Table E-16 INDUSTRIAL WATER DEMAND BY WATER RESOURCE REGION (In High Scenario)

(Unit: MCM/year)

WRR	1995	2000	2005	2010	2015	2020	2025
I	72.9	77.1	80.7	86.0	93.5	104.1	119.6
II	16.1	17.8	18.7	20.0	21.7	24.0	27.4
III	209.3	228.8	272.4	337.7	433.4	568.8	758.2
IV	625.8	626.1	690.2	865.0	1,093.9	1,424.4	1,928.9
V	19.8	23.9	25.4	27.6	30.7	34.8	41.1
VI	569.3	570.2	588.1	595.2	601.2	605.8	609.3
VII	165.8	166.4	234.7	248.7	316.1	407.4	541.3
VIII	31.4	49.8	62.4	80.9	106.7	143.1	195.5
IX	5.7	13.7	25.5	32.5	41.9	56.3	77.9
X	210.4	209.1	216.7	219.5	241.1	273.3	324.7
XI	215.1	214.7	217.6	224.5	233.6	245.5	263.1
XII	92.0	91.9	93.7	96.1	99.4	103.9	110.7
Total	2,233.5	2,289.4	2,526.1	2,833.8	3,313.0	3,991.5	4,997.6

Table E-17 INDUSTRIAL WATER DEMAND BY WATER RESOURCE REGION (In Low Scenario)

(Unit: MCM/year)

WRR	1995	2000	2005	2010	2015	2020	2025
I	72.9	76.1	79.4	82.7	86.2	89.7	92.8
II	16.1	17.3	18.4	19.1	19.9	20.6	21.3
III	209.3	221.7	258.2	298.7	346.0	393.2	432.6
IV	625.8	628.4	718.2	838.3	949.8	1,054.8	1,154.1
V	19.8	22.2	24.7	25.9	27.1	28.3	29.4
VI	569.3	568.6	569.3	568.6	567.7	566.6	565.2
VII	165.8	163.6	219.4	217.3	248.4	276.8	302.7
VIII	31.4	45.5	57.4	68.0	79.5	90.8	100.5
IX	5.7	13.7	23.5	27.3	31.2	35.7	40.0
X	210.4	208.9	209.7	209.9	220.1	231.2	243.6
XI	215.1	214.9	215.8	219.8	223.8	227.1	230.1
XII	92.0	92.5	92.9	94.2	95.5	96.7	97.8
Total	2,233.5	2,273.2	2,486.9	2,670.0	2,895.3	3,111.4	3,310.1

Table E-18 ECONOMIC ZONE AND WATER DEMAND ESTIMATION

(Unit: MCM/year)

WRR	Province	Name of Economic Zone	Status	Area	1996		2000		2005		2010		2015		2020		2025		Preferred Industries
				ha.	Land Utilized	Water Demand	Land Utilized	Water Demand	Land Utilized	Water Demand	Land Utilized	Water Demand	Land Utilized	Water Demand	Land Utilized	Water Demand	Land Utilized	Water Demand	
I	Benguet	BAGUIO EZ	Existing	113.7	30%	0.68	80%	1.83	100%	2.28	100%	2.28	100%	2.28	100%	2.28	100%	2.28	Electronics and other high technology
III	Bataan	BATAAN EZ	Existing	1600	25%	8.03	70%	22.48	95%	30.51	100%	32.12	100%	32.12	100%	32.12	100%	32.12	Light and medium
		HERMOSA EZ	New	600		-	15%	1.81	80%	9.64	100%	12.05	100%	12.05	100%	12.05	100%	12.05	Light, non-pollutive
		PNOC PETROCHEMICAL COMPLEX	New	150		-	15%	0.45	80%	2.41	100%	3.01	100%	3.01	100%	3.01	100%	3.01	Petrochemical industries
	Pampanga	ANGELES INDUSTRIAL PARK EZ	Existing	32		-	15%	0.10	80%	0.51	100%	0.64	100%	0.64	100%	0.64	100%	0.64	Light and medium
	Tarlac	LUISITA INDUSTRIAL PARK SEPZ	Existing	29.4	63%	0.37	90%	0.53	100%	0.59	100%	0.59	100%	0.59	100%	0.59	100%	0.59	Light and medium
	Zambales	SUBIC SHIPYARD SEPZ	Existing	70.77	28%	0.40	70%	0.99	100%	1.42	100%	1.42	100%	1.42	100%	1.42	100%	1.42	Marine-related industries
	Sub-Total (WRR-3)			2482.17		8.80		26.36		45.08		49.83		49.83		49.83		49.83	
IV	Batangas	FIRST BATANGAS INDUSTRIAL PARK EZ	New	54		-	15%	0.16	80%	0.87	100%	1.08	100%	1.08	100%	1.08	100%	1.08	Metal based electronical machineries, electric/
		FIRST PHILIPPINE INDUSTRIAL PARK EZ	New	75		-	15%	0.23	80%	1.20	100%	1.51	100%	1.51	100%	1.51	100%	1.51	Light manufacturing, high technology
		LIMA TECHNOLOGY CENTER	New	485		-	15%	1.46	80%	7.79	100%	9.74	100%	9.74	100%	9.74	100%	9.74	Light to medium and high technology
		RLC SEPZ	New	95		-	15%	0.29	80%	1.53	100%	1.91	100%	1.91	100%	1.91	100%	1.91	Light to medium industries
		STO. TOMAS BATANGAS ECOZONE	New	133		-	15%	0.40	80%	2.14	100%	2.67	100%	2.67	100%	2.67	100%	2.67	Light to medium industries
		TABANGAO SEPZ	Existing	88	23%	0.41	70%	1.24	100%	1.77	100%	1.77	100%	1.77	100%	1.77	100%	1.77	
		CAVITE EZ	Existing	275.8	64%	0.37	90%	4.98	100%	5.54	100%	5.54	100%	5.54	100%	5.54	100%	5.54	Electronics, garments, light industries including metals
		CAMBRIDGE INDUSTRIAL PARK EZ	New	88		-	15%	0.26	80%	1.41	100%	1.77	100%	1.77	100%	1.77	100%	1.77	Light and medium industries
		DAIICHI INDUSTRIAL PARK SEPZ	New	60		-	15%	0.18	80%	0.96	100%	1.20	100%	1.20	100%	1.20	100%	1.20	Light and medium industries
		FIL-ESTATE SEZ	New	266.9		-	15%	0.80	80%	4.29	100%	5.36	100%	5.36	100%	5.36	100%	5.36	Light to medium high technology industries
		FILINVEST INDUSTRIAL PARK CAVITE	New	86		-	15%	0.26	80%	1.38	100%	1.73	100%	1.73	100%	1.73	100%	1.73	Light and medium industries
		FILOIL SEZ	New	37.5		-	15%	0.11	80%	0.60	100%	0.75	100%	0.75	100%	0.75	100%	0.75	
		FIRST CAVITE INDUSTRIAL ESTATE	Existing	53.7	78%	0.94	95%	1.02	100%	1.08	100%	1.08	100%	1.08	100%	1.08	100%	1.08	Light and medium non-pollutant industries
		GATEWAY BUSINESS PARK SEPZ	Existing	100	52%	1.04	85%	1.71	100%	2.01	100%	2.01	100%	2.01	100%	2.01	100%	2.01	Light and medium non-pollutant industries
		TAIPAN GOLD INDUSTRIAL EZ	New	100		-	30%	0.60	80%	1.61	100%	2.01	100%	2.01	100%	2.01	100%	2.01	
	Laguna	CARMERAY INDUSTRIAL PARK SEPZ	Existing	46	73%	0.67	100%	0.92	100%	0.92	100%	0.92	100%	0.92	100%	0.92	100%	0.92	Light to medium, electronics/electrical
		FILINVEST SEZ	New	250		-	15%	0.75	80%	4.02	100%	5.02	100%	5.02	100%	5.02	100%	5.02	Non-polluting industries
		LAGUNA INTERNATIONAL INDUSTRIAL PARK SEPZ	Existing	32	57%	0.37	85%	0.55	100%	0.64	100%	0.64	100%	0.64	100%	0.64	100%	0.64	Light to medium, non-pollutannt industries
		LAGUNA TECHNOPARK	Existing	139.4	73%	1.28	95%	2.66	100%	2.80	100%	2.80	100%	2.80	100%	2.80	100%	2.80	Light to medium, essencially non-polluting
		LIGHT INDUSTRY & SCIENCE PARK I	Existing	67	76%	0.65	100%	1.35	100%	1.35	100%	1.35	100%	1.35	100%	1.35	100%	1.35	Light to medium non-polluting industries
		LIGHT INDUSTRY & SCIENCE PARKII	Existing	65	30%	0.25	80%	1.04	100%	1.30	100%	1.30	100%	1.30	100%	1.30	100%	1.30	Light to medium non-polluting industries
		LIIP CALAMBA INDUSTRIAL COMMUNITY	New	114.7		-	15%	0.35	80%	1.84	100%	2.30	100%	2.30	100%	2.30	100%	2.30	Light to medium non-polluting industries
		SOUTHWOODS ECOCENTRUM TOURISM	New	76		-	15%	0.23	80%	1.22	100%	1.53	100%	1.53	100%	1.53	100%	1.53	Theme Park
		TOYOTA STA. ROSA SEPZ	Existing	25		0.54	100%	0.50	100%	0.50	100%	0.50	100%	0.50	100%	0.50	100%	0.50	Automobile parts
	Metro Manila	VICTORIAL WAVE SEPZ	Existing	50	30%	0.30	80%	0.80	100%	1.00	100%	1.00	100%	1.00	100%	1.00	100%	1.00	Export oriented light to medium industries
	Sub-Total (WRR-4)			2863		6.81		22.86		49.76		57.47		57.47		57.47		57.47	
V	Albay	LEGASPI CITY SEPZ	New	33.1		-	15%	0.10	80%	0.53	100%	0.66	100%	0.66	100%	0.66	100%	0.66	Foof processing, light metal industries.
VII	Cebu	MACTAN EPZ	Existing	150	67%	2.02	90%	2.71	100%	3.01	100%	3.01	100%	3.01	100%	3.01	100%	3.01	Light and medium industries
		CEBU LIGHT INDUSTRIAL PARK EZ	New	63		-	15%	0.19	80%	1.01	100%	1.26	100%	1.26	100%	1.26	100%	1.26	Light to medium, non-polluting manufacturing
		MACTAN EPZ II	Existing	63.3	10%	0.13	60%	0.76	95%	1.21	100%	1.27	100%	1.27	100%	1.27	100%	1.27	Light and medium industries
		NEW CEBU TOWNSHIP	Existing	36.6		-	15%	0.11	80%	0.59	100%	0.73	100%	0.73	100%	0.73	100%	0.73	Light industry, manufacturing and
		WEST CEBU INDUSTRIAL PARK SEZ	New	245		-	15%	0.74	80%	3.93	100%	4.92	100%	4.92	100%	4.92	100%	4.92	Export processing, shipbuilding, heavy
	Sub-Total (WRR-7)			557.9		2.15		4.51		9.75		11.19		11.19		11.19		11.19	
VIII	Leyte	LEYTE INDUSTRIAL DEVELOPMENT ESTATE	Existing	427.7	53%	4.55	85%	7.30	100%	8.59	100%	8.59	100%	8.59	100%	8.59	100%	8.59	
		TACLOBAN SEZ	New	236.9		-	15%	0.71	80%	3.80	100%	4.76	100%	4.76	100%	4.76	100%	4.76	
	Sub-Total (WRR-8)			664.6		4.55		8.01		12.39		13.34		13.34		13.34		13.34	
IX	Zamboanga del Sur	AYALA DE ZAMBOANGA INDUSTRIAL PARK EZ	New	50		-	15%	0.15	80%	0.80	100%	1.00	100%	1.00	100%	1.00	100%	1.00	Small and medium scale industries
X	Agusan del Norte	TUBAY AGRI-PROCESSING CENTER	New	196		-	15%	0.59	80%	3.15	100%	3.93	100%	3.93	100%	3.93	100%	3.93	Agri-based industries
		NASPIT AGUSAN DEL NORTE INDUSTRIAL	New	296		-	15%	0.89	80%	4.75	100%	5.94	100%	5.94	100%	5.94	100%	5.94	Ligh and medium industries
	Surigao del Norte	PHILNICO INDUSTRIAL ESTATE SEZ	New	100		-	15%	0.30	80%	1.61	100%	2.01	100%	2.01	100%	2.01	100%	2.01	Downstream Nickel refinery operations
	Sub-Total (WRR-10)			592		-		1.78		9.51		11.88		11.88		11.88		11.88	
XI	Davao Oriental	FIRST ORIENTAL BUSINESS & INDUSTRIAL PARK EZ	New	57		-	15%	0.17	80%	0.92	100%	1.14	100%	1.14	100%	1.14	100%	1.14	Processed fruites, can vegitables, furniture.
XII	South Cotabato	FILINVEST SEPZ	New	120		-	15%	0.36	80%	1.93	100%	2.41	100%	2.41	100%	2.41	100%	2.41	Non-polluting industries
	Lanao del Sur	NSC SEZ	New	274		-	15%	0.83	80%	4.40	100%	5.50	100%	5.50	100%	5.50	100%	5.50	Downstream steel manufacturing
	Sub-Total (WRR-12)			394		-		1.19		6.33		7.91		7.91		7.91		7.91	
	Grand-Total			6,849		24.62		69		122		137		137		137		137	

Data Source: PEZA(Economic Zone, Area, Status, Land utilized as of 1996)

Note: Land utilization ratio: 15%, 30%, 45%,60%,70%, 80%, 85%, 90%, 95%, 100% for 10 years

Water demand referred from existing record: CAVITE EZ, FIRST CAVITE INDUSTRIAL ESTATE, LAGUNA TECHNOPARK, LIGHT INDUSTRY & SCIENCE PARK I/II, TOYOTA STA. ROSA SEPZ

Assumed unit water consumption: 55 m^3/ha/day

Table E-19 MUNICIPAL AND INDUSTRIAL WATER DEMAND BY WATER RESOURCE REGION (in High Economic Scenario)

(Unit : MCM/year)

Water Resources Region	1995			2000			2005			2010			2015			2020			2025		
	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total
I	47.4	72.9	120.4	60.7	77.1	137.8	76.9	80.7	157.5	96.2	86.0	182.2	118.6	93.5	212.1	142.9	104.1	247.0	170.1	119.6	289.6
II	39.3	16.1	55.4	50.7	17.8	68.4	64.8	18.7	83.5	81.5	20.0	101.5	100.2	21.7	121.9	119.4	24.0	143.5	140.2	27.4	167.7
III	216.5	209.3	425.8	297.3	228.8	526.1	397.6	272.4	670.0	511.6	337.7	849.3	646.2	433.4	1,079.5	792.9	568.8	1,361.8	954.7	758.2	1,712.9
IV	1,211.1	625.8	1,836.9	1,562.9	626.1	2,189.0	1,868.9	690.2	2,559.2	2,229.5	865.0	3,094.6	2,477.3	1,093.9	3,571.1	2,689.0	1,424.4	4,113.4	3,100.8	1,928.9	5,029.7
V	77.8	19.8	97.7	101.6	23.9	125.5	124.5	25.4	150.0	154.6	27.6	182.3	188.6	30.7	219.2	224.6	34.8	259.4	261.1	41.1	302.3
VI	106.3	569.3	675.6	147.5	570.2	717.7	197.7	588.1	785.8	259.2	595.2	854.4	330.9	601.2	932.0	410.1	605.8	1,015.9	500.2	609.3	1,109.5
VII	123.8	165.8	289.6	183.6	166.4	350.0	253.5	234.7	488.2	330.7	248.7	579.4	411.2	316.1	727.3	490.9	407.4	898.3	564.0	541.3	1,105.2
VIII	51.2	31.4	82.6	67.5	49.8	117.3	88.7	62.4	151.1	115.0	80.9	195.9	147.0	106.7	253.6	183.5	143.1	326.6	236.5	195.5	432.0
IX	73.2	5.7	78.8	103.9	13.7	117.6	143.5	25.5	169.1	193.0	32.5	225.5	251.3	41.9	293.3	317.5	56.3	373.8	380.5	77.9	458.3
X	83.1	210.4	293.5	111.5	209.1	320.6	150.3	216.7	367.1	198.9	219.5	418.4	257.5	241.1	498.6	320.8	273.3	594.2	388.8	324.7	713.5
XI	88.8	215.1	304.0	109.2	214.7	323.8	133.7	217.6	351.3	161.6	224.5	386.1	192.3	233.6	425.9	224.0	245.5	469.5	258.1	263.1	521.2
XII	68.5	92.0	160.5	100.5	91.9	192.4	147.8	93.7	241.4	210.1	96.1	306.3	286.2	99.4	385.6	375.1	103.9	479.0	475.0	110.7	585.6
Total	2,187.1	2,233.5	4,420.7	2,896.8	2,289.4	5,186.2	3,648.0	2,526.1	6,174.1	4,542.1	2,833.8	7,375.9	5,407.2	3,313.0	8,720.2	6,290.9	3,991.5	10,282.5	7,430.0	4,997.6	12,427.6

Table E-20 MUNICIPAL AND INDUSTRIAL WATER DEMAND BY WATER RESOURCE REGION (in Low Economic Scenario)

(Unit : MCM/year)

Water Resources Region	1995			2000			2005			2010			2015			2020			2025		
	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total	Municipal	Industrial	Total
I	47.4	72.9	120.4	60.7	76.1	136.8	76.9	79.4	156.3	96.2	82.7	178.9	118.6	86.2	204.7	142.9	89.7	232.6	170.1	92.8	262.9
II	39.3	16.1	55.4	50.7	17.3	67.9	64.8	18.4	83.2	81.5	19.1	100.7	100.2	19.9	120.1	119.4	20.6	140.0	140.2	21.3	161.5
III	216.5	209.3	425.8	297.3	221.7	519.0	397.6	258.2	655.7	511.6	298.7	810.4	646.2	346.0	992.2	792.9	393.2	1,186.1	954.7	432.6	1,387.3
IV	1,211.1	625.8	1,836.9	1,562.9	628.4	2,191.2	1,868.9	718.2	2,587.1	2,229.5	838.3	3,067.9	2,477.3	949.8	3,427.1	2,689.0	1,054.8	3,743.8	3,100.8	1,154.1	4,254.9
V	77.8	19.8	97.7	101.6	22.2	123.8	124.5	24.7	149.3	154.6	25.9	180.5	188.6	27.1	215.7	224.6	28.3	252.9	261.1	29.4	290.5
VI	106.3	569.3	675.6	147.5	568.6	716.0	197.7	569.3	767.0	259.2	568.6	827.8	330.9	567.7	898.5	410.1	566.6	976.7	500.2	565.2	1,065.4
VII	123.8	165.8	289.6	183.6	163.6	347.2	253.5	219.4	473.0	330.7	217.3	548.0	411.2	248.4	659.7	490.9	276.8	767.7	564.0	302.7	866.7
VIII	51.2	31.4	82.6	67.5	45.5	112.9	88.7	57.4	146.1	115.0	68.0	183.1	147.0	79.5	226.5	183.5	90.8	274.3	236.5	100.5	337.1
IX	73.2	5.7	78.8	103.9	13.7	117.6	143.5	23.5	167.0	193.0	27.3	220.3	251.3	31.2	282.6	317.5	35.7	353.2	380.5	40.0	420.5
X	83.1	210.4	293.5	111.5	208.9	320.4	150.3	209.7	360.0	198.9	209.9	408.8	257.5	220.1	477.6	320.8	231.2	552.1	388.8	243.6	632.4
XI	88.8	215.1	304.0	109.2	214.9	324.1	133.7	215.8	349.5	161.6	219.8	381.5	192.3	223.8	416.1	224.0	227.1	451.1	258.1	230.1	488.2
XII	68.5	92.0	160.5	100.5	92.5	193.0	147.8	92.9	240.7	210.1	94.2	304.3	286.2	95.5	381.7	375.1	96.7	471.8	475.0	97.8	572.8
Total	2,187.1	2,233.5	4,420.7	2,896.8	2,273.2	5,170.0	3,648.0	2,486.9	6,134.9	4,542.1	2,670.0	7,212.0	5,407.2	2,895.3	8,302.6	6,290.9	3,111.4	9,402.3	7,430.0	3,310.1	10,740.1

Table E-21 MUNICIPAL AND INDUSTRIAL WATER DEMAND BY MAJOR RIVER BASIN (In High Economoic Scenario)

(unit : MCM/year)

WRR	Major River Basin	1995			2000			2005			2010			2015			2020			2025		
		Municipal	Industrial	Total	Municipa	Industrial	Total	Municipal	Industrial	Total	Municipa	Industrial	Total	Municipa	Industrial	Total	Municipa	Industrial	Total	Municipa	Industrial	Total
I	Abra	2.0	19.6	21.7	2.9	19.8	22.7	4.1	19.9	24.0	5.5	20.1	25.6	7.1	20.3	27.5	9.0	20.7	29.7	11.0	21.3	32.3
	Laoag	0.4	3.4	3.9	0.6	3.5	4.1	0.8	3.5	4.3	1.1	3.5	4.6	1.4	3.6	5.0	1.8	3.7	5.5	2.2	3.8	6.0
	Others	44.9	49.9	94.8	57.1	53.9	111.0	72.0	57.3	129.2	89.6	62.4	152.0	110.0	69.5	179.6	132.2	79.7	211.9	156.8	94.5	251.3
	Total	47.4	72.9	120.4	60.7	77.1	137.8	76.9	80.7	157.5	96.2	86.0	182.2	118.6	93.5	212.1	142.9	104.1	247.0	170.1	119.6	289.6
II	Cagayan	34.6	1.7	36.2	44.6	3.1	47.7	57.0	4.0	61.0	71.7	5.1	76.8	88.2	6.5	94.7	105.1	8.6	113.7	123.4	11.6	135.0
	Abulug	0.0	5.1	5.1	0.0	5.1	5.1	0.0	5.1	5.1	0.0	5.1	5.1	0.0	5.1	5.1	0.0	5.1	5.1	0.0	5.1	5.1
	Others	4.7	9.3	14.0	6.1	9.5	15.6	7.8	9.6	17.4	9.8	9.8	19.6	12.0	10.0	22.0	14.3	10.3	24.6	16.8	10.7	27.5
	Total	39.3	16.1	55.4	50.7	17.8	68.4	64.8	18.7	83.5	81.5	20.0	101.5	100.2	21.7	121.9	119.4	24.0	143.5	140.2	27.4	167.7
III	Pampanga	129.2	64.2	193.4	173.5	75.9	249.4	228.3	102.0	330.3	290.5	141.1	431.6	363.6	198.4	562.0	443.0	279.5	722.5	530.4	392.9	923.4
	Agno	26.5	11.0	37.5	35.5	13.4	48.9	46.5	18.8	65.3	59.1	26.8	85.9	73.8	38.6	112.3	89.8	55.2	145.0	107.4	78.5	185.9
	Others	60.8	134.0	194.9	88.4	139.5	227.8	122.7	151.6	274.3	162.1	169.8	331.8	208.8	196.4	405.2	260.1	234.1	494.2	316.9	286.8	603.7
	Total	216.5	209.3	425.8	297.3	228.8	526.1	397.6	272.4	670.0	511.6	337.7	849.3	646.2	433.4	1,079.5	792.9	568.8	1,361.8	954.7	758.2	1,712.9
IV	Pasig-Laguna Bay	709.8	374.5	1,084.3	911.3	376.3	1,287.6	1,086.8	418.0	1,504.8	1,292.7	535.7	1,828.5	1,436.4	689.9	2,126.3	1,558.1	912.5	2,470.6	1,798.3	1,252.4	3,050.7
	Amnay-Patrick	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.3	0.1	0.3	0.4	0.1	0.4	0.5
	Others	501.3	251.2	752.4	651.5	252.0	903.5	782.0	272.2	1,054.2	936.7	329.2	1,265.9	1,040.7	403.8	1,444.5	1,130.8	511.6	1,642.4	1,302.4	676.1	1,978.5
	Total	1,211.1	625.8	1,836.9	1,562.9	628.4	2,191.2	1,868.9	690.2	2,559.2	2,229.5	865.0	3,094.6	2,477.3	1,093.9	3,571.1	2,689.0	1,424.4	4,113.4	3,100.8	1,928.9	5,029.7
V	Bicol	31.7	2.8	34.5	41.1	4.5	45.5	50.2	5.1	55.3	62.0	6.1	68.0	75.3	7.3	82.6	89.3	9.1	98.4	103.6	11.7	115.3
	Others	46.1	17.1	63.2	60.5	19.4	79.9	74.4	20.3	94.7	92.6	21.6	114.2	113.3	23.3	136.6	135.2	25.8	161.0	157.6	29.4	187.0
	Total	77.8	19.8	97.7	101.6	23.9	125.5	124.5	25.4	150.0	154.6	27.6	182.3	188.6	30.7	219.2	224.6	34.8	259.4	261.1	41.1	302.3
VI	Panay	0.2	2.0	2.2	0.3	2.0	2.3	0.4	2.0	2.4	0.5	2.0	2.5	0.7	2.0	2.7	0.8	2.0	2.9	1.0	2.0	3.1
	Ilog-Hilabangan	26.8	152.1	179.0	37.2	152.4	189.6	49.9	156.9	206.8	65.4	158.7	224.1	83.6	160.2	243.8	103.6	161.3	265.0	126.4	162.2	288.6
	Jalaur	0.7	0.5	1.2	0.9	0.5	1.5	1.2	0.7	1.9	1.6	0.7	2.3	2.1	0.7	2.8	2.5	0.8	3.3	3.1	0.8	3.9
	Others	78.6	414.6	493.2	109.0	415.3	524.4	146.2	428.5	574.7	191.6	433.8	625.4	244.5	438.2	682.8	303.1	441.7	744.8	369.6	444.3	813.9
	Total	106.3	569.3	675.6	147.5	570.2	717.7	197.7	588.1	785.8	259.2	595.2	854.4	330.9	601.2	932.0	410.1	605.8	1,015.9	500.2	609.3	1,109.5
VII	Total	123.8	165.8	289.6	183.6	166.4	350.0	253.5	234.7	488.2	330.7	248.7	579.4	411.2	316.1	727.3	490.9	407.4	898.3	564.0	541.3	1,105.2
VIII	Total	51.2	31.4	82.6	67.5	49.8	117.3	88.7	62.4	151.1	115.0	80.9	195.9	147.0	106.7	253.6	183.5	143.1	326.6	236.5	195.5	432.0
IX	Total	73.2	5.7	78.8	103.9	13.7	117.6	143.5	25.5	169.1	193.0	32.5	225.5	251.3	41.9	293.3	317.5	56.3	373.8	380.5	77.9	458.3
X	Aguasan	0.1	1.9	2.0	0.2	1.9	2.1	0.3	1.9	2.1	0.4	1.9	2.2	0.5	1.9	2.4	0.6	2.0	2.5	0.7	2.0	2.7
	Tagoloan	30.0	45.6	75.6	40.1	45.2	85.3	53.9	47.9	101.9	71.2	49.0	120.1	92.0	56.9	148.9	114.4	68.8	183.2	138.5	87.6	226.1
	Cagayan De Oro	32.1	56.4	88.5	43.0	55.9	98.9	57.9	58.9	116.8	76.4	60.0	136.4	98.8	68.4	167.3	123.0	81.1	204.1	148.9	101.2	250.1
	Others	20.8	106.5	127.4	28.2	106.2	134.4	38.3	108.0	146.3	50.9	108.7	159.6	66.3	113.8	180.1	82.9	121.5	204.4	100.7	133.8	234.5
	Total	83.1	210.4	293.5	111.5	209.1	320.6	150.3	216.7	367.1	198.9	219.5	418.4	257.5	241.1	498.6	320.8	273.3	594.2	388.8	324.7	713.5
XI	Tagun-Libuganon	3.7	39.4	43.1	6.2	0.8	7.0	9.8	39.5	49.3	14.0	39.6	53.6	18.7	39.8	58.4	23.8	40.0	63.8	29.5	40.3	69.8
	Buayan-Malungun	26.7	133.1	159.8	36.7	15.2	51.9	49.8	133.7	183.5	65.0	135.4	200.4	81.9	137.7	219.6	100.0	140.6	240.7	119.7	145.0	264.7
	Davao	19.4	4.0	23.5	21.5	4.0	25.5	23.2	4.7	27.9	25.0	6.4	31.4	27.0	8.7	35.6	28.5	11.7	40.2	30.0	16.1	46.1
	Others	39.0	38.6	77.5	44.8	11.5	56.3	50.9	39.8	90.7	57.6	43.1	100.6	64.8	47.5	112.2	71.7	53.2	124.9	78.9	61.7	140.6
	Total	88.8	215.1	304.0	109.2	31.5	140.7	133.7	217.6	351.3	161.6	224.5	386.1	192.3	233.6	425.9	224.0	245.5	469.5	258.1	263.1	521.2
XII	Mindanao	46.0	13.8	59.8	67.5	14.1	81.6	99.2	14.9	114.2	141.1	16.6	157.7	192.2	18.8	211.0	251.9	21.8	273.7	318.9	26.4	345.2
	Agus	4.8	72.6	77.4	7.0	72.7	79.7	10.3	72.7	83.0	14.6	72.9	87.6	20.0	73.1	93.1	26.2	73.5	99.6	33.1	73.9	107.0
	Others	17.7	5.5	23.3	26.0	5.7	31.7	38.3	6.0	44.2	54.4	6.6	61.0	74.1	7.5	81.6	97.1	8.6	105.7	123.0	10.4	133.3
	Total	68.5	92.0	160.5	100.5	92.5	193.0	147.8	93.7	241.4	210.1	96.1	306.3	286.2	99.4	385.6	375.1	103.9	479.0	475.0	110.7	585.6
	Grand Total	2,187.1	2,233.5	4,420.7	2,896.8	2,292.4	5,189.3	3,648.0	2,526.1	6,174.1	4,542.1	2,833.8	7,375.9	5,407.2	3,313.0	8,720.2	6,290.9	3,991.5	10,282.5	7,430.0	4,997.6	12,427.6

Table E-22 MUNICIPAL AND INDUSTRIAL WATER DEMAND BY MAJOR RIVER BASIN (In Low Economic Scenario)

(unit : MCM/year)

WRR	Major River Basin	1995 Municipal	1995 Industrial	1995 Total	2000 Municipal	2000 Industrial	2000 Total	2005 Municipal	2005 Industrial	2005 Total	2010 Municipal	2010 Industrial	2010 Total	2015 Municipal	2015 Industrial	2015 Total	2020 Municipal	2020 Industrial	2020 Total	2025 Municipal	2025 Industrial	2025 Total
I	Abra	2.0	19.6	21.7	2.9	19.7	34.3	4.1	19.8	47.7	5.5	106.4	61.2	7.1	20.1	27.2	9.0	20.2	29.2	11.0	20.3	31.4
	Laoag	0.4	3.4	3.9	0.6	3.5	6.1	0.8	3.5	8.5	1.1	209.9	10.9	1.4	3.5	5.0	1.8	3.6	5.4	2.2	3.6	5.8
	Others	44.9	49.9	94.8	57.1	52.9	136.9	72.0	56.1	182.9	89.6	39.5	231.3	110.0	62.5	172.6	132.2	65.9	198.1	156.8	68.9	225.8
	Total	47.4	72.9	120.4	60.7	76.1	177.4	76.9	79.4	239.1	96.2	134.3	303.4	118.6	86.2	204.7	142.9	89.7	232.6	170.1	92.8	262.9
II	Cagayan	34.6	1.7	36.2	44.6	2.7	49.0	57.0	3.7	64.1	71.7	5.2	80.6	88.2	5.0	93.2	105.1	5.6	110.7	123.4	6.2	129.6
	Abulug	0.0	5.1	5.1	0.0	5.1	13.4	0.0	5.1	21.6	0.0	40.8	27.0	0.0	5.1	5.1	0.0	5.1	5.1	0.0	5.1	5.1
	Others	4.7	9.3	14.0	6.1	9.5	30.5	7.8	9.6	47.0	9.8	219.8	58.8	12.0	9.8	21.8	14.3	9.9	24.2	16.8	9.9	26.8
	Total	39.3	16.1	55.4	50.7	17.3	93.0	64.8	18.4	132.7	81.5	15.3	166.3	100.2	19.9	120.1	119.4	20.6	140.0	140.2	21.3	161.5
III	Pampanga	129.2	64.2	193.4	173.5	71.7	247.3	228.3	93.5	330.0	290.5	72.8	423.4	363.6	146.1	509.7	443.0	174.4	617.4	530.4	197.9	728.4
	Agno	26.5	11.0	37.5	35.5	12.5	48.1	46.5	17.0	64.0	59.1	6.1	81.9	73.8	27.8	101.6	89.8	33.6	123.4	107.4	38.5	145.9
	Others	60.8	134.0	194.9	88.4	137.5	242.2	122.7	147.6	335.0	162.1	94.2	439.3	208.8	172.1	380.9	260.1	185.2	445.3	316.9	196.2	513.1
	Total	216.5	209.3	425.8	297.3	221.7	537.6	397.6	258.2	729.0	511.6	2,670.0	944.6	646.2	346.0	992.2	792.9	393.2	1,186.1	954.7	432.6	1,387.3
IV	Pasig-Laguna Bay	709.8	374.5	1,084.3	911.3	374.8	1,290.6	1,086.8	418.0	1,632.6	1,292.7	768.4	2,061.1	1,436.4	592.9	2,029.3	1,558.1	663.6	2,221.7	1,798.3	730.5	2,528.8
	Amnay-Patrick	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.3	0.1	0.2	0.3	0.1	0.2	0.3
	Others	501.3	251.2	752.4	651.5	251.3	905.9	782.0	272.2	1,148.0	936.7	515.3	1,452.0	1,040.7	356.8	1,397.6	1,130.8	391.1	1,521.9	1,302.4	423.4	1,725.8
	Total	1,211.1	625.8	1,836.9	1,562.9	626.1	2,196.7	1,868.9	690.2	2,780.8	2,229.5	1,283.7	3,513.3	2,477.3	949.8	3,427.1	2,689.0	1,054.8	3,743.8	3,100.8	1,154.1	4,254.9
V	Bicol	31.7	2.8	34.5	41.1	3.8	47.9	50.2	4.8	61.5	62.0	13.4	75.4	75.3	5.8	81.1	89.3	6.3	95.7	103.6	6.8	110.3
	Others	46.1	17.1	63.2	60.5	18.4	102.6	74.4	19.9	143.9	92.6	82.2	174.8	113.3	21.3	134.6	135.2	22.0	157.2	157.6	22.6	180.2
	Total	77.8	19.8	97.7	101.6	22.2	150.5	124.5	24.7	205.4	154.6	95.6	250.2	188.6	27.1	215.7	224.6	28.3	252.9	261.1	29.4	290.5
VI	Panay	0.2	2.0	2.2	0.3	2.0	2.2	0.4	2.0	2.4	0.5	1.9	2.5	0.7	2.0	2.6	0.8	2.0	2.8	1.0	2.0	3.0
	Ilog-Hilabangan	26.8	152.1	179.0	37.2	152.0	187.0	49.9	152.2	202.2	65.4	149.9	215.4	83.6	151.8	235.3	103.6	151.5	255.1	126.4	151.1	277.5
	Jalaur	0.7	0.5	1.2	0.9	0.5	1.5	1.2	0.5	1.8	1.6	0.5	2.1	2.1	0.5	2.6	2.5	0.5	3.1	3.1	0.5	3.6
	Others	78.6	414.6	493.2	109.0	414.1	517.3	146.2	414.7	561.1	191.6	408.6	600.2	244.5	413.5	658.0	303.1	412.6	715.7	369.6	411.6	781.3
	Total	106.3	569.3	675.6	147.5	568.6	708.0	197.7	569.3	767.4	259.2	561.0	820.2	330.9	567.7	898.5	410.1	566.6	976.7	500.2	565.2	1,065.4
VII	Total	123.8	165.8	289.6	183.6	163.6	345.3	253.5	219.4	520.4	330.7	262.9	593.6	411.2	248.4	659.7	490.9	276.8	767.7	564.0	302.7	866.7
VIII	Total	51.2	31.4	82.6	67.5	45.5	120.5	88.7	57.4	160.1	115.0	87.8	202.8	147.0	79.5	226.5	183.5	90.8	274.3	236.5	100.5	337.1
IX	Total	73.2	5.7	78.8	103.9	13.7	141.9	143.5	23.5	220.8	193.0	92.6	285.6	251.3	31.2	282.6	317.5	35.7	353.2	380.5	40.0	420.5
X	Aguasan	0.1	1.9	2.0	0.2	1.9	2.0	0.3	1.9	2.1	0.4	1.9	2.2	0.5	1.9	2.4	0.6	1.9	2.5	0.7	1.9	2.6
	Tagoloan	30.0	45.6	75.6	40.1	45.1	84.2	53.9	45.4	98.8	71.2	45.1	116.3	92.0	49.2	141.2	114.4	53.3	167.7	138.5	57.8	196.3
	Cagayan De Oro	32.1	56.4	88.5	43.0	55.8	97.5	57.9	56.1	113.4	76.4	55.7	132.2	98.8	60.2	159.0	123.0	64.6	187.5	148.9	69.4	218.3
	Others	20.8	106.5	127.4	28.2	106.2	131.1	38.3	106.4	143.1	50.9	105.3	156.2	66.3	108.8	175.1	82.9	111.5	194.4	100.7	114.4	215.2
	Total	83.1	210.4	293.5	111.5	208.9	314.8	150.3	209.7	357.3	198.9	207.9	406.8	257.5	220.1	477.6	320.8	231.2	552.1	388.8	243.6	632.4
XI	Tagun-Libuganon	3.7	39.4	43.1	6.2	39.4	45.1	9.8	39.4	51.0	14.0	51.1	65.1	18.7	39.6	58.3	23.8	39.6	63.5	29.5	39.7	69.2
	Buayan-Malungun	26.7	133.1	159.8	36.7	133.0	167.7	49.8	133.3	188.8	65.0	172.4	237.4	81.9	135.3	217.1	100.0	136.1	236.1	119.7	136.8	256.6
	Davao	19.4	4.0	23.5	21.5	3.9	25.5	23.2	4.2	27.5	25.0	5.2	30.3	27.0	6.2	33.2	28.5	7.0	35.5	30.0	7.8	37.8
	Others	39.0	38.6	77.5	44.8	38.3	82.8	50.9	38.9	91.2	57.6	49.9	107.5	64.8	42.7	107.5	71.7	44.3	116.0	78.9	45.8	124.7
	Total	88.8	215.1	304.0	109.2	214.7	321.0	133.7	215.8	358.4	161.6	278.6	440.2	192.3	223.8	416.1	224.0	227.1	451.1	258.1	230.1	488.2
XII	Mindanao	46.0	13.8	59.8	67.5	13.7	82.3	99.2	14.4	115.0	141.1	18.7	159.7	192.2	16.2	208.4	251.9	17.0	268.8	318.9	17.7	336.6
	Agus	4.8	72.6	77.4	7.0	72.6	84.8	10.3	72.7	93.2	14.6	98.1	112.7	20.0	72.9	92.8	26.2	73.0	99.1	33.1	73.0	106.1
	Others	17.7	5.5	23.3	26.0	5.5	32.0	38.3	5.8	44.6	54.4	7.5	61.9	74.1	6.5	80.6	97.1	6.8	103.9	123.0	7.0	130.0
	Total	68.5	92.0	160.5	100.5	91.9	199.1	147.8	92.9	252.7	210.1	124.2	334.3	286.2	95.5	381.7	375.1	96.7	471.8	475.0	97.8	572.8
	Grand Total	2,187.1	2,233.5	4,420.7	2,896.8	2,270.1	5,305.8	3,648.0	2,459.0	6,724.1	4,542.1	3,719.2	8,261.3	5,407.2	2,895.3	8,302.6	6,290.9	3,111.4	9,402.3	7,430.0	3,310.1	10,740.1

Table E-23 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR SELECTED MAJOR CITIES

(1/9) Metro Manila (Unit;MCM/year)

	Municipal (MWSS)	Industrial (Private)	Total
1995	976.0	91.5	1,067.5
2000	1,259.0	91.7	1,350.7
2005	1,480.0	115.9	1,595.9
2010	1,746.0	182.0	1,928.0
2015	1,993.0	268.5	2,261.5
2020	2,074.0	393.5	2,467.5
2025	2,299.0	584.2	2,883.2

(2/9) Metro Cebu (Unit;MCM/year)

	Municipal (MCWD)	Industrial (Private)	Total
1995	40.8	18.2	59.1
2000	58.9	18.3	77.2
2005	92.9	22.5	115.4
2010	151.2	23.4	174.6
2015	194.8	27.6	222.4
2020	245.3	33.3	278.6
2025	300.6	41.6	342.3

(3/9) Davao City (Unit;MCM/year)

	Municipal (DCWD)	Industrial (Private)	Total
1995	48.7	1.6	50.2
2000	54.2	1.5	55.7
2005	58.2	1.8	60.0
2010	72.9	2.5	75.4
2015	90.4	3.3	93.7
2020	113.5	4.5	118.0
2025	146.3	6.2	152.5

(4/9) Baguio City (Unit;MCM/year)

	Municipal (BWD)	Industrial (Private)	Total
1996	12.0	-	12.0
2000	29.4	-	29.4
2005	37.8	-	37.8
2010	50.0	-	50.0
2015	61.1	-	61.1
2020	73.7	-	73.7
2025	87.3	-	87.3

(5/9) Angeles City (Unit;MCM/year)

	Municipal (AWD)	Industrial (Private)	Total
1995	11.1	0.0	11.1
2000	13.0	0.1	13.1
2005	14.7	0.5	15.2
2010	16.5	0.6	17.1
2015	20.2	0.6	20.8
2020	24.3	0.6	24.9
2025	30.6	0.6	31.3

(6/9) Bacolodo City (Unit;MCM/year)

	Municipal (Bacolodo	Industrial (Private)	Total
1995	16.1	20.5	36.6
2000	22.0	20.9	42.9
2005	31.9	28.9	60.8
2010	40.5	32.1	72.6
2015	49.5	34.8	84.3
2020	59.4	36.9	96.3
2025	72.3	38.4	110.7

(7/9) Metro Iloilo (Unit;MCM/year)

	Municipal (MIWD)	Industrial (Private)	Total
1995	7.5	1.5	9.0
2000	28.7	1.5	30.2
2005	31.7	1.8	33.5
2010	33.2	2.0	35.2
2015	37.1	2.1	39.1
2020	40.9	2.2	43.1
2025	44.4	2.2	46.6

(8/9) Cagayan de Oro City (Unit;MCM/year)

	Municipal (CCWD)	Industrial (Private)	Total
1995	28.7	0.5	29.2
2000	47.1	0.5	47.6
2005	58.0	0.6	58.6
2010	72.6	0.6	73.3
2015	84.7	0.9	85.6
2020	93.4	1.3	94.7
2025	96.4	1.9	98.3

(9/9) Zamboanga City (Unit;MCM/year)

	Municipal (ZCWD)	Industrial (Private)	Total
1995	24.2	3.2	27.5
2000	38.5	9.0	47.5
2005	54.7	17.5	72.2
2010	74.4	22.5	96.9
2015	97.9	29.3	127.1
2020	123.7	39.6	163.3
2025	148.0	55.0	203.0

Table E-24 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR METRO MANILA

Year	Municipal Water								Industrial Water	
	Population		Service Coverage			Water Demand			Water Demand	
	Under MWSS (x1,000)	Pop. Servd. (x1,000)	House connec (%)	Public faucet (%)	Total (%)	Unit Consumpt (lpcd)	Water Demand (MCM/year)	NRW (%)	Private (MCM/year)	Total (MCM/year)
1995	11,425	7,084	55	7	62	375	976.0	56	91.5	1,067.5
2000	12,602	9,325	67	7	74	370	1,259.0	50	91.7	1,350.7
2005	13,846	11,077	74	6	80	366	1,480.0	45	115.9	1,595.9
2010	15,015	13,213	83	6	88	362	1,746.0	40	182.0	1,928.0
2015	16,096	15,291	90	5	95	357	1,993.0	35	268.5	2,261.5
2020	17,086	16,232	93	2	95	350	2,074.0	30	393.5	2,467.5
2025	18,018	17,117	95	0	95	368	2,299.0	30	584.2	2,883.2
	(3)	(1)	(1)	(1)	(1)	(1), (2)		(1)		

Notes: (1) This study evaluated the present condition in comparison with that in M/P.
(2) M/P in 1995
(3) Census 1995
The service areas of MWSS are Metro Manila and its adjoining area including a part of Cavite and Rizal Province in Water Resource Region-IV.
In this study, supply area are assumed not to be expanded up to the year of 2025, although MWSS plans to expand the service area.
The amount of water demand is larger than that in Master Plan of MWSS, because NRW is estimated to be higher in this study.
Water demand in the M/P: 1,226 MCM/year in 2000, 1,420 MCM/year in 2005, 1,578 MCM/year in 2010, 1,732 MCM/year in 2015
NRW in the M/P: 49% in 2000, 43% in 2005, 36% in 2010, 30% in 2015

Table E-25 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR METRO CEBU

Year	Municipal Water								Industrial Water	
	Population		Service Coverage			Water Demand			Water Demand	
	Under MWSS Service Area (x1,000)	Pop. Servd. (x1,000)	House connect. (%)	Public faucet (%)	Total (%)	Unit Consumption (lpcd)	Water Demand (MCM/year)	NRW (%)	Private (MCM/year)	Total (MCM/year)
1996	1,332	315	N.A.	N.A.	24	355	40.8	38	18.2	59.1
2000	1,499	479	N.A.	N.A.	32	337	58.9	30	18.3	77.2
2005	1,738	788	N.A.	N.A.	45	323	92.9	30	22.5	115.4
2010	2,014	1,282	N.A.	N.A.	64	323	151.2	30	23.4	174.6
2015	2,015	1,390	N.A.	N.A.	69	384	195.0	22	27.6	222.4
2020	2,277	1,867	N.A.	N.A.	82	360	245.0	20	33.3	278.6
2025	2,573	2,444	N.A.	N.A.	95	337	300.0	20	41.6	342.3

Note: Population, Pop. Served., Water demand and NRW up to the year 2010 were provided by MCWD, and the figures after 2015 were estimated in this study.

Table E-26 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR DAVAO CITY

	Municipal Water								Industrial Water Water Demand	
	Population		Service Coverage			Water Demand				
	Under MWSS Service Area (x1,000)	Pop. Servd. (x1,000)	House connect. (%)	Public faucet (%)	Total (%)	Unit Consumption (lpcd)	Water Demand (MCM/year)	NRW (%)	Private (MCM/year)	Total (MCM/year)
1995	1,005	813	N.A.	N.A.	81	164	48.0	40	1.6	50.2
2000	1,188	821	N.A.	N.A.	69	181	54.2	33	1.5	55.7
2005	1,369	848	N.A.	N.A.	62	188	58.2	30	1.8	60.0
2010	1,579	1,046	N.A.	N.A.	66	191	72.9	28	2.5	75.4
2015	1,751	1,276	N.A.	N.A.	73	194	90.4	25	3.3	93.7
2020	1,942	1,555	N.A.	N.A.	80	200	113.5	22	4.5	118.0
2025	2,240	1,900	N.A.	N.A.	85	211	146.3	20	6.2	152.5
	(1)	(1)			(1)	(2)	(2)	(2)		

Notes: 1. Population up to 2020 are reffered to the Technical Report.
2. Water demand, unit consumption and others were estimated in this study.

Table E-27 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR BAGUIO CITY

Year	Population/Service Coverage					Munipal Water Demand (m^3/day)							
	Pop.(Residents)	Pop. (Transients/ Students)	Pop. Total	Pop. Served	Cov. (%)	Unit consumption (Lpcd)	Domestic	Commercial/ Industrial	Government /Institutional	Sub-total	NRW		Total
1996	226,887	21,977	248,864	120,248	53%	128	15,392	4,720	847	21,000	12,000	36%	33,000
2000	288,000	24,000	312,000	218,400	70%	135	29,484	33,157	1,736	64,000	16,000	20%	80,000
2005	357,000	27,000	384,000	307,200	80%	142	43,622	36,871	2,317	83,000	21,000	20%	104,000
2010	434,000	30,000	464,000	417,600	90%	149	62,222	44,433	3,040	110,000	28,000	20%	138,000
2015	518,000	33,000	551,000	495,900	90%	157	77,856	52,040	3,980	134,000	34,000	20%	168,000
2020	607,000	36,000	643,000	578,700	90%	165	95,486	60,822	5,195	162,000	41,000	20%	203,000
2025	701,000	39,000	740,000	666,000	90%	173	115,218	69,438	6,779	191,000	48,000	20%	239,000
	*1)	*2)			*3)	*4)		*5)	*6)			*7)	

Note: *1) : set in this Study (based on the urban growth rate provided by NSO)
*2),3),5),6) based on the BWD report
*4) Unit water consumptions for domestic use are determined with reference to the LWUA Design Criteria
*7) : set in this Study

Table E-28 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR ANGELES CITY

Year	Municipal Water										Industrial Water	Total
	Population/Coverage			Water Demand (m^3/day)							Water Demand	
	Population	Population Served		Total	Domestic	Commercial	Industrial	Institutional	Unaccounted-for		Private(PEZA)	
1995	234,015	92,710	40%	30,336	14,656	3,406	-	138	12,136	40%		30,336
2000	271,895	122,019	45%	35,629	20,256	4,442	-	243	10,688	30%	274	35,903
2005	297,350	148,675	50%	40,350	21,794	7,331	-	374	10,851	25%	1,397	41,747
2010	319,677	182,162	57%	45,072	23,331	10,220	-	505	11,016	20%	1,753	46,825
2015	338,180	213,053	63%	55,351	28,652	12,551	-	620	13,528	20%	1,753	57,105
2020	353,423	243,862	69%	66,523	34,435	15,084	-	745	16,259	20%	1,753	68,276
2025	366,134	292,907	80%	83,897	43,428	19,024	-	940	20,505	20%	1,753	85,651

Note: 1. Pop. served, water demand were referred to PCWSII under OECF loan project.
2. Increasing rate of unit consumption :1% per year (after 2010)
3. Increasing rate of Service coverage :same as 2000-2010 rate (after 2010)

Table E-29 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR BACOLODO CITY

Year	Municipal Water										Industrial Water	Total
	Population/Coverage			Water Demand (m^3/day)							Water Demand	
	Population	Population Served		Total	Domestic	Commercial	Industrial	Institutional	Unaccounted-for		Private	
1995	402,350	130,460	32%	44,200	N.A.	N.A.	N.A.	N.A.	N.A.		56,079	100,279
2000	314,787	191,598	61%	60,381	34,112	8,850	1,500	770	15,149	20%	57,274	117,655
2005	369,333	251,529	68%	87,433	46,916	13,054	4,400	1,090	21,973	20%	79,173	166,606
2010	434,872	320,067	74%	110,997	62,989	18,174	6,000	1,500	22,334	17%	88,005	199,002
2015	527,634	400,898	76%	135,568	78,768	20,603	7,000	1,855	27,342	17%	95,280	230,848
2020	615,585	493,570	80%	162,749	97,240	22,661	8,000	2,170	32,678	17%	100,998	263,747
2025	712,535	617,183	87%	198,041	121,994	24,924	9,000	2,515	39,608	17%	105,337	303,378

Note: 1. Municipal water demands (1995) were referred to data from LWUA.
2. Data on municipal water (2000-2025) were referred to Options for System Development, ADB-LWUA.
3. Population (2000-2025) represents population in Bacolodo City Water District service area.

Table E-30 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR METRO ILOILO

	Municipal Water										Industrial Water	Total
	Population/Coverage			Water Demand (m^3/day)							Water Demand	
	Population	Population Served		Total	Domestic	Commercial	Industrial	Institutional	Unaccounted-for		Private	
1995	449,151	113,830	25%	20,603	N.A.	N.A.	N.A.	N.A.	N.A.		4,044	24,647
2000	585,008	345,024	59%	78,517	54,962	39,345	10,997	1,122	362	30%	4,095	82,612
2005	624,318	399,667	64%	86,761	60,733	47,078	12,094	1,171	390	30%	5,033	91,794
2010	666,338	420,654	63%	91,080	63,756	49,542	12,535	1,260	415	30%	5,411	96,491
2015	711,256	470,211	66%	101,510	71,057	55,394	13,824	1,388	451	30%	5,723	107,233
2020	759,280	520,141	69%	112,137	78,496	61,451	15,106	1,454	485	30%	5,967	118,105
2025	810,626	565,298	70%	121,634	85,144	66,901	16,132	1,559	522	30%	6,153	127,788

Data Source:Metro Iloilo Water District

Table E-31 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR CAGAYAN DE ORO CITY

Year	Municipal Water										Industrial Water	Total
	Population/Coverage			Water Demand (m^3/day)							Water Demand	
	Population	Population Served		Total	Domestic	Commercial	Industrial	Institutional	Unaccounted-for		Private	
1995	452,279	365,100	81%	78,500	50,600	6,800		1,300	15,700	20%	1,457	79,957
2000	521,268	443,078	85%	129,000	83,100	11,200		2,200	25,800	20%	1,414	130,414
2005	624,204	561,784	90%	159,000	10,200	13,800		2,700	31,800	20%	1,670	160,670
2010	732,803	681,507	93%	199,000	13,900	17,700		3,000	39,800	20%	1,763	200,763
2015	842,942	800,795	95%	232,000	16,200	20,600		3,500	46,400	20%	2,491	234,491
2020	928,853	882,410	95%	256,000	178,300	22,700		3,800	51,200	20%	3,575	259,575
2025	959,912	911,916	95%	264,000	183,900	23,400		3,900	52,800	20%	5,305	269,305

Notes: 1. Population Served and Water Demand up to year 2010 were base on PCWSIII Project under OECF loan.
2. The water demand after year 2015 were estimated in this study.

Table E-32 MUNICIPAL AND INDUSTRIAL WATER DEMAND FOR ZAMBOANGA CITY

Year	Municipal Water									Industrial Water	Total
	Population/Coverage			Water Demand (m^3/day)						Water Demand	
	Population	Population Served		Total	Domestic	Commercial	Industrial	Institutional	Unaccounted-for	Private	
1995	511,140	321,000	63%	66,400	N.A.	N.A.	N.A.	N.A.	N.A.	8,900	75,300
2000	679,836	509,877	75%	105,545	N.A.	N.A.	N.A.	N.A.	N.A.	24,700	130,245
2005	875,958	700,766	80%	149,964	N.A.	N.A.	N.A.	N.A.	N.A.	47,909	197,873
2010	1,095,264	930,974	85%	203,883	N.A.	N.A.	N.A.	N.A.	N.A.	61,560	265,443
2015	1,335,762	1,202,186	90%	268,087	N.A.	N.A.	N.A.	N.A.	N.A.	80,170	348,258
2020	1,591,838	1,480,410	93%	339,014	N.A.	N.A.	N.A.	N.A.	N.A.	108,386	447,399
2025	1,778,292	1,689,378	95%	405,451	N.A.	N.A.	N.A.	N.A.	N.A.	150,697	556,148

Notes: 1. Population, population coverage and water demand for year 1995 were based on data from LUWA.
2. The water demands after year 2000 were estimated in this Study.

Part – E

Figures

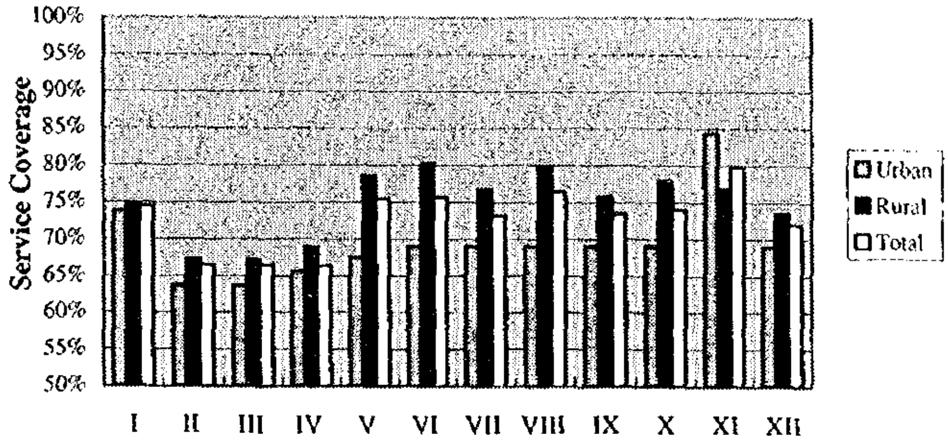


Figure E-1 EXISTING SERVICE COVERAGE

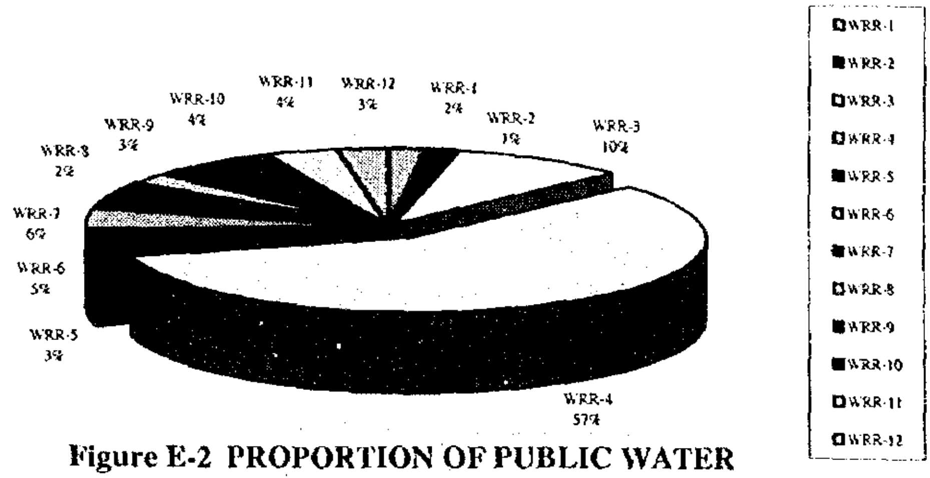


Figure E-2 PROPORTION OF PUBLIC WATER DEMAND (1995)

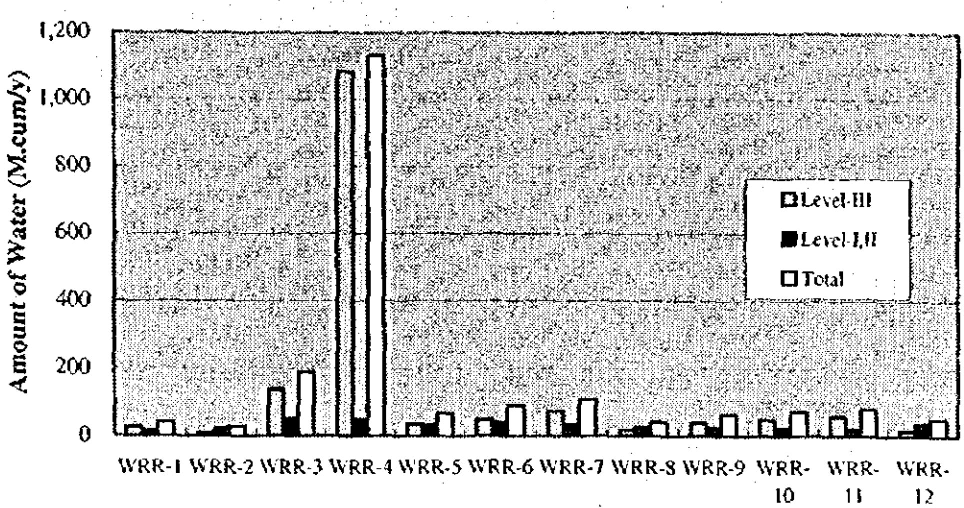
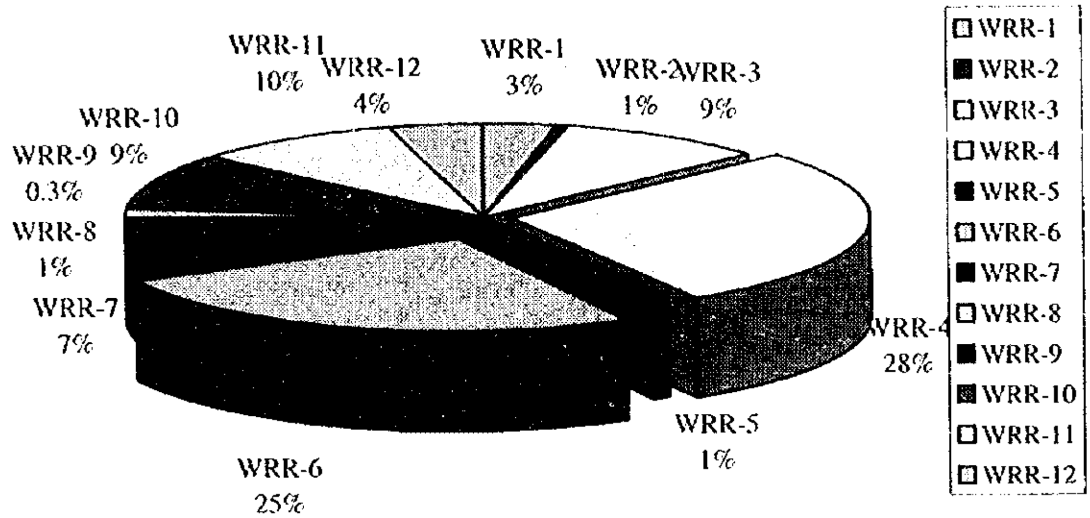


Figure E-3 EXISTING WATER DEMAND OF PUBLIC WATER SUPPLY



FigureE-4 INDUSTRIAL WATER USE BY WRR (1995)

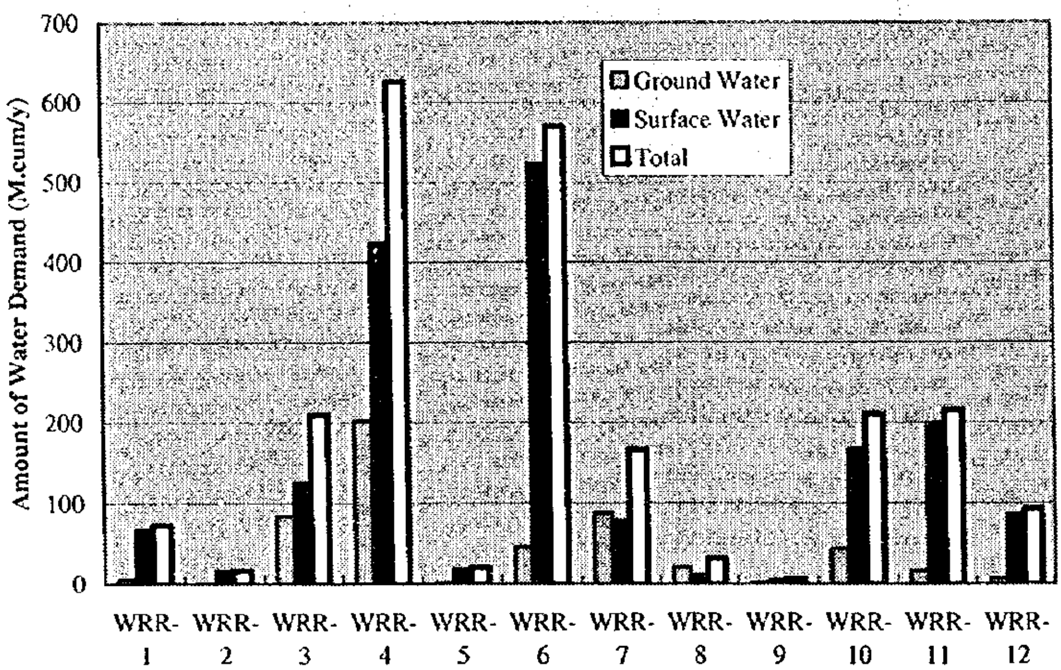


Figure E-5 INDUSTRIAL WATER DEMAND (1995)

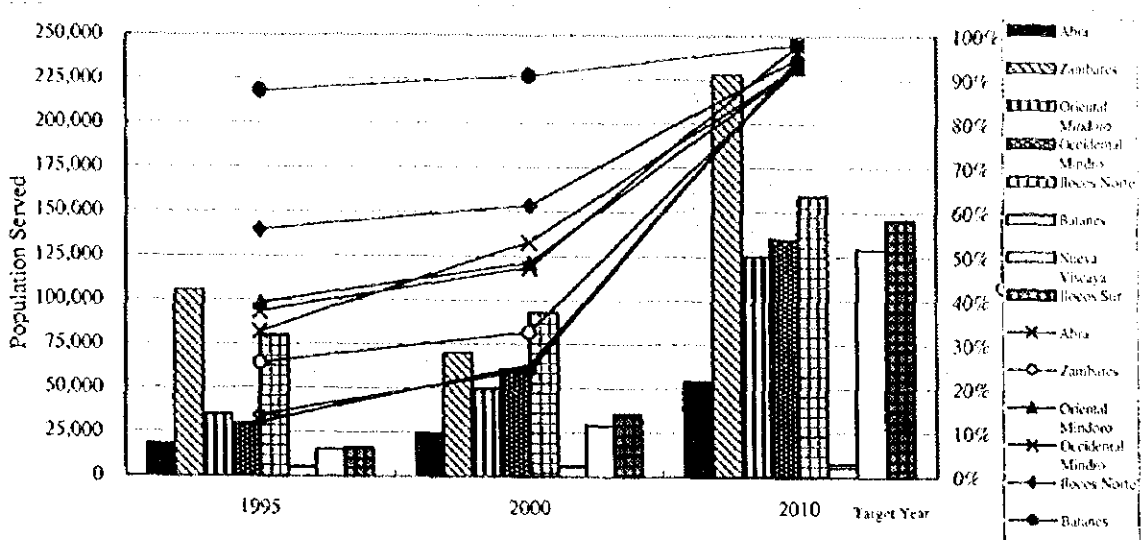


Figure E-6 TREND FOR LEVEL-III, URBAN

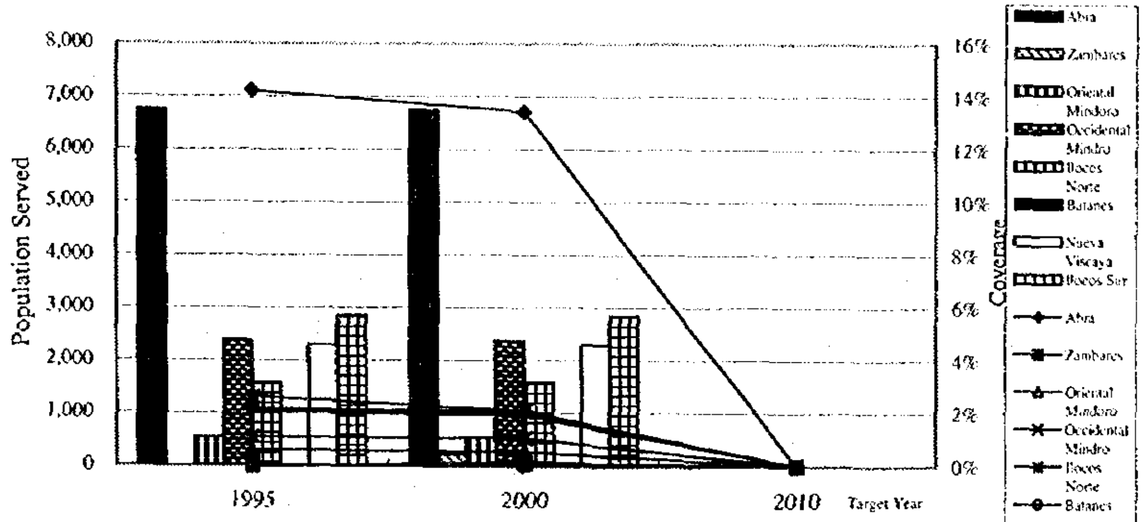
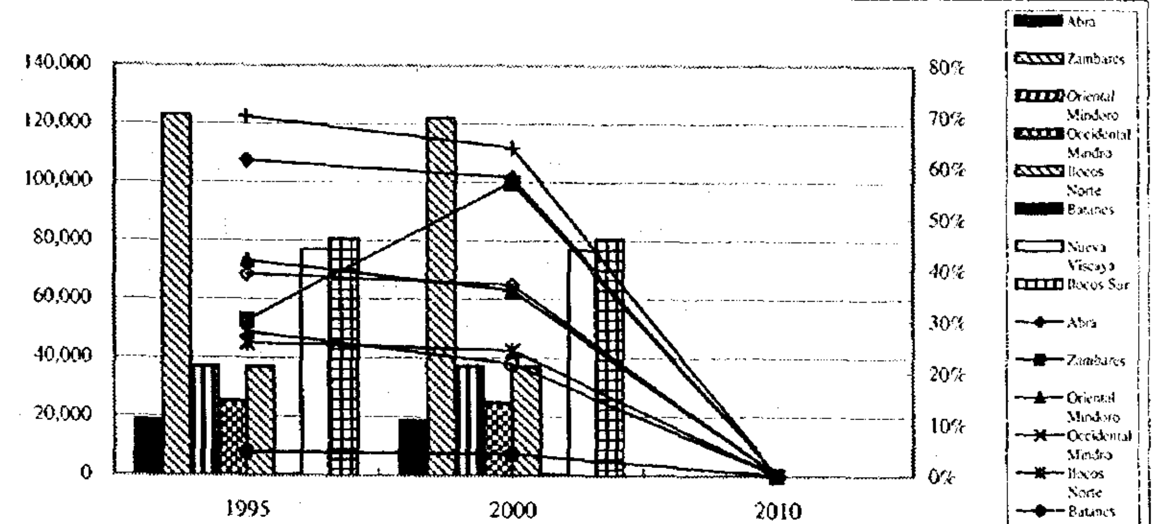


Figure E-7 TREND FOR LEVEL-II, URBAN



FigureE-8 TREND FOR LEVEL-I, URBAN

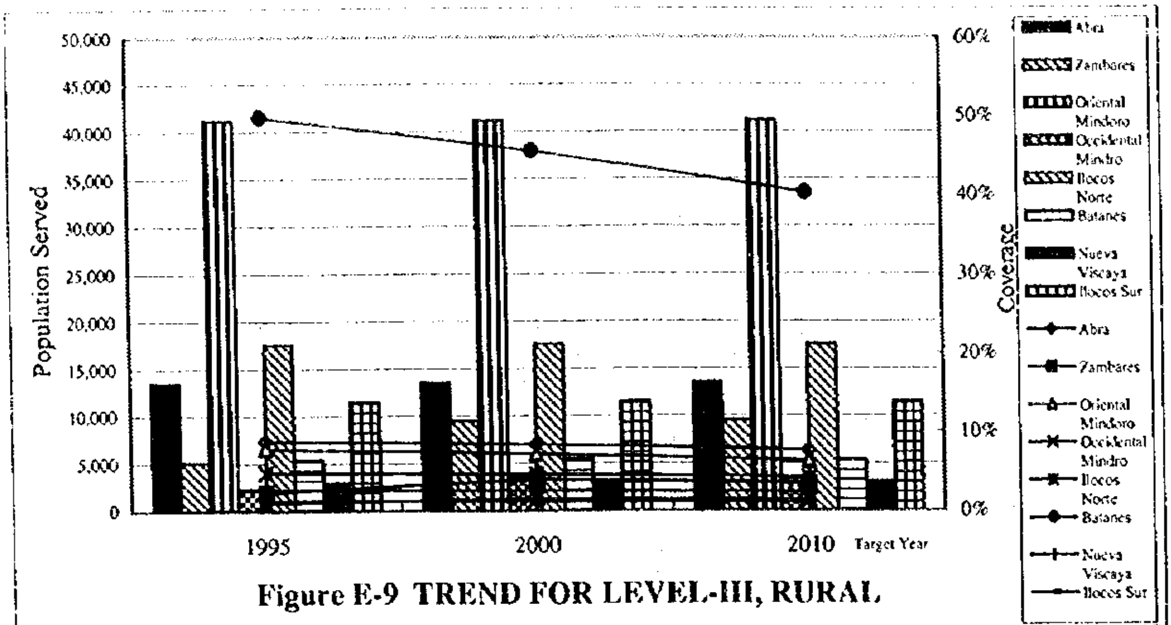


Figure E-9 TREND FOR LEVEL-III, RURAL

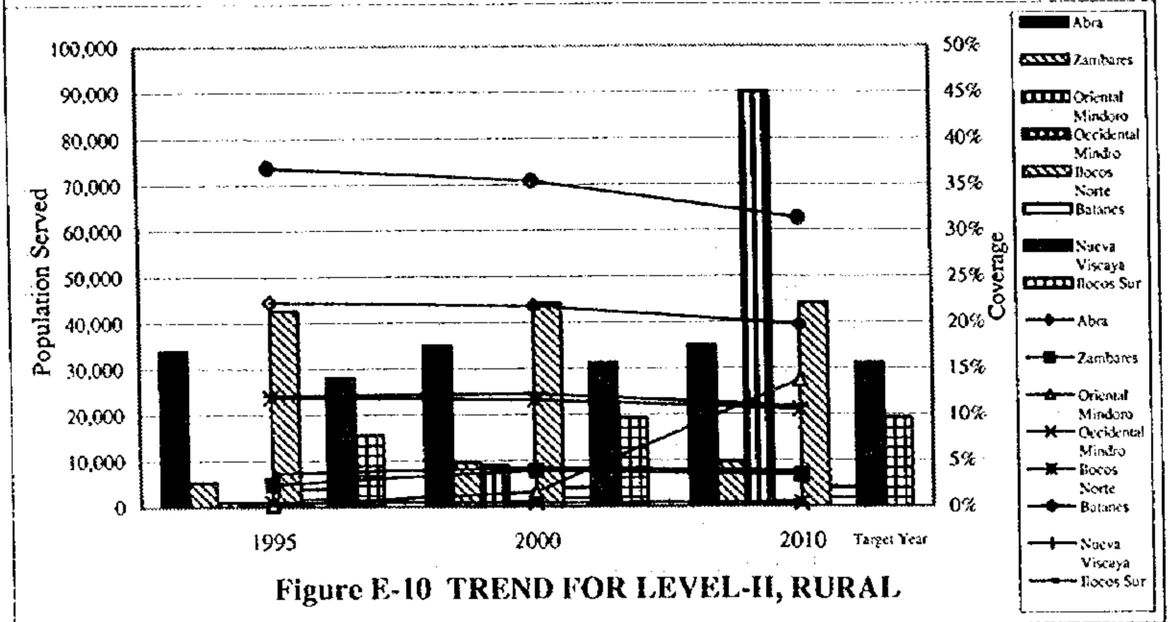


Figure E-10 TREND FOR LEVEL-II, RURAL

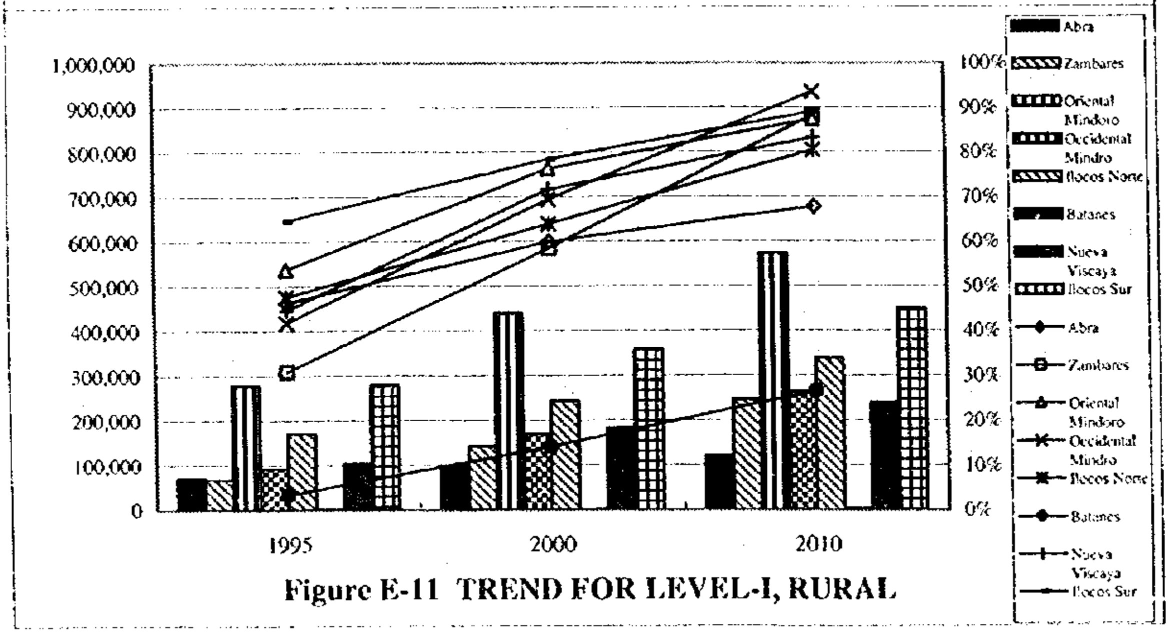


Figure E-11 TREND FOR LEVEL-I, RURAL

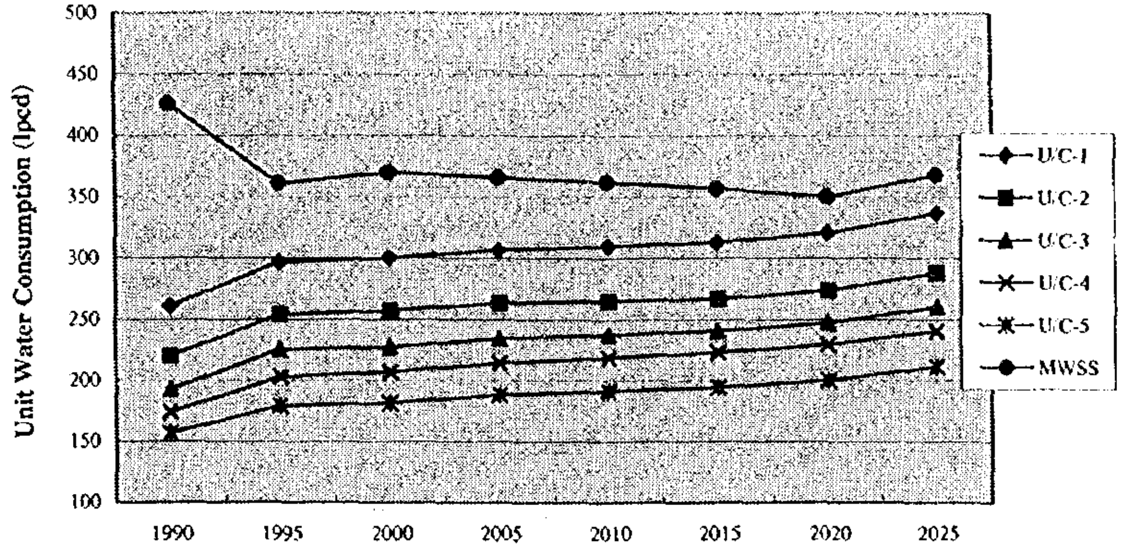


Figure E-12 UNIT WATER CONSUMPTION FOR LEVEL-III SYSTEM

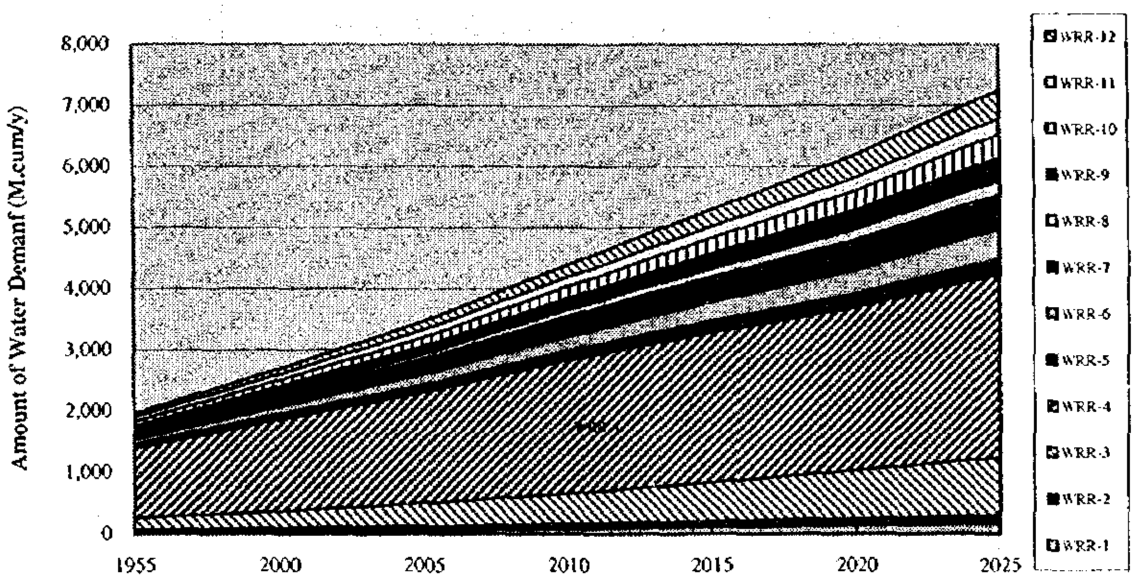


Figure E-13 PUBLIC WATER DEMAND

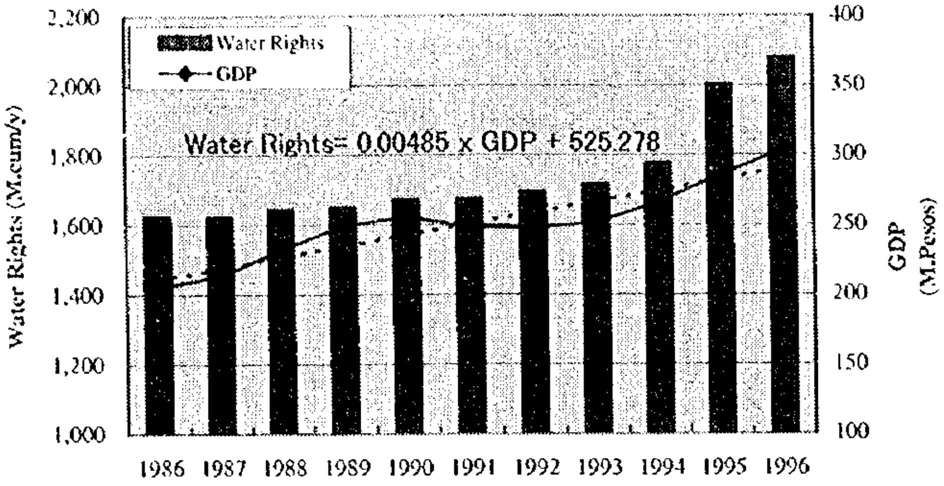


Figure E-14 WATER RIGHTS AND INDUSTRIAL GDP

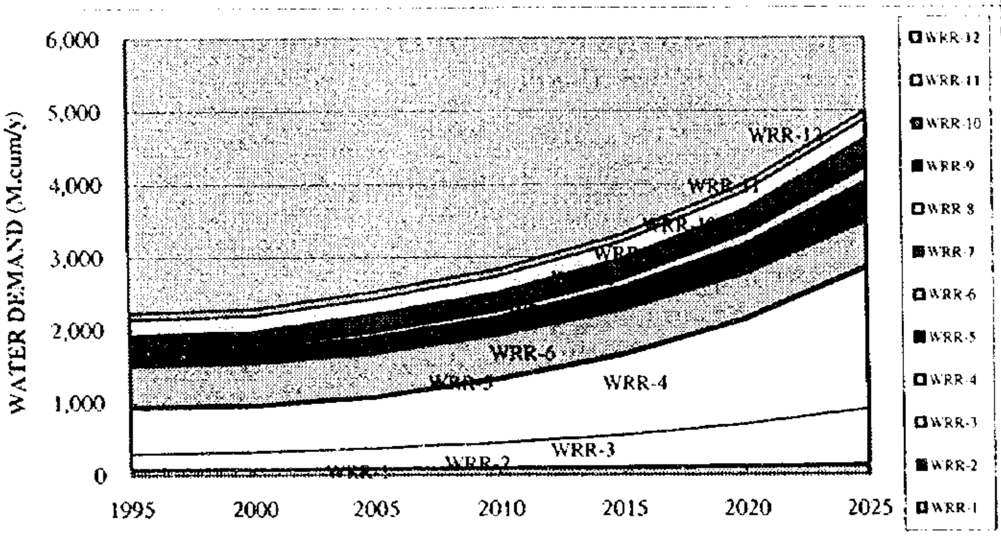


FIGURE E-15 INDUSTRIAL WATER DEMAND (High Scenario)

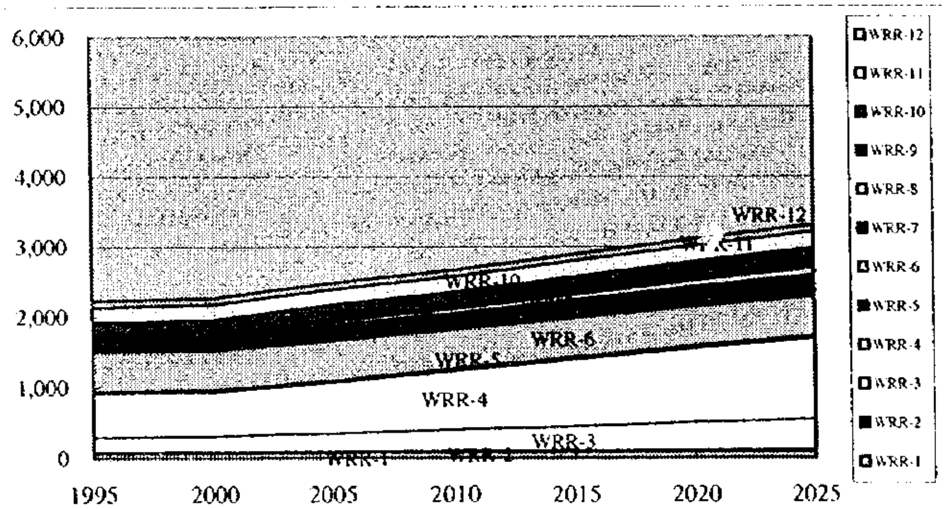
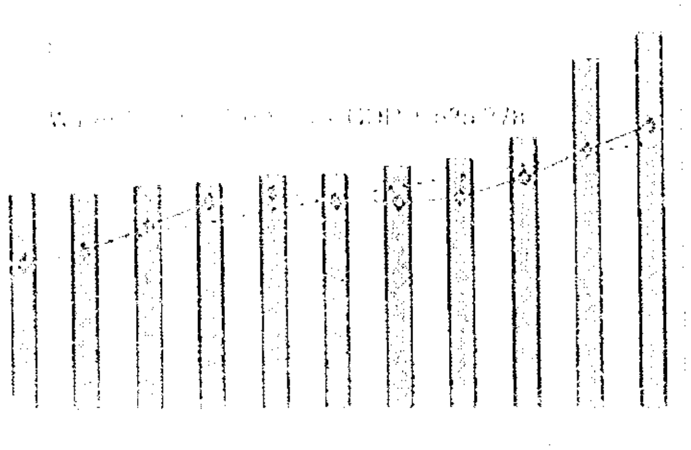


FIGURE E-16 INDUSTRIAL WATER DEMAND (Low Scenario)



[illegible] AND INDUSTRIAL GDP

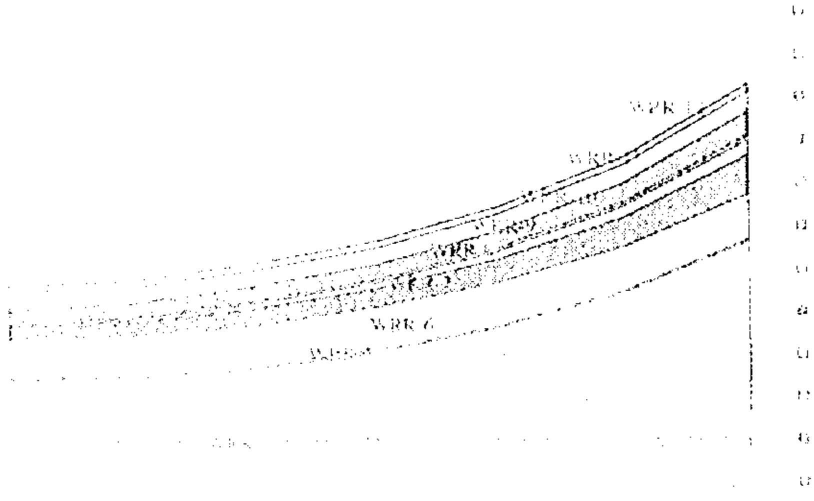
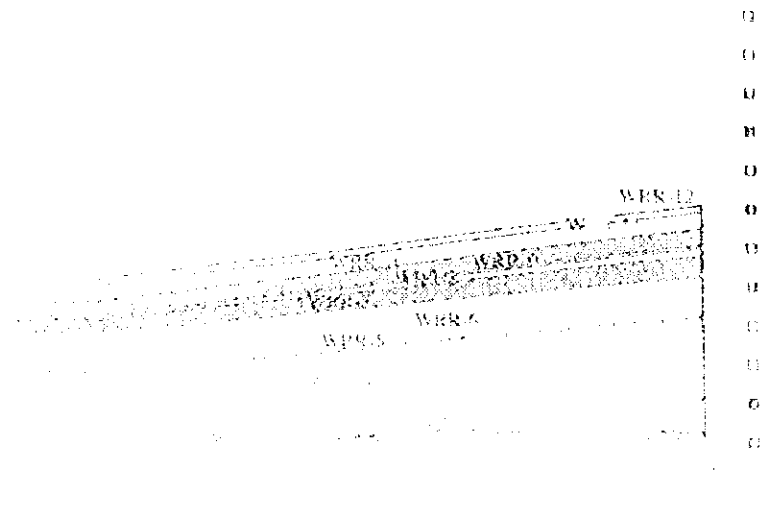


FIGURE [illegible] INDUSTRIAL WATER DEMAND (High Scenario)



[illegible] INDUSTRIAL WATER DEMAND (Low Scenario)

Part – F

AGRICULTURAL WATER DEMAND

Abbreviation

NIA	:	National Irrigation Administration
DPWH	:	the Department of Public Works and Highways
BSWM	:	Bureau of Soils and Water Management
NIS	:	National Irrigation Systems
NIA C.O.	:	NIA Central Office
NWRB	:	National Water Resources Board
BAS	:	Bureau of Agricultural Statistics
BAI	:	Bureau of Animal Industry
LDC	:	Livestock Development Council
DA	:	Department of Agriculture
BFAR	:	Bureau of Fisheries and Aquatic Resources
CIS	:	*Communal Irrigation System*
SWIM	:	Small Water Impounding Management Project
DD	:	Diversion Dam
STW	:	Shallow Tubewell
ISF	:	Irrigation Service Fee
O&M	:	Operation and Maintenance
IA	:	Irrigators' Associations
PIS	:	Pump Irrigation System
m	:	meter
MCM	:	million cubic meters
SRIP	:	Small Reservoir Impounding Projects
LGU	:	Local Government Unit
lps	:	liter per second
lps/ha	:	liter per second per hectare
IS	:	Irrigation Superintendent
WRF	:	Water Resources Facilities
ISF	:	Irrigation Service Fee
IOSP	:	Irrigation Operations Support Project
WRDP	:	Water Resources Development Project
GAA	:	General Appropriations Act
IOSPs	:	Irrigation Operation Support Projects
NIPs	:	National Irrigation Projects

CIPs	:	Communal Irrigation Projects
DA	:	Department of Agriculture
ADB	:	Asian Development Bank
SRIPs	:	Small Reservoir Impounding Projects
MARIIS	:	Magat River Integrated Irrigation System
JICA	:	Japan International Cooperation Agency
ARIS	:	Agno River Irrigation System
LARIS	:	Lower Agno River Irrigation System
ADRIS	:	Ambayoan-Dipalo River Irrigation System
PDD	:	Project Development Department
BFAR	:	Bereau of Fisheries and Aquatic Resources
BAS	:	Bureau of Agricultural Statistics
WRR	:	Water Resources Regions

PART -F AGRICULTURAL WATER DEMAND

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Part-F AGRICULTURAL WATER DEMAND

F1 Data Availability

The data and information used in estimating the future water use were collected from the concerned agencies. Inventory of the existing irrigation systems, study reports and other relevant data/information on irrigation developments were collected from NIA and BSWM. The data on updated irrigation plans and the 10-year irrigation development program of NIA and BSWM covering the period from 1997 to 2006 were also provided to the Study.

The data and information on livestock and poultry were obtained from the Bureau of Agricultural Statistics (BAS), Bureau of Animal Industry (BAI), and Livestock Development Council (LDC), where all these agencies are under the Department of Agriculture (DA). Data on fisheries were gathered from Bureau of Fisheries and Aquatic Resources (BFAR) and BAS. The Medium-Term on Agricultural Development Plan for 1993-1998 is the only agricultural development plan available to this date. Some of the data made available to the Study were presented in administrative region. The distribution thereof in each province and water resources region was determined on a proportional basis.

The agricultural water demand for the year 1996 to 2025 were projected based on the proposed agricultural development plans, as well as the future socio-economic conditions of the agricultural sector discussed in the preceding Chapter. Agricultural water demand was derived for irrigation, livestock, poultry and fisheries. Its estimates for the year 1996 to 2025 are discussed in the following sections.

F2 Existing Irrigation Systems

The National Irrigation Administration (NIA) and Bureau of Soils and Water Management (BSWM) are the major agencies in promoting the irrigation development in the Philippines. Irrigation development has been an important factor in meeting the government objectives for the agricultural growth in the country. Numerous irrigation systems that are developed nationwide are classified into national irrigation system (NIS), communal irrigation system (CIS), small water impounding management project (SWIM), diversion dam (DD), and shallow tubewell (STW).

F2.1 National Irrigation System (NIS)

The NIS generally covers irrigation service areas of more than 1,000 ha. NIA, the prime government agency responsible for irrigation development, builds, operates and maintains NIS and delegates partial or full management of the same to duly organized irrigators' cooperatives or associations.

NIA is also authorized to charge irrigation service fee (ISF) on irrigated lands within NIS service areas at levels sufficient to finance the operation and maintenance (O&M) cost and to recover the initial investment cost. The current ISF rates vary according to the type of system and the cropping season, as follows:

Irrigation Service Fee System of NIS

Type of System	Production Rate in Cavans of Paddy per ha (1 Cavan=50 kg) WET SEASON (WS)	DRY SEASON (DS)
Diversion System	2.0	3.0
Reservoir System	2.5	3.5
Pump-lift System	6.0 - 8.0	6.0 - 10.0

The farmer-beneficiary could be exempted from payment of the ISF if the average actual harvest is less or equal to 2 ton/ha due to water shortage or calamities such as typhoon, flood, fire, etc., which is beyond the control of the farmer.

As of 1996, there are 173 NIS nationwide covers a service area of 651,812 ha. The salient features of each NIS was incorporated in the database established by the Study. Table F-1 shows the list of existing NIS.

F2.2 Communal Irrigation System (CIS)

The CIS is a small-scale irrigation system with an irrigation service area of less than 1,000 ha. There are two types of the CIS in the country. The first type is constructed by farmers without any financial assistance from the government, which is classified into private systems. The second type is constructed by NIA and other government agencies, which are to be owned, operated and maintained by the Irrigators' Associations (IA) without government assistance. The beneficiaries are required to pay 10 percent of the chargeable construction cost during the construction stage and an amount of the remaining 90 percent is to be repaid without interest for a period not exceeding 50 years.

The development of CISs in the country was initiated during the Spanish period. In the 1950's, the government started the construction of CIS. As of December 1996, there are 9,107 CIS with a total service area of 670,018 ha. The CIS is further classified into amortizing, non-amortizing and private systems.

Generally, the CIS is served by the unregulated flow of small rivers and streams. An intake without diversion weir is usually provided for this system. The water distribution system consists of main and lateral canals.

The summary of the inventory of the Communal Irrigation Systems (CIS) is presented in Table F-2. List of individual CIS was included in the database developed by the Study.

F2.3 Small Water Impounding Management (SWIM) and Diversion Dam

SWIM projects entail the construction of medium-sized dams with heights of not more than 30 m and/or storage volume not exceeding 50 MCM, which store water for irrigation particularly in less developed and drought-prone areas. These impounding dams and reservoirs located on natural streams ensure year round irrigation and serve as flood control facilities in some cases. Other components include power generation, domestic water supply, watershed management and fish culture. DPWH, NIA through Small Reservoir Impounding Projects (SRIP) and BSWM undertake the implementation of SWIM projects and then turned over to farmer beneficiaries for operation and maintenance.

The diversion dam is of a concrete rockfill, which is constructed across a channel or river with continuous flow to raise the water level and allow the diversion of water by gravity from the source to the point of use. The developmental purpose of the diversion dam is to irrigate and control river bank erosion. BSWM undertakes the construction of the diversion dam and doles out to duly formed IA. NIA also implements this kind of irrigation system, which is classified under CIS.

As of December 1996, NIA, BSWM and DPWH implemented a total of 256 SWIM projects with total irrigation service area of 15,762 ha. BSWM developed 569 diversion dams with the total irrigation service area of 21,233 ha. The SWIM projects and diversion dams nationwide cover an irrigation service area of 36,995 ha. Table F-3 shows the inventory of SWIMs and Diversion Dams.

F2.4 Shallow Tubewell (STW)

A shallow tubewell irrigation system consists of one or more fully developed shallow tubewell (STW) equipped with appropriate pumping units that can serve a contiguous area owned by an individual or groups of farmers. The pumping unit consists of a centrifugal pump powered by a 5-10 horsepower diesel engine or electric motor. The STW, in general, provides water to rainfed lowland and supplement irrigation needs on areas that are not effectively served by existing irrigation systems. BSWM undertakes the implementation of the shallow tubewell irrigation systems and doles out to the beneficiaries who are properly endorsed by the Local Government Unit (LGU).

As of December 1996, BSWM implemented 984 shallow tubewell irrigation systems nationwide with a total irrigation service area of 2,878 ha. Inventory of shallow tubewells is presented in Table F-3.

F3 Present Irrigation Practices

F3.1 Irrigation Practices of NIS

The NIS is one of the types of existing irrigation areas for which the NIA is responsible. The NISs are all managed by an irrigation superintendent (IS) and his staff, the number of which depends on the size of the areas managed. Each office has its administrative, technical and financial sections and its own equipment, which are maintained by the regional equipment division. These NISs are under the direct supervision of the regional operation division.

On the field level of the NIS, the areas are divided into 750 ha divisions. Each division is managed by a Water Resources Facilities (WRF) technician together with two or three WRF ditchtenders to provide the basic functions of the office, depending on the size of the division and length of canals. One WRF ditchtender is assigned to a canal with 3.5 km length. The WRF technicians are in charge of the operation activities of the division and the maintenance of the canals and act as collectors of Irrigation Service Fee (ISF) in their respective areas.

Operation and maintenance of the NIS are two main functions in the field level. As a standard procedure, the operations group takes care of the water delivery, gates operation and maintenance, and other functions related to water delivery. Discharge measurements are likewise the task of the operation group. The maintenance group is tasked to clean and maintain the canal systems operated by NIA. Other canals are maintained by the Irrigators' Association (IA) whose remuneration are set on a sharing basis and agreed by both IA and NIA. The collection of irrigation fees from farmers is handled by the respective collectors or assistant collectors duly designated by the NIS office. To monitor the current trend of operation and maintenance activities, monthly meeting between NIA and IA Officers are held regularly, supplemented by the seasonal NIA-IA operation and maintenance conferences.

F3.1.1 Water Management Practices

The Irrigators' Associations are the backbone in the implementation phase of the irrigation project. The water delivery schedules, cropping calendars and patterns of planting are determined jointly by the operation and maintenance staff, institutional development group and by the representatives of the Board of Directors of IA during the NIA-IA O&M conferences.

The schedule of conferences held every cropping season is as follows:

(i) The NIA-IA O&M planning session is held approximately one month before the start of the wet cropping season. During this planning session, water delivery, cropping calendar and pattern of planting are determined.

(ii) The NIA-IA mid-cropping season assessment is made after the area has been totally planted to evaluate the outcome of land soaking and preparation activities and implement program for crop maintenance.

(iii) The NIA-IA evaluation is made after the area has been totally harvested to evaluate the outcome of the season operational activities and prepare plans and programs for the succeeding cropping season.

It is noted that the system adopts a sequential start for land soaking during the initial release of irrigation water (usually in April and May) until the system-wide area is totally soaked.

The water management in the systems is not being conducted properly and effectively because of the following constraints:

1) Absence of measuring devices for canal and river discharge
Each system office of the NIS maintains a record of daily intake discharge. However, the records are fragmentary and unreliable considering that no measuring device is installed at the canals. It is therefore impossible to determine whether the present water use is sufficient. It is also very difficult for the NIS offices to prepare the cropping calendar based on the probable water supply.

2) Insufficient information to the farmers on water delivery and distribution schedule
Farmers do not follow the cropping calendar due to water delivery problems. In some systems, the farmers are not properly informed of the water delivery and distribution schedules.

3) Lack of drainage and water control facilities
The most common problems are deteriorating canals and structures, silted and defective diversion works, inadequate drainage and on-farm facilities, and poorly maintained service roads.

4) Lack of technical staff
The stage heights of flow in the main canal and laterals are recorded through staff gauge readings. Usually, the calibration of the staff gauges is conducted annually to get reliable discharge measurements in the canals. However, due to the shortage of technical staff and calibration equipment, most of the canals are not calibrated with the corresponding discharge regularly. With the rapid siltation of the canals, erroneous data are obtained. Thus, an effective water management of a particular system is difficult to implement at present.

F3.1.2 Operation and Maintenance

Maintenance crews regularly check the gates and structures of the irrigation system. Removal of floating debris and application of lubricants to the mechanical parts of the gates are regularly conducted. Major repairs are scheduled when the situation is urgent. Through proper scheduling, repairs may be done simultaneously during water delivery period.

On the maintenance of canals, the IS organizes the WRF ditchtenders from several WRF Technician Divisions to serve as maintenance crews assigned to sections that require immediate cleaning.

The damsite area and gates of the diversion dam are maintained and operated by WRF Operators assigned in the area. These operators also record the intake discharge, rainfall, water level and maximum and minimum flood levels.

The operation and maintenance of control structures and gates along the main canal and laterals are done by WRF technicians and WRF ditchtenders. However, no records of discharge and water elevations are maintained.

The main canal and laterals are being maintained by WRF ditchtenders who are assigned to clean a 3.5 km of canal as their section areas. They are also in charge of water distribution in the area. In compliance to a NIA Memorandum Circular, cutting grasses along the main canal is to be undertaken only for 45 days. If there are no WRF ditchtenders in the area and no Type I contract, maintenance works are done by the maintenance crew of the office.

Maintenance of on-farm facilities such as main farm ditch is done by the farmer-beneficiaries of the concerned facilities in the area. However, the farmers in some areas do not undertake such maintenance works because of the absence of a contract with NIA and unclear specification as to the responsibilities imposed to farmers.

The desilting, rehabilitation and improvement works of existing facilities in the main canal and laterals are done or planned to be done under several projects such as Irrigation Operations Support Project (IOSP), Water Resources Development Project (WRDP), other rehabilitation programs and also through the General Appropriations Act (GAA), etc.

The problems that affects the operation and maintenance of the systems are as follows:

1) Insufficient O&M works

Due to the shortage of fund and technical staff, O&M is not properly done. Consequently, it causes deterioration of irrigation and drainage facilities and improper water management. *Under such a situation, irrigation water cannot be delivered and distributed efficiently.*

2) Insufficient cost for O&M

At present, the ISF collected is lower than the O&M cost. Therefore, it is difficult for the NIS office to allocate enough funds to the operation and maintenance cost of the water control facilities.

3) Absence of practical O&M manuals

There is no practical O&M manual that the field staff can understand easily and utilize effectively. The "General Operation and Maintenance Manual" prepared by NIA is not utilized for the purpose since it is not easy for the field staff to understand it.

F3.2 Present Irrigation Practices of CIS and Other Small Scale Irrigation Systems

The operation and maintenance of CIS, SWIM, Diversion Dams and STW irrigation systems are carried out by the water users associations. All the irrigation practices are dependent on the training and experiences of the farmers.

F4 Status of the Irrigation Development

F4.1 Potential Irrigable Area

Urbanization has been affecting many irrigation systems, particularly around the agro-industrial growth areas. In these major population centers, agricultural lands including irrigated areas are being converted, at a very fast rate, to urban and industrial uses.

The Department of Agrarian Reform is authorized under the Comprehensive Agrarian Reform Law to approve or disapprove the conversion of agricultural lands to non-agricultural areas. On the other hand, the Local Government Code governs the reclassification of agricultural lands to other uses. LGUs are empowered to reclassify agricultural lands that are profitable for agricultural uses, as determined by DA, and which shall have greater economic value if used for other purposes.

Pending the adoption of comprehensive guidelines on land reclassification, AO No. 20 of 7 December 1992, mandates that agricultural lands classified as follows cannot be converted for residential, commercial or industrial uses:

- all irrigated lands where water is available to support rice and other crop production, and all irrigated land where water is not available but are for rehabilitation, and;

- all irrigable lands already covered by irrigation projects with firm funding commitments at the time of application for land conversion.

From the report NIA-CORPLAN, the estimated potential irrigable area in 1980 was about 3.2 million ha nationwide. The estimate of the potential irrigable area was based on the topographic survey of land area with 3 percent slopes. The reassessment in 1991 indicated that the potential irrigable area is over 6.1 M ha, which include areas more difficult to irrigate like sugar land, tree crops and forest categories.

Since there are no available new data regarding the potential irrigable area at the time of the Study, the area of 3.1 M ha was adopted. This figure is also used by NIA in their estimate of the status of irrigation development. The summary of potential irrigable areas by province is presented in Table F-4, Column 2.

However, the estimates of 3.2 M ha needs further reassessment, taking into account the effects of Mt. Pinatubo eruptions on agricultural lands in Region 3. Irrigable areas in Bataan, Tarlac, Pampanga and Zambales add up to over 400,000 ha. A big portion of these will likely be unfit for irrigation in the next five to ten years.

F4.2 Irrigation Service Area Coverage

The irrigation service area covered by the 173 NIS amounts to 651,812 ha, which is about 48 percent of the total service area of the country or 20.85 percent of the potential irrigable area. For the CIS with a total of 9,107, served an area of 670,018 ha, which is 63 percent of the nationwide irrigation area or 21.43 percent of the potential irrigable area. The 256 SWIMs and 569 diversion dams covers a total service area of 36,995 ha, which is about 3 percent of the country's irrigation service area or 1.18 percent of the potential irrigable area. The shallow tubewells covers an irrigation service area of 2,878 ha, which is occupies a small percentage in the potential irrigable area.

As a whole, the present irrigation systems of 11, 087 covers a total irrigation area of about 1.36 M ha or about 43.56 percent of the 3.2 M ha potential irrigable area. Most of these areas are devoted to rice cultivation.

The status of the irrigation development as of 1996 is presented in Table F-4. The irrigation development schemes of each water resources regions are illustrated in Figure F-1 to Figure F-12.

F4.3 Irrigation Development Program of NIA and BSWM

The Ten-Year Development Program of NIA For 1997 to 2006 was provided to the Study by the NIA-CORPLAN, which was prepared in September 1997. The NIA Program includes twenty seven (27) on going projects, twenty three (23) priority projects and twenty one (21) other projects and programs, which are to be locally and foreign funded. By year 2006, it is contemplated to develop 373,845 ha of new irrigation areas, where 340,308 ha under the national irrigation projects (NIPs) and 33,537 ha under the communal irrigation projects (CIPs). The program includes rehabilitation and improvement of about 882,056 ha of the existing irrigation systems, where 833,915 ha under NISs and 44,141 ha under CISs. Also, to improved selected NIS with a total service area of 21,000 ha, sustain O&M of NISs covering a total service area of 651,812 ha, reforest 11,300 ha in Magat watershed, and improve drainage facilities and access roads with a total length of 2350 km and 6061 km, respectively. It would implement sixty seven (67) small reservoir impounding projects (SRIPs) within the period. The project location and description of each of the proposed irrigation development including its implementation period and estimated cost are shown in Table F-5.

The Department of Agriculture (DA) has entrusted the implementation of Small Scale Irrigation Infrastructure Program to BSWM. This program includes the development of small water impounding projects (SWIPs), diversion dams (DDs), shallow tubewells (STWs) and single farm reservoir projects (SFRs). The BSWM provided the Study their Ten Year Small Scale Irrigation Infrastructure Program For 1997 to 2006. By year 2006, the program will implement: 1,586 SWIPs/DDs , which will serve an irrigation area of 72,452 ha; 55,861 STWs which will cover an irrigation area of 114,815 ha; and 27,271 SFRs, which will cover an irrigation area of 23,068 ha. During the Study period, there is no information on the rehabilitation or improvement of the existing irrigation development. The total estimated cost of the program is to be financed by the Philippine government. The breakdown of the number of infrastructures and their budgetary costs by province is shown in Table F-6.

The physical target area of the NIA and BSWM irrigation development program were allocated in their respective year and location by water resources region as shown in Table F-7.

F4.4 Irrigation Development Beyond Year 2006.

Beyond the 10-year period (1997 to 2006) of its Irrigation Development Program, NIA is mandated to continue the country's irrigation development program. This would include the program for the acceleration of the completion of its projects, adequate packaging of future projects and introducing improved management systems and practices. NIA shall continue implementing the irrigation component of CARP and pursue the development of small reservoir irrigation projects. For O&M, focus will be on the following: improvement in the quality of service, restoration of areas damaged by natural calamities, introduction of measures to reduce negative environmental impacts, ensure safety of dams, developing a dynamic and viable NIA-IA partnership in systems management and irrigation of diversified crops.

The agency will maintain the intensified generation of income from existing and other sources. It shall develop an effective organization responsive to the future needs and changes in the irrigation environment.

These future thrusts and strategies of NIA are hinged on the newly enacted Agriculture and Fisheries Modernization Act of 1997 (R.A. 8435). This law prescribed the urgent measures relative to the modernization of the agriculture and fisheries sectors of the country in order to enhance their profitability. It was provided in this law that NIA shall continue to plan, design, develop, rehabilitate and improve the NISs. It shall continue its O&M activities on major irrigation structures and to gradually turn over the O&M of secondary facilities of NISs to IAs. It was also provided in the law that the government shall also encourage the construction of irrigation facilities through other viable schemes such as build-operate-transfer, build-transfer, and other schemes that fast-track the development of irrigation systems. The law further provided that the DA shall review all irrigation systems every four (4) years to determine their viability or ineffectiveness.

In line with this, although there is no concrete information available on irrigation development beyond year 2006, the Study was able to project irrigation area to be developed from 2006 to 2025. The projection was carried out on the assumption that the future irrigation development program will be approximately on the same rate with the current ten-year program of NIA and BSWM. By year 2025, the projected new irrigation area, including the new areas to be developed until 2006 reaches to 1.5 M ha. The new irrigation area by province is projected based on the remaining potential irrigable area of the province. Table F-8 shows the breakdown of new irrigation areas by province.

F5 Estimated Palay Production

The palay production was estimated in two scenarios, designated as Case 1 and Case 2. In Case 1, the palay production was estimated to meet the GDP in high economic growth scenario. Likewise, in Case 2, the projected palay production satisfied the GDP in low economic growth scenario. It is noted that the adopted GDP was determined in the socio-economic aspect of the Study. The estimated palay production for Case 1 is 28.9 M metric ton in year 2025, which is 54 percent higher than the projected GDP of 18.8 M metric ton. For Case 2, the palay production in year 2025 is estimated at 18.8 M metric ton, which is 51 percent of the GDP in lower economic growth scenario of 12.4 M metric ton. The estimated palay production in Case 1 is too much to meet adopted GDP. Similarly, in Case 2, which could even suffice the GDP IN high economic growth scenario. However, for water resources planning point of view, the Study should adopted the estimates in consideration of the mandates of NIA which is to continue developing the remaining potential irrigable area. It is also assumed that the current irrigation development will be fully implemented by year 2006. Table F-9 shows the estimated palay production for Case 1 and 2.

F6 Cropping Intensity

According to NIA, most of the actual irrigated areas of NISs are smaller than their design service areas not only during the dry season, but also during wet season. The average irrigated areas during wet season between 1985 and 1995 account for 73 percent of the total irrigation service area. For the dry season, the irrigated areas account for about 62% of the irrigation service area. The average cropping intensity for the wet and dry season is derived to be 135.2 percent.

For the CIS, the irrigated area as of 1996 reached to 44 percent and 63 percent of the total irrigation service area during the dry and wet season respectively. The average cropping intensity for the year is derived to be 107.3 percent.

There is no sufficient data/information on irrigated areas of the irrigation systems that were implemented by the BSWM.

In the report of the NIA CORPLAN, the cropping intensity for NISs is projected until 2002 which will increase to 152 percent in 1997 to 163 percent in 2002. Accordingly, the Systems Management of NIA, the cropping intensity could be increased to 175 percent to year 2025 provided that there will be intensive improvement and rehabilitation of NISs. For the CIS and BSWM irrigation systems there is no available projection study on the cropping intensity. Based on the information gathered, the Study assumed that the cropping intensity is increased to 150 percent by the year 2025. The projected average cropping intensity for the existing NIS, CIS and BSWM irrigation systems that assumed in the Study are shown below:

Projected Cropping Intensity for NIS, CIS & BSWM Systems

(UNIT: %)

System	1996		2000		2005		2010		2015		2020		2025	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
NIS	73.00	62.00	86.00	73.00	90.00	73.00	90.00	73.00	95.00	80.00	95.00	80.00	95.00	80.00
CIS & BSWM	63.00	44.00	76.79	53.21	80.00	60.00	80.00	60.00	85.00	65.00	85.00	65.00	85.00	65.00

For the proposed new areas, the cropping intensity from 1997 to 2025 is assumed to be 200 percent, or for wet and dry seasons is assumed to be 100 percent respectively. The assumed cropping intensity for the proposed new areas was based on those latest feasibility studies on irrigation projects formulated under NIA.

F7 Harvested Area and Production Yield

The total harvested area nationwide by year 2025 for Case 1 is 2.7 M ha and 2.5 M ha during wet and dry seasons respectively, or a total of 5.2 M ha/year. For Case 2, the total harvested area nationwide during wet and dry season is 1.8 M ha and 1.6 M ha respectively, or a total of 3.4 M ha/year. It is noted that the projection of the harvested area was estimated based on the assumption that all the projected irrigated area are planted with palay and harvested. The projection of irrigated area is discussed in F9, Irrigation Water Demand.

As of 1996, the actual yield under NIA is reported to be 3.73 MT/ha/year. The NIA CORPLAN projected that the yield will increase to 4.0 MT/ha/year in year 2000. Based on the results from previous studies, the yield is assumed to increase at 5.5 MT/ha/year in average by year 2025, considering that the Department of Agriculture should have an intensive program on the improvement of farm technology.

F8 Calculation of Irrigation Water Requirement

In the studies of irrigation water requirement for two crops of rice, the cropping calendar was arranged and developed to fully utilize effectively the rainfall especially during the land preparation stage, and further conform with the available manpower and resources. The pattern of cropping calendar was prepared for each irrigation system or group of irrigation systems. The cropping calendar and the resulting ten-day diversion requirement for the two crops of rice and diversified crops for a representative project in each provinces are integrated in the database developed by the Study. Table F-10 shows the summary of water duty for irrigation by province.

There are six (6) stages of activities involved in the paddy field. These are land soaking, land preparation, nursery and transplanting, crop maintenance, drainage and harvest. Except during drainage and harvest, water is required in the four (4) operational activities wherein water level in the paddy is allowed to fluctuate, depending on the stage of crop growth.

The percolation rate was estimated using the average values which vary less than 1mm/day for heavy clay to 5mm/day for sandy soil.

The crop water requirement for paddy can be expressed as follows:

$$CWR = (kls \times LS + klp \times LP + kn \times N + kfc \times FC) \times T_{unit}$$

where:

CWR = Crop Water Requirement (mm)
kls = Area factor of land soaking
LS = Land soaking requirement (mm/day)
klp = Area factor of land preparation
LP = Land preparation requirement (mm/day)
kn = Area factor for nursery
N = Nursery requirement (mm/day)
kfc = Area factor for field crop requirement
FC = Field crop requirement (mm/day)
T_{unit} = number of days for calculation basis

In diversified crops, deep percolation and land soaking are not considered in the estimation of irrigation water requirement.

a) Land Soaking Requirement

The land soaking requirement is the amount of water needed to saturate the soil prior to the initial tilling.

$$LS = Sn/t + Ev + P$$
$$Sn = (Sc - Mc \times Bd)/100 \times Drz$$

where:

LS = Land soaking water requirement (mm/day)
Sn = Soil saturation requirement (mm)

T = number of days to saturate the soil (7 days)
Ev = Evaporation (mm/day)
P = Percolation rate (mm/day)
Sc = Soil saturation capacity (%)
Mc = Soil moisture content (%)
Wet season paddy Mc = Pwp
Dry season paddy Mc = (Fc + Pwp)/2
Pwp = Permanent wilting point (%)
Fc = Field capacity (%)
Bd = Bulk density
Drz = Depth of root zone (300mm)

The rate of Sc, Pwp, Fc, and Bd are selected from the following table according to the soil texture.

Soil Texture	Sc (%)	Pwp (%)	Fc (%)	Bd
Sand	38	4	9	1.65
Sandy Loam	43	6	14	1.50
Loam	47	10	22	1.40
Clay Loam	49	13	27	1.35
Silty Clay	51	17	35	1.25

b) Land Preparation Requirement

The land preparation requirement is the amount of water needed to replace the losses due to evaporation and percolation to satisfy and maintain the depth of ponding.

LP = Ev + P + Sp/Tsp

where:

LP = Land Preparation requirement (mm/day)
Ev = Evaporation (mm/day)
P = Percolation rate (mm/day)
Sp = Depth of ponding for transplanting (25mm)
Tsp = Number of days for land preparation (20 days)

c) Nursery Requirement

The requirement for nursery is the amount of water needed for the transplanted crop.

N = (LP + kc Eto + P) x 1/20

where:

N = Nursery requirement (mm/day)
LP = Land preparation requirement (mm/day)
kc = Crop coefficient
Eto = Potential evapotranspiration (mm/day)
P = Percolation rate (mm/day)

d) Field Crop Requirement

The field crop requirement is the amount of water consumed by the crop from transplanting up to the period 15 days before harvesting including the percolation in the paddy field.

$$FC = kc * Eto + P$$

Where:

FC	=	Field crop requirement (mm/day)
kc	=	Crop coefficient
Eto	=	Potential evapotranspiration (mm/day)
P	=	Percolation rate (mm/day)

The crop coefficient of paddy is based on the actual data prepared by NSDB-NIA Water Management Improvement Project. The potential evapotranspiration is estimated using the observed pan evaporation or the modified penman method based on the meteorological data recorded at the synoptic stations as previously mentioned.

e) Farm Water Requirement

The farm water requirement is estimated as follows:

$$FWR = CWR - RE$$

where:

FWR	=	Farm water requirement (mm)
CWR	=	Crop water requirement (mm/day)
RE	=	Effective rainfall (mm)

The effective rainfall (RE) is estimated by using daily water balance study assuming 50mm high of paddy dike. In calculating the effective rainfall, the daily rainfall data recorded at the representative station were summarized in a 10-day total. The 10-day rainfall in each month with the basic drought year of 5- year return period was adopted in estimating the field water requirement.

f) Diversion Water Requirement

The diversion water requirement (DWR) is defined as the farm requirement including allowances for farm waste, operation losses and conveyance losses.

$$DWR = FWR/ EF$$

where:

DWR	=	Diversion Water Requirement (mm)
FWR	=	Field Water Requirement (mm)
EF	=	Overall irrigation efficiency

The overall irrigation efficiencies adopted for wet and dry season crops are as follows:

	Wet Season (%)	Dry Season (%)
On- farm	63	75
Conveyance	80	82
Operational	90	90
Overall	45	55

F9 Irrigation Water Demand

The projected irrigation water demand was estimated based on the areas to be irrigated, which is determined in two scenarios adopted in the Study. Under Case 1 or the high economic growth scenario, the areas to be irrigated by year 2025 includes the irrigation areas being served by the existing irrigation systems, new areas to be developed under the current irrigation development program of NIA & BSWM and new areas projected in the Study. The total irrigation area is amounted to 2.86 M ha. For Case 2 or the low economic growth scenario, the areas being irrigated is the same as in Case 1 except for the projected new areas in the Study of 915,820 ha. It was assumed that for Case 2, there is no new area to be developed after year 2006. The total irrigation areas under Case 1 and 2 are shown in Table F11 and Table F-12, respectively.

The irrigated area is determined by multiplying the projected cropping intensity with the irrigation area. By year 2025, the irrigated area for Case 1 by 2025 is estimated at 2.7 M ha and 2.5 M ha during the wet and dry season, respectively or a total of 5.2 M ha. For Case 2, the irrigated area is estimated at 1.8 M ha and 1.6 M ha during the wet and dry season, respectively or a total of 3.4 M ha. The breakdown of the irrigated area by province is presented in Tables F-13 and F-14 for Case 1 and 2, respectively.

The irrigation water demand is estimated by the product of the projected irrigated areas during wet and dry season and the ten-day irrigation water requirement for paddy field. The total irrigation water demand in year 2025 for Case 1 and Case 2 is estimated at 59,884 MCM/year and 38,836 MCM/year, respectively. It is noted that the irrigation water demand for Case 1 and Case 2 is the same until year 2005. Tables F-15a to F-15k show the estimated water demand by province/water resources region for Case 1 and Case 2.

F10 Irrigation Water Demand by Major River Basins

The Study delineated and identified the existing and proposed irrigation development within the twenty (20) major river basins in the country. The irrigation service areas of NIS, CIS, SWIMs and other small-scale irrigation systems within the river basin were summed up. Some of the proposed target areas most especially the projected areas in the Study have no specific site yet for irrigation development. Thus, the irrigation areas within the basin were determined based on the level land with slopes of 3 percent, which is suitable for irrigation development of the basin. The schematic diagrams of the irrigation development in each major river basin are presented in Figure F-13 to Figure F-33.

The irrigation water demand by major river basin is estimated based on the delineated irrigated area, as shown in Tables F-16 for Case 1 and F-17 for Case 2 with the irrigation water requirement by basin as shown in Table F-18. The irrigation water requirement was determined based on the average of the water requirement of the provinces within the basin. Tables F-19a to F-19k show the estimated ten-day irrigation water demand by major river basins under Case 1 and 2.

F11 Irrigation Water Demand Shared by Groundwater Source

The use of groundwater for irrigation is being explored at many places where surface water is limited or not available. This is an alternative solution to the more costly construction of complex irrigation. The government is implementing irrigation systems projects using groundwater as source, so as to the privately owned irrigation systems.

As of April 1997, the NWRB's List of Water Rights Grants shows that there are 1,382 approved water permits to appropriate groundwater source for irrigation use. The total amount of water to be withdrawn is 21,200 LPS, which is estimated to cover a service irrigation area of about 14,400 ha. The estimated area is based on the average water requirement of 1.5 LPS/ha. This average water duty is being used by the NWRB in evaluating water permit application for irrigation purposes. The inventory of approved water rights on groundwater utilization for irrigation is presented in Table F-20.

On the current irrigation development plan of NIA and BSWM, there are still proposed new areas to be served by groundwater irrigation development. By year 2025, the irrigated area to be served by groundwater is amounted to 245,720 ha both for Case 1 and 2. After year 2006, the study assumed that no groundwater development should be done for irrigation purposes.

The total irrigated area includes the areas being served by the existing shallow tubewells, areas being irrigated by the approved water rights and the areas to be developed under the current irrigation development plan.

The irrigation water demand shared by groundwater sources was estimated at 4,694 MCM in year 2006 and will remain constant until year 2025. The breakdown of irrigation water demand shared by groundwater by province is presented in Tables F-21a to F21d and by major river basin is shown in Tables F-22a to F-22d.

F12 Other Agricultural Water Demand

Other future agricultural water demand was projected for each of two agricultural sub-sectors other than irrigation, namely livestock/poultry and fishery. In the preliminary report of this study, both sub-sectors were discussed and data were thoroughly presented. Since significant revisions were made in fishery, water demand projections concerning the livestock/poultry and fishery sub-sectors were undertaken considering the high and low economic growth scenarios.

F12.1 Livestock and Poultry

Livestock considered for the future water demand projection consists of cattle, carabao and hog. Small ruminants such as goat and sheep are not included. In case of poultry, only broiler chicken was considered. The population and production of cattle, carabao, hog and chicken in 1996 are as follows:

1996 Inventory of Livestock and Poultry

	Population (1000 head)	Production (1000 metric ton)	Slaughtered (1000 head) Livestock
Cattle	2,012	213	533
Carabao	2,708	104	260
Hog	8,807	1,213	7,582
Total	13,606	1,530	8,374
Poultry (Chicken)	100,273	947	100,273

Source: Bureau of Agricultural Statistics

The 1996 inventory shows that the shares of slaughtered livestock consist of 13.9 % for cattle, 6.8 % for carabao and 79.3 % for hog. According to the Livestock Development Council (LDC), the average live weight of cattle and carabao is 380 kg/head, hog is 80 kg/head and chicken is 1.3 kg/head. The market age of cattle and carabao ranges from 2 to 3 years, hog from 4 to 6 months and broiler chicken is about 45 days.

The assumptions considered in the projection of the livestock population for the years 2000, 2005, 2010, 2015, 2020, and 2025 are as follows:

(i) The study adopted the average live weight per head of cattle, carabao and hog, which was determined by the LDC.

(ii) The target of the Medium-Term on Livestock Development Plan by 1998 is to increase the population of cattle, carabao and hog to 3.0 million, 2.5 million and 10.8 million, respectively and chicken for more than 100 million. Since there is no available study of livestock beyond 1998, the projection was made based on the framework for major agricultural commodities in terms of GDP and production determined through the socio-economic projection.

(iii) The population of cattle will increase from 2.02 million heads in 1996 to 3.0 million heads by the year 2000. For every five years, cattle population needs to be increased by 6.67% to sustain cattle production in the year 2025. Accordingly, the population of carabao was assumed constant until the year 2025. Since the market age of hog is 4 to 6 months, it was assumed that hog farms expand to twice in the number of hog population in a year. For chicken, harvest should be conducted at every 45 days.

The projected livestock population nationwide by year 2025 is estimated at 44.7 M heads and 23.2 M heads for Case 1 and Case 2 respectively. For poultry, the projected population by year 2025 is estimated at 2,517 M heads and 1,108 M heads under Case 1and 2 respectively. The livestock/poultry population by province for Case 1 and 2 is presented in Table F-23 and Table 24, resepctively.

The water demand for livestock and poultry nationwide for Case 1 is estimated at 434 MCM in 2025. For Case 2, the water demand is also estimated at 218 MCM in 2025. The study adopted the water requirement of 2.4 x 10^{-4} LPS per head for livestock raising and 1.46 x 10^{-6} LPS per head for poultry. This was based on NWRB criteria in determining the amount of water in granting water rights.

The estimated water demand for livestock and poultry by province under Case 1 and Case 2 are shown in Tables F-25 and F-26, respectively. For the major river basin, the estimated water demand for livestock and poultry in Case 1 and 2 is likewise shown in Tables F-27 and F-28, respectively.

F12.2 Fisheries

The total fish production in 1996 is 2.69 million tons. The commercial fishery accounted to 893,210 tons or 33 percent of the total production. Municipal inland production accounts to 186,670 tons or 7 percent of total production, while municipal marine is 785,720 tons or 29 percent of the total production. The aquaculture production accounted for 825,390 tons or 31 percent of the total production. The Study determined the water demand only for the aquaculture fishponds that utilize freshwater and brackish water and for the species of Bangus (Milkfish) and Sugpo (Prawn).

The existing fishpond area as of 1996 for Bangus is 99,682 ha nationwide. By year 2025, the fishpond area for Bangus will increase to 167,941 ha for Case 1 and 143,420 ha for Case 2. For Sugpo, the existing fishpond area as of 1996 is 40,143 ha. By year 2025, the fishpond area is estimated at 78,026 ha and 66,618ha for Case 1 and 2 respectively.

The water demand for fishery in 1996 was estimated at 6,899 MCM. By the year 2025, the water demand was projected to reach 12,655 MCM for Case 1. As for Case 2, the water demand is 10,806 MCM in 2025. Table 29 and Table 30 show the provincial breakdown of water demand for Case 1 and Case 2, respectively. The water demand for fishery by major river basin under Case 1 and Case 2 was also determined and shown in Tables F-31 and F-32.

The water demand was estimated based on the fishpond water requirement of 0.9259 LPS/ha for *Bangus* (Milkfish) and other species under brackish and fresh water fishpond, and 3.15 LPS/ha for *Sugpo* (Prawn). These criteria are currently used by NWRB as basis in granting water rights for fishery purposes.

F12.3 Total Agricultural Water Demand

The total agricultural water demand by province and water resources region as of 1996 was estimated at 25,533 MCM or 69.95 MCM/day. About 18,527 MCM or 72.6 percent is shared by irrigation sub-sector. The livestock/poultry sub-sector accounted for 107 MCM or 0.42 percent of the total agricultural water demand. For the fishery sub-sector, the water demand in 1996 was estimated at 6,899 MCM or 27 percent of the total agricultural water demand.

Under Case 1, the agricultural water demand is expected to reach 72,973 MCM or 200 MCM/day in the target year 2025. About 59,884 MCM would be required for irrigation. Livestock and poultry would require 434 MCM and fisheries would need 12,655 MCM by year 2025. The total agricultural water demand. Likewise, under Case 2 is expected to reach 51925 MCM or 142 MCM/day in 2025. Irrigation would require 38,836 MCM and 218 MCM for livestock and poultry. About 10,806 MCM would be needed for fisheries. The summaries of agricultural water demand under Case 1 and Case 2 by province/water resources region are shown in Tables F-33 and F-34.

Agricultural water demand by major river basin was also estimated and shown in Tables F-35 and F-36 for Case 1 and Case 2, respectively.

F13 Water Resources Management from the Aspect of Irrigation Water Use

F13.1 Genearl

Water resource management has many concerns and components. These are data collection and processing, water-related laws and policies, water-related institutions and agencies, water resources potential and development, water demand and usage, and many others. It can also be viewed from many perspectives. The agricultural aspect is the most significant as it is presently the country's largest consumer of water resources. However, this is being challenged by the increasing demand for domestic use. Domestic use has also the priority among the uses. Eventually, the water available for agricultural use will decrease and an effective water resource management is necessary to mitigate its impact on the farmers, in particular, and on the populace, in general.

The overall management and development of the water resources is coordinated and integrated by the National Water Resources Board (NWRB). In the case of agricultural use, NIA is the agency mandated to develop and operate irrigation projects and systems. In addition, BSWM and the LGU have also constructed a number of irrigation projects. Other agricultural activities such as livestock and poultry require a minimal amount of water in its operations while aquaculture are limited in scope; both falls under the authority of the Department of Agriculture (DA).

NIA develops and operates various types of irrigation systems consisting of NISs which are mostly diversion schemes with few large storage reservoirs, CISs, SWIPs, and PISs. The development of irrigation in the country followed many stages, initially concentrating on the construction of large diversion schemes and gradually evolving in the promotion of communal size projects. The shift in strategy was motivated by the ever increasing cost of development and the need to shorten the duration of construction. To reduce the operational cost and improve the irrigation water revenue, NIA adopted and pioneered the participatory approach whereby farmers' associations were organized to takeover the management of their irrigation systems.

The seasonal rainfall distribution favored the construction of SRIPs which help increase the dry season crop production. This scheme was found to be costly and only few were eventually constructed. The drilling of STWs have the same advantage of increasing the dry season area and is relatively inexpensive to construct, unfortunately, only a few suitable sites are available for development.

As of the end of 1996, NIA and BSWM irrigated around 43 percent of the 3.1 million hectares of potential irrigable area or equivalent to 1.36 million ha. On the average, the irrigated systems could efficiently serve 80 and 60 percent of service area during the wet and dry season, respectively. The designed service area could not be fully covered due to limited water supply, deteriorating condition of the watershed, damages brought by typhoons and floodings, inadequate maintenance and others. NIA is unable to solve these problems due to limited financial resources.

F13.2 Present Situation and Necessity of Improvement/Rehabilitation of Irrigation Facilities

Present situation of the country's irrigation systems, as gathered from investigation reports prepared by NIA, pointed out the necessity of improving irrigation facilities such as diversion and conveyance facilities. NIA studies shows that the following items constitutes the otherwise unfavorable situation of irrigation systems resulting to inefficiency in water management:

a. Diversion Works: Majority of diversion works were not provided with silt excluders causing heavy siltation at the intakes and spillways. Also, most diversion dams have a scoured downstream apron and damaged retaining walls.

b. Conveyance Channels: Most of irrigation main canals have siltation problems and have eroded embankments. This situation is aggravated by either the lack or poor maintenance of O&M roads.

c. Canal Structures: The problem is brought about by lack of measuring devises, lack of control structures, improper location of structures (check structures, turnouts, etc.), no provisions for gates or destroyed gates.

d. Lack of on-farm irrigation canals and drainage facilities

e. Lack of on-farm structures and the improper location of the same.

To address current problems that besets irrigation systems is to undertake improvement works that would result to higher irrigation efficiency. These includes, but not limited to:

i) Desilting of canals and restoration of the canal design section;

ii) Provision of measuring devises to be able to determine the required design discharge in the canals and to determine whether the present water use would suffice;

iii) Provide check structures with gates where needed;

iv) Replacement of destroyed/defective check gates;

v) Provision of turnouts, farm ditches, and other on-farm facilities necessary to ensure water delivery;

vi) Rehabilitation of existing irrigation facilities and improvement of drainage system to reduce flood damages;

vii) To facilitate water management, installation of steel gates at all point of turnouts and head structures should be given preference;

viii) On-farm channels should be constructed at a density of 70 m/ha for farm ditches and 60 m/ha for farm drains; and

xi) Rehabilitation of service roads for proper maintenance of these irrigation facilities.

F13.3 Present Situation and Necessity of Improvement and Strengthening of O&M for NISs and CIPs.

Based on current O&M practices as reported by concerned NIA offices, the following constitutes the most common problems on this aspect:

a. Lack of funds and technical staff to conduct satisfactory O&M activities.

b. Low irrigation service fees (ISF) and collections that could be tapped to fund O&M activities.

c. Inavailability of practical O&M manuals that could be easily understood and put into effective used by farmers themselves.

To improve and sustain effective water management, sound O&M practices should be performed as follows:

i) Improvement of ISF rates and collection system;

ii) Training of technical staff on proper water management and O&M activities;

iii) Preparation of O&M manuals that could be applied by farmers for their contribution in the maintenance of irrigation on-farm facilities; and

iv) Strengthening of IAs for the O&M of irrigation systems.

F13.4 Present Situation and Necessity of Investigation of Existing Irrigation Systems

The dismal situation and current problems besetting irrigation systems are the results of inadequate planning and insufficient O&M being applied. Currently, it was observed that turnouts are not properly located and as a result, illegal or unauthorized turnouts are constructed by farmers. Inadequate on-farm facilities such as farm ditches, farm drains and turnouts, has made it impossible for the irrigation system to serve other portions of the service area

The prevailing situation of the country's irrigation systems should be investigated further in the formulation of rationalized irrigation water supply systems. Existing alignment, location of irrigation intake sites, and related concerns should be evaluated for proper usage of irrigation water supply.

F13.5 Present Situation and Necessity of Introduction of Meteo-hydrological Data Collection System

Accurate and sufficient data and information on meteo-hydrological concerns are essential in long-term planning and development of irrigation projects. Presently, meteorological and hydrological data are collected by different government offices and agencies. Observation stations were established based on specific purposes such as weather forecasting, irrigation planning and operation, hydropower, water supply, etc. Most of the meteorological data are collected by PAGASA while the streamflow records are gathered by the Bureau of Research and Standards (BRS). Most of the recent data collected are unpublished and the processing of these data are done manually. Currently, a database for groundwater data has been established by NWRB, the Philippine Groundwater Database System.

There is an urgent need to standardize and automate the collection, processing, retrieval and dissemination of these meteo-hydrological data. Accurate data are necessary not only in the planning stage but is equally important in the operation and maintenance stage specially in the management of water supply. NIA's O&M activities on NISs and CISs generate large volume of data that needs to be collated, sorted and evaluated. To maintain the accuracy and integrity of these data, a database system is necessary. At present, NIA is endeavored to move in this direction but technical and financial constraints are hindering them to pushed through with this undertaking.

F13.6 Other Related Matters on Water Resources Management

Future strategy for water resources management will include the protection, preservation and enhancement of watershed, prevention of contamination of the water sources, conjunctive use of water resources and better regulation of these resources. This indicate a need to strengthen the coordination of various agencies in water resource development to resolve future conflicts and to maximize the benefit from available water resources.