irian Jaya	506.1	506.1	506.1	506.1	506.1	506.1	506.1
7040	Irian Jaya	393.4	393.4	393.4	393.4	393.4	393.4	393.4

Source : JICA-FIDP Team calculation

Table 3.12 Irrigation Potential Area by Province (1990-2020)

('000 ha)

Code	Province	Projection Year						
		1990	1995	2000	2005	2010	2015	2020
11	D.I.Aceh	274.5	274.3	272.4	270.4	267.9	266.0	263.1
12	Sumatera Utara	379.6	378.2	375.1	373.4	369.9	369.0	366.6
13	Sumatera Barat	283.6	283.6	283.6	283.6	283.6	283.6	283.6
14	Riau	875.8	875.8	875.8	875.8	875.8	875.8	875.8
15	Jambi	500.4	500.4	500.4	500.4	500.4	500.4	500.4
16	Sumatera Selatan	1,275.0	1,274.9	1,274.6	1,274.5	1,274.4	1,274.3	1,274.2
17	Bengkulu	117.8	117.8	117.8	117.8	117.8	117.8	117.8
18	Lampung	302.7	300.9	297.1	295.3	293.4	292.6	290.7
	SUMATERA	4,009.4	4,005.9	3,996.8	3,991.2	3,983.2	3,979.5	3,972.2
31	DKI.Jakarta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	Jawa Barat	79.2	77.2	71.6	69.2	66.6	65.2	62.3
33	Jawa Tengah	4.2	2.8	0.0	0.0	0.0	0.0	0.0
34	Yogyakarta	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	Jawa Timur	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	JAWA	83.4	80.0	71.6	69.2	66.6	65.2	62.3
51	Bali	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	Nusa Tenggara Barat	8.6	8.3	7.7	7.3	6.9	6.8	6.4
53	Nusa Tenggara Timur	55.1	54.5	53.4	52.6	51.8	51.2	50.4
54	Timor Timur	34.6	34.5	34.2	34.0	33.9	33.8	33.6
	BALI & NT	98.3	97.3	95.3	93.9	92.6	91.8	90.4
61	Kalimantan Barat	1,135.9	1,135.9	1,135.9	1,135.9	1,135.9	1,135.9	1,135.9
62	Kalimantan Selatan	821.2	821.2	821.2	821.2	821.2	821.2	821.2
63	Kalimantan Tengah	478.3	478.3	478.3	478.3	478.3	478.3	478.3
64	Kalimantan Timur	1,257.2	1,257.2	1,257.2	1,257.2	1,257.2	1,257.2	1,257.2
	KALIMANTAN	3,692.6	3,692.6	3,692.6	3,692.6	3,692.6	3,692.6	3,692.6
71	Sulawesi Utara	69.5	69.3	69.0	68.8	68.5	68.4	68.2
72	Sulawesi Tengah	136.5	136.4	136.2	136.0	135.7	135.5	135.2
73	Sulawesi Tenggara	174.2	174.1	173.9	173.8	173.7	173.7	173.6
74	Sulawesi Selatan	154.8	154.0	152.5	151.2	149.6	148.4	146.6
	SULAWESI	535.0	533.8	531.6	529.8	527.5	526.0	523.6
81	Maluku	364.6	364.5	364.4	364.3	364.1	364.1	363.9
82	Irian Jaya	2,160.2	2,160.2	2,160.2	2,160.2	2,160.2	2,160.2	2,160.2
	MALUKU & IJ	2,524.8	2,524.7	2,524.6	2,524.5	2,524.3	2,524.3	2,524.1
	INDONESIA	10,943.5	10,934.3	10,912.5	10,901.2	10,886.8	10,879.4	10,865.2

Source : JICA FIDP Team Calculation

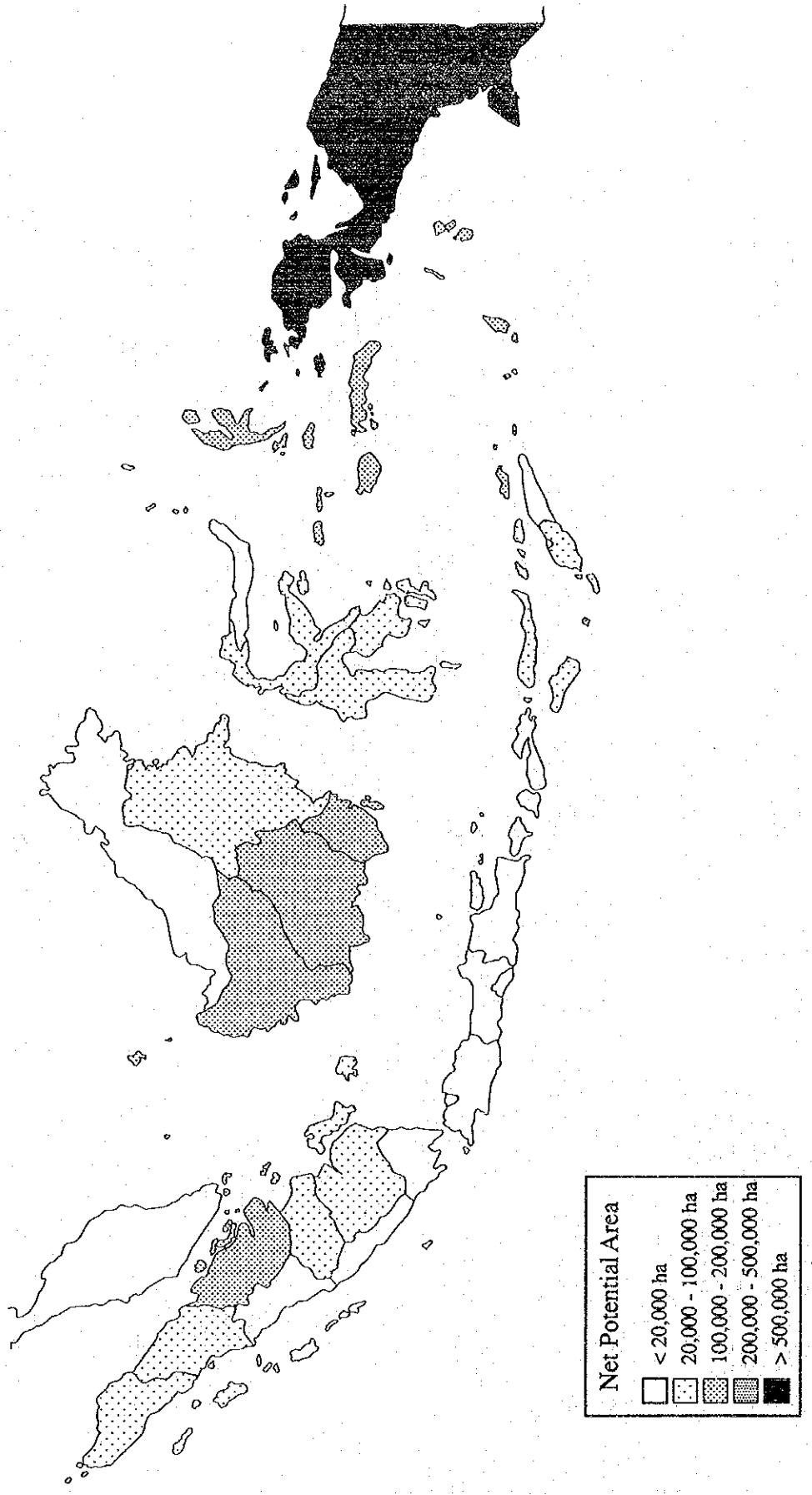


Figure 3.1 Land Potential for Paddy Field Extension within Fully Suitable Land by Province

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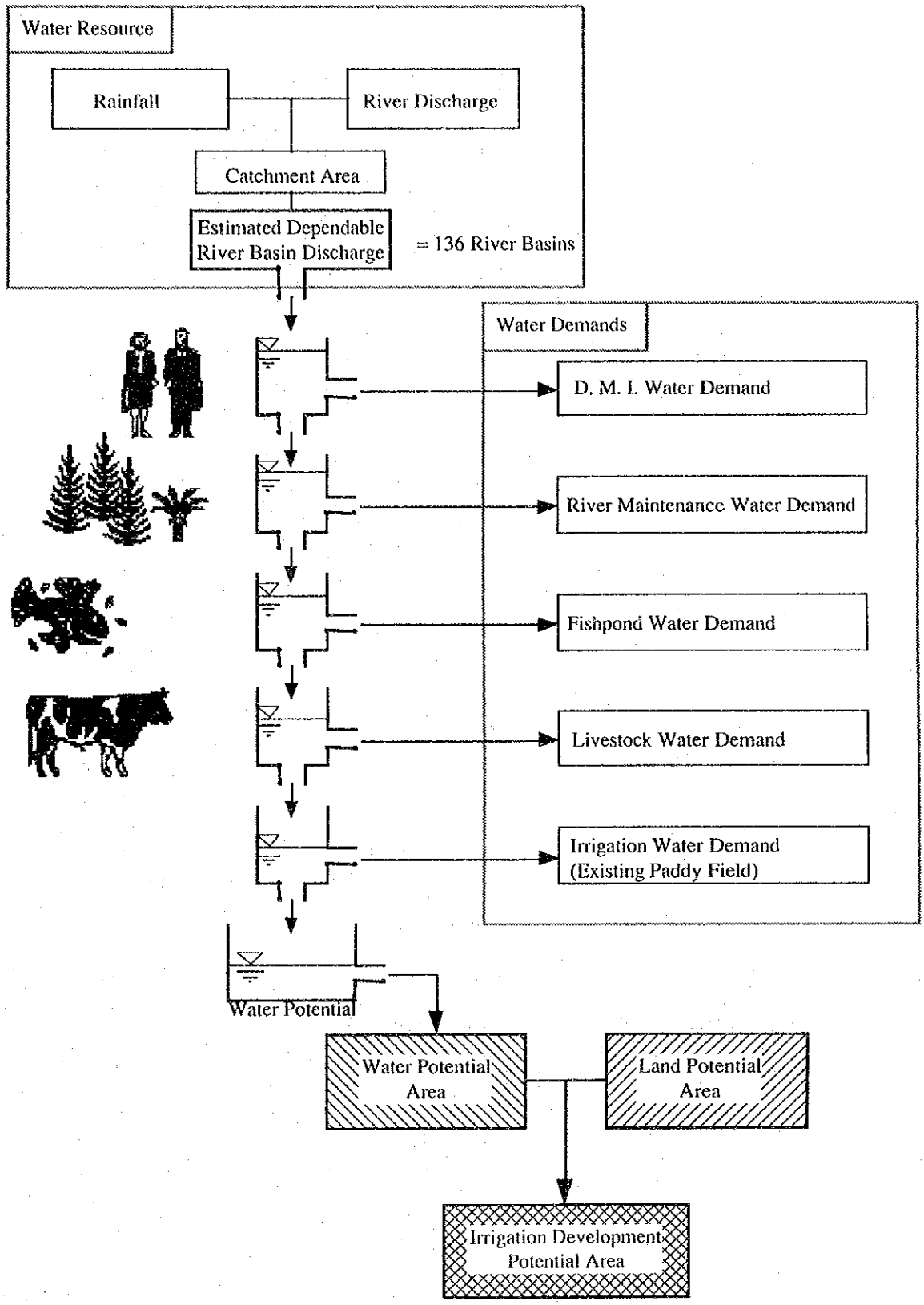

Figure 3.2 Analysis Flow for Estimation of Irrigation Potential

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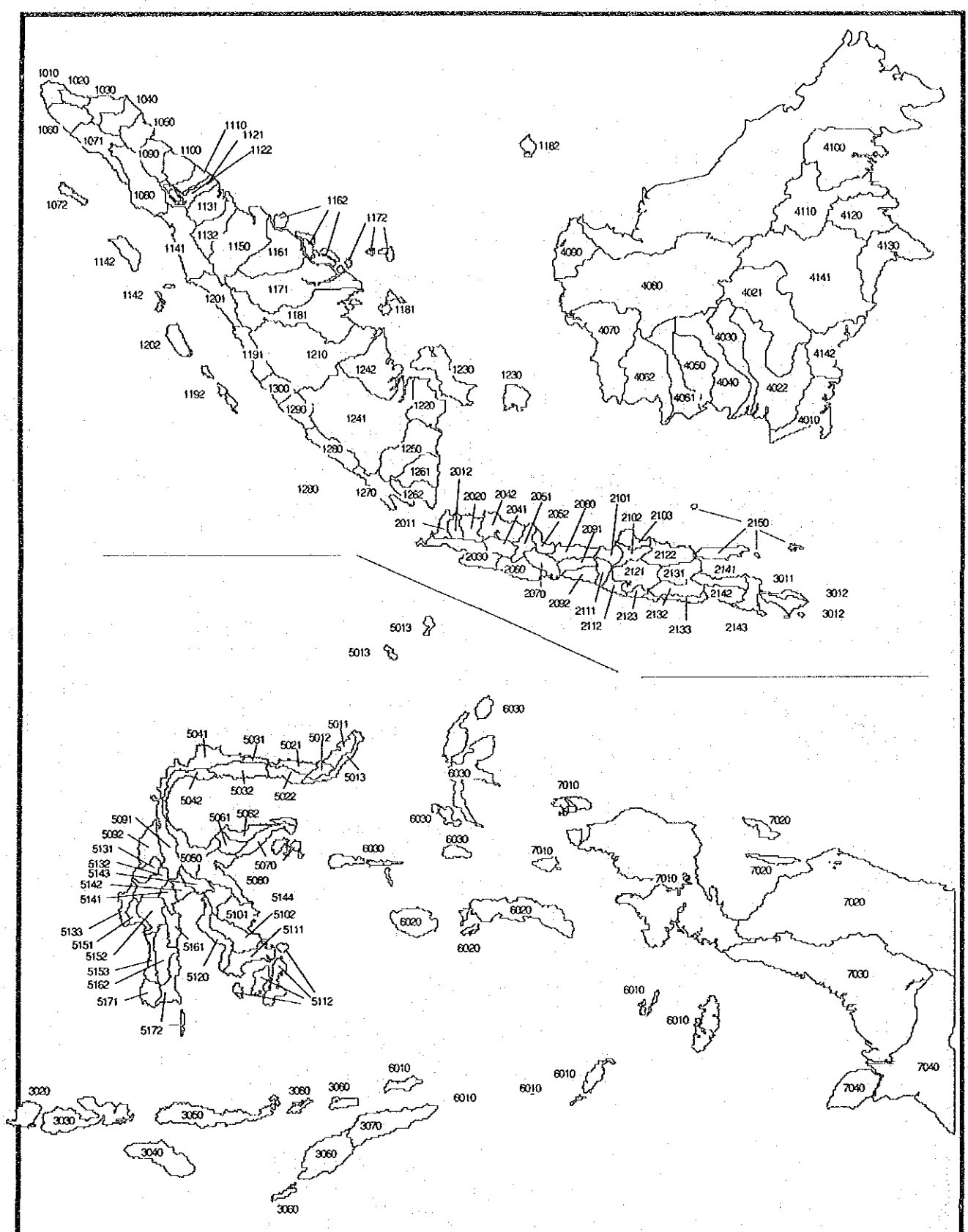

Note: The number of river basin totals 136 instead of 90 (SWS).
For details see Annex D.

Figure 3.3 River Basins and Code Numbers Used in JICA-FIDP Study

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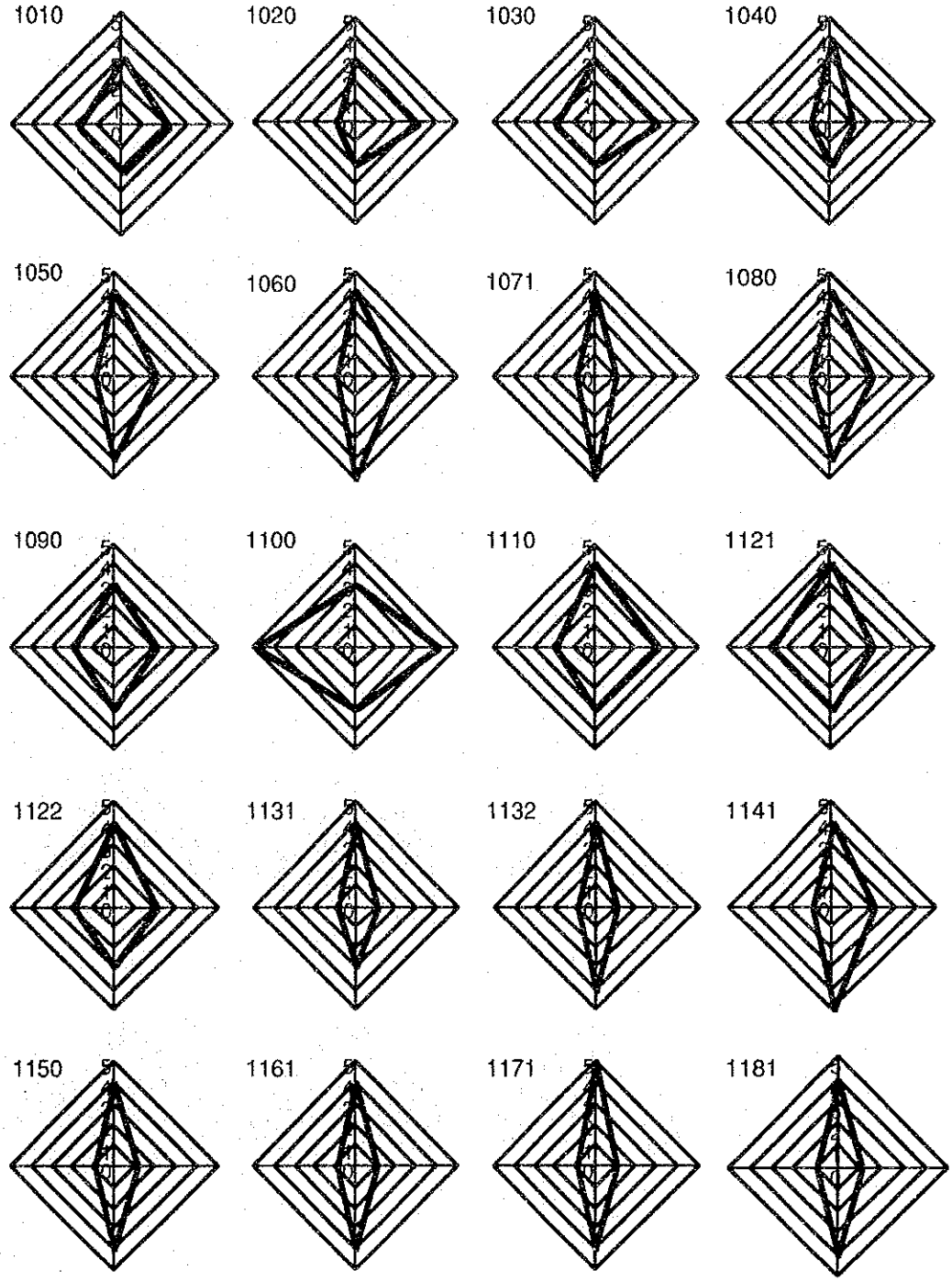

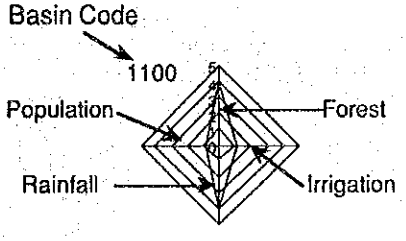

Class division

Class	Forest (%)	Irrigation (%)	Population (person/km2)	Rainfall (mm)
1	12.5 ~ 30.0	0 ~ 2.5	0 ~ 2.5	< 1,500
2	30.0 ~ 46.0	2.5 ~ 5.0	25 ~ 75	1,500 ~ 2,000
3	46.0 ~ 63.0	5.0 ~ 10.0	75 ~ 150	2,000 ~ 2,500
4	63.0 ~ 80.0	10.0 ~ 15.0	150 ~ 250	2,500 ~ 3,000
5	>80.0	>15.0	>250	>3,000

Figure 3.4 Radar Chart of Present Basin Condition (1/6)

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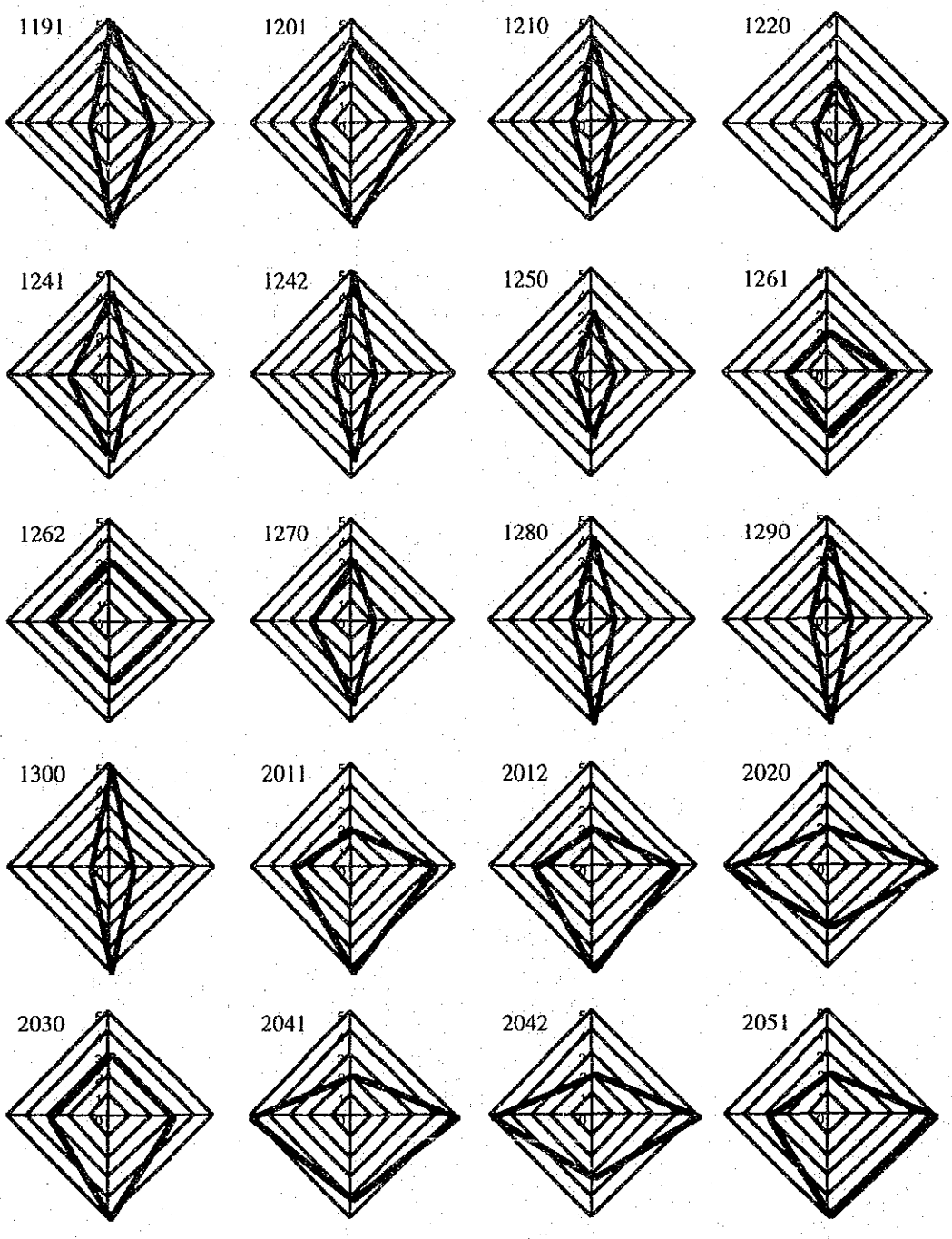

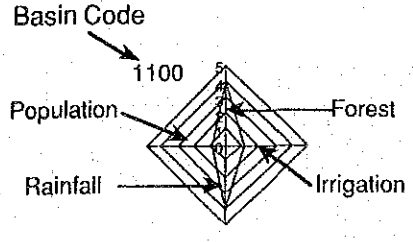

Class division

Class	Forest (%)	Irrigation (%)	Population (person/km2)	Rainfall (mm)
1	12.5 ~ 30.0	0 ~ 2.5	0 ~ 2.5	< 1,500
2	30.0 ~ 46.0	2.5 ~ 5.0	25 ~ 75	1,500 ~ 2,000
3	46.0 ~ 63.0	5.0 ~ 10.0	75 ~ 150	2,000 ~ 2,500
4	63.0 ~ 80.0	10.0 ~ 15.0	150 ~ 250	2,500 ~ 3,000
5	>80.0	>15.0	>250	>3,000

Figure 3.4 Radar Chart of Present Basin Condition (2/6)

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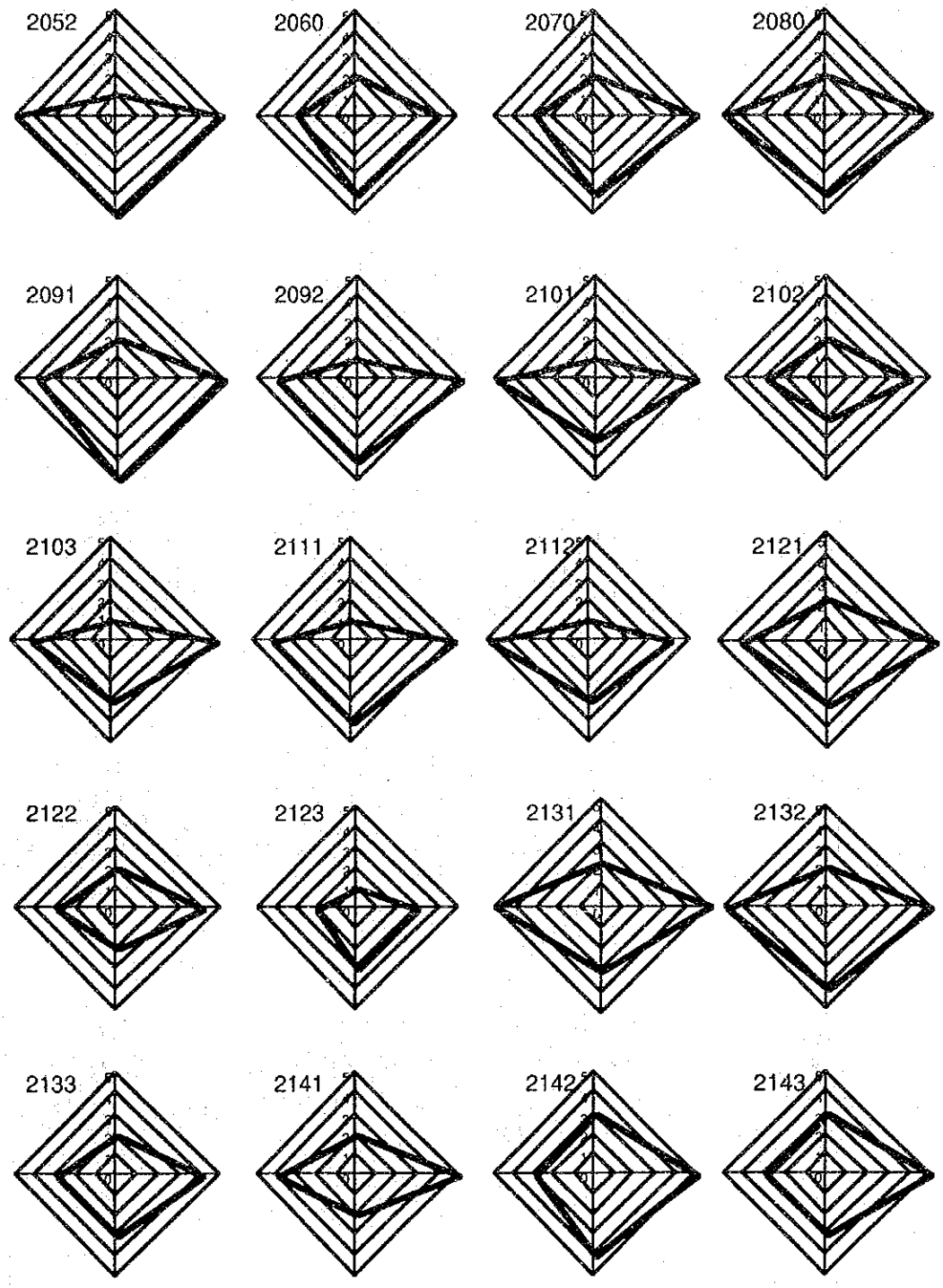

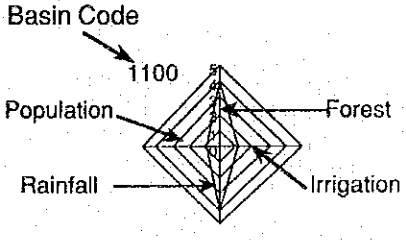

Class division

Class	Forest (%)	Irrigation (%)	Population (person/km2)	Rainfall (mm)
1	12.5 ~ 30.0	0 ~ 2.5	0 ~ 2.5	< 1,500
2	30.0 ~ 46.0	2.5 ~ 5.0	25 ~ 75	1,500 ~ 2,000
3	46.0 ~ 63.0	5.0 ~ 10.0	75 ~ 150	2,000 ~ 2,500
4	63.0 ~ 80.0	10.0 ~ 15.0	150 ~ 250	2,500 ~ 3,000
5	>80.0	>15.0	>250	>3,000

Figure 3.4 Radar Chart of Present Basin Condition (3/6)

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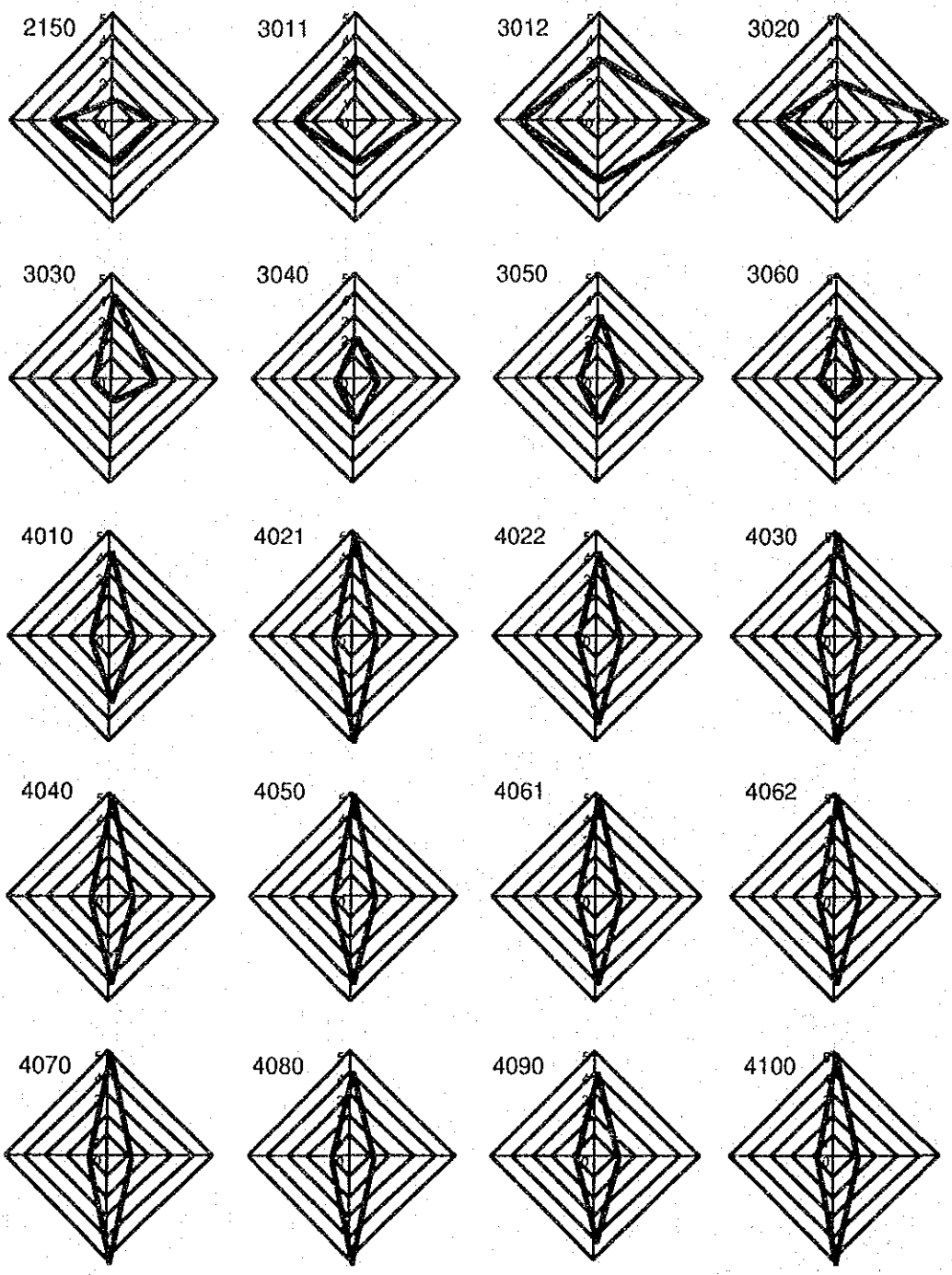

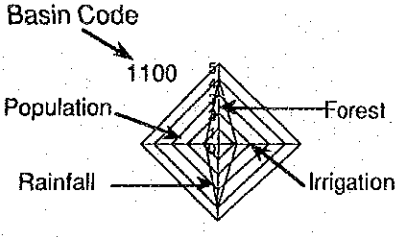

Class division

Class	Forest (%)	Irrigation (%)	Population (person/km2)	Rainfall (mm)
1	12.5 ~ 30.0	0 ~ 2.5	0 ~ 2.5	< 1,500
2	30.0 ~ 46.0	2.5 ~ 5.0	25 ~ 75	1,500 ~ 2,000
3	46.0 ~ 63.0	5.0 ~ 10.0	75 ~ 150	2,000 ~ 2,500
4	63.0 ~ 80.0	10.0 ~ 15.0	150 ~ 250	2,500 ~ 3,000
5	>80.0	>15.0	>250	>3,000

Figure 3.4 Radar Chart of Present Basin Condition (4/6)

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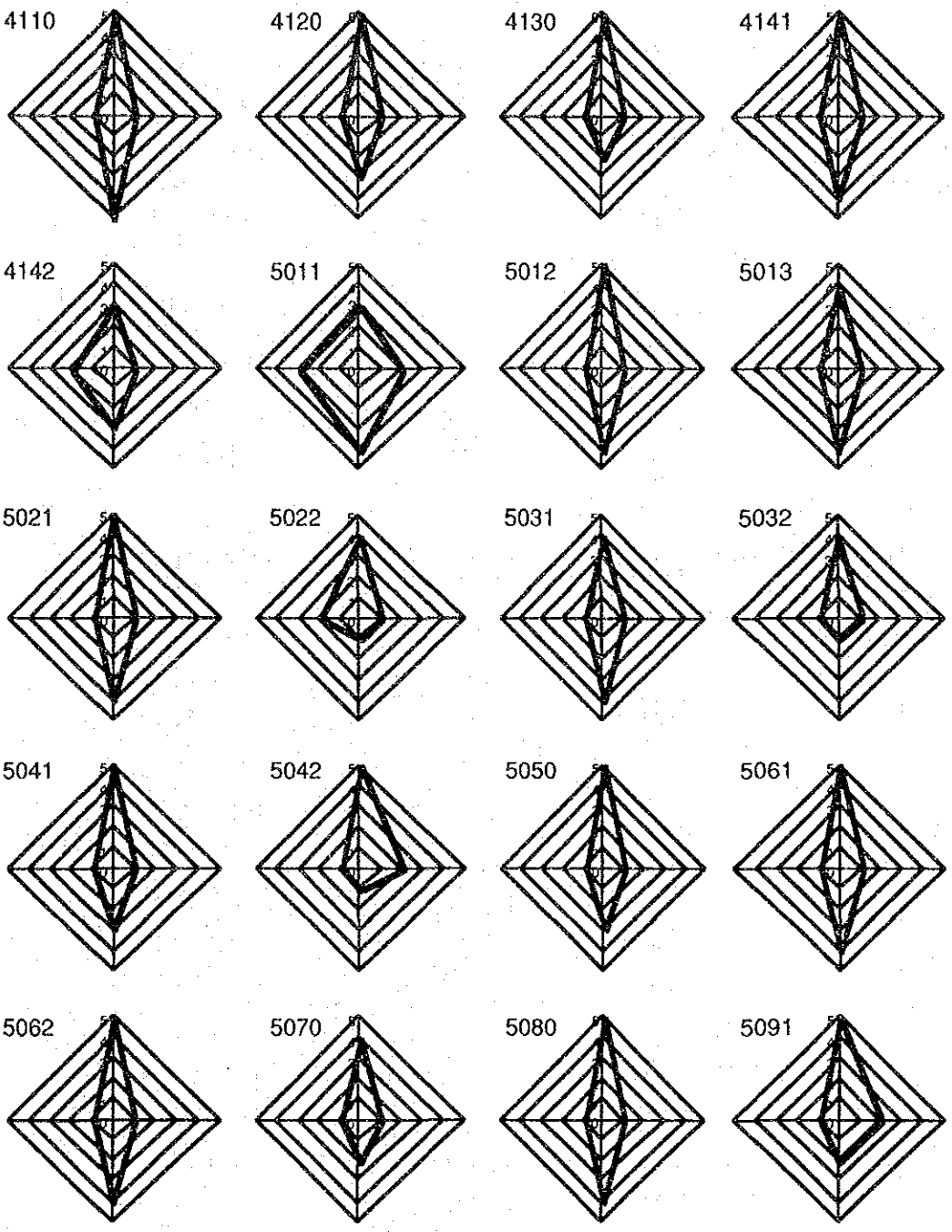

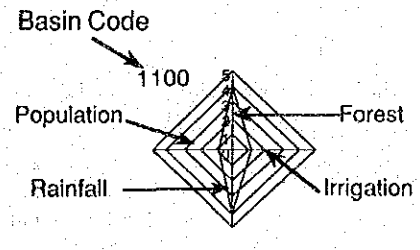

Class division

Class	Forest (%)	Irrigation (%)	Population (person/km2)	Rainfall (mm)
1	12.5 ~ 30.0	0 ~ 2.5	0 ~ 2.5	< 1,500
2	30.0 ~ 46.0	2.5 ~ 5.0	25 ~ 75	1,500 ~ 2,000
3	46.0 ~ 63.0	5.0 ~ 10.0	75 ~ 150	2,000 ~ 2,500
4	63.0 ~ 80.0	10.0 ~ 15.0	150 ~ 250	2,500 ~ 3,000
5	>80.0	>15.0	>250	>3,000

Figure 3.4 Radar Chart of Present Basin Condition (5/6)

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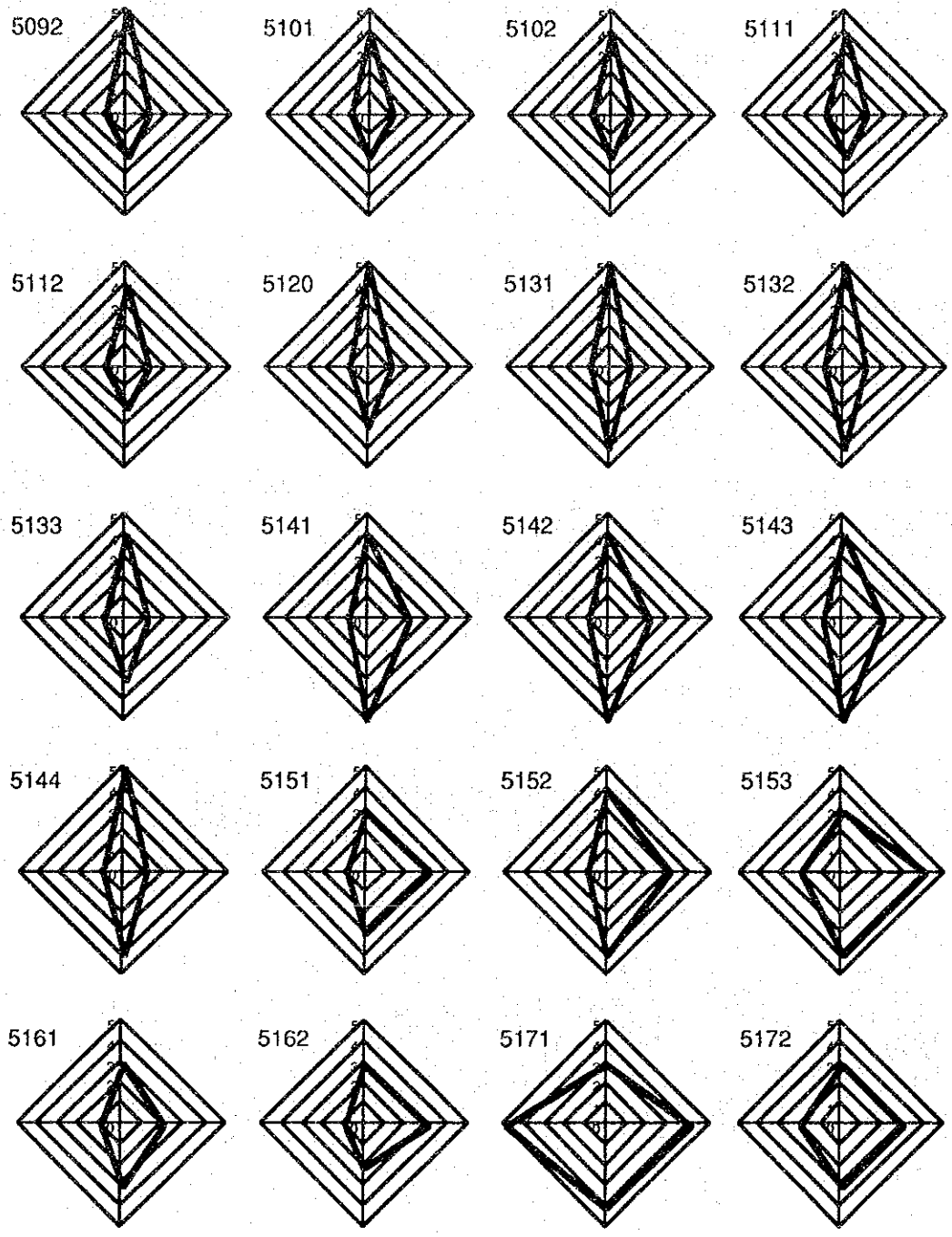

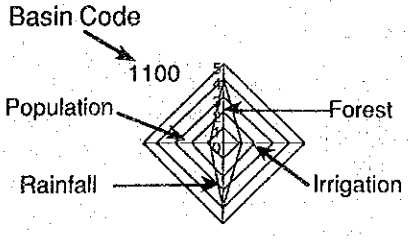

Class division

Class	Forest (%)	Irrigation (%)	Population (person/km2)	Rainfall (mm)
1	12.5 ~ 30.0	0 ~ 2.5	0 ~ 2.5	< 1,500
2	30.0 ~ 46.0	2.5 ~ 5.0	25 ~ 75	1,500 ~ 2,000
3	46.0 ~ 63.0	5.0 ~ 10.0	75 ~ 150	2,000 ~ 2,500
4	63.0 ~ 80.0	10.0 ~ 15.0	150 ~ 250	2,500 ~ 3,000
5	>80.0	>15.0	>250	>3,000

Figuire 3.4 Radar Chart of Present Basin Condition (6/6)

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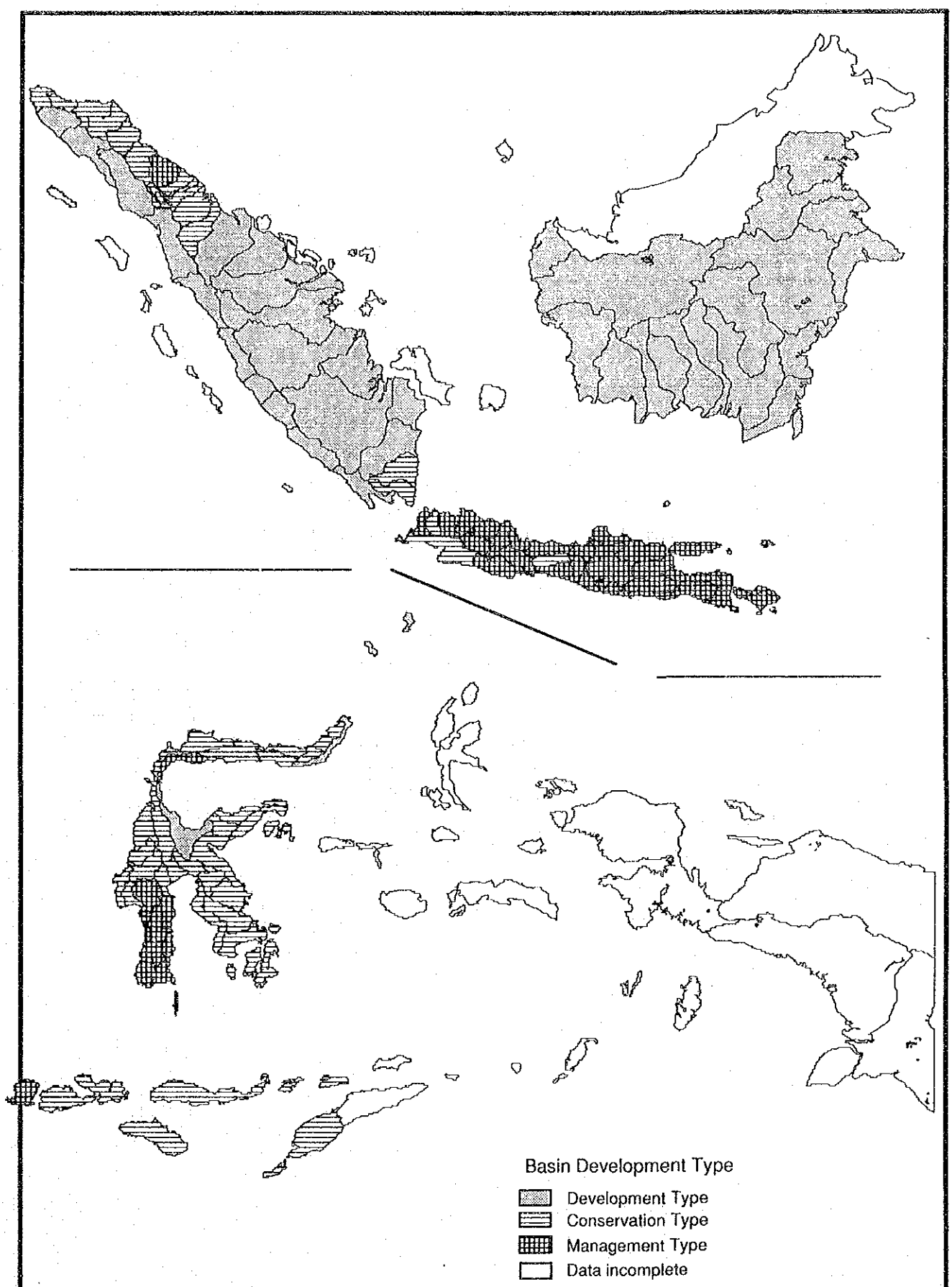

Figure 3.5 Type of Basin Development in Indonesia

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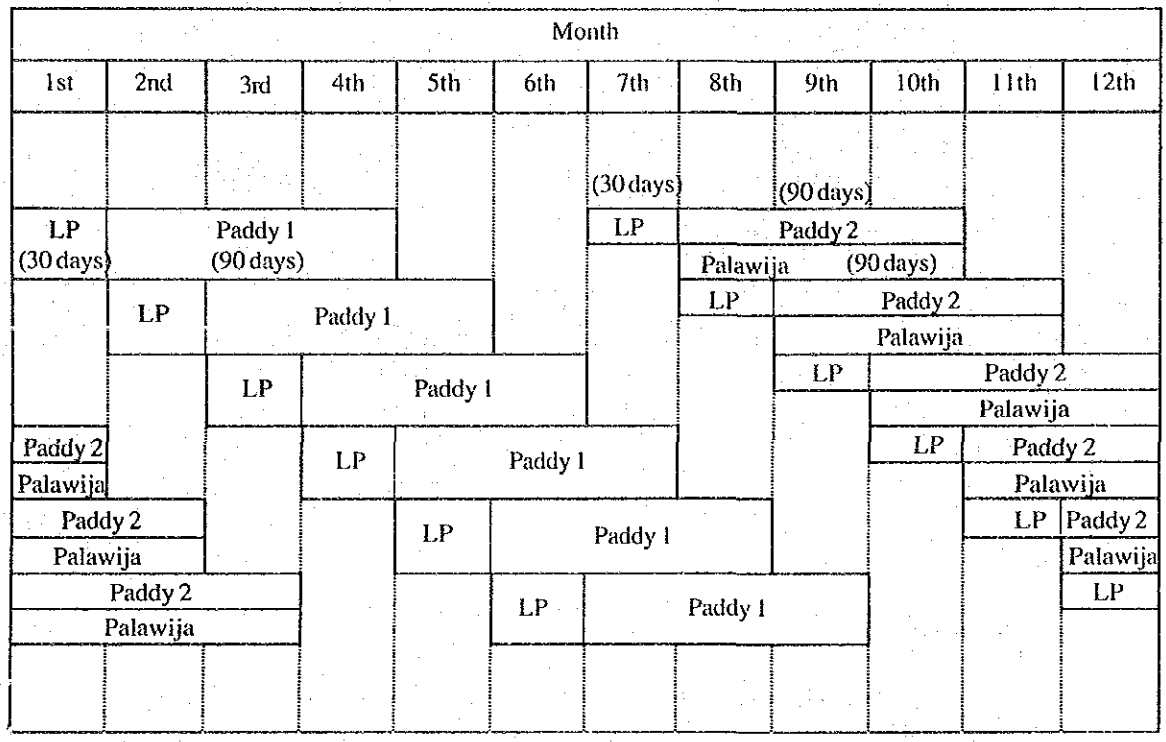

Notes: LP = Land Preparation
Paddy 1 is wet season crop (100 % density)
Paddy 2 + Palawija is dry season crop. (Variable density)

Figure 3.6 Typical Cropping Pattern Used for Calculation of Irrigation Water Requirement

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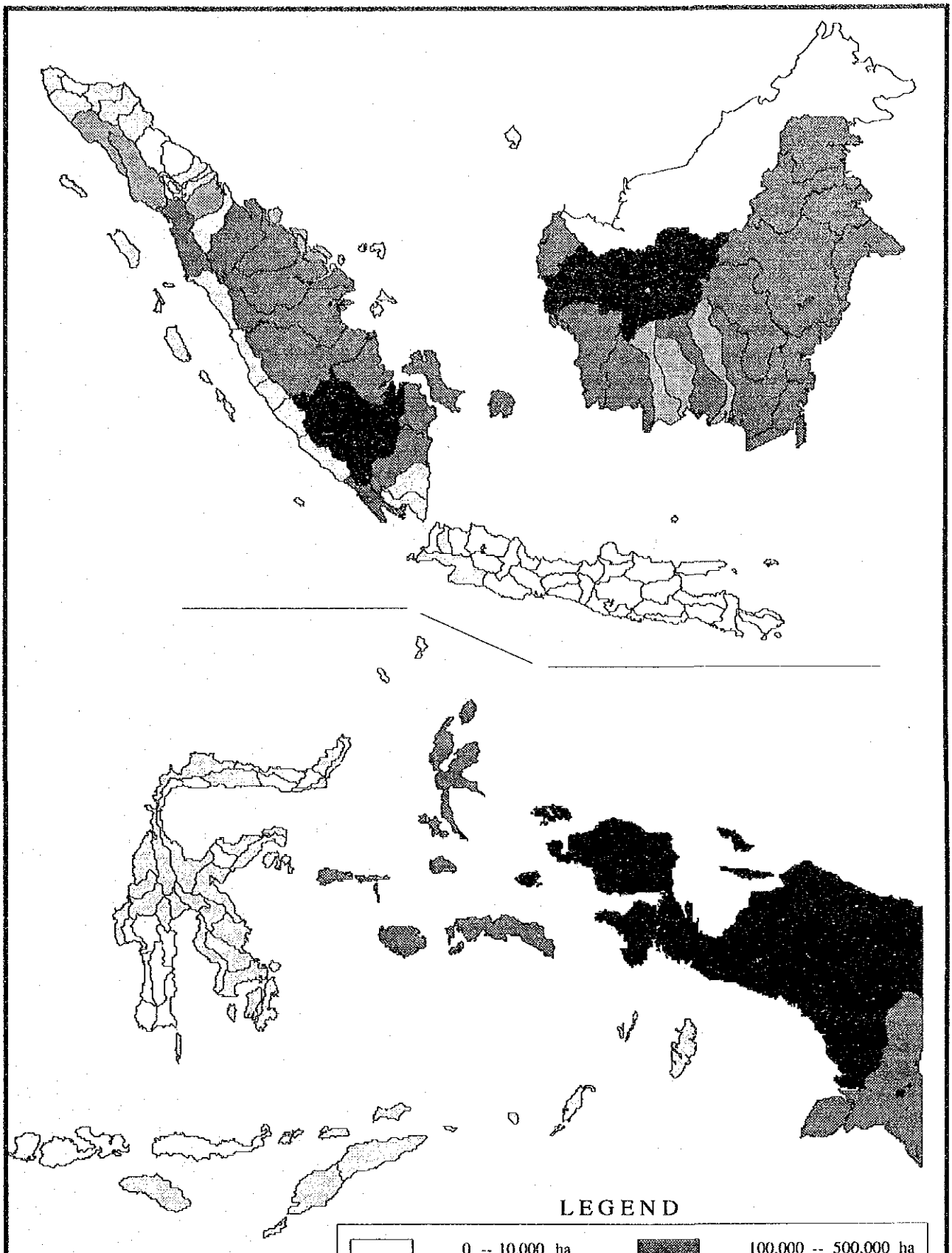

Figure 3.7 Irrigation Potential Area by River Basin in year of 2020

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PART II

JUSTIFICATION OF IRRIGATION DEVELOPMENT

Chapter 4

PART II JUSTIFICATION OF IRRIGATION DEVELOPMENT

4. RICE DEMAND PROJECTION

Rice demand projection in the study aims to build a framework for long-term irrigation development planning. The objective is to provide a target of total amount of rice to be supplied in the future. In principle the study pursues to present a direction towards how to manipulate the supply capacity. Demand projection is thus made independently of supply-demand equilibrium. The study has tried to keep its simplicity and maneuverability in mind. Upon conditional change, either in supply side or demand side, the long-term program is expected to be revised by Indonesian government authority. Another aspect concerned in the course of this work was consistency with other models to be adopted in national economic planning.

Several studies on future demand for rice have been made by various institutions and researchers so far. Before defining projection procedure and parameters to be used, methodologies of previous studies were overviewed.

In this text, "per capita demand/consumption" is defined as a residual divided by population after deducting feed and seed consumption and wastes from amount produced, imported and released from storage while "total demand" contains any kind of disappearance.

4.1 Projection Methodology

In this study, total annual rice demand is forecasted at first by estimating per capita consumption in each year. "Consumption" here is given in terms of "disappearance base" rather than of "actual food consumption". After multiplying this disappearance base consumption by population, feed and seed use and wastes are added to obtain total demand amount. Per capita annual consumption is calculated with a formula:

$$\begin{aligned} \ln Q_t &= a + \eta_t \cdot \ln(PCE_t / POP_t) + \varepsilon \cdot \ln P_t \\ &= a + \eta_t \cdot (\ln PCE_t - \ln POP_t) + \varepsilon \cdot \ln P_t \end{aligned}$$

where, Q is per capita consumption, a is the intercept, PCE is total private consumption expenditure, POP is population, P is rice price, η is expenditure elasticity, ε is price elasticity and t represents year.

Cross price effect of other commodities on rice consumption is not built in because these elasticities are estimated to be very low or close to zero by various studies. Own price elasticity is assumed to be constant while expenditure elasticity assumed to change every year. Total expenditure is given as a function of GDP with constant private consumption expenditure elasticity at 1.12, following BAPPERTA model assumption[1] . Then $\ln PCE_t$ is defined as:

$$\ln PCE_t = b + 1.12 \bullet \ln GDP_t$$

where b is the intercept.

Actual data of 1990 was used as the base of the calculation.

The projection of both population and rice demand is separately made for urban and rural fractions in each province aiming to reflect the difference in consumption taste. Provincial and urban-rural difference was captured with SUSENAS data since it is the only source available that presents segmented consumption data. Transformation to disappearance base was made using national level proportional difference ratio. Process of estimating provincial per capita food consumption of rice for the base year 1990 is shown in Table 4.2.

The effect of changing age composition is not counted in demand projection, although a change in demographic structure do affect the "effective growth rate" for food consumption[2]. This effect is expected to be negligible as compared to population increase itself .

4.2 Parameter Assumptions

All numbers used in this demand projection as parameter estimates are given in Table 4.1. The background and procedure in selecting and modifying these numbers are briefly explained below:

---

1 Kesavan, T., Klaus Altimeier, Christian Rake, Alirahman and Bambang Adinugroho, An analytical Model of Indonesian Agriculture: Design and Structure, Winrock International and Bureau of Agriculture and Irrigation, BAPPENAS, July 1992.

2 As ratio of economically active population which consume more food over total population increase, average per capita consumption is expected to be larger. Tabor and Heldley estimated that during the 1980s, the effect of age composition on calorie consumption was at 0.108% per annum (Magiera Stephen L. "Agricultural Demand Projections for Indonesia." Consultant report of the World Bank, November 14, 1991.)

(1) Expenditure Elasticity

In this projection we adopt the same expenditure elasticity as used in BAPPERTA model up to the year 2000. BAPPERTA's expenditure elasticity of about 0.2 at present seems reasonable and consistent with the result of econometric analysis given in Appendix-1 of Annex A. For years later than 2000, elasticity was assumed to decrease in a decreasing rate. According to this elasticity forecast, the "saturation point" of per capita rice consumption would be around 2010 if income increases homogeneously between urban and rural.

According to Engel's law, the income elasticity[1] of demand for food is expected to decline as income level becomes higher. This phenomenon has already observed in most of rice consuming Asian countries. In Indonesia income elasticity is still estimated to be positive in any study, although generally it is believed to be shrinking over time. Figure 4.1 depicts per week consumption of cereals and tubers by expenditure class based on SUSENAS 1990 data. The cross section data implies that income elasticity has already turned to be negative for higher expenditure class. When national income increases, each income class may also shift upwards, and then deceleration of consumption would result. This can prove rationale of declining expenditure elasticity assumed in BAPPERTA model.

The result of a multi-national econometric analysis by Ito et al. (1989) is depicted in Figure 4.2. The far higher income countries, namely, Japan and Taiwan aside, those with relatively lower income such as Malaysia and Thailand are concluded to have negative income elasticity at less than -0.4 by 1985 in the study. Thus, the elasticity for Indonesian rice in the demand projection that is forecasted to decrease to be **-0.07 by 2020** seems rather moderate one or at least not an extreme. An alternative is prepared as a case of lower expenditure elasticity in urban area at -0.3 by 2020.

(2) Economic Growth

Growth of private consumption expenditure accompanied by national economic growth is a drive of changing per capita consumption demand. Setting scenario(s) of economic growth is as important as determining income elasticity parameter. The GDP growth rate in real term in next five year plans are targeted at 6.2% per annum for Repelita VI, 6.6% for Repelita VII, 7.1% for Repelita VIII, 7.8% for Repelita IX and 8.7% for Repelita X, respectively. Since our projection is separately made for urban and rural areas, real growth rate at **7%** for urban

[1] Hereinafter, the terms of "income elasticity" and "expenditure elasticity" will be used for the same meaning. In the following analysis responsiveness of consumption is discussed with respect to "total expenditure". Therefore "expenditure elasticity" is preferably used.

and at 4% for rural, respectively, is used for projection up to 2000. After that, more accelerated economic growth at 9% and 5% is assumed. An alternative is prepared for the case of decelerated growth for urban and rural, at 6% and 4% during 1990 - 2000 and 7% and 4% during 2000 - 2020, respectively.

(3) Population Growth

Population growth will be the main force of demand increase as income elasticity declines with income growth. BAPPENAS, in consultation with CBS and the University of Indonesia, has recently set projected population to be used for a series of five year development plans, to avoid any discrepancy of basic figures among agencies. The population growth parameter in the study is also taken from it. Future population projected presents rather moderate numbers among those in other projections as shown in the following table. The difference at 2020 is less than 10 millions or 4% of total population estimates. A higher growth rate scenario that uses the same growth rate with that of the BAPPERTA model was prepared as an extreme alternative.

Comparison of Population Projection Results

Unit: million

Projection	1995	2000	2010	2015	2020
BAPPERTA Model 1992[1]	200	218			
FIDP 1992 (Baseline)	195.3	210.4	238.9	251.5	262.4
(higher growth scenario)	197.5	216.0	251.0	266.7	281.1
University of Indonesia(UI) 1991[2]	195.8	210.3	235.1	245.4	253.7
United Nations (UN) 1989[3]	194.8	208.3	232.0	243.0	253.6
IWRD 1992[4]	192.5	205.8		241.2	

Note: BAPPERTA model, UI 1991 and UN 1989 are made before 1990 census result is announced. All the three projection had already overestimated 1990 population by 3 million, 1.2 million and 1.3 million, respectively.

[1] Kesavan, T., Klaus Altimeier, Christian Rake, Alirahman and Bambang Adinugroho, *An analytical Model of Indonesian Agriculture: Design and Structure*, Winrock International and Bureau of Agriculture and Irrigation, BAPPENAS, July 1992.

[2] Ananta, Aris and Evi Nurvidya Arifin. *Projection of Indonesian Population 1990-2020*, Demographic Institute, Faculty of Economics University of Indonesia, Population Projection Series No.2, Jakarta, January 1991

[3] United Nations. *Prospects of World Urbanization 1988*. New York, 1989

[4] Delft Hydraulics et al. Population Projection and Database, Technical note 1, Integrated Water Resources Development (IWRD) Project, Bina Program Pengairan (BPP), Jakarta, May 1991

The projection forecasts population on provincial level. Until the year 2000, officially projected population is adopted in each province (CBS 1993[1]). After year 2000, it is assumed that inter-provincial difference in population growth rates will hold proportionally. Provinces that had higher increase rate are assumed to show relatively high growth rate in future. In a long-run, this assumption could be violated, but it is hardly possible to predict such a relative change. The influence of transmigration is not separately treated since there are no indications of change in magnitude and direction of migration so far (Delft Hydraulics et al. 1991[2]). The influence is thus already included in population growth rates of each province.

(4) Urbanization

Since the projection is made separately for urban and rural areas, assumption on urbanization is another key factor to be discussed. Estimated urbanization rate by BAPPENAS is applied for future urban-rural population ratios in the study.

(5) Price Elasticity and Price Forecast

Unlike the income elasticity, own price elasticity was given constant at **0**. Since paddy price has been controlled by the Government policy, drastic change in price would not be expected. It is therefore expected that the price fluctuation will not affect consumption of rice or will affect to a negligible extent.

(6) Others

Other coefficients assumed in the projection model are of conversion factors used to transform food consumption amount into total demand amount. Conversion factors used in Food Balance Sheet by CBS[3] shown below are employed in this projection.

- Milling rate from rough rice (*gabah kering giling*) to milled rice is 65%
- Seed use is at 39.97 kg of rough rice for every ha of planted area
- Rough rice for feed consumption is at 2% of paddy production
- Wastes are at 5.4% before milling and 2.5% after milling

[1]Central Bureau of Statistics (CBS). Proyeksi Penduduk Indonesia per Propinsi 1990-2000, Jakarta, March 1993

[2]Delft Hydraulics et al. Population Projection and Database, Technical note 1, Integrated Water Resources Development (IWRD) Project, Bina Program Pengairan (BPP), Jakarta, May 1991

[3] Central Bureau of Statistics (CBS). Neraca Bahan Makanan di Indonesia (Food Balance Sheet), various years, Jakarta.

When converting food demand for rice into total demand, a coefficient of 1.118 derived from 1990 actual data (for derivation, see Table 4.1) was applied to avoid using planted area as explanatory variable. Numbers above are fixed throughout the study period in this projection. In a long-run, these conversion factors would be changed due to improved technology and management. In modifying them, however, one have to be careful because a change in these factors will significantly alter the final demand estimates.

4.3 Projection Results

Calculation for rice demand projection was made with aforementioned methodology and assumed parameters. Results of projection are summarized below.

(1) Population Projection

The population projection outcomes for baseline and lower growth rate scenarios are given in Table 4.3 for national level. Total population in the year 2020 will reach at 262 million in base line scenario. Provincial level projections of total and urban-rural population are in Tables 4.4 and 4.5 but only for the baseline scenario. Figure 4.3 explicitly presents urban and rural population changes in Jawa and outer-Jawa regions up to the year 2020. Urban population is expected to catch up rural population and the urbanization rate will reach 50% around 2020.

(2) Per Capita Consumption

Future per capita consumption (PCC) under the baseline parameter assumptions is given in Table 4.6 and drawn in Figure 4.4. While urban PCC will hit the peak in the middle of 1990s and then sluggishly decrease after then, rural PCC is expected to increase until the middle of 2010s. On the national average, starting from 147.1 kg/year in 1990, PCC will reach a peak at 154.1 kg/year in 2005 and then gradually decrease to be 147.3 kg/year.

(3) Total Demand Amount

Finally the amount of paddy needed to be supplied for Indonesian market was estimated after multiplying population and converting from food consumption to total demand base. The numbers are in the most right column of Table 4.6 and summarized as below:

Rice Demand Projection for Indonesia

Unit: million ton

Year	1990	1993	1998	2003	2008	2013	2018
Food Consumption in milled rice	26.46	28.30	31.19	33.77	35.97	37.60	38.50
Total Demand in rough rice	45.52	48.68	53.66	58.09	61.87	64.67	66.23

The projection result shows that by the year 2019 supply amount must be increased by about 21 million tons or 45% of the production in 1990. The demand trend is depicted in Figure 4.5. Tables 4.7 and 4.8 show provincial demand projection. The net increase in rice demand between 1990 and 2018 was divided into effect of increased PCC and that of increased population. It was found that 98.0% of demand increase during the period will be attributed to population increase and remaining 2.0% to PCC change during the period. Increased population is thus regarded as the vehicle of expanding rice demand.

(4) Alternative Scenarios

Projections under four alternative scenarios as shown below are made to examine the sensitivity of projection to parameter changes.

1) Higher population growth scenario

   Use higher population growth rate which is the same as the one used in BAPPERTA model projection.

2) Lower income elasticity scenario

   Income elasticity will decrease faster in urban area to reach to -0.3 in 2020.

3) Decelerated economic growth scenario

   Annual growth rate of GDP in urban and rural areas will be lower with 6% and 4% during 1990 - 2000 and 7% and 4% after 2000 respectively.

5) Higher population growth & Lower economic growth scenario

   A mixture of scenarios 1) and 3). Simultaneous occurrence of them would produce the highest demand projection.

The simulation results are summarized below and drawn in Figure 4.6.

Rice Demand Projection for Indonesia

Unit: million ton, rough rice

Scenario	1993	1998	2003	2008	2013	2018
Baseline	48.68	53.66	58.09	61.87	64.67	66.23
1) Higher Population Growth	48.95	54.60	59.89	64.49	68.09	70.47
2) Lower Income Elasticity	48.68	53.66	58.07	61.73	64.15	64.80
3) Lower Economic Growth	48.66	53.63	58.10	61.96	64.87	66.59
4) 1) + 3)	48.93	54.58	59.91	64.59	68.29	70.85

Only the scenarios with higher population growth show significantly different projection results, while others derive only less than 2% difference from the baseline scenario by 2020. The forth scenario from which the lowest forecasts are expected derives 7.0% higher demand estimate than that of the baseline at 2018. As shown in Figure 4.6, four similar scenarios show almost saturated demand trend for the final five years of the projection period. This is due to the effect of decreased per capita consumption that compare to the effect of increased population.

4.4 Comparison with Other Studies

The projection result was compared with other previous studies referred to in literature overview in order to examine its adequacy. The comparison is given in Table 4.9. The projection shows slightly larger total demand as compared with other projection except that of BAPPERTA model. The differences at the year 2000, which is the final year of three of five projections, lie mostly within the range of three million tons. Some has already under-estimated 1990 total demand, which implies if the base years were the same, the difference would be smaller. The comparison result supports that the projection presents a reasonable forecast.

As mentioned above, the accuracy of the demand projection highly depends on that of population projection. Applying this projection for irrigation planning would require close monitoring on the change in population growth rate. The part of population growth in the demand projection model needs to be calibrated every five year with data from population censuses and inter-census surveys (SUPAS).

Table 4.1 Parameter Assumptions for Rice Demand Projection

1) Population & Urbanization

a. Population Growth Rate

Year	*1. Baseline*		*2. Higher*		
1990	1.73%		1.94%		30.91%
1991	1.70%		1.92%		
1992	1.66%	Average	1.90%	Average	
1993	1.63%	Growth Rat	1.88%	Growth Rate	
1994	1.60%	1990-1995	1.86%	1990-1995	at 1995
1995	1.57%	1.66%	1.84%	1.90%	33.02%
1996	1.54%		1.82%		
1997	1.51%	Average	1.80%	Average	
1998	1.48%	Growth Rat	1.78%	Growth Rate	
1999	1.45%	1995-2000	1.76%	1995-2000	at 2000
2000	1.42%	1.51%	1.71%	1.80%	36.34%
2001	1.39%		1.66%		
2002	1.36%	Average	1.62%	Average	
2003	1.33%	Growth Rat	1.57%	Growth Rate	
2004	1.30%	2000-2005	1.53%	2000-2005	at 2005
2005	1.26%	1.36%	1.49%	1.62%	40.64%
2006	1.23%		1.44%		
2007	1.20%	Average	1.40%	Average	
2008	1.16%	Growth Rat	1.36%	Growth Rate	
2009	1.13%	2005-2010	1.33%	2005-2010	at 2010
2010	1.09%	1.20%	1.29%	1.40%	44.48%
2011	1.06%		1.25%		
2012	1.03%	Average	1.22%	Average	
2013	0.99%	Growth Rat	1.18%	Growth Rate	
2014	0.96%	2010-2015	1.15%	2010-2015	at 2015
2015	0.92%	1.03%	1.12%	1.22%	47.63%
2016	0.89%		1.09%		
2017	0.86%	Average	1.06%	Average	
2018	0.82%	Growth Rat	1.03%	Growth Rate	
2019	0.79%	2015-2020	1.00%	2015-2020	at 2020
2020	0.75%	0.86%	0.97%	1.06%	51.22%

2) Per Capita Consumption of Rice

a. Expenditure Elasticity

	1. Baseline			*2. Accelerated*		
	Total	Urban	Rural	Total	Urban	Rural
1990	0.18	0.06	0.24	0.18	0.06	0.24
1991	0.17	0.05	0.23	0.17	0.05	0.23
1992	0.16	0.04	0.22	0.16	0.04	0.22
1993	0.15	0.03	0.21	0.15	0.03	0.21
1994	0.14	0.02	0.20	0.14	0.02	0.20
1995	0.13	0.01	0.19	0.13	0.01	0.19
1996	0.12	0.00	0.18	0.12	0.00	0.18
1997	0.11	-0.01	0.17	0.11	-0.01	0.17
1998	0.10	-0.02	0.16	0.10	-0.02	0.16
1999	0.09	-0.03	0.15	0.09	-0.03	0.15
2000	0.08	-0.04	0.14	0.08	-0.04	0.14
2001	0.07	-0.04	0.13	0.07	-0.04	0.13
2002	0.06	-0.04	0.12	0.06	-0.05	0.12
2003	0.05	-0.05	0.11	0.05	-0.05	0.11
2004	0.05	-0.05	0.10	0.04	-0.06	0.10
2005	0.04	-0.05	0.09	0.03	-0.07	0.09
2006	0.03	-0.05	0.08	0.02	-0.07	0.08
2007	0.02	-0.06	0.07	0.01	-0.08	0.07
2008	0.01	-0.06	0.06	0.00	-0.09	0.06
2009	0.01	-0.06	0.05	-0.01	-0.10	0.05
2010	0.00	-0.06	0.04	-0.02	-0.11	0.04
2011	-0.01	-0.07	0.03	-0.03	-0.12	0.03
2012	-0.02	-0.07	0.02	-0.04	-0.13	0.02
2013	-0.03	-0.07	0.01	-0.05	-0.15	0.01
2014	-0.03	-0.08	0.00	-0.07	-0.16	0.00
2015	-0.04	-0.08	-0.01	-0.08	-0.18	-0.01
2016	-0.05	-0.08	-0.02	-0.10	-0.20	-0.02
2017	-0.06	-0.09	-0.03	-0.11	-0.22	-0.03
2018	-0.06	-0.09	-0.04	-0.13	-0.25	-0.04
2019	-0.07	-0.10	-0.05	-0.15	-0.27	-0.05
2020	-0.08	-0.10	-0.06	-0.17	-0.30	-0.06

b. Economic Growth

(GDP Growth)

1. Baseline

1990-2000

Urban 7%

Rural 4%

2000-2020

Urban 9%

Rural 5%

2. Slowered

1990-2000

Urban 6%

Rural 4%

2000-2020

Urban 7%

Rural 4%

c. Other Parameters

Own Price Elasticity: 0

Expenditure Elasticity w.r.t. GDP Growth: 1.120

Rice Milling Rate: 0.650

Calculation of Base Year Consumption (1990)

a. Producton: Paddy	(1,000 ton	45,179
b. Feed Consumption (2% of a.)	(1,000 ton	904
c. Seed Use (39.97 kg/ha, paddy)	(1,000 ton	420
d. Waste (5.4% of a.)	(1,000 ton	2,440
e. Net Import (Food Blance Sheet)	(1,000 ton	46
f. Change in Stock (")	(1,000 ton	-173
g. Available Rice	(1,000 ton	27,139
h. Waste at milled rice (2.5% of g.)	(1,000 ton	678
i. Food Consumption	(1,000 ton	26,461
j. Per Capita Food Consumption	(kg/year)	147.14
Food Consumption to Total Demand:	(a*0.65+(e-f))/	**1.118**

Per Capita Consumption by		SUSENAS 1990		Adjusted to disappearance base
Urban	(kg/year)	112.00	→	139.13
Rural	(kg/year)	121.34	→	150.73

Table 4.2 Estimation of Per Capita Consumption by Province

Calculation Process 1.:
Consumption in 1990

1990 Adjusted National Consumption	
7,730,845	18,730,052

Code No.	Privince	SUSENAS 1990 Per Capita Consumption Urban (kg/year)	Rural (kg/year)	Population Census 1990 Urban (thousand)	Rural (thousand)	Total Consumption From SUSENAS Data Urban (ton)	Rural (ton)	Adjusted 1990 Total Consumption Urban (ton)	Rural (ton)	Adjusted 1990 Per Capita Consumption Urban (kg/year)	Rural (kg/year)
11	D.I Aceh	136.72	150.48	544	2,896	74,318	435,820	92,298	542,063	169.80	187.17
12	Sumatera Utara	116.85	144.44	3,665	6,660	428,220	961,995	531,823	1,196,507	145.12	179.65
13	Sumatera Barat	128.01	154.86	812	3,208	103,990	496,797	129,149	617,904	158.98	192.62
14	Riau	110.18	122.59	1,057	2,254	116,442	276,269	144,614	343,617	136.83	152.47
15	Jambi	120.40	152.05	437	1,598	52,646	242,963	65,384	302,191	149.53	189.11
16	Sumatera Selatan	110.13	132.60	1,864	4,502	205,243	596,934	254,899	742,452	136.77	164.92
17	Bengkulu	143.65	158.25	243	948	34,837	149,992	43,265	186,557	178.41	196.83
18	Lampung	127.07	127.59	754	5,304	95,818	676,763	119,001	841,742	157.82	158.70
31	D.K.I Jakarta	102.62	0.00	8,281	0	849,762	0	1,055,353	0	127.44	
32	Jawa Barat	119.88	146.26	12,098	22,960	1,450,220	3,358,216	1,801,085	4,176,869	148.88	181.92
33	Jawa Tengah	105.90	102.77	7,728	20,914	818,440	2,149,358	1,016,454	2,673,320	131.52	127.83
34	D.I Yokyakarta	97.98	89.43	1,298	1,624	127,213	145,226	157,991	180,628	121.68	111.22
35	Jawa Timur	102.20	95.00	8,980	23,742	917,786	2,255,545	1,139,835	2,805,393	126.93	118.16
51	Bali	126.50	140.42	738	2,052	93,296	288,182	115,868	358,433	157.10	174.65
52	Nusa Tenggara Barat	133.49	145.06	586	2,803	78,183	406,664	97,099	505,799	165.78	180.42
53	Nusa Tenggara Timur	119.25	86.45	374	2,911	44,630	251,694	55,428	313,051	148.10	107.53
54	Timor Timur	86.66	76.81	59	693	5,071	53,211	6,298	66,182	107.63	95.53
61	Kalimantan Barat	113.41	128.90	647	2,609	73,396	336,322	91,153	418,310	140.85	160.32
62	Kalimantan Tengah	122.74	143.45	247	1,161	30,378	166,556	37,727	207,158	152.44	178.41
63	Kalimantan Selatan	106.63	129.52	707	1,906	75,438	246,850	93,689	307,026	132.43	161.10
64	Kalimantan Timur	124.99	132.13	922	967	115,274	127,732	143,163	158,869	155.23	164.34
71	Sulawesi Utara	128.64	117.22	568	1,923	73,010	225,354	90,673	280,290	159.76	145.79
72	Sulawesi Tengah	130.04	125.20	284	1,439	36,995	180,171	45,945	224,092	161.51	155.71
73	Sulawesi Selatan	128.48	139.64	1,693	5,320	217,570	742,903	270,209	924,005	159.56	173.68
74	Sulawesi Tenggara	114.77	95.21	232	1,129	26,587	107,537	33,019	133,752	142.53	118.42
81	Maluku	104.08	67.16	355	1,511	36,972	101,449	45,917	126,180	129.26	83.53
82	Irian Jaya	109.45	63.88	394	1,229	43,082	78,520	53,505	97,661	135.93	79.45
	INDONESIA	112.00	121.34	55,567	124,263	6,224,816	15,059,023	7,730,845	18,730,052	139.13	150.73

Table 4.3 Population Projection Toward 2020

	Baseline		Higher Senario	
Year	Population (thousand)	Growth Rate (per cent)	Population (thousand)	Growth Rate (per cent)
1990	179,830	1.73%	179,830	1.94%
1991	182,941	1.70%	183,318	1.92%
1992	186,044	1.66%	186,838	1.90%
1993	189,136	1.63%	190,388	1.88%
1994	192,217	1.60%	193,967	1.86%
1995	195,282	1.57%	197,575	1.84%
1996	198,343	1.54%	201,211	1.82%
1997	201,389	1.51%	204,873	1.80%
1998	204,422	1.48%	208,560	1.78%
1999	207,440	1.45%	212,273	1.76%
2000	210,440	1.42%	216,009	1.71%
2001	213,425	1.39%	219,705	1.66%
2002	216,400	1.36%	223,359	1.62%
2003	219,351	1.33%	226,970	1.57%
2004	222,273	1.30%	230,538	1.53%
2005	225,158	1.26%	234,061	1.49%
2006	228,004	1.23%	237,538	1.44%
2007	230,809	1.20%	240,968	1.40%
2008	233,569	1.16%	244,350	1.36%
2009	236,283	1.13%	247,685	1.33%
2010	238,948	1.09%	250,971	1.29%
2011	241,563	1.06%	254,208	1.25%
2012	244,123	1.03%	257,395	1.22%
2013	246,628	0.99%	260,532	1.18%
2014	249,074	0.96%	263,619	1.15%
2015	251,461	0.92%	266,655	1.12%
2016	253,784	0.89%	269,641	1.09%
2017	256,043	0.86%	272,576	1.06%
2018	258,234	0.82%	275,460	1.03%
2019	260,357	0.79%	278,294	1.00%
2020	262,409	0.75%	281,077	0.97%

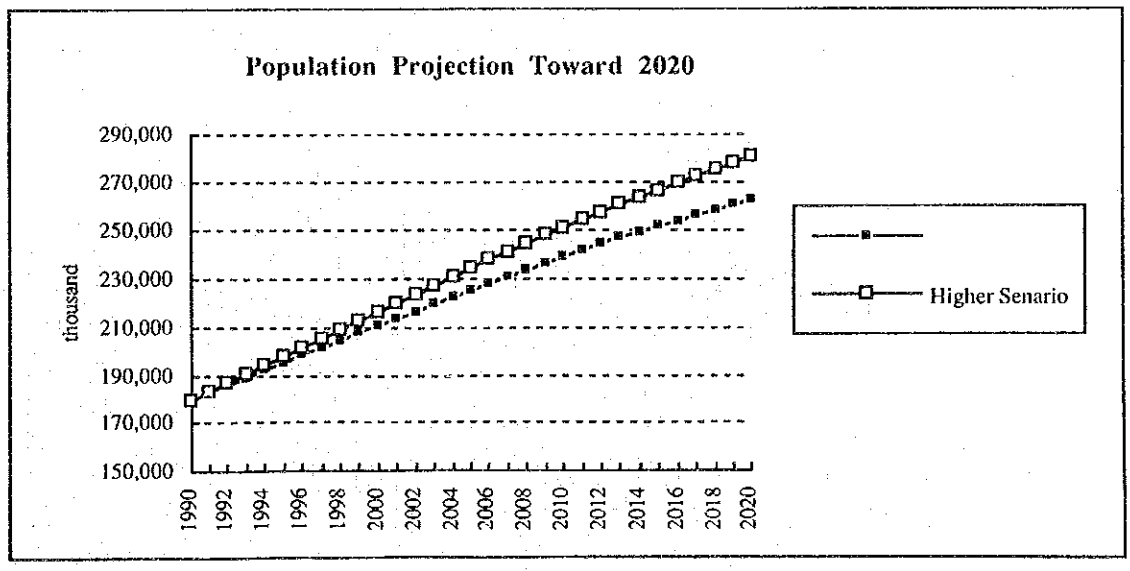


Table 4.4 Population Projection by Province

Unit: thousand

Code No.	Province	1990 (adjusted)	1993	1998	2003	2008	2013	2018
11	D.I Aceh	3,440	3,699	4,123	4,541	4,942	5,313	5,643
12	Sumatera Utara	10,325	10,857	11,636	12,372	13,054	13,663	14,192
13	Sumatera Barat	4,020	4,204	4,521	4,821	5,100	5,350	5,568
14	R i a u	3,311	3,681	4,344	5,040	5,742	6,421	7,048
15	J a m b i	2,035	2,246	2,619	3,006	3,393	3,763	4,102
16	Sumatera Selatan	6,366	6,910	7,798	8,687	9,551	10,356	11,079
17	Bengkulu	1,190	1,321	1,570	1,832	2,099	2,358	2,599
18	Lampung	6,058	6,529	7,237	7,933	8,597	9,208	9,751
31	D.K.I Jakarta	8,281	8,819	9,717	10,594	11,427	12,190	12,864
32	Jawa Barat	35,058	37,318	41,242	45,088	48,749	52,107	55,084
33	Jawa Tengah	28,642	29,297	30,252	31,103	31,858	32,508	33,057
34	D.I Yokyakarta	2,922	2,918	2,914	2,906	2,899	2,891	2,885
35	Jawa Timur	32,722	33,486	34,692	35,775	36,741	37,575	38,282
51	B a l i	2,790	2,856	2,968	3,070	3,161	3,240	3,307
52	Nusa Tenggara Barat	3,389	3,562	3,816	4,057	4,279	4,478	4,651
53	Nusa Tenggara Timur	3,286	3,477	3,755	4,021	4,269	4,491	4,686
54	Timor Timur	751	812	891	968	1,041	1,107	1,166
61	Kalimantan Barat	3,256	3,506	3,898	4,285	4,656	4,997	5,301
62	Kalimantan Tengah	1,409	1,548	1,791	2,040	2,288	2,523	2,738
63	Kalimantan Selatan	2,613	2,789	3,086	3,378	3,656	3,911	4,137
64	Kalimantan Timur	1,889	2,148	2,637	3,171	3,729	4,285	4,812
71	Sulawesi Utara	2,490	2,588	2,759	2,919	3,066	3,197	3,310
72	Sulawesi Tengah	1,724	1,868	2,114	2,360	2,600	2,824	3,026
73	Sulawesi Selatan	7,014	7,365	7,929	8,465	8,963	9,410	9,800
74	Sulawesi Tenggara	1,361	1,505	1,746	1,994	2,241	2,476	2,692
81	M a l u k u	1,866	2,006	2,237	2,466	2,686	2,889	3,071
82	Irian Jaya	1,623	1,821	2,132	2,457	2,782	3,095	3,382
	Sumatera	36,745	39,448	43,847	48,234	52,478	56,432	59,983
	Jawa	107,625	111,837	118,816	125,466	131,675	137,272	142,173
	Bali, NTB, NTT &Timt	10,216	10,706	11,431	12,116	12,750	13,317	13,810
	Kalimantan	9,167	9,991	11,412	12,874	14,328	15,716	16,989
	Sulawesi	12,588	13,326	14,547	15,738	16,870	17,907	18,827
	Maluku & Irian Jaya	3,489	3,826	4,369	4,923	5,468	5,984	6,453
	Jawa	107,625	111,837	118,816	125,466	131,675	137,272	142,173
	Off-Jawa	72,205	77,299	85,606	93,885	101,895	109,356	116,061
	I N D O N E S I A	179,830	189,136	204,422	219,351	233,569	246,628	258,234

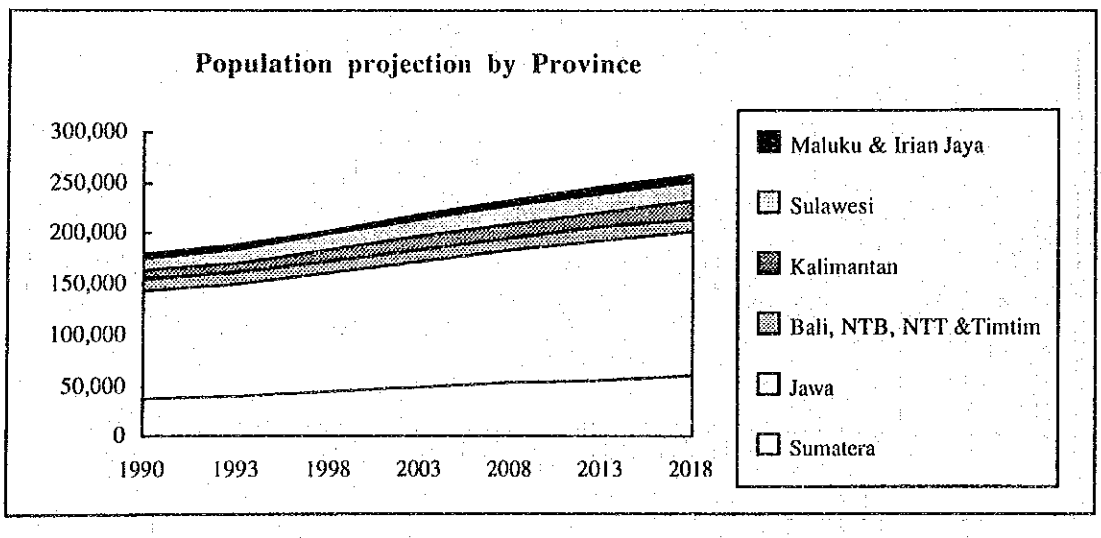


Table 4.5 Population Projection: Urban versus Rural

Unit: thousand

Code No.	Province	1990(adjusted)			1993			1998			2003			2008			2013			2018		
		Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
11	D.I Aceh	544	2,896	3,440	657	3,042	3,699	875	3,247	4,123	1,124	3,418	4,541	1,432	3,510	4,942	1,843	3,470	5,313	2,357	3,286	5,643
12	Sumatera Utara	3,665	6,660	10,325	4,114	6,742	10,857	4,832	6,803	11,636	5,467	6,905	12,372	6,149	6,905	13,054	7,010	6,653	13,663	7,978	6,215	14,192
13	Sumatera Barat	812	3,208	4,020	917	3,287	4,204	1,101	3,419	4,521	1,282	3,539	4,821	1,491	3,610	5,100	1,756	3,595	5,350	2,063	3,505	5,568
14	Riau	1,057	2,254	3,311	1,223	2,458	3,681	1,515	2,829	4,344	1,832	3,208	5,040	2,211	3,531	5,742	2,676	3,745	6,421	3,198	3,850	7,048
15	Jambi	437	1,598	2,035	519	1,728	2,246	670	1,949	2,619	837	2,169	3,006	1,039	2,354	3,393	1,294	2,469	3,763	1,594	2,508	4,102
16	Sumatera Selatan	1,864	4,502	6,366	2,074	4,835	6,910	2,398	5,399	7,798	2,722	5,966	8,687	3,102	6,448	9,551	3,564	6,792	10,356	4,063	7,016	11,079
17	Bengkulu	243	948	1,190	300	1,021	1,321	420	1,149	1,570	549	1,283	1,832	695	1,404	2,099	881	1,477	2,358	1,102	1,497	2,599
18	Lampung	754	5,304	6,058	837	5,692	6,529	958	6,279	7,237	1,060	6,873	7,933	1,167	7,430	8,597	1,298	7,910	9,208	1,434	8,316	9,751
31	D.K.I Jakarta	8,281	0	8,281	8,819	0	8,819	9,717	0	9,717	10,594	0	10,594	11,427	0	11,427	12,190	0	12,190	12,864	0	12,864
32	Jawa Barat	12,098	22,960	35,058	14,196	23,122	37,318	18,134	23,107	41,242	21,652	23,436	45,088	25,155	23,594	48,749	29,524	22,583	52,107	34,467	20,617	55,084
33	Jawa Tengah	7,728	20,914	28,642	8,521	20,776	29,297	9,797	20,455	30,252	10,933	20,169	31,103	12,214	19,645	31,858	13,890	18,618	32,508	15,832	17,226	33,057
34	D.I Yokyakarta	1,298	1,624	2,922	1,424	1,494	2,918	1,635	1,279	2,914	1,704	1,202	2,906	1,704	1,195	2,899	1,740	1,151	2,891	1,789	1,096	2,885
35	Jawa Timur	8,980	23,742	32,722	9,825	23,661	33,486	11,180	23,513	34,692	12,308	23,467	35,775	13,532	23,209	36,741	15,139	22,436	37,575	16,970	21,312	38,282
51	Bali	738	2,052	2,790	833	2,023	2,856	1,003	1,966	2,968	1,140	1,930	3,070	1,276	1,886	3,161	1,451	1,789	3,240	1,654	1,653	3,307
52	Nusa Tenggara Barat	586	2,803	3,389	648	2,914	3,562	743	3,074	3,816	829	3,228	4,057	926	3,353	4,279	1,049	3,430	4,478	1,185	3,466	4,651
53	Nusa Tenggara Timur	374	2,911	3,286	433	3,044	3,477	534	3,221	3,755	642	3,379	4,021	773	3,496	4,269	942	3,549	4,491	1,146	3,540	4,686
54	Timor Timur	59	693	751	67	745	812	78	812	891	89	879	968	101	940	1,041	115	992	1,107	131	1,035	1,166
61	Kalimantan Barat	647	2,609	3,256	728	2,778	3,506	856	3,042	3,898	995	3,291	4,285	1,167	3,488	4,656	1,383	3,614	4,997	1,629	3,672	5,301
62	Kalimantan Tengah	247	1,161	1,409	297	1,251	1,548	391	1,400	1,791	507	1,533	2,040	663	1,625	2,288	870	1,653	2,523	1,131	1,607	2,738
63	Kalimantan Selatan	707	1,906	2,613	793	1,996	2,789	937	2,150	3,086	1,083	2,295	3,378	1,258	2,398	3,656	1,475	2,436	3,911	1,720	2,417	4,137
64	Kalimantan Timur	922	967	1,889	1,086	1,062	2,148	1,387	1,250	2,637	1,718	1,453	3,171	2,112	1,616	3,729	2,593	1,692	4,285	3,129	1,683	4,812
71	Sulawesi Utara	568	1,923	2,490	632	1,957	2,588	741	2,018	2,759	846	2,073	2,919	966	2,100	3,066	1,119	2,078	3,197	1,295	2,015	3,310
72	Sulawesi Tengah	284	1,439	1,724	346	1,523	1,868	465	1,649	2,114	609	1,752	2,360	797	1,804	2,600	1,051	1,774	2,824	1,375	1,651	3,026
73	Sulawesi Selatan	1,693	5,320	7,014	1,874	5,491	7,365	2,163	5,766	7,929	2,410	6,055	8,465	2,673	6,290	8,963	3,004	6,406	9,410	3,368	6,432	9,800
74	Sulawesi Tenggara	232	1,129	1,361	284	1,221	1,505	384	1,362	1,746	502	1,492	1,994	654	1,587	2,241	855	1,622	2,476	1,105	1,586	2,692
81	Maluku	355	1,511	1,866	423	1,583	2,006	548	1,689	2,237	691	1,776	2,466	868	1,818	2,686	1,102	1,788	2,889	1,389	1,682	3,071
82	Irian Jaya	394	1,229	1,623	458	1,363	1,821	559	1,574	2,132	664	1,793	2,457	786	1,997	2,782	934	2,161	3,095	1,097	2,286	3,382
	Sumatera	9,375	27,370	36,745	10,643	28,806	39,448	12,772	31,075	43,847	14,873	33,361	48,234	17,286	35,193	52,478	20,322	36,110	56,432	23,789	36,193	59,983
	Jawa	38,385	69,240	107,625	42,784	69,052	111,837	50,462	68,354	118,816	57,191	68,275	125,466	64,031	67,643	131,675	72,483	64,789	137,272	81,922	60,251	142,173
	Bali, NTB, NTT &Tim	1,756	8,460	10,216	1,981	8,726	10,706	2,358	9,073	11,431	2,700	9,416	12,116	3,075	9,675	12,750	3,557	9,759	13,317	4,116	9,693	13,810
	Kalimantan	2,524	6,643	9,167	2,904	7,087	9,991	3,570	7,842	11,412	4,303	8,571	12,874	5,200	9,128	14,328	6,321	9,395	15,716	7,609	9,380	16,989
	Sulawesi	2,777	9,811	12,588	3,135	10,192	13,326	3,752	10,795	14,547	4,366	11,372	15,738	5,089	11,781	16,870	6,028	11,879	17,907	7,143	11,685	18,827
	Maluku & Irian Jaya	749	2,740	3,489	880	2,946	3,826	1,107	3,263	4,369	1,354	3,569	4,923	1,654	3,814	5,468	2,035	3,949	5,984	2,486	3,967	6,453
	Jawa	38,385	69,240	107,625	42,784	69,052	111,837	50,462	68,354	118,816	57,191	68,275	125,466	64,031	67,643	131,675	72,483	64,789	137,272	81,922	60,251	142,173
	Off-Jawa	17,181	55,023	72,205	19,542	57,756	77,299	23,559	62,047	85,606	27,597	66,288	93,885	32,303	69,591	101,895	38,264	71,092	109,356	45,143	70,919	116,061
	INDONESIA	55,567	124,263	179,830	62,327	126,809	189,136	74,021	130,401	204,422	84,788	134,563	219,351	96,335	137,234	233,569	110,747	135,881	246,628	127,064	131,170	258,234
	Ratio over Population	30.9%	69.1%		33.0%	67.0%		36.2%	63.8%		38.7%	61.3%		41.2%	58.8%		44.9%	55.1%		49.2%	50.8%	

Table 4.6 Projection of Demand for Rice in Indonesia

Year	Per Capita Consumption (kg/year)			Population (1,000)		Food Demand (1,000 ton)				Total Demand
	Urban	Rural	Indonesia	Urban	Rural	Urban	Rural	Indonesia	(in Paddy)	
1990	139.13	150.73	147.14	55,567	124,263	7,731	18,730	26,461	40,709	45,516
1991	139.40	152.01	148.02	57,766	125,175	8,052	19,027	27,080	41,661	46,580
1992	139.62	153.25	148.85	60,020	126,024	8,380	19,314	27,693	42,605	47,636
1993	139.78	154.47	149.63	62,327	126,809	8,712	19,588	28,301	43,539	48,680
1994	139.90	155.63	150.35	64,571	127,645	9,034	19,865	28,899	44,460	49,710
1995	139.96	156.75	151.00	66,862	128,421	9,358	20,130	29,488	45,366	50,723
1996	139.96	157.83	151.60	69,202	129,141	9,686	20,382	30,068	46,258	51,720
1997	139.90	158.87	152.13	71,588	129,801	10,015	20,621	30,637	47,133	52,699
1998	139.78	159.87	152.59	74,021	130,401	10,346	20,847	31,193	47,989	53,656
1999	139.57	160.75	152.97	76,117	131,323	10,623	21,110	31,733	48,820	54,585
2000	139.28	161.58	153.29	78,241	132,199	10,898	21,361	32,258	49,628	55,488
2001	138.99	162.36	153.56	80,394	133,030	11,174	21,599	32,773	50,420	56,374
2002	138.68	163.10	153.78	82,578	133,821	11,452	21,826	33,277	51,196	57,241
2003	138.35	163.77	153.95	84,788	134,563	11,730	22,038	33,768	51,951	58,085
2004	138.00	164.40	154.06	87,059	135,214	12,014	22,230	34,244	52,683	58,904
2005	137.64	164.97	154.13	89,351	135,808	12,298	22,405	34,703	53,390	59,694
2006	137.26	165.49	154.14	91,662	136,343	12,582	22,563	35,144	54,068	60,453
2007	136.86	165.94	154.10	93,990	136,818	12,864	22,703	35,567	54,718	61,179
2008	136.44	166.33	154.00	96,335	137,234	13,144	22,826	35,969	55,338	61,872
2009	136.04	166.68	153.82	99,169	137,114	13,490	22,854	36,344	55,914	62,516
2010	135.61	166.95	153.57	102,030	136,919	13,836	22,859	36,695	56,454	63,120
2011	135.16	167.16	153.26	104,915	136,648	14,180	22,841	37,022	56,956	63,682
2012	134.68	167.28	152.88	107,821	136,302	14,522	22,801	37,323	57,419	64,199
2013	134.18	167.33	152.45	110,747	135,881	14,860	22,737	37,597	57,842	64,672
2014	133.68	167.30	151.91	113,978	135,096	15,237	22,601	37,838	58,212	65,086
2015	133.15	167.18	151.31	117,229	134,232	15,609	22,440	38,049	58,538	65,450
2016	132.59	166.97	150.65	120,496	133,288	15,977	22,255	38,232	58,818	65,763
2017	132.00	166.67	149.91	123,776	132,267	16,338	22,045	38,383	59,051	66,024
2018	131.37	166.28	149.11	127,064	131,170	16,693	21,811	38,504	59,237	66,232
2019	130.72	165.80	148.23	130,357	130,000	17,040	21,554	38,594	59,375	66,386
2020	130.02	165.22	147.29	133,650	128,758	17,377	21,274	38,651	59,463	66,485

Contribution to Demand Increase (1990-2019) Capita Consumption= 2.0% Population= 98.0%

Table 4.7 Rice Demand Projection for Food Consumption by Province

Unit: milled rice, thousand ton

Code No.	Province	1990	1993	1998	2003	2008	2013	2018
11	D.I Aceh	634	691	784	874	952	1,014	1,051
12	Sumatera Utara	1,728	1,841	1,999	2,128	2,228	2,283	2,290
13	Sumatera Barat	747	794	870	937	991	1,028	1,046
14	Riau	488	546	649	763	873	971	1,048
15	Jambi	368	408	480	558	631	694	742
16	Sumatera Selatan	997	1,092	1,247	1,410	1,558	1,683	1,776
17	Bengkulu	230	257	308	365	420	470	509
18	Lampung	961	1,048	1,183	1,323	1,452	1,565	1,653
31	D.K.I Jakarta	1,055	1,129	1,237	1,327	1,403	1,457	1,487
32	Jawa Barat	5,978	6,433	7,177	7,827	8,378	8,743	8,895
33	Jawa Tengah	3,690	3,857	4,087	4,232	4,327	4,364	4,335
34	D.I Yokyakarta	339	347	356	354	350	343	333
35	Jawa Timur	3,945	4,127	4,386	4,562	4,685	4,751	4,747
51	Bali	474	495	526	546	559	563	558
52	Nusa Tenggara Barat	603	644	705	761	808	845	867
53	Nusa Tenggara Timur	368	398	442	484	521	553	576
54	Timor Timur	72	79	89	99	108	115	121
61	Kalimantan Barat	509	555	627	700	765	818	856
62	Kalimantan Tengah	245	271	317	366	412	449	476
63	Kalimantan Selatan	401	433	486	537	581	616	637
64	Kalimantan Timur	302	345	424	514	605	688	757
71	Sulawesi Utara	371	393	430	460	485	504	514
72	Sulawesi Tengah	270	297	342	389	431	467	492
73	Sulawesi Selatan	1,194	1,274	1,398	1,511	1,606	1,678	1,722
74	Sulawesi Tenggara	167	187	221	258	294	327	355
81	Maluku	172	189	218	247	275	301	324
82	Irian Jaya	151	171	203	238	273	307	337
	Sumatera	6,153	6,676	7,520	8,357	9,105	9,707	10,114
	Jawa	15,007	15,893	17,243	18,302	19,142	19,658	19,797
	Bali, NTB, NTT &Tim	1,518	1,616	1,762	1,889	1,996	2,076	2,122
	Kalimantan	1,457	1,603	1,854	2,117	2,362	2,572	2,726
	Sulawesi	2,002	2,151	2,391	2,618	2,816	2,976	3,083
	Maluku & Irian Jaya	323	361	422	486	548	608	660
	Jawa	15,007	15,893	17,243	18,302	19,142	19,658	19,797
	Off-Jawa	11,454	12,407	13,950	15,467	16,828	17,939	18,707
	INDONESIA	26,461	28,301	31,193	33,768	35,969	37,597	38,504

Table 4.8 Demand Projection for Paddy by Province

Unit: rough rice, thousand ton

Code No.	Privince	1990	1993	1998	2003	2008	2013	2018
11	D.I Aceh	1,091	1,189	1,349	1,503	1,638	1,744	1,808
12	Sumatera Utara	2,973	3,166	3,439	3,661	3,832	3,927	3,939
13	Sumatera Barat	1,285	1,365	1,497	1,612	1,705	1,769	1,798
14	Riau	840	939	1,116	1,312	1,501	1,670	1,803
15	Jambi	632	702	825	959	1,086	1,194	1,276
16	Sumatera Selatan	1,716	1,879	2,146	2,425	2,680	2,895	3,055
17	Bengkulu	395	442	530	627	722	808	875
18	Lampung	1,653	1,802	2,034	2,275	2,497	2,691	2,843
31	D.K.I Jakarta	1,815	1,941	2,127	2,283	2,413	2,507	2,558
32	Jawa Barat	10,283	11,066	12,345	13,463	14,411	15,040	15,300
33	Jawa Tengah	6,347	6,635	7,030	7,280	7,442	7,506	7,456
34	D.I Yokyakarta	582	597	613	609	602	590	574
35	Jawa Timur	6,786	7,099	7,545	7,847	8,059	8,171	8,166
51	Bali	816	852	905	939	962	969	959
52	Nusa Tenggara Barat	1,037	1,108	1,213	1,309	1,390	1,453	1,492
53	Nusa Tenggara Timur	634	684	760	832	896	950	991
54	Timor Timur	125	136	153	170	185	198	208
61	Kalimantan Barat	876	954	1,078	1,203	1,315	1,408	1,473
62	Kalimantan Tengah	421	466	546	630	708	773	819
63	Kalimantan Selatan	689	744	836	924	1,000	1,059	1,096
64	Kalimantan Timur	520	593	730	885	1,040	1,184	1,303
71	Sulawesi Utara	638	677	739	791	835	867	884
72	Sulawesi Tengah	464	510	589	668	741	802	847
73	Sulawesi Selatan	2,054	2,191	2,405	2,599	2,763	2,887	2,962
74	Sulawesi Tenggara	287	321	380	444	506	563	611
81	Maluku	296	326	376	425	473	518	557
82	Irian Jaya	260	295	350	410	470	528	579
	Sumatera	10,585	11,484	12,936	14,374	15,661	16,698	17,397
	Jawa	25,814	27,338	29,660	31,481	32,926	33,814	34,054
	Bali, NTB, NTT &Tim	2,611	2,780	3,032	3,250	3,433	3,570	3,651
	Kalimantan	2,506	2,758	3,189	3,642	4,064	4,424	4,690
	Sulawesi	3,444	3,700	4,114	4,503	4,844	5,119	5,304
	Maluku & Irian Jaya	556	620	725	835	943	1,046	1,136
	Jawa	25,814	27,338	29,660	31,481	32,926	33,814	34,054
	Off-Jawa	19,702	21,342	23,996	26,604	28,945	30,858	32,178
	INDONESIA	45,516	48,680	53,656	58,085	61,872	64,672	66,232

Table 4.9 Comparison of Projections of Indonesian Rice Demand

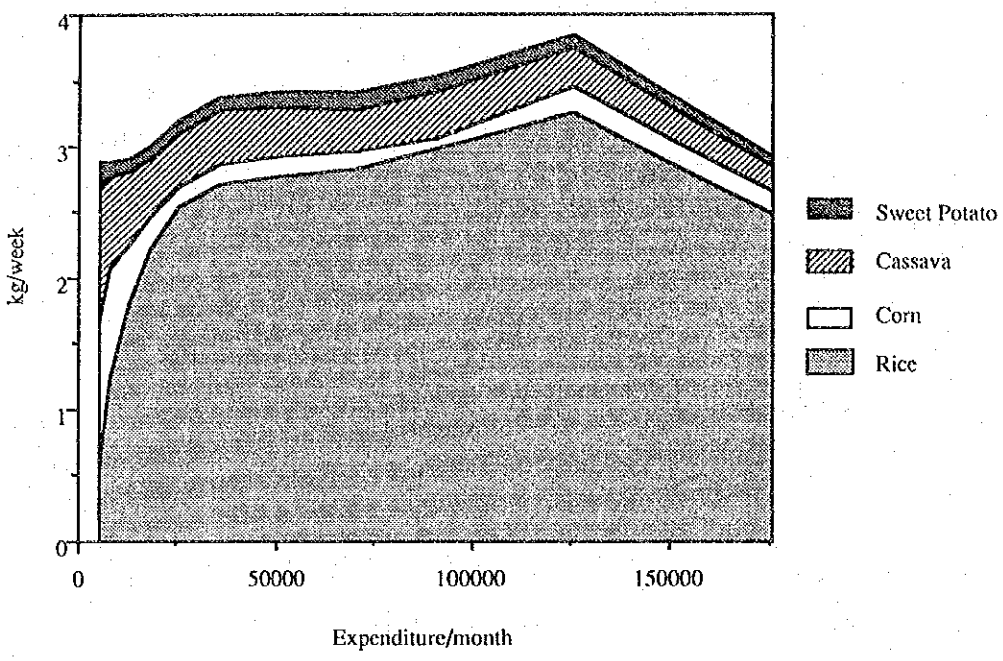
Study	Case	Projection Period	Assumptions: Population Growth Rate (% per annum)	Assumptions: Income/Expenditure Growth Rate (% per annum)	Assumptions: Expenditure Elasticity	Demand Projection: 1990	1995	2000	2010	2015
							(million ton of rough rice))			
BAPPERTA Model	Baseline	1988-2000	1.98% - 1.76%	6.5% (-1992) 5.0% (1993-)	0.20 - 0.08	45.17	51.12	56.73		
	High Rice Price	"	"	"	"		50.67	55.36		
	Fertilizer Subsidy	"	"	"	"		51.19	55.87		
	HIgh Rice Yield	"	"	"	"		51.33	56.51		
IWRD 1992		1990-2015	1.4% (- 2000)	-	-	44.96	46.78	49.81		57.40
		"	1.1% (2000 -)	-	-					
IBRD 1991	6% GDP growth	1988-2010	1.9% - 1.2%	6.0%	0.14 - -0.11		51.24	56.04	61.86	
							(47.44)	(51.88)	(57.27)	**
DGFCA-MOA 1988		1986-2000	2.17% - 1.88%	2.25% - 0.93%*	0.7 - 0.17	43.72	48.89	54.08		
FAO 1991	Neutral	1985-2000	1.6%	1.90%*	Urban 0.05			54.29		
	Urban-Biased	"	1.6%	Urban 2.21% Rural 1.55%	Rural 0.33			53.43		
	Rural Biased	"	1.6%	Urban 1.56% Rural 2.23%				55.12		
FIDP 1993	Baseline	1990-2020	1.73% - 0.75%	Urban 9.0% - 7.0%	0.06 - -0.10	45.52	50.72	55.49	63.12	65.45
				Rural 5.0% - 4.0%	0.24 - -0.06	(actual)				
	High Population	"	1.94% - 0.97%	"	"	45.52	51.23	56.78	66.05	69.19

Notes: Studies with plural sets of assumptions are represented by of midium or most likely case.

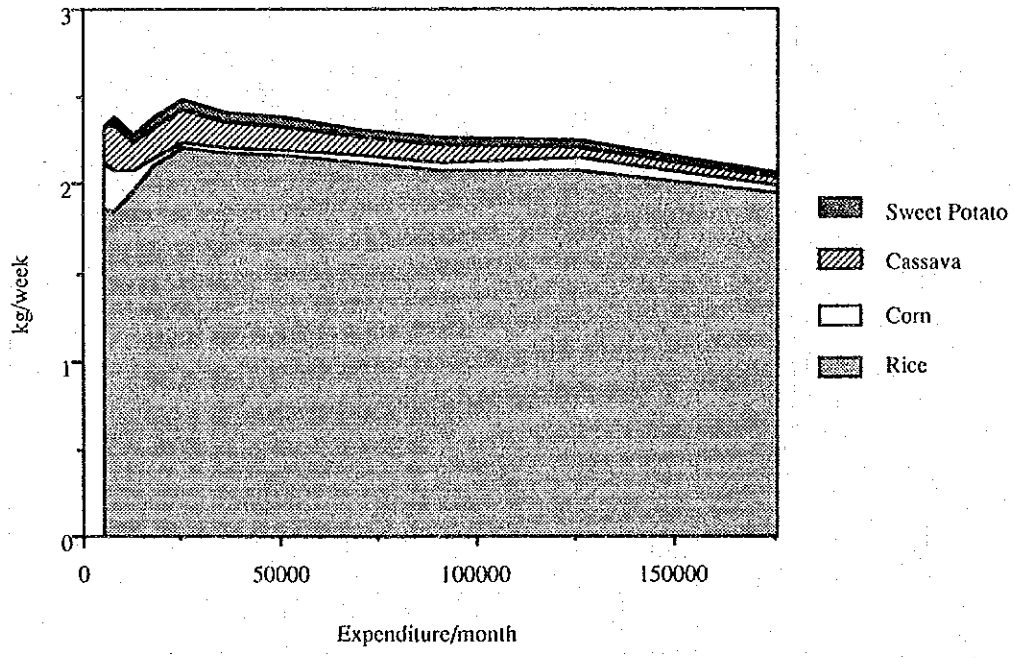
* Income growth rates in FAO 1991 and DGFCA-MOA 1988 are on per capita basis.

** Numbers reported (in parenthesis) are of food and feed consumption only. 8% of wastes and seed use is added for comparison.

Rural 1990



Urban 1990



Source: BPS 1991a (SUSENAS 1990)Note: Expenditure classes are represented by middle value of expenditure range.

Figure 4.1 Cereals and Tuber Consumption byExpenditure Class in 1990

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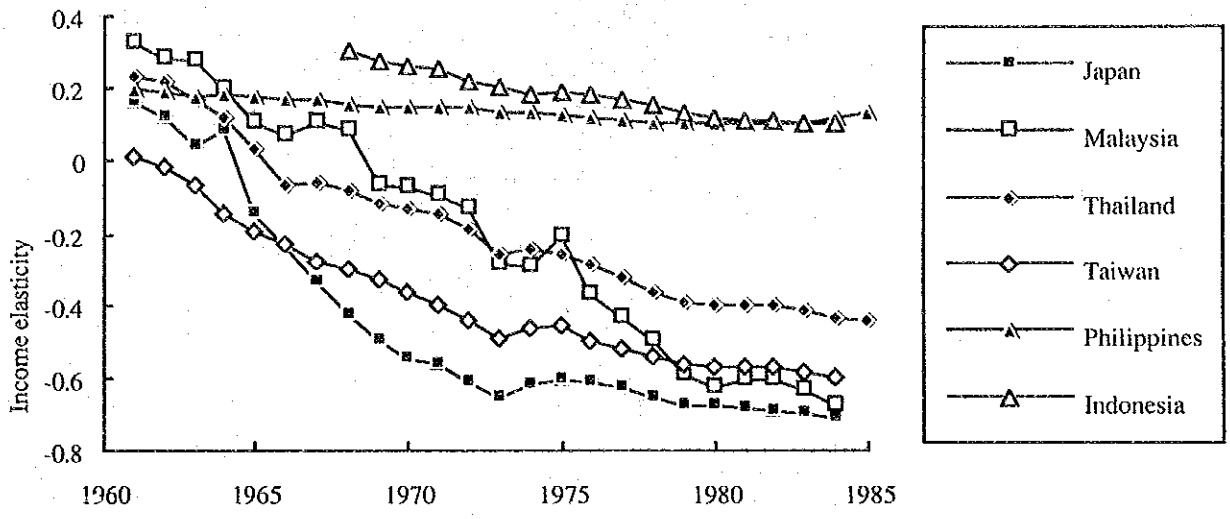
Income Elasticities of Rice in Asian Countries Estimated by Ito et al.



Income Elasticity Estimates/Forecasts

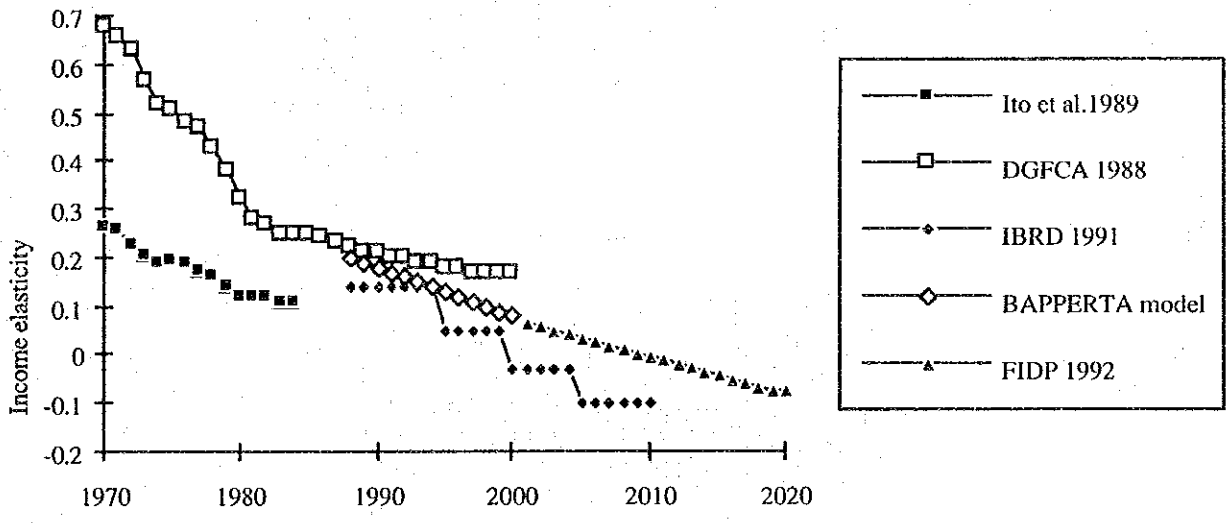


Figure 4.2 Estimations for Income Elasticities

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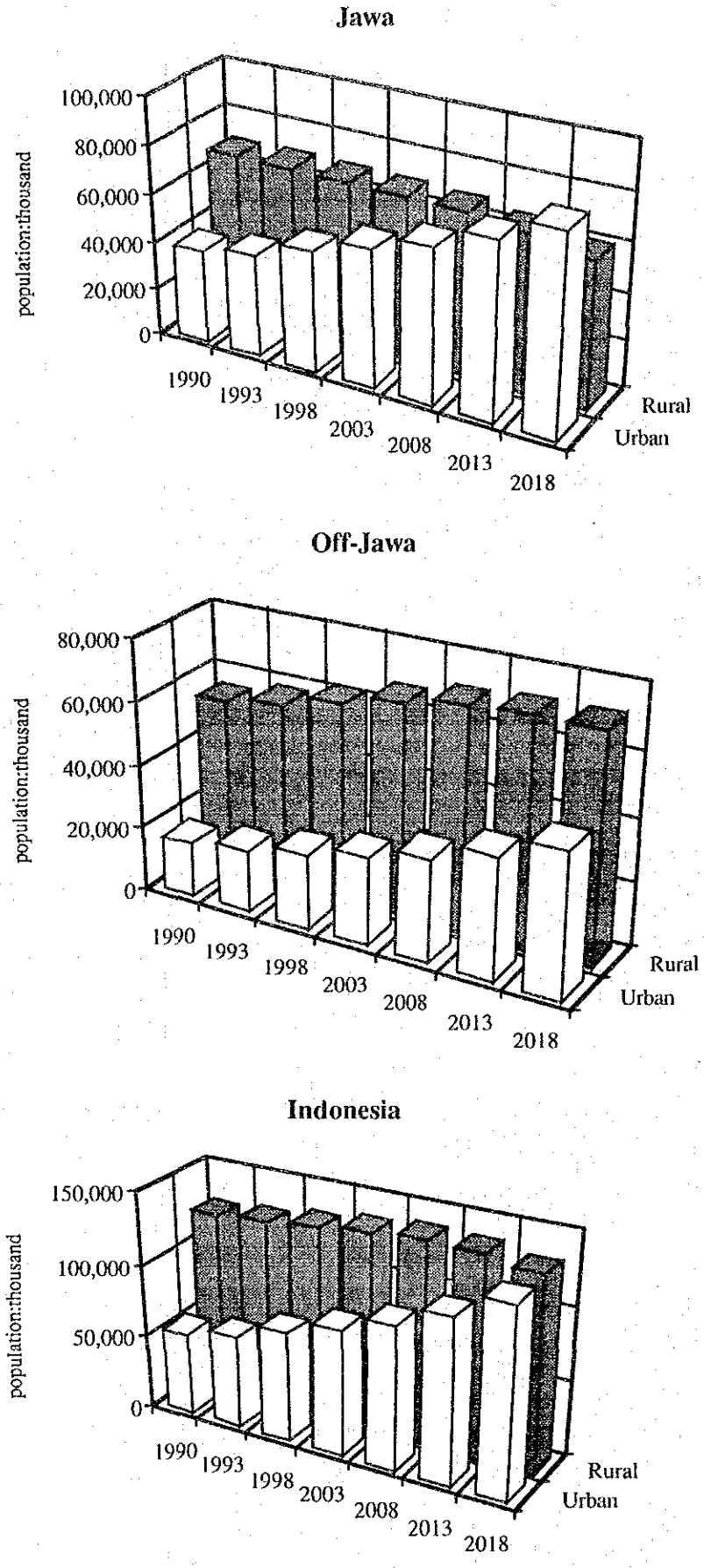

Figure 4.3 Population Projection
Urban versus Rural

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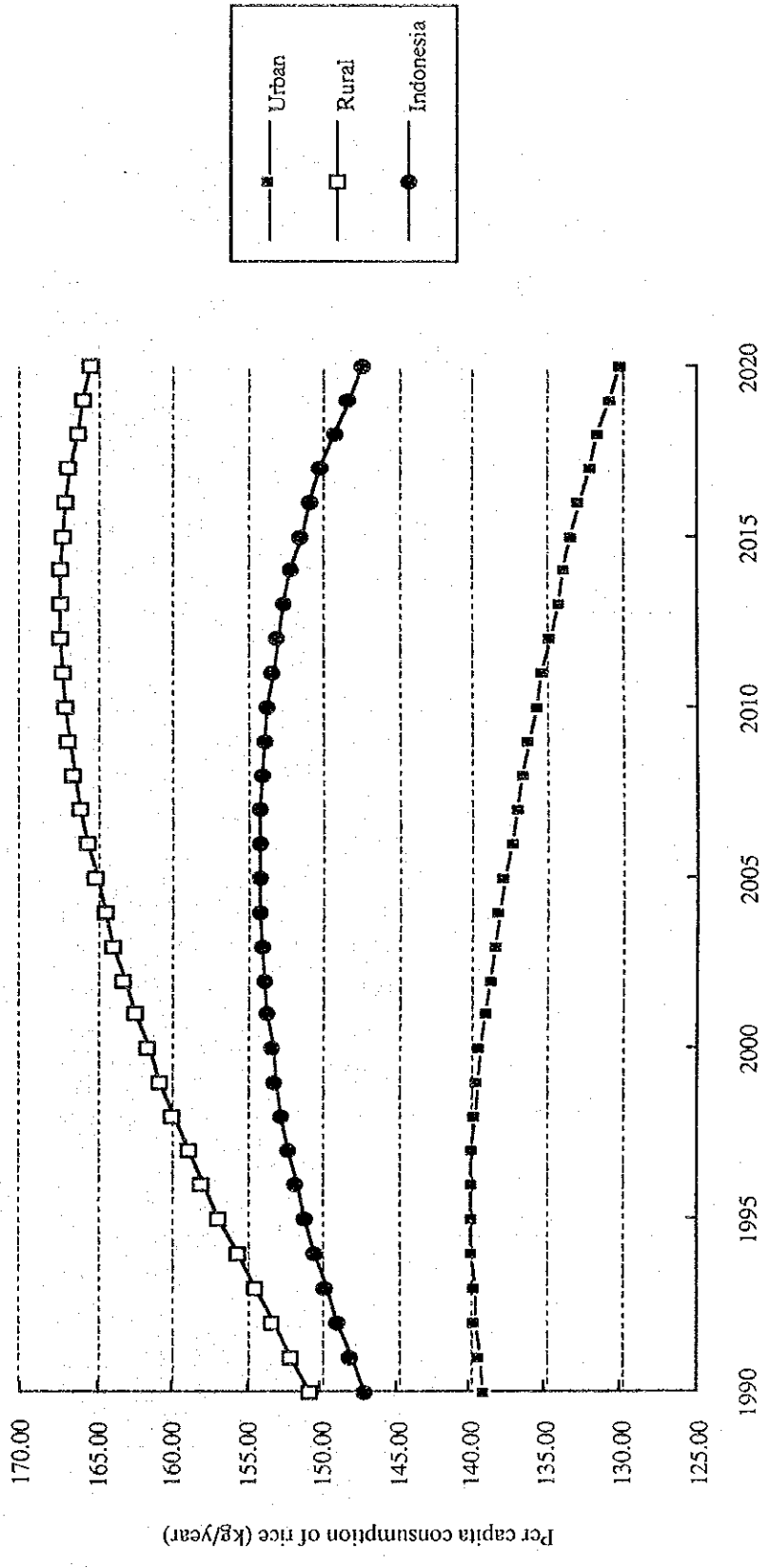

Figure 4.4 Projection of Per Capita Consumption of Rice up to 2020

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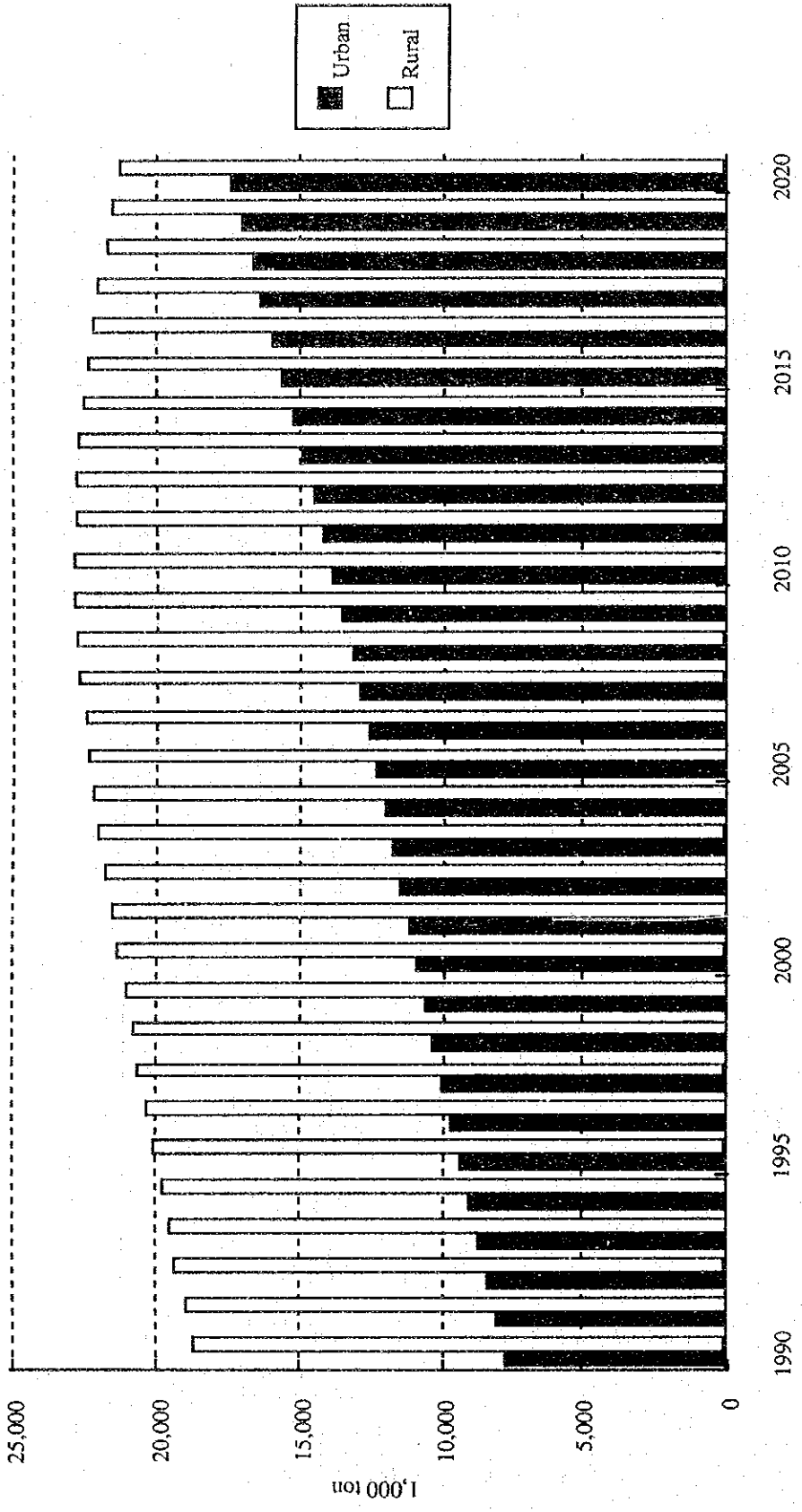

Figure 4.5 Food Consumption Demand for Rice up to 2020

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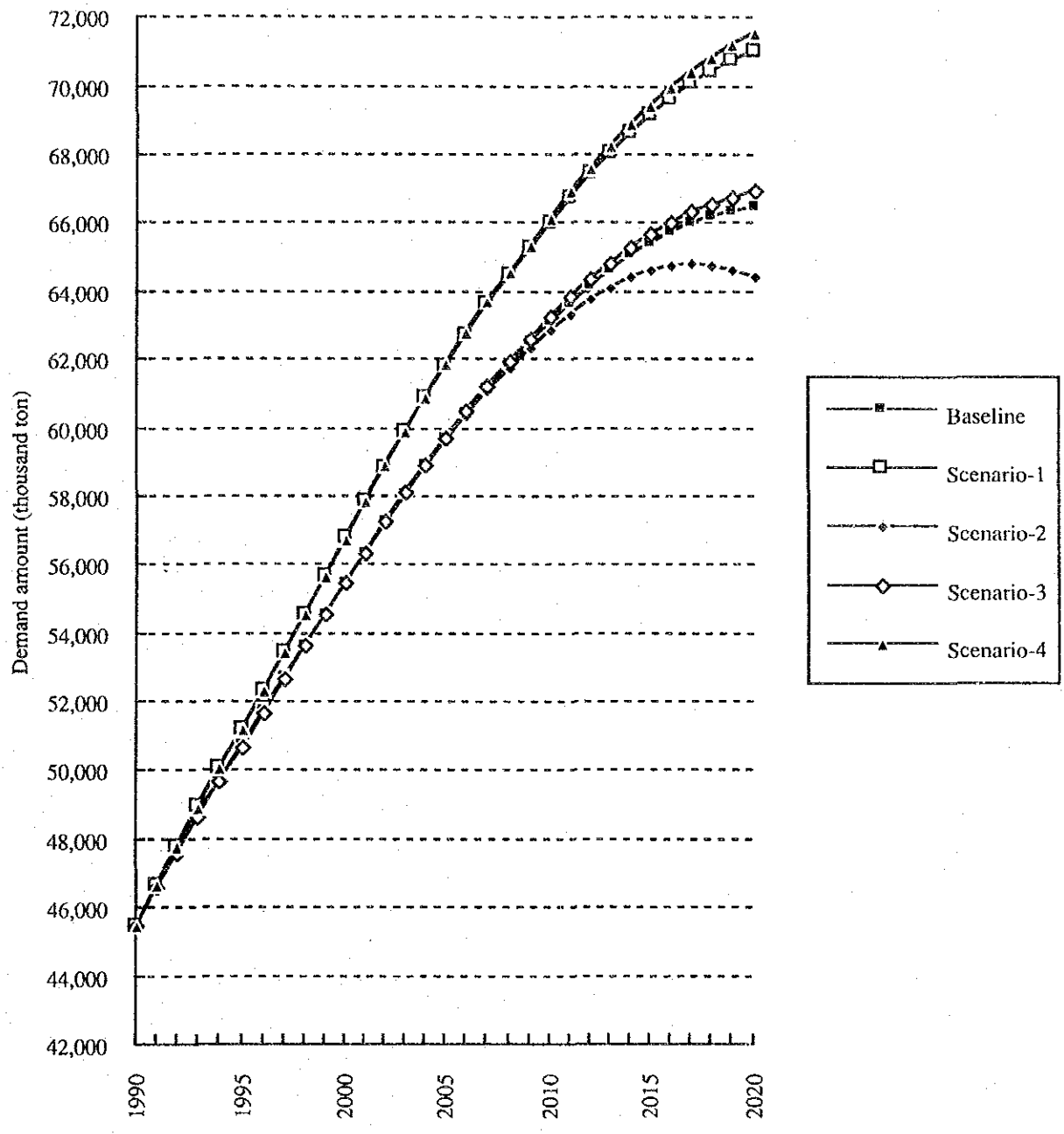

Figure 4.6 Paddy Demand Projection under Alternative Scenarios

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Chapter 5

5. RICE PRODUCTION POTENTIAL

5.1 Prologue

The latest data shows that total paddy production in 1992 recorded 48.24 million tons of which 94% or 45.41 million tons owe to lowland paddy, and the remaining 6% or 2.83 million tons came from upland paddy. The paddy production amount stagnated from 1989 to 1991, but the production in 1992 suddenly increased, which is mainly supported by increase in the harvested area. The harvested area, yield and paddy production in recent three years is shown below:

Paddy production record in the last three years (1990-1992)

	1990			1991			1992		
	H.A.	Yield	Prod.	H.A.	Yield	Prod.	H.A.	Yield	Prod.
Sumatera	2,577	3.65	9,414	2,560	3.71	9,503	2,877	3.69	10,621
Jawa	5,419	5.02	27,177	5,184	5.09	26,393	5,552	5.09	28,274
Bali & Nusa Tenggara	584	4.04	2,361	586	4.08	2,391	586	4.10	2,407
Kalimantan	899	2.41	2,163	915	2.46	2,254	975	2.51	2,452
Sulawesi	1,008	4.00	4,028	1,014	4.04	4,094	1,096	4.06	4,446
Maluku & Irian Jaya	16	2.24	36	22	2.44	53	15	2.45	37
Indonesia	10,502	4.30	45,179	10,282	4.35	44,688	11,103	4.34	48,240

Remarks: H.A.: harvested area (thousand ha); Yield (ton/ha); Prod: production (thousand ton; rough rice)
Source: DGFCA, Ministry of Agriculture and CBS

It is obvious that the drastic increase in paddy production in 1992 compared with 1991 is due to the expansion of the harvested area. While planted aera of paddy decreased due to the long duration of dry season in 1991, favorable rainfall during the period from the end of 1991 to beginning of 1992 increased the planted area of paddy which was harvested in the first quater of 1992. This phenomena suggests that the rice cultivation in Indonesia is still much affected by the rainfall pattern. Irrigation, therefore, can be expected to be an important measure to stabilize the paddy production.

In line with the national policy that self-sufficiency in rice should be maintained, paddy production should be increased to meet the increased demand as seen in the previous chapter. This chapter describes the possible ways to increase paddy production based on the analysis of the past production performance, factors which affect paddy production. Finally, provinces were categorized into three groups for their potential by the analysis. Development direction for each group was indicated.

Despite of its importance in considering future dietary change of Indonesian people, we will not deal much with other food crops in this chapter. When treat those crops, one must

consider the overall food policy in Indonesia including price policy, research and extension, environment on external trade, etc., which are beyond our scope. Regarding irrigation sub-sector, as a part of agriculture sector, paddy is the most important crop due to its high water consumption rate. When paddy is put on the center in irrigation planning, it means that water will be secured for other food crops in case diversified. The importance of diversified crops may be discussed when sustainableatatus of self sufficiency will be attained.

5.2 Past Paddy Production Performance

5.2.1 Paddy Production Performance - overview -

Changes in the harvested area, yield and production of lowland paddy and upland paddy during 1980 to 1992 by province and island groups are shown on Tables 5.1 to 5.6, and Figures 5.1 to 5.6, respectively. During the last 13 years harvested area of lowland paddy has increased from 7.82 million ha in 1980 to 9.80 million ha in 1992. The yield level has also increased from 3.58 ton/ha to 4.63 ton/ha. As a result, the production has increased from 28.0 million ton in 1980 to 45.4 million tons in 1992.

As for upland paddy, harvested area changed slightly from 1.18 million ha in 1980 to 1.30 million ha in 1992. However, the harvested area of upland paddy fluctuated year by year, and the change in the harvested area of upland paddy is statistically not significant. The yield has increased from 1.40 ton/ha to 2.17 ton/ha during the same period. The production slightly increased by 1.16 million tons consequently, which accounts for only 6% of the increase of lowland paddy production.

It can, therefore, be understood that the attainment of Indonesia's self-sufficiency in rice is mainly attributed to the increase of lowland paddy production. Further discussion then will be largely focused on lowland paddy.

5.2.2 Change in Harvested Area, Yield and Production

To avoid intervention of climate or other factors to affect production, three-year-average values are used to see the changes in area, yield and production of lowland paddy, as shown below (also refer to Tables 5.7 to 5.9):

Changes in Harvested Area, Yield and Production of Lowland Paddy

Province/Island	Harvested area (1,000 ha)			Yield (ton/ha)			Production (1,000 ton)		
	'80-'82	'90-'92	Increase	'80-'82	'90-'92	Increase	'80-'82	'90-'92	Increase
Sumatera	1,662	2,260	598	3.28	3.96	0.68	5,448	8,961	3,513
Jawa	4,603	5,024	420	4.23	5.25	1.02	19,490	26,378	6,888
Bali & Nusa Tenggara	440	504	64	3.74	4.42	0.68	1,643	2,230	587
Kalimantan	577	667	90	2.44	2.75	0.31	1,406	1,835	429
Sulawesi	679	983	304	3.33	4.16	0.83	2,261	4,086	1,825
Maluku & Irian Jaya	2	11	9	2.20	2.74	0.54	4	31	27
Indonesia	7,963	9,448	1,485	3.80	4.61	0.81	30,253	43,523	13,270

Source: JICA-FIDP team calculation based on the CBS data

The harvested area increased by 1.49 million ha, of which Sumatera accounts for 0.60 million or 40% of the increase. Jawa, a far dominant paddy production center, increased by 0.42 million ha, 29% of total increase, followed by Sulawesi, 0.30 million ha or 20% of the total. Outstanding increase of harvested area among provinces during these period is observed in Sulawesi Selatan with 199 thousand ha, followed by Sumatera Utara with 191 thousand ha, Jawa Barat with 174 thousand ha, and Jawa Tengah with 159 thousand ha.

The yield of lowland paddy increased remarkably in Jawa with increase rate of 1.02 ton/ha. Sulawesi also shows significantly high increase with 0.83 ton/ha, followed by Sumatera and Bali and Nusa Tenggara. Jawa Barat shows the highest increase of yield among provinces with 1.23 ton/ha during the period, followed by Jawa Tengah with 1.05 ton/ha, D.I.Yogyakarta with 0.97 ton/ha, Nusa Tenggara Barat with 0.92 ton/ha, Sulawesi Selatan and Sumatera Barat with 0.91 ton/ha, Bali and Sulawesi Tenggara with 0.90 ton/ha.

Of the total production increase of 13.3 million tons, Jawa accounts for 6.9 million tons or more than 50% of the total increase. Sumatera is the second with 3.5 million tons or 26% of total increase, followed by Sulawesi with 1.8 million tons or 14% of the total. Remarkable increase in paddy production is recorded in Jawa Barat with an increase of 3.1 million tons, followed by Jawa Tengah with 2.2 million tons, Jawa Timur with 1.6 million tons, Sulawesi Selatan with 1.4 million tons, and Sumatera Utara with 1.1 million tons. As seen above, Jawa is still a dominant paddy production center although its share in harvested area and production during the period declined from 58% to 53% for harvested area, and from 64% to 61% for production, respectively,

It is noteworthy that after attaining self-sufficiency in rice in 1984, an annual increasing rate of both harvested area and yield has declined, as shown in Tables 5.7 to 5.9, and summarized below:

Changes in the Increase Rate of Harvested Area, Yield and Production of Low land Paddy (%)

Province/Island	Harvested Area			Yield			Production		
	1st half	2nd half	Total	1st half	2nd half	Total	1st half	2nd half	Total
Sumatera	3.44	2.80	3.41	2.25	1.59	2.06	5.78	4.43	5.55
Jawa	1.45	0.30	1.09	2.49	1.86	2.40	3.98	2.18	3.51
Bali & Nusa Tenggara	1.03	1.73	1.48	1.76	1.63	2.02	2.81	3.39	3.53
Kalimantan	0.47	2.45	1.77	1.03	1.42	1.50	1.51	3.91	3.29
Sulawesi	4.33	3.21	3.25	3.15	1.35	2.70	7.62	4.60	6.03
Maluku & Irian Jaya	17.85	21.59	15.65	2.48	1.97	2.54	20.98	23.83	18.59
Indonesia	1.89	1.40	1.75	2.33	1.56	2.18	4.43	2.98	4.11

Remarks: 1st half means the period between '80-'82 and '85-'87 2nd half means the period between '85-'87 and '91-'92; Total means the period between '80-'82 and '90-'92.
Source: JICA-FIDP team calculation based on the CBS data.

The increase rate of lowland paddy production decreased obviously as seen in the above table. An annual increasing rate of the harvested area declined from 1.9% in the first five years to 1.4% in the second five years for the whole Indonesia. Especially in Jawa, it decreased drastically from 1.45% in the first five years to 0.30% in the second five years. As for the increasing rate of yield, it also declined from 2.33% in the first half period to 1.56% in the second half. As a result, an annual average increase rate of paddy production decreased from 4.33% to 2.98% during the same period. It seems reasonable that the growth rate of paddy production decreased after attaining self-sufficiency in rice.

5.3 Environment of Paddy Production

5.3.1 Area of Lowland Paddy Field by Irrigation Type and Ecosystem

The lowland paddy field is classified into three categories by water regime i.e., irrigated, rainfed and swamp/other areas which includes temporary fallow land. In Indonesia, the irrigated field is further classified into three types; technical, semi-technical and simple. The area of lowland paddy field by water regime and type of irrigation is shown in Table 5.10 and summarized below:

Area of Lowland Paddy Area by Water Regime and Type of Irrigation as of 1991

Unit: 1,000 ha

Province/Island	Irrigated land				Rainfed	Tidal Swamp	Inland swamp and others	Total
	Technical	Semi technical	Simple	Sub-total				
Sumatera	167.9	228.0	514.2	910.1	606.5	216.1	486.5	2,219.3
Jawa	1425.8	438.7	681.6	2,546.1	847.5	0.5	25.5	3,419.5
Bali & Nusa Tenggara	45.9	170.6	91.0	307.5	70.8	0.0	30.0	408.3
Kalimantan	12.5	13.4	114.1	139.9	369.1	283.2	510.1	1,302.4
Sulawesi	183.1	99.2	246.3	528.6	271.1	1.8	63.9	865.5
Maluku & Irian Jaya	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	1,835.1	950.0	1,647.1	4,432.2	2,165.1	501.7	1,116.0	8,215.0

Note: Sample irrigation includes village irrigation. Others including temporary fallow land
Source: Agricultural Survey Land Area by Utilization in Jawa 1991, CBS
Agricultural Survey Land Area by utilization for Outside of Jawa 1991, CBS

The total lowland paddy field area is 8.2 million ha as of 1991. The largest paddy area is found in Jawa with 3.4 million ha or 42% of the total, followed by Sumatera with 2.2 million ha or 27% of total, and Kalimantan with 1.3 million ha or 16% of total, respectively.

Irrigated paddy field area is 4.4 million ha, accounting for 54% of total. Jawa has the largest irrigated area with 2.5 million ha or 57% of the total irrigated, followed by Sumatera with 0.91 million ha or 21% of the total, and Sulawesi with 0.53 million ha or 12% of the total, respectively. Within irrigated area, technical irrigation schemes are concentrated in Jawa, which shares 78% of total technical irrigation area. The area ratio of irrigated field to total lowland paddy field is the highest in Jawa and Bali and Nusa Tenggara with around 75%, followed by Sulawesi (61%) and Sumatera (41%), while the lowest in Kalimantan with 11%.

The area of rainfed paddy field is 2.2 million ha, 27% of total lowland paddy field. Jawa shares 848 thousand ha or 39% of total rainfed paddy field, followed by Sumatera (607 thousand ha or 28% of the total) and Kalimantan (370 thousand ha or 17% of the total). Other area including tidal swamp and fresh water swamp is 1.6 million ha. They are mainly distributed in Sumatera and Kalimantan, and very limited in other islands.

The change in paddy field area by different irrigation type as well as water regime is shown in Table 5.11 and summarized below:

Changes in area of wetland by type of irrigation and water regime

Unit : 1,000 ha

	Technical		Semi technical		Simple		Sub total	
	1983	1991	1983	1991	1983	1991	1983	1991
Sumatera	133.9	167.9	164.6	228.6	534.5	514.2	833.0	910.1
Jawa	1,341.2	1,425.8	473.8	438.7	679.9	681.6	2,494.9	2,546.1
B & NT	56.2	45.9	131.7	170.8	102.6	91.0	290.5	307.5
Kalimantan	9.9	12.5	8.8	13.4	138.8	114.1	157.5	139.
Sulawesi	110.4	185.1	75.0	99.2	226.4	226.4	411.8	528.6
M & IJ	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	1,651.7	1,835.1	853.9	950.0	1,682.1	1,647.1	4,187.7	4,432.2

	Rainfed		Tidal swamp		Inland swamp and others		Total	
	1983	1991	1983	1991	1983	1991	1983	1991
Sumatera	533.0	606.6	243.3	216.1	370.3	486.5	1,979.7	2,219.3
Jawa	911.4	847.5	3.4	0.5	22.4	25.5	3,432.1	3,419.5
B & NT	73.5	70.8	0.0	0.0	2.7	30.0	366.7	408.3
Kalimantan	393.9	369.1	233.8	283.2	87.1	510.1	872.4	1,302.4
Sulawesi	321.4	271.1	5.7	1.8	7.2	63.9	746.1	865.5
M & IJ	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Indonesia	2,233.2	2,165.1	486.2	501.7	489.7	1,116.0	7,397.0	8,215.0

Note: Others includes temporary fallow land
Source: Agricultural survey Land Area by Utilization in Jawa 1983 and 1991, CBS
Agricultural survey Land Area by Utilization for Outside of Jawa 1983 and 1991, CBS