2.6 Landuse and Irrigation

2.6.1 Landuse

Present landuse in Lebanon is summarized in Table-2.1 based on the landuse map by Lebanon Agricultural Research Institute/FAO (1995). Although the recent urbanization in the last 7 years has stipulated conversion of land to other usage, such as an increase in urban areas, it is limited to the suburbs of the major cities along the Mediterranean sea. Besides, irrigation schemes have focused on mainly rehabilitation since 1994 after the cease of civil war, and the large expansion of new irrigation projects has been launched recently. Thus, assuming that the present landuse does not vary much from the figures in Table 2.6-1, the present landuse in Lebanon is discussed below.

Approximately 32.6% (3,407.7 km^2) of the national land (10,452 km^2) is used for the agriculture. Field crops (49.7%) and orchard (48.3%) dominate the agriculture land as major use of agriculture land. Horticulture, one of the profitable crops in irrigation, is limited to only 2.0% in area and mainly practiced in Mount Lebanon and South Lebanon. Spatial variation of the agriculture is consistent with topographical features. Arable land extends in the coastal plain near the northern and southern borders, and Bekaa plain. Thus, 41.2%, 22.9% and 12.3% of the agriculture land are located in Bekaa, North Lebanon and South Lebanon Mohafaza respectively.

Table-2.6-1 Present Landuse

Unit:km2

Landuse		Mohafaza						Total
		Beirut	Mount Lebanon	North Lebanon	South Lebanon	Bekaa	Nabatieh	
Agriculture Land		0.05	348.94	780.92	418.47	1,405.65	453.64	3,407.65
	Horticulture	0.05	19.94	9.98	29.16	6.03	1.27	66.42
	Field Crops	0.00	50.68	319.50	88.79	1,003.51	232.18	1,694.66
	Orchard	0.00	278.31	451.44	300.52	396.11	220.20	1,646.57
Grassland		0.13	430.56	430.22	146.14	1,887.86	343.63	3,238.54
Forest		0.20	808.39	654.33	301.88	617.41	248.84	2,631.06
Urban Area		19.12	285.08	106.16	77.94	86.81	78.97	654.07
Barren Land		0.31	158.70	81.16	7.01	251.57	2.16	500.91
Swamp/Water		0.02	1.26	2.62	0.17	9.97	0.02	14.05
Total		19.83	2,032.92	2,055.39	951.62	4,259.26	1,127.26	10,452.00

Source: Lebanon Agricultural Research Institute/FAO (1995) updated by the Team

Grassland whose use is limited to animal husbandry in small scale dominates the landuse in Lebanon, accounting for 31.0% of the national area, and its half extends in Bekaa plain. Forest (25.2% of the national area) is preserved mostly along the Mediterranean sea due to relatively high precipitation, while urban area (1.8% of the national area) is mainly located in the narrow coastal

strip of the Mediterranean sea, accounting for 74.7% of the total urban area. Since the Qaraoun dam with the surface water area of 12 km^2 is located in Bekaa plain, almost 70% of the swamp and water land is located in Bekaa Mohafaza.

From the viewpoint of the domination of natural environment assessed by the ratio of forest and swamp/water to total land by each Mohafaza, the highest natural environment remains in Mount Lebanon (39.8%), followed by North Lebanon (32.0%) and South Lebanon (31.7%).

2.6.2 Present Irrigation

(1) Institutions in Irrigation Sector

In addition to the institutional framework concerning water resources management to be described later in the section 2.8, brief description for the roles of institutions restricted to irrigation sector is made below. Institutions involved in irrigation sector are mainly, MEW (the Ministry of Energy and Water), and LRA (the Litani River Authority). Both institutions are responsible for planning and implementation of irrigation inclusive of water resources development.

LRA has been created by the law dated on 14th August 1954 and rectified later on 30th December 1955. The law defined the main tasks of LRA to execute the Litani River Scheme for irrigation, drainage and domestic water and to execute hydraulic electrical power generation and electrical networks between powerhouse and electrical distribution networks covering all Lebanese regions. The following tasks were also added to LRA by the government, namely, hydraulic measurement on all Lebanese rivers, study and execution of different mountain lakes like Kawachra in Akkar Zone, Kfarhouna in Jezzine and Ballout in Matn region, technical land survey and studies of dams on northern Lebanese rivers, and Bisri dam studies. Recently, the new law of water authorities specifies that LRA is responsible for all irrigation schemes in the Sounth Bekaa and South Lebanon regions.

MOA (Ministry of Agriculture) is responsible for formulation of agriculture policy and extension services at the field level; however, its capability to handle the tasks has been seriously diminished due to the civil war. In this connection, LRA also has an extension service. Only two autonomous authorities under MOA, GP (the Green Plan) and ARIL (the Agricultural Research Institute of Lebanon), maintain the operation at low capacity. GP is involved in land preservation, land reclamation, road construction, small hydraulic development and on-farm level infrastructure works, while ARIL conducts applied researches for sustainable agriculture development. At present, MOA is not directly involved in irrigation in terms of water resources development and extension services to farmers.

(2) Existing Irrigation Schemes

It is recognized generally that 60 to 70% of available water in Lebanon has been consumed by irrigation. Although irrigation is the largest sector in water use, data to identify consumption of irrigation water, such as irrigated area, cropping pattern, cropping calendar, intake volume and so

on, are very limited because the civil war has resulted in weakness of government capacity to handle extension service and water resources management. Thus, the existing irrigation schemes were identified based on the previous studies and confirmed through the discussion with authorities concerned.

Two previous reports, "Irrigation in the Near East Region in Figures (FAO, 1997)" and "Global Result of Agriculture Census (FAO/MOA, 2000)" estimated the irrigated area respectively in 1993 and 1999, as follows.

Table 2.6.2 Irrigation Area by Previous Studies

Year	Cultivated Area	Equipped Irrigation Area	Net Irrigated Area	Surface Irrigation	Sprinkler Irrigation	Micro Irrigation
1993	189,206	87,500	NA	53,500	21,000	13,000
	Ratio to the total equipped irrigation area			61%	24%	15%
1999	261,000	NA	104,010	66,130	29,040	8,840
	Ratio to the total net irrigated area			64%	28%	8%

Source: 1993 for "Irrigation in the Near East Region in Figures (FAO, 1997)"
1999 for "Global Result of Agriculture Census (FAO/MOA, 2000)"

Note: Net irrigated area in 1999 is defined as the land irrigated at least once during the crop cultivation and the minimum plot counted for irrigated area is 0.025 ha (250 m^2). Thus, house gardening and very occasional irrigation that are normally excluded from irrigation are included.

Net irrigated area of 104,000 ha given by the FAO/MOA census includes the areas that are hardly considered to be regularly irrigated with irrigation water supplied only once during the cropping period and also negligibly small land down to the scale of 0.025 ha that can belong to house gardening, providing a problem that may lead to over-estimation of current water consumption for irrigation if this figure is applied for analysis. Besides, the government has focused on the rehabilitation and modernization of irrigation schemes since 1994 without expansion of new schemes, except the Canal 800 which is under construction at present. It is, therefore, assumed that irrigation area in terms of equipped area has not been expanded on a large scale during the period from 1993 until date, and 90,000 ha approximately could be the base for estimation of current consumption of irrigation.

Through the inventory of previous studies and information from MEW, 67 irrigation schemes were identified, covering mainly medium (between 100 ha and 1,000 ha) and large (over 1,000 ha) scales. The total equipped area of those schemes is 65,600 ha as listed in Table 2.6.3 and as plotted in Figure 2.6.1.

Assuming that the rest of equipped irrigation area consists of small-scale irrigation exploited by individual farmers, the FAO/MOA census was adopted to estimate those areas by Caza base.

Table 2.6.4 Existing Schemed and Small Scale Irrigation Area

Category	67 Schemed Irrigation	Small Scale Irrigation	Total
Equipped Area (ha)	65,600	24,400	90,000
Net Irrigated Area (ha)	59,070	21,960	81,030

Distribution of small scale and scattered irrigation areas of 24,400 ha in total was made in proportion to the areas by Caza shown in the FAO/MOA census. Such results are given in Table 2.6.5.

Various crops are being planted in Lebanon, such as maize, potato, wheat, onion, tobacco, water melon as field crops, tomato, cabbage and other green vegetables as market crops and apple, grape, pear, citrus, cherry and olive as perennial/fruit crops. In order to grasp water requirement for irrigation, those crops are simply categorized into three, namely cereals represented by winter wheat, vegetables and fruit trees. Ratios of cropped areas against the net irrigated area, after categorized into above three, are also given in Table 2.6.3 for schemed irrigation and in Table 2.6.5 for small scale irrigation by Caza.

FAO/MOA census also gives irrigated areas classified by different sources of water such as surface water and groundwater. 48% of the total volume of water consumed for irrigation are supplied from surface sources including spring water, while 52% are withdrawn from groundwater aquifer according to the census.

As for irrigation method, surface irrigation system such as furrow irrigation is adopted over 70.4% of the total irrigated land in Lebanon, while sprinkler and drip irrigation systems are adopted respectively in 23.4% and 6.2% of irrigated land. All water diverted from surface sources are used for surface irrigation, and on the other hand, 43%, 45% and 12% of water extracted from groundwater resources are used for surface, sprinkler and drip irrigation systems, respectively.

The philosophy adopted for the irrigation scheme in Lebanon is that water is becoming scarce, too valuable and expensive to mobilize. Hence both the administration and farmers should comply with a high irrigation efficiency. Consequently irrigation efficiency adopted are as in Table 2.6.6.

Figure 2.6.1 Location of Existing Irrigation Schemes

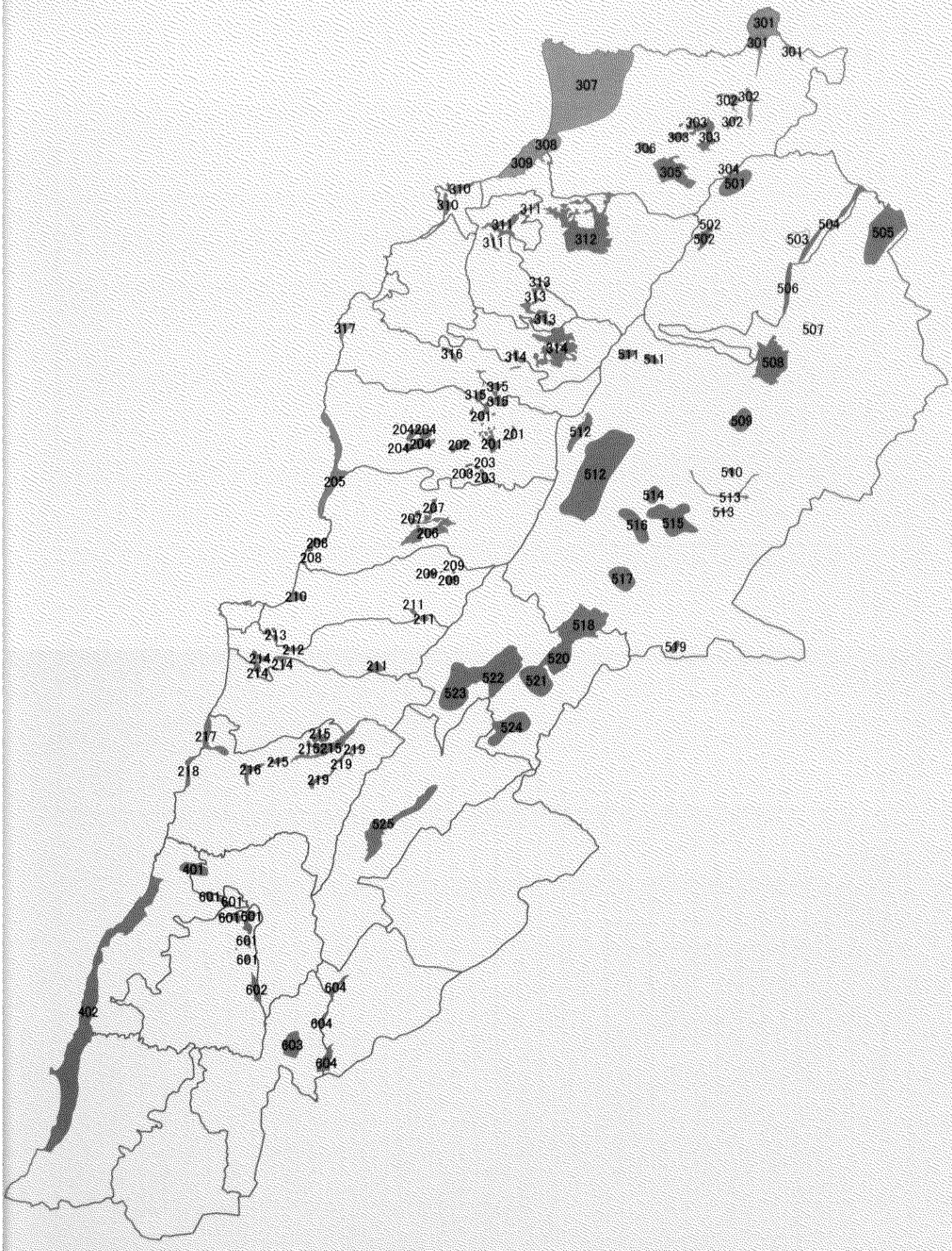


Table 2.6.3(1) Existing Schemed Irrigation

CODE	SCHEME NAME	EQUIPPED AREA (ha)	NET IRRIGATED AREA (ha)	SURFACE IRRIGATION (ratio)	SPRINKLER IRRIGATION (ratio)	DRIP IRRIGATION (ratio)	Cereals Winter Wheat (ratio)	Fruit Trees (ratio)	Vegetables (ratio)	Type of Fruits	Surafce Water + Springs (ratio)	Groundwater (ratio)
201	Akoura-Laqlouk	1,100	990	0.704	0.234	0.062	0.06	0.64	0.30	citrus	0.48	0.52
202	Qartaba & Surroundings	250	230	0.704	0.234	0.062	0.06	0.64	0.30	citrus	0.48	0.52
203	Lassa, Ghabat, Mezarib, Mghairi, Afqa & Surroundings	120	110	0.704	0.234	0.062	0.06	0.64	0.30	citrus	0.48	0.52
204	Ehmej and Surroundings	700	630	0.704	0.234	0.062	0.06	0.64	0.30	citrus	0.48	0.52
205	Adonis (Keserouan)	400	360	0.704	0.234	0.062	0.02	0.65	0.33	citrus	0.48	0.52
206	Kfardebian and Faraya	540	490	0.704	0.234	0.062	0.02	0.65	0.33	citrus	0.48	0.52
207	Mayrouba and Hrajel	340	310	0.704	0.234	0.062	0.02	0.65	0.33	citrus	0.48	0.52
208	Nahr El Kalb - El Wata	80	70	0.704	0.234	0.062	0.02	0.65	0.33	citrus	0.48	0.52
209	Bouknta-Sawnine and Bekaata	320	290	0.704	0.234	0.062	0.00	0.81	0.19	citrus	0.48	0.52
210	Antelias	100	90	0.704	0.234	0.062	0.00	0.81	0.19	citrus	0.48	0.52
211	Hammana - Tarchich-Aintoura & Surroundings	200	180	0.704	0.234	0.062	0.00	0.81	0.19	citrus	0.48	0.52
212	Dayshounieh- Hazmieh & Surroundings	100	90	0.704	0.234	0.062	0.00	0.77	0.23	citrus	0.48	0.52
213	South Beirut Suburbs	300	270	0.704	0.234	0.062	0.00	0.77	0.23	citrus	0.48	0.52
214	Wadi Chahrour & Surroundings	200	180	0.704	0.234	0.062	0.00	0.77	0.23	citrus	0.48	0.52
215	Nabaa Es Safa	860	770	0.704	0.234	0.062	0.02	0.77	0.21	citrus	0.48	0.52
216	Jahiliye	150	140	0.704	0.234	0.062	0.02	0.77	0.21	citrus	0.48	0.52
217	Dammour Plain	400	360	0.704	0.234	0.062	0.02	0.77	0.21	citrus	0.48	0.52
218	Jiyeh	100	90	0.704	0.234	0.062	0.02	0.77	0.21	citrus	0.48	0.52
219	Nabaa El Barouk	280	250	0.704	0.234	0.062	0.02	0.77	0.21	citrus	0.48	0.52
301	Bouqaiaa	1,100	990	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
302	Mashta Hasan-Mashta Hammoud-Chadra	810	730	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
303	Akkar El Attica	560	500	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
304	Akkar Highland Farms-Karm Sbat & Surroundings	200	180	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
305	Fneideq-Mechmech	990	890	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
306	Joumeh Area- Rahbeh - Takrit & Surroundings	400	360	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
307	Akkar Plain and Arka River	8,000	7,200	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
308	Akkar El Bared	800	720	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
309	Minieh	1,220	1,100	0.704	0.234	0.062	0.17	0.59	0.24	citrus	0.48	0.52
310	Tripoli	200	180	0.704	0.234	0.062	0.17	0.59	0.24	citrus	0.48	0.52
311	Zgharta	500	450	0.704	0.234	0.062	0.11	0.78	0.11	citrus	0.48	0.52
312	Danniyeh	5,000	4,500	0.704	0.234	0.062	0.17	0.59	0.24	citrus	0.48	0.52
313	Ehden	450	410	0.704	0.234	0.062	0.11	0.78	0.11	citrus	0.48	0.52
314	Bcharre	840	760	0.704	0.234	0.062	0.05	0.87	0.08	citrus	0.48	0.52
315	Tannourine	330	300	0.704	0.234	0.062	0.06	0.62	0.32	citrus	0.48	0.52
316	Kfarhilda	80	70	0.704	0.234	0.062	0.06	0.62	0.32	citrus	0.48	0.52
317	Batroun Plain	100	90	0.704	0.234	0.062	0.06	0.62	0.32	citrus	0.48	0.52

Table 2.6.3(2) Existing Schemed Irrigation

CODE	SCHEME NAME	EQUIPPED AREA (ha)	NET IRRIGATED AREA (ha)	SURFACE IRRIGATION (ratio)	SPRINKLER IRRIGATION (ratio)	DRIP IRRIGATION (ratio)	Cereals Winter Wheat (ratio)	Fruit Trees (ratio)	Vegetables (ratio)	Type of Fruits	Surafce Water + Springs (ratio)	Groundwater (ratio)
401	Saida-Jezzine	390	350	0.704	0.234	0.062	0.19	0.66	0.15	banana	0.48	0.52
402	Qasmieh - Ras El Ain	4,440	4,000	0.704	0.234	0.062	0.19	0.66	0.15	banana	0.48	0.52
501	Hermel High land Farms	1,100	990	0.704	0.234	0.062	0.50	0.09	0.41	grapes	0.48	0.52
502	Marjhine	160	140	0.704	0.234	0.062	0.50	0.09	0.41	grapes	0.48	0.52
503	Hermel Watershed	650	590	0.704	0.234	0.062	0.50	0.09	0.41	grapes	0.48	0.52
504	Assi Plain	400	360	0.704	0.234	0.062	0.50	0.09	0.41	grapes	0.48	0.52
505	El Qaa	3,000	2,700	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
506	Oyoun Taqtaq	100	90	0.704	0.234	0.062	0.50	0.09	0.41	grapes	0.48	0.52
507	Ras Baalbeck	300	270	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
508	Laboue	2,080	1,870	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
509	Chaat & Surroundings	800	720	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
510	Younine	100	90	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
511	Oyoun Orghosh - Barqa-Nabha & Surroundings	400	360	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
512	Yammouneh	5,600	5,040	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
513	Wadi Nahle & Surroundings	150	140	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
514	Iaat Plain	270	240	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
515	Baalbeck Plain-Douris & Surroundings	2,000	1,800	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
516	Haouch Barada - Majdaloun & Surroundings	1,000	900	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
517	Talia & Surroundings	1,000	900	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
518	Yahfoufa, Jenta, Serrasin & Surroundings	1,670	1,500	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
519	Maaraboun & Ham	120	110	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
520	Rayak, Ali Nahri & Surroundings	870	780	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
521	Torbol - Delhamieh & Surroundings	1,500	1,350	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
522	Zahle & Surroundings	2,000	1,800	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
523	Chtaura - Qab Elias Plain	2,000	1,800	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
524	Anjar-Chamsine & Surroundings	1,500	1,350	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
525	South Bekaa (Phase I), Left Bank	2,220	2,000	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
601	Iqlim El Touffah	320	290	0.704	0.234	0.062	0.43	0.20	0.37	citrus	0.48	0.52
602	Nabatiyeh (Al Midane Plain)	220	200	0.704	0.234	0.062	0.43	0.20	0.37	citrus	0.48	0.52
603	Marjeyoun & Khiam Plain	620	560	0.704	0.234	0.062	0.61	0.08	0.31	citrus	0.48	0.52
604	Hasbani	500	450	0.704	0.234	0.062	0.44	0.45	0.11	citrus	0.48	0.52
	Total	65,600	59,070									

Source: Area: JICA Study based on the reference shown in "Reference Sheet" and interview with authorities concerned

Ratios of irrigation method, irrigated crops and water source: MOA and FAO census (2000)

Table 2.6.5 Irrigation Area by Caza (small scale and scattered irrigation area)

Ratio: ratio to net irrigated area

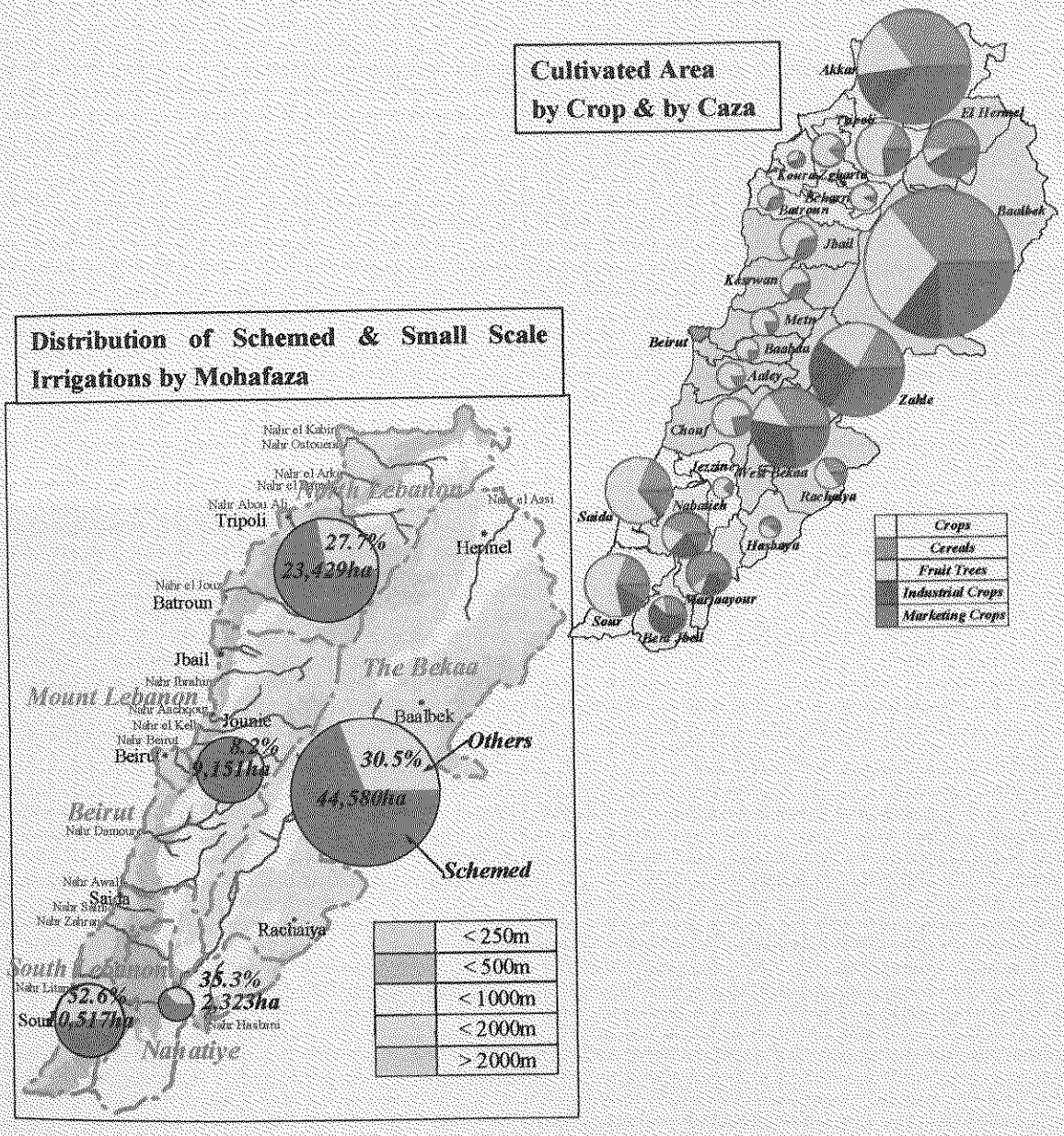
Caza Code	Caza Name	Equipped Area (ha)	Net Irrigated Area (ha)	Surface Irrigation (ratio)	Sprinkler Irrigation (ratio)	Drip Irrigation (ratio)	Cereals - Winter Wheat (ratio)	Fruit Trees (ratio)	Vegetables (ratio)	Type of Fruits	Surafce Water including Springs (ratio)	Groundwater (ratio)
10	Beirut	0	0	0.704	0.234	0.062	0.00	0.00	0.00	non	0.48	0.52
20	Baabda Center	410	370	0.704	0.234	0.062	0.00	0.77	0.23	citrus	0.48	0.52
21	Metn Center	450	410	0.704	0.234	0.062	0.00	0.81	0.19	citrus	0.48	0.52
22	Chouf Center	390	350	0.704	0.234	0.062	0.02	0.77	0.21	citrus	0.48	0.52
23	Aaley Center	990	890	0.704	0.234	0.062	0.00	0.83	0.17	citrus	0.48	0.52
24	Kesrwan	300	270	0.704	0.234	0.062	0.02	0.65	0.33	citrus	0.48	0.52
25	Jbail	0	0	0.704	0.234	0.062	0.06	0.64	0.30	citrus	0.48	0.52
31	Tripoli	0	0	0.704	0.234	0.062	0.17	0.59	0.24	citrus	0.48	0.52
32	Koura	170	150	0.704	0.234	0.062	0.18	0.37	0.45	citrus	0.48	0.52
33	Zgharta	630	570	0.704	0.234	0.062	0.11	0.78	0.11	citrus	0.48	0.52
34	Batroun	120	110	0.704	0.234	0.062	0.06	0.62	0.32	citrus	0.48	0.52
35	Akkar	600	540	0.704	0.234	0.062	0.35	0.17	0.48	citrus	0.48	0.52
36	Bcharri	400	360	0.704	0.234	0.062	0.05	0.87	0.08	citrus	0.48	0.52
37	Minieh-Dinnieh	0	0	0.704	0.234	0.062	0.17	0.59	0.24	citrus	0.48	0.52
41	Saida Center	3,400	3,060	0.704	0.234	0.062	0.19	0.66	0.15	banana	0.48	0.52
43	Sour	1,980	1,780	0.704	0.234	0.062	0.20	0.58	0.22	banana	0.48	0.52
47	Jezzine	150	140	0.704	0.234	0.062	0.12	0.76	0.12	banana	0.48	0.52
51	Zahle	4,310	3,880	0.704	0.234	0.062	0.17	0.22	0.61	grapes	0.48	0.52
52	West Bekaa	6,370	5,730	0.704	0.234	0.062	0.34	0.13	0.53	grapes	0.48	0.52
53	Baalbek	2,360	2,120	0.704	0.234	0.062	0.36	0.28	0.36	grapes	0.48	0.52
54	El Hermel	290	260	0.704	0.234	0.062	0.50	0.09	0.41	grapes	0.48	0.52
55	Rachaiya	260	230	0.704	0.234	0.062	0.33	0.51	0.16	grapes	0.48	0.52
61	Nabatieh	650	590	0.704	0.234	0.062	0.43	0.20	0.37	citrus	0.48	0.52
62	Bent Jbeil	90	80	0.704	0.234	0.062	0.28	0.10	0.62	citrus	0.48	0.52
63	Marjaayoun	0	0	0.704	0.234	0.062	0.61	0.08	0.31	citrus	0.48	0.52
64	Hasbaya	80	70	0.704	0.234	0.062	0.44	0.45	0.11	citrus	0.48	0.52
Total		24,400	21,960									

Source: JICA Study based on MOA and FAO census (2000)

Table 2.6.6 Irrigation Efficiency Adopted

Irrigation System	Efficiency			
	Conveyance	Distribution	On-farm	Overall
Sprinkler	0.95	0.95	0.8	0.7
Drip			0.9	0.8

From the above table, an overall irrigation efficiency for surface irrigation is simply assumed to be 0.6.



2.6.3 Proposed/Ongoing Irrigation Scheme

With intention to utilize existing available water mainly from surface resources most effectively, MEW and LRA have proposed 12 irrigation schemes as listed in Table 2.6-7 and as visualized in Figure 2.6-2. Among those 12 schemes, three schemes, namely 1) South Bekaa (Phase 2) - Left Bank scheme, 2) the Hydro-Agricultural Development of South Lebanon - Irrigation and Water Supply Scheme - Conveyor 800 and 3) Southern Qaraoun Irrigation Scheme have been under realistic study and execution, and others are still at the preliminary study level requiring further studies.

Table 2.6 7 Proposed/Ongoing Irrigation Scheme

Hydro-System	Scheme Name	Net Irrigation Area (ha)	Source of Water	Water Requirement (MCM)	Present Phase
El Kabir	Noura Et Tahta Dam	5,000	El Kabir River	35	Preliminary Study
El Bared	El Bared Dam	750	El Bared River	10	Preliminary Study
El Assi	Assi River Basin Project	6,700	El Assi River	*66*[2]	Preliminary Study
Spring	Younine Dam	1,545	Yammouneh Spring	17	Preliminary Study
Litani-Awali	Southern Qaraoun Irrigation Scheme	500	Qaraoun Dam	*3*[1]	**under study**
	South Bekaa (Phase 2), Left Bank	6,700	Qaraoun Dam	30	**under study/execution**
			Kamed El Laouz Wells	12	
			Aanjar Chamsine	2	
	South Bekaa, Right Bank and North Zone	12,800	Kamed El Laouz Wells	63	Feasibility Study
			Aanjar Chamsine	31	
	Hydro Agricultural Development of South Lebanon- Conveyor 800	13,230	Qaraoun Dam	89	**under study/execution**
	Conveyor Anane-Nabatieh	3,500	Qaraoun Dam	13	Preliminary Study
			Ain Zarqa	11	
	Saida-Jezzine (Phase 2)	1,200	Qaraoun Dam	8	Preliminary Study
	Middle South (Khardale Dam)	9,000	Khardale Dam	59	Preliminary Study
	Qasmieh - Ras El Ain (Phase 2)	2,100	Khardale Dam	18	Preliminary Study

1): Assuming 6,500 m3/ha, the water requirement was estimated by JICA Study.

2): Assuming 11,000 m3/ha, the water requirement was estimated by JICA Study.

Only Qaraoun dam out of dams mentioned in the table exists.

The total net irrigated area accounts for 63,025 ha after completion of all of the proposed schemes, however, majority of schemes deal with improvement of existing irrigation systems aiming at maximizing utilization of available surface water with modernization of irrigation system to

improve irrigation efficiency. Mitigation of groundwater over-exploitation and increase in storing winter water by dams and hill lakes are the MEW intention in the next 10 years (10 Years Work Plan, 1999). However, almost all proposed/ongoing schemes, except 4 schemes, namely 1) El Bared Dam Scheme, 2) Younine Dam Scheme, 3) South Bekaa (Ohase 2) Left Bank Scheme and 4) South Bekaa Right Bank and North Zone Scheme would involve expansion of irrigation area. Areas to be expanded in future are shown in Figure 2.6-8.

Figure 2.6.2 Location of Proposed/Ongoing Irrigation Schemes

Table 2.6.8 Proposed/Ongoing Irrigation Scheme

Code	Scheme Name	Equipped Area (ha)	Net Irrigated Area (ha)	New Expansion Ares (ha)	Water Requirement (MCM/year)	Irrigation Method	Source of Water (ratio)		SOURCE OF WATER		
							Surafce Water including Springs	Groundwater	SOURCE 1	SOURCE 2	SOURCE 3
P1	Noura Et Tahta Dam Scheme	NA	5,000	2,300	35	pressurized	1.00	0.00	El Kabir River		
P2	El Bared Dam Scheme	850	750	0	10	pressurized	1.00	0.00	El Bared River		
P3	Assi River Basin Project	NA	6,700	6,700	66	pressurized	1.00	0.00	El Assi River		
P4	Younine Dam Scheme	NA	1,545	0	17	pressurized	1.00	0.00	Yammouneh Spring		
P5	Southern Qaraoun Irrigation Scheme	NA	500	500	3	pressurized	1.00	0.00	Qaraoun Dam		
P6	South Bekaa (Phase 2), Left Bank	NA	6,700	0	44	pressurized	0.73	0.27	Qaraoun Lake	Kamed El Laouz Wells (4)	Aanjar Chamsine
P7	South Bekaa, Right Bank and North Zone	14,800	12,800	0	94	pressurized	0.33	0.67	Qaraoun Lake	Kamed El Laouz Wells (4)	Aanjar Chamsine
P8	Hydro Agricultural Development of South lebanon- Conveyor 800	14,700	13,230	13,230	89	pressurized	1.00	0.00	Nahr El Litani-Qaraoun Lake	Anjar-Chamsine Sources	Wells
P9	Conveyor Anane-Nabatieh	NA	3,500	3,500	24	pressurized	1.00	0.00	Qaraoun Lake	Ain Zarqa	
P10	Saida-Jezzine	NA	1,200	1,200	8	pressurized	1.00	0.00	Anane Basin		
P11	Qasmieh - Ras El Ain (Phase 2)	NA	2,100	2,100	45	pressurized	0.40	0.60	Kfar sir Dam	wells	
P12	Khardale	NA	9,000	9,000	59	pressurized	1.00	0.00	Khardale Dam		

MCM: million m3
Source: MEW and LRA (Litani River Authority)

2.7 Hydro-power Generation

2.7.1 Power Supply in Lebanon

(1) Present Power Generation System

Rehabilitation and modernization of electricity supply have been conducted after the civil war and their total cost amounted to approximately US$ 1.4 billion at the end of 2001 (Progress Report, May 2002, CDR). The first priority to restore the capacity of 1,250 MW was achieved at the end of 1996 with the total cost of US$ 376 million, and the expansion of its supply, involving an increase in generating capacity, extension of transmission network, administrative reform and so on, has been currently executed in order to meet the future demand in 2005 (2,500 MW). Table 2.7-1 summarizes existing hydro and thermal power plants in Lebanon.

Table 2.7-1 Existing Power Generation Plants

As of 2002

Type	Company	Plant Name	Nominal Capacity (MW)	Water Resources/ Type of Generators
Hydro Power Plant	EDL	Safa	13.2	Nahr Ed Damour
	Kadisha	Abou Ali	8.0	Abou Ali River
		Blaouza	8.4	Abou Ali River
		Mar Lichaa	3.3	Abou Ali River
		Becharre	1.6	Abou Ali River
		Sub-Total	21.3	
	LRA	Abdel Al (Markabi)	34.0	Litani River
		Paul Arcache (Awali)	108.0	Litani-Awali River
		Charles Helou (Joun)	48.0	Litani-Awali River
		Sub-Total	190.0	
	Nahar El Bared	Bared 1	13.5	Nahr El Bared
		Bared 2	3.7	Nahr El Bared
		Sub-Total	17.2	
	SPFHE	Nahr Ibrahim 1	15.0	Nahr Ibrahim
		Nahr Ibrahim 2	10.0	Nahr Ibrahim
		Nahr Ibrahim 3	5.1	Nahr Ibrahim
		Sub-Total	30.1	
	Total		271.8	
Thermal Power Plant	EDL	Zouk	642.8	Fuel turbine
		Jieh	347.5	Fuel turbine
		Zahle	7.4	-
		Hraichi	65.0	Steam turbine
		Sour (Tyr)	70.0	Gas turbine
		Baalbeck	70.0	Gas turbine
		Beddawi (Tripoli)	435.0	Combined cycle plant
		Zahrani	435.0	Combined cycle plant
	Total		2072.7	
Grand Total			2344.5	

Source: "EDF International", April 1999

All hydro-power plants were constructed during 1960s, while the recent expansion of power generation has been achieved by introducing new thermal power plants, such as Sour, Baalbeck, Beddawi and Zahrani plants. Sour and Baalbeck plants have been operated since the end of 1996, and construction of Beddawi and Zahrani plants with the nominal capacity of 435 MW each was completed in 2000. As a result, the share of hydro-power plants in terms of the nominal capacity declines to 11.6% (272 MW).

There are 5 authorities concerned with the power generation, such as EDL (*Electricite Du Liban*), Kadisha, LRA, Bared and SPFHE. EDL dominates the power generation (89% of the total generating capacity) by operating 8 thermal power plants and one hydro-power plant. Besides, EDL is only the authority responsible for power supply. Thus, the excess of power generated by other authorities is sold to EDL. EDL, Kadisha and LRA (Litani River Authority) belong to the government, while other 2 are private enterprises. However, there is a proposal to privatize the electricity sector.

(2) Power Production

Annual productions of energy in the last 4 years are described in Figure 2.7-1. Average growth rate of energy production from 1997 (8,329 GWh) to 2000 (9,236 GWh) is approximately 3.5%. Thermal-power production is constant at the share of 80% in the total, while hydro-power production contributes to less than 10% but fluctuates depending on available discharge. Since the discharge in 1999 and 2000 was low due to the dry year, hydro-power production limited to only 332 GWh and 449 GWh respectively, that are almost half of other years. The deficit of electricity supply was supplemented by import from Syria and this import became significant, increasing more than double in the last 4 years (from 609 GWh in 1997 to 1,397 GWh in 2000). However, since 2002, the import from Syria is limited only during the peak hours as a result of rehabilitation and modernization of the electricity sector in the last decade.

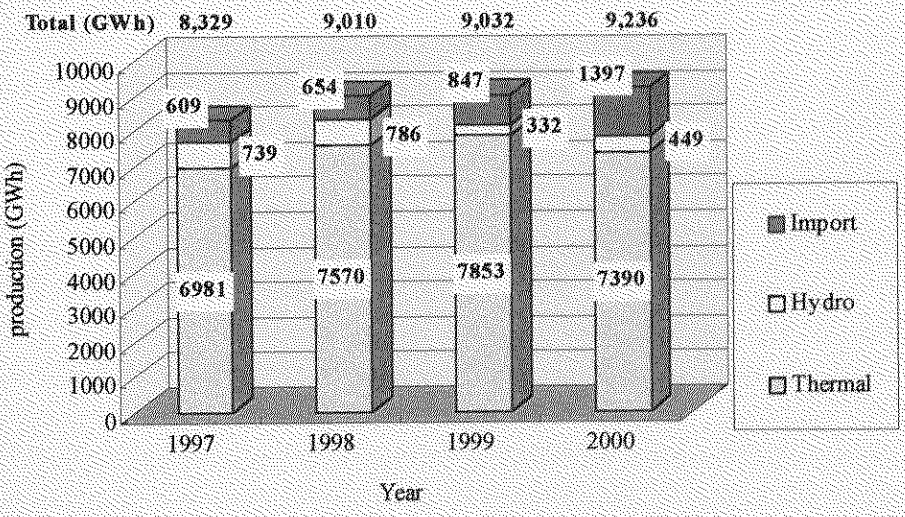


Figure 2.7-1 Annual Production of Energy by Type

(3) Electricity Bill

The electricity bill for residential use ranges between LBP 35/kWh and LBP 200/kWh depending on the rate of consumption. The flat rate is applied to other uses, such as small industries, agriculture and public facilities. In addition to the bill shown in Table 2.7-2, subscribers have to pay municipal tax (10% of electricity bill), O/M fee (about LBP 5,000/month) and subscription fee (about LBP 7,000/month).

Table 2.7-2 Electricity Bill

User	Monthly Consumption (kWh/month)	Bill	
		(LBP/kWh)	(US$/kWh)
Residents	Up to 100	35	0.023
	100 – 300	55	0.037
	300 – 400	80	0.053
	400 – 500	120	0.080
	>500	200	0.133
Small Industry	Flat	115	0.077
Agriculture	Flat	115	0.077
Public Facility	Flat	140	0.093

Source: extracted from "Lebanon State of the Environment Report", 2001, Ministry of Environment

Original source: EDL

2.7.2 Hydro-Power

(1) Significance of LRA in Power Generation

Figure 2.7-2 describes the hydro-power production in 1998 as an example to discuss the seasonal fluctuation of hydro-power generation and the share of LRA power plants. The production generated by the hydro-power plants in 1998 is 786 GWh, equivalent to 9% of the total production inclusive of thermal plants and import from Syria. Comparing the LRA power production in 1998 (557 GWh) with the LRA average power production over the last 20 years (500 GWh), the year of 1998 is considered the average year.

Since the hydro-power generation depends on available discharge, its production fluctuates seasonally. In Lebanon, 90% of total precipitation concentrates in a period from November to March (wet season), implying that river discharge is high during the wet season and early dry season. The peak discharge is observed in the most of rivers during March and April when melting of snow contributes to runoff. During the dry season, the river flow decreases and reaches the minimum in September and October. Those hydrological characteristics agree with the seasonal fluctuation of hydro-power generation, the highest production in April (105 GWh) and lowest production in October (46 GWh).

LRA utilizes the Qaraoun dam with a storage capacity of 220 million m^3 for hydro-power generation. There are three power plants, Markabi (EL. 659m), Awali (EL. 226m) and Joun (EL. 32m). The Markabi plant is located about 6.4 km downstream from the dam. Other two stations are located in the Awali basin and water is conveyed from the Markabi plant through the tunnel under Mt. Jabal Niha. Since the volume stored in the dam during the wet season is large enough to maintain the power generation throughout the year, the production does not decline much even during the dry season. Thus, LRA's hydro-power stations equipped with the largest capacity (190 MW) dominate the hydro-power generation in Lebanon. For example, in 1998, its share to the annual hydro-power generation was approximately 70%.

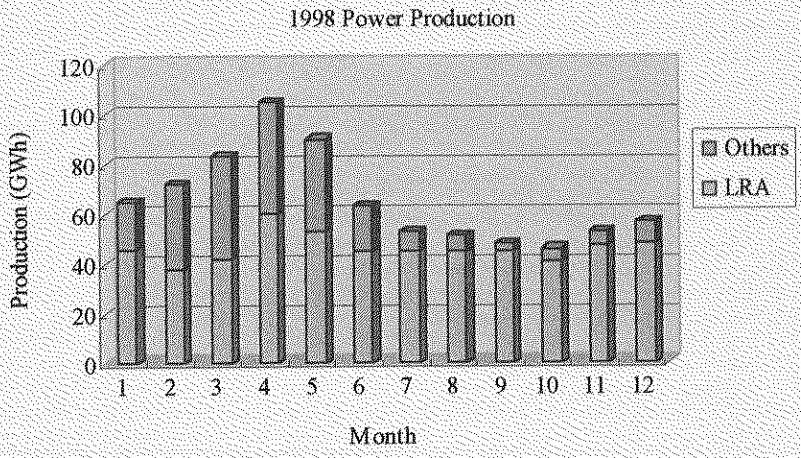


Figure 2.7-2 Hydro-Power Production in 1998

(2) Water Use for Hydro-Power

Hydro-power systems in Lebanon, except the Litani-Awali system belonged to LRA, utilize water from the river basin concerned and drain it into the same river after generating power. As a result, those systems actually consume little water. On the other hand, the Litani-Awali system consisting of three power plants utilizes water from two river basins, Litani and Awali, by conveying water from one basin to another. Since the inter-basin water use is crucial for the water resources management, the current water use of the Litani-Awali hydro-power system was studied.

Table 2.7-3 shows the total power production, inflow discharge to the Qaraoun dam, discharge utilized for hydro-power at the Markabi plant (the most upstream power plant in the Litani-Awali system and only one power plant in Litani river basin) and power sales to EDL in the last 20 years. According to the table, average discharge used for power generation at the Markabi plant is 242 million m3/year out of 279 million m3/year (inflow discharge to the dam). Although volume of water used for hydro-power ranges from 45.4 million m^3/year to 560.0 million m^3/year depending on the precipitation, almost 90% of the discharge available at the Qaraoun dam has been utilized for the hydro-power generation.

The average power production by three hydro-power plants is 504 GWh. LRA own consumption

of energy is only 1.4% of the total production and the rest is sold to EDL. Since 1994, the price to sell the power to EDL is constant at the rate of 41 LBP/kWh, equivalent to US$ 0.027/kWh.

Table 2.7-3 Power Production by LRA with Discharge

Year	Total Power Production (GWh)	Power Supplied to EDL (GWh)	Invoice to EDL (million LBP)	Annual Inflow to Qaraoun Dam (million m^3)	Annual Discharge at Markabi (million m^3)
1982	403.2	393.4	36.1	239.0	149.0
1983	744.7	731.9	63.3	442.9	351.1
1984	727.1	718.6	62.4	363.7	353.6
1985	360.8	351.1	43.6	277.5	273.7
1986	298.0	278.2	60.7	168.4	121.6
1987	818.0	792.1	524.3	394.2	394.8
1988	841.0	815.0	1,669.8	560.5	423.6
1989	268.9	262.8	1,170.3	169.7	115.0
1990	179.0	177.8	1,002.8	72.7	65.2
1991	346.7	344.9	9,397.8	208.0	142.2
1992	947.6	945.6	33,188.7	728.0	560.3
1993	826.3	824.2	29,425.0	495.6	495.2
1994	609.1	607.0	24,887.9	301.0	257.0
1995	509.5	508.1	20,830.9	213.0	236.0
1996	572.6	570.4	23,385.0	254.5	240.0
1997	487.7	484.5	19,863.5	175.1	213.0
1998	556.9	554.7	22,744.5	269.9	240.0
1999	167.6	166.1	6,810.5	72.9	73.8
2000	260.1	258.5	10,599.5	105.1	88.9
2001	148.3	146.8	6,020.5	61.0	45.4
Average	503.7	496.6		278.6	242.0

Source: LRA

Table 2.7-4 shows the water balance at two power plants, Awali and Joun, from 1998 to 2001. Discharge used at Markabi plant is conveyed to Awali basin, combining with runoff from basin between the Qaraoun dam and Markabi plant, drainage from the Qaraoun dam, discharge from Ain Zarqa spring and recharge from Awali tunnel that is used for water conveyance from Litani basin to Awali basin. Although the volume of water from each source varies annually depending on hydrological conditions, in average, 55%, 24% and 15% of the total discharge available to convey to Awali basin are supplied from Qaraoun dam through Markabi plant, Ain Zarqa spring and Awali tunnel respectively. It implies that Ain Zarqa spring and Awali tunnel recharge are significant in

terms of water volume.

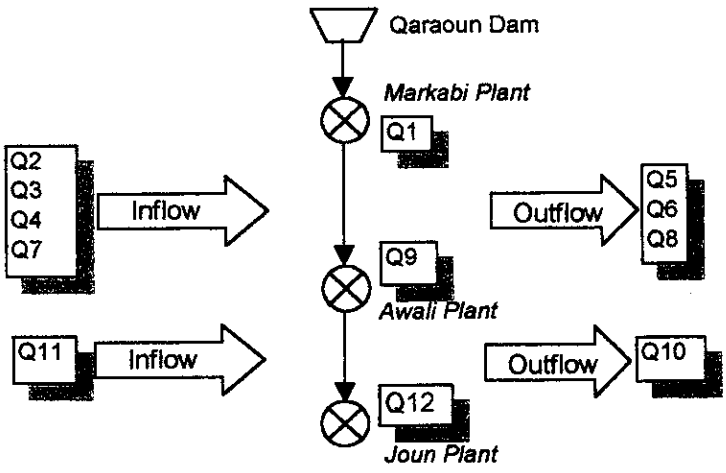
80% of total discharge available to convey to Awali basin is used for power generation at the Awali plant and the rest is consumed by irrigation (Qasmieh and Lebaa schemes) and leakage from the Anane regulation pond. As shown in Table 2.7-4, three successive dry years (1999 –2001) did not affect the water supply to two irrigation schemes. Water drained to Qasmieh irrigation scheme through Litani river ranges at 14.93 – 29.66 million m^3/year, while water drained to Lebaa irrigation scheme is almost constant at around 4 million m^3/year. This means that present water allocation in the Litani-Awali system gives priority to irrigation.

Table 2.7-4 Discharge Allocation for Hydro-Power Plants of LRA

Unit: MCM

No.	Year	1998	1999	2000	2001
Q1	Discharge at Markabi Plant	238.05	74.19	89.41	47.41
Q2	Incoming Flow from basin of Qaraoun Dam-Markabi Plant	16.22	0.54	2.16	0.59
Q3	Discharge from Qaraoun Dam	9.40	0.00	14.00	5.82
Q4	Incoming Flow from Ain Zarqa	49.85	34.49	44.53	34.66
Q5	Water conveyed to Qasmieh Irrigation Scheme	14.93	29.66	21.88	26.75
Q6	Water conveyed to Lebaa Irrigation Scheme	4.35	4.48	3.99	3.96
Q7	Incoming Flow from Awali Tunnel	23.62	17.14	27.37	27.05
Q8	Leakage from Aazour (Anane Basin)	10.17	0.99	4.34	1.64
Q9	Discharge at Awali Plant	307.69	91.23	147.26	83.18
Q10	Leakage from Awali Basin	-	7.88	7.88	7.88
Q11	Incoming Flow from Bisri (Awali) River	96.38	53.71	82.57	59.45
Q12	Discharge at Joun Plant	404.07	137.06	221.95	134.75

Note: Monthly Data from LRA were modified by JICA Study Team to calculate annual discharge.
Discharge at Markabi plant is slightly different from Table 2.7-3 due to rounding and significant figures.



Discharge used for power generation at the Awali plant is combined with the flow of Awali river and conveyed through pipeline to the Joun plant. Intake volume from Awali river ranges at 53.71 – 96.38 million m^3/year, contributing 24 – 40% of the total discharge used at the Joun plant. On the other hand, leakage (loss) from the Awali regulation pond is estimated at 7.88 million m^3/year.

Water used at the Joun plant is drained to Awali river.

At the present, the most of water available at the Qaraoun dam is used for power generation; however, after completion of Conveyor 800 and 900 schemes, which is under execution and aims to irrigate 23,400 ha (equipped area) in total, consuming approximately 120 million m^3/year from the Qaraoun dam, the water use of the Qaraoun dam will be considerably changed and power generation by the Qaraoun dam will be limited to during the winter when irrigation is not necessary and the peak hours during the summer.

2.8 Institutions in the Water Sector

2.8.1 Administrative Structure of Lebanon

Administrative organizations are continuously evolving in Lebanon, since it is still under way of postwar reconstruction of infrastructure and institution. Major organizations of the executive branch so far static in recent months are shown in Figure 2.8-1. Budget allocation to these organizations in 2001 and 2002 is shown in Table 2.8-1, as names and numbers of ministries stayed identical in these two years only. While a US$ 3 billion worth of debt service (which is equivalent to the gross national products) is addressed from the national exchequer, donor assistance (loan and grant) received and invested through the Council for Development and Reconstruction (CDR) is not counted for in the national budget.

Table 2.8-1: Allocation of National Budget, 2001 - 2002

Unit: thousand LL

		2001		2002	
1	Presidency	4,076,000	0.04%	3,725,488	0.04%
2	Government	44,400,000	0.45%	43,202,677	0.46%
3	Prime Minister's office	977,988,437	9.88%	732,014,104	7.81%
4	Legal Council	1,783,285	0.02%	1,711,905	0.02%
5	Ministry of Justice	49,813,478	0.50%	48,456,450	0.52%
6	Ministry of Foreign Affairs	98,816,900	1.00%	93,961,387	1.00%
7	Ministry of Interior	417,117,678	4.21%	385,513,570	4.11%
8	Ministry of Finance	172,138,457	1.74%	86,609,036	0.92%
9	Ministry of Public Works & Transport	286,795,172	2.90%	194,303,271	2.07%
10	Ministry of Defense	886,755,200	8.96%	811,894,697	8.66%
11	Ministry of Education	812,607,500	8.21%	791,926,493	8.45%
12	Ministry of Health	315,274,401	3.18%	289,526,933	3.09%
13	Ministry of Economy and Trade	27,477,191	0.28%	8,261,154	0.09%
14	Ministry of Agriculture	60,132,459	0.61%	34,848,568	0.37%
15	Ministry of Telecommunication	13,407,500	0.14%	13,906,541	0.15%
16	Ministry of Labor	58,144,703	0.59%	57,421,649	0.61%
17	Ministry of Information	23,947,625	0.24%	21,096,171	0.23%
18	Ministry of Energy and Water	79,934,729	0.81%	63,327,580	0.68%
19	Ministry of Tourism	11,725,041	0.12%	10,013,932	0.11%
20	Ministry of Culture	25,273,276	0.26%	18,798,572	0.20%
21	Ministry of Environment	8,992,500	0.09%	5,394,964	0.06%
22	Ministry of Displaced	7,186,500	0.07%	6,728,526	0.07%
23	Ministry of Youth and Sports	25,169,500	0.25%	22,358,429	0.24%
24	Ministry of Social Affairs	106,720,518	1.08%	106,178,795	1.13%
25	Ministry of Industry	6,458,500	0.07%	5,188,195	0.06%
26	Debt service	4,300,000,000	43.43%	4,500,000,000	48.00%
27	Salaries and Retirement Dues	878,000,000	8.87%	900,000,000	9.60%
28	Securities	199,874,451	2.02%	118,630,936	1.27%
	Total	9,900,000,000	100.00%	9,375,000,000	100.00%

Source: National Budget 2001 and 2002

Executive Branch of the Republic of Lebanon

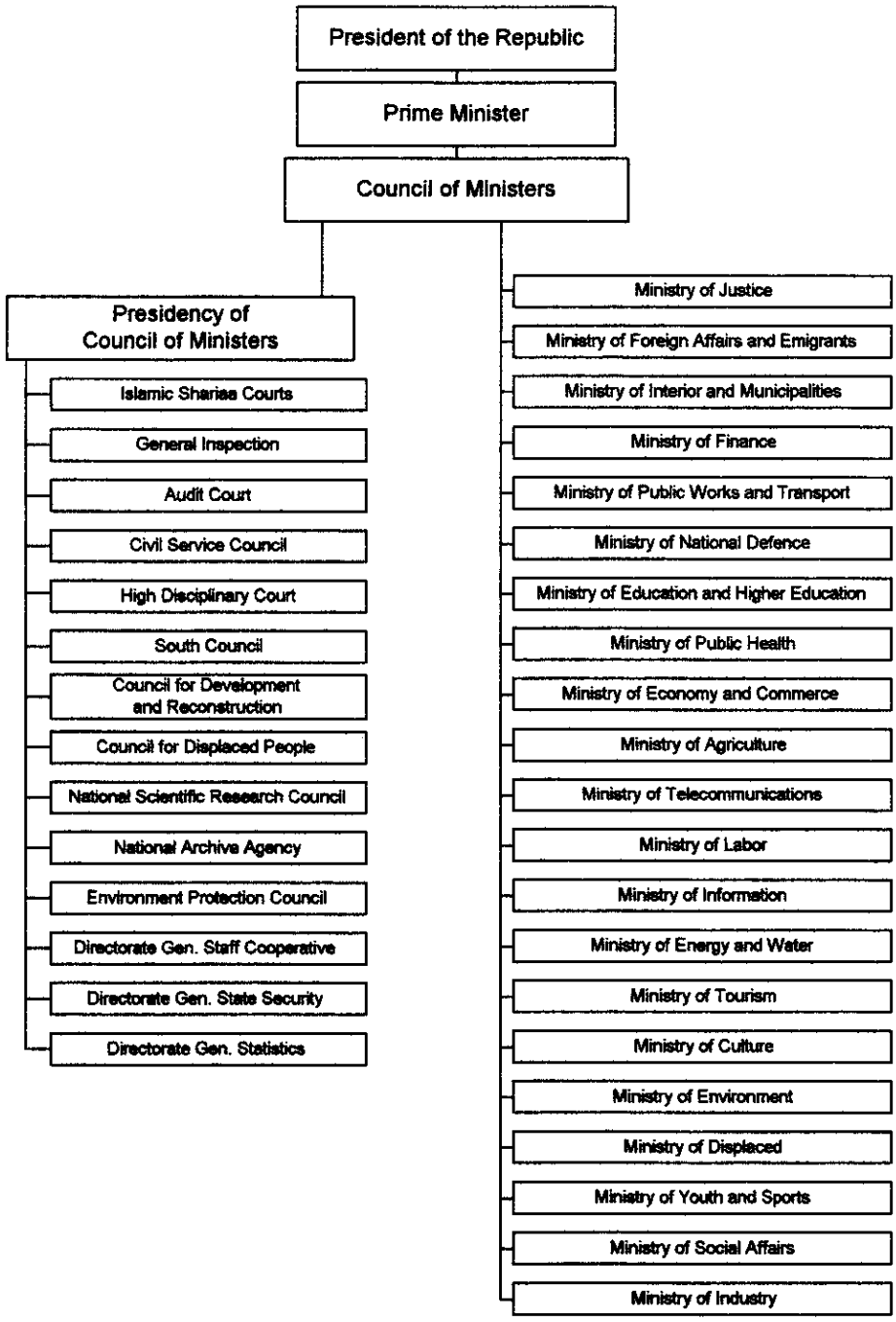


Figure 2.8-1: Organization of the Government of Lebanon

Besides the largest share to debt services, large allocations to defence, education, and the Prime Minister's office particularly, are notable. With that large fund, the Prime Minister is leading postwar reconstruction and reorganization through councils attached to the Presidency of Council of Ministers. CDR, a virtually only organ that plans and implements infrastructure investment projects in Lebanon, is placed under the Presidency and investing all donor assistance to various sectors. While it does not appear in the organization chart, Minister of State for Administrative Reform is also attached to the Presidency, and his office (Office of Minister of State for Administrative Reform, or OMSAR) has recently launched on capacity building and streamlining of administrative structures. It appears that reconstruction and development of physical infrastructure as well as reform and enhancement of institution and organizations are planned and implemented by the Presidency without heavy recourse to the line ministries.

During the events of war, many qualified Lebanese, who could find jobs in foreign countries, fled from the county, and so did civil servants. Many did not return, if they were so qualified that they may stay with good jobs. It was a resolution by the Council of Ministers in 1995 to generally ban new recruitment of civil servants. Since then, a government office cannot hire a new employee without a previous and exceptional approval by the Council of Ministers. It, also, cannot fire an employee before the retirement age of 64, unless a minister warns him 3 times repeatedly, or the ousting is sentenced by the Disciplinary Court. The government salary is quite low, lower than that of the comparable position in the private sector. As a result, many government offices now suffer from understaffing in terms of quantity and quality. Young recruits are exceptional and sporadic, and a fast aging of the staff is commonplace.

Like "confessionalism" or sectarian representation in the National Assembly, post assignment of the government officials proportional to influence of religious sects and clans is penetrated into not only director generals and directors but to the level of department heads. While it may be against the achievement based promotion system and thus a threat to the working ethics, it has to stay as it is as the core of National Covenant.

2.8.2 Stakeholders of the Water Resources Sector

Among these organizations, the present study for the water resource management shall focus on the relevant offices and stakeholders as follows:

1. Ministry of Energy and Water (MEW)
2. Water Authorities under MEW
3. Litani River Authority under MEW
4. Municipalities
5. Ministry of Interior and Municipalities
6. Ministry of Agriculture and Cooperatives
7. Ministry of Public Health
8. Council for Development and Reconstruction
9. Ministry of Environment
10. Ministry of Public Works and Transport
11. Others, users and donors

Ministry of Energy and Water (MEW)

MEW was created by Law No. 20 of 1966 and its amendments. Recently, Law No. 221 of May 29, 2000, which was succeedingly amended by Law No. 241 dated August 7, 2000, Law No. 337 dated December 14, 2001 and Decree No. 8122 of July 11, 2002, redefined roles of Ministry of Energy and Water, and 4 Water Authorities (Public Water and Wastewater Establishments) as well as Litani River Authority (LRA).

To protect and develop, the Law says, hydraulic natural resources, MEW assumes jurisdiction over the water resources in Lebanon. Its competencies and missions are to study supply and demand, and global situation of the water resources in Lebanon, to prepare the national water master plan, to design, implement and operate large hydraulic facilities, to conserve and control the water resources including surface and underground water, and to exercise administrative supervision over Water Authorities (WA) and LRA.

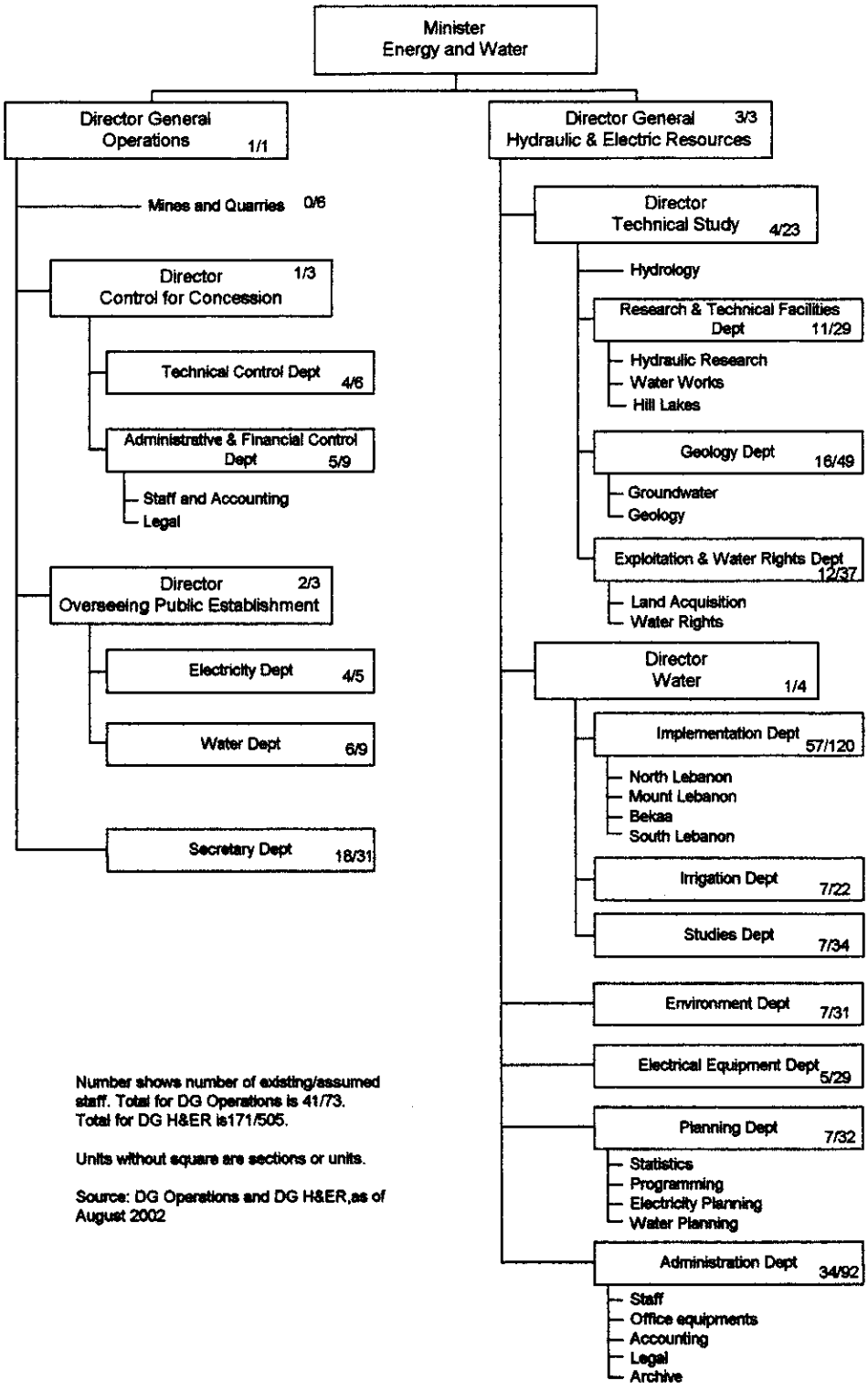
MEW has two directorate generals. It is assumed to undertake research and studies, prepare a national water management master plan, plan and implement large scale projects through Directorate General of Hydraulic and Electric Resources (DGHER), and exercise administrative supervision over WA's through Directorate General of Operations (DGO), and, more importantly, it is again assumed to organize a Performance Evaluation Committee. It is expected that; under DGHER, Geology Department keep register of groundwater wells, and record hydrogeological behaviors of aquifers; and Planning Department should have launched data collection for preparation of a national water management master plan; and, under DGO, Water Department keep register, data on water supply facilities, operation plans and financial statements of all the 21 WA's

and water committees.

As shown in organization chart of MEW (Figure 2.8-2), it has a 212 existing staff against 578 assumed positions[1] as of August 2002. Due to the ban on new recruitment at the public sector, average age of staff of this ministry is quite high. In recent years, however, some new recruitments and transfer from the other ministries were made as exceptional cases that should be approved by the Council of Ministers.

[1] Assumed number of staff or jobs are fixed and approved by Civil Service Council.

Figure 2.8.2: Organization of Ministry of Energy and Water



Number shows number of existing/assumed staff. Total for DG Operations is 41/73. Total for DG H&ER is171/505.

Units without square are sections or units.

Source: DG Operations and DG H&ER,as of August 2002

Water Authorities

According to the Law 221, four regional water authorities (RWA) shall be financially autonomous and organized in Beirut/Mount Lebanon, North Lebanon, Bekaa and South Lebanon. They will be located in Beirut, Tripoli, Zahleh and Saida respectively. Regarding organization of RWA's, the Law says, management of RWA shall be undertaken by a board of directors consisting of a president and 6 members. Nomination of these members are proposed by MEW and approved by the Council of Ministers. The members should be university graduates with specialties of law, water and environment, medicine, engineering, accounting and business administration. The president of the board shall, at the same time, be the general executive manager of RWA. As of July 2002, the presidents and all board members of 4 RWA's were nominated and are assumed to prepare organizations, regulations and budget including tariff of each RWA.

A RWA shall carry out research, planning, implementation, operation, maintenance and renovating potable and irrigation water supply and wastewater systems within framework of the national water master plan, that is assumed to be prepared by MEW. The roles of RWA include submission of audited financial statement and proposal on water tariff for approval by the Council of Ministers through MEW and Ministry of Finance. RWA shall also control quality of potable water, irrigation water and treated discharge from wastewater treatment plants.

Thus, in the new regime of the water sector, MEW stays overseeing and control position except in the case of large scale hydraulic projects, which MEW directly plans and implements. Planning and implementation of project for other potable and irrigation water and wastewater are now duties of RWAs' in addition to the operation and maintenance of existing facilities, that have been done by WA's under the old regime.

Until the new organization framework will be effectively implemented, there are 21 WA's and 209 local water management committees, of which 66 are supplying potable water with others mostly irrigation water. They suffered from chronic deficits due to large ratio of unaccounted-for water (up to more than 50%) and inadequate tariff, which cannot cover even operation and maintenance costs alone. In the case of Bekaa RWA, under which 3 WA's are expected to be integrated, it is the first question to liquidate LL 30 billion accumulated debt including unpaid salary of LL 4.7 billion in Baalbek-Hermel WA (see Table 2.8-2 for debt of 3 WA's under Bekaa RWA). In addition, they are not allowed to fire their dormant employees with average age of nearly 60, who are unable to function. Table 2.8-3 shows number of employees in 21 WA's, so far collected from various sources. Even a few exceptional WA's, that run on a profit, pay little or no attention to the proper maintenance, inviting spiral aggravation of facilities and equipments and a larger loss of water, and supplying water of the observedly improper quality.

It is intended to bring about efficient management and improve financial balance, by merging them into four regional WA's and by introducing efficient private sector participation, wherever possible. This effort, however, started only a few months ago, and the appointed general managers have begun trials to identify their inventories with scarce human, technical and financial resources.

Table 2.8-2: Accumulated Debt (Account Payable) of Water Authorities in Bekaa

Unit: million LL

Payable to:	Baalbek-Hermel	Zahle	Chamsine	Total
Electricity of Lebanon	4,778	2,500	10,000	17,278
Electricity of Zahle		1,562		1,562
Social Security	3,608	743	176	4,527
Municipalities	764	1,100	601	2,465
Employees	4,663			4,663
Ministry of Finance (Stamps)	19			19
Ministry of Finance (Income tax)	10			10
Total	13,842	5,905	10,777	30,524

Source: President of Bekaa Regional Water Authority, July 2002

Table 2.8-3: Number of Employees in 21 Water Authorities

Water Authority	Permanent	Temporary	Total
Beirut	340	0	340
Barouk	26	150	176
Ein el Delbe	85	52	137
Jbail	114	0	114
Kesrouan	36	104	140
Metn	37	45	82
Akkar	n.a.	n.a.	n.a.
Batroun	22	26	48
Becharre	8	0	8
Deniye	n.a.	n.a.	n.a.
Kobeyat	n.a.	n.a.	n.a.
Koura	23	0	23
Tripoli	75	0	75
Zogharta	13	0	13
Jamal Amel	12	45	57
Nabeh el Tasse	52	45	97
Saida	27	12	39
Sour	36	9	45
Baalbek-Hermel	196	0	196
Chamsine	50	5	55
Zahle	120	0	120
Total	1,272	493	1,765

Source: Various sources including interviews with WA's

Litani River Authority

Litani River Authority (LRA) was created by the Law of August 14, 1954 and its consecutive amendments. It was originally organized as an implementing agency for the development of Litani River Projects (Karaoun dam and 3 hydropower stations) planned by the government departments with assistance by the US technical commission. LRA stayed with the operation of these projects and is now a planning and operating agency for irrigation water supply, bulk water supply to water committees and power generation of the Litani basin (southern part of Bekaa and South Lebanon). In this context, its functions include those of 4 water authorities. LRA is also maintaining the river gauging stations all over Lebanon.

LRA has four departments (Irrigation Operation, Hydropower, Technical and Administrative) and an Accounting Unit. The Technical Department used to maintain 130 river gauging stations. Most were lost during the war, and until now 38 stations have been recovered and hydraulic data are collected. It has a plan to restore 6 stations in 2002, but no concrete future plan to recover the rest

of them.

LRA produces a 600 million kWh of hydropower annually and sells it to Electricity of Lebanon (EDL) for 41 LL per kWh. Revenue from hydropower accounts for 24.6 billion LL (16 million US$) per year, while that from a part of irrigation schemes accounts for 1.7 billion LL. While cost recovery of the irrigation projects was a conditionality of The World Bank's US 57 million loan, among which a 25 million is allocated for the LRA implementation, pricing of the irrigation water is a political issue, in view of productivity of the Lebanon's major crops that lost market competitiveness with imports during the war. LRA, therefore, functions as an organ of the inter-sector cross subsidy from power to agriculture.

LRA has 685 jobs for full-fledged services, but as of July 2002 only 275 employees including 21 engineers are in place. It had 305 existing staff against 723 assumed (proposed) positions in 1999 (Table 2.8-4). Due to ban of new recruitment in the public sector, the average age of staff is quite high and its number is decreasing.

Table 2.8-4: Manpower Distribution of Litani River Authority

Department	Technical personnel		Administrative personnel		Total	
	Existing	Assumed	Existing	Assumed	Existing	Assumed
Irrigation operation	24	75	22	79	46	154
Hydropower	66	110	12	41	78	151
Technology	92	185	28	74	120	259
Administration	6	6	39	114	45	120
Accounting unit	1	0	11	36	12	36
Other	2	0	2	3	4	3
Total	191	376	114	347	305	723

Source: LRA Intermediate 5 year Plan, 1999-2003
Note: Number of staff existing and assumed (by Civil Service Council) is as of February 1999.

Ministry of Interior and Municipalities

Ministry of Interior and Municipalities used to approve wastewater projects, which should be maintained by municipalities. Municipalities were responsible for maintenance of wastewater facilities including sewers. After new Law No. 337 (amendment to Law 221), these are responsibilities of the WA's with administrative supervision by MEW. Therefore, in theory, concerned division now under the Ministry of Interior and Municipalities should be moved into MEW.

Ministry of Agriculture

Ministry of Agriculture recently merged the Ministry of Housing and Cooperatives. It used to undertake studies and designs of wastewater and drainage systems upon request through the Ministry of Interior and Municipalities from municipalities. Under the new regime, it is desired to move these staff to MEW.

Ministry of Public Health

Ministry of Public Health is responsible for water quality of domestic supply and wastewater discharged. It also reviews and approves wastewater and drainage schemes.

Council for Development and Reconstruction

By replacing the Ministry of General Planning, Council for Development and Reconstruction (CDR) was created in 1977 (Law 5, January 31, 1977). It is attached to the Council of Ministers, or more precisely to the Presidency of the Council of Ministers, which is headed by the Prime Minister. CDR shall formulate plans, policies and projects for development and reconstruction for approval by the Council of Ministers. Unlike to other public institutions, it is privileged to maintain direct contacts with foreign countries and multilateral agencies by bypassing the Ministry of Foreign Affairs, as it is an only channel of the official development assistance (ODA) to Lebanon.

By merging the Executive Council for the Construction Project and the Executive Council for Major Project, Beirut in 2001, CDR became virtually an only implementing agency of all the donor assisted projects, while the responsible ministries are assumed to be the executing agencies only nominally. The implication is that CDR implements more than 90 percent of the public investment projects in Lebanon, in view of the scale of ODA compared with that of the national exchequer.

CDR has been and is the main thrust of the reconstruction efforts of Lebanon. Between 1992 and 2001, it awarded contracts with value of US$ 6,209 million, of which about US$ 3,079 million worth of works have been executed (CDR Progress Report, May 2002). Foreign financing including ODA and commercial bank loans channelled through CDR reached US$ 5,515 million by end of 2002, among which US$ 4,421 million was ratified with the balance earmarked. Major donors are IBRD (16 %), Arab Fund for Economic & Social Development (13 %), Islamic Development Bank (11 %), European Investment Bank (11 %), Kuwait (9 %), Saudi Arabia (8 %) and Italy (8 %).

These foreign financing are distributed to the physical infrastructure including electricity, telecommunication, roads and highways (36 %); the social infrastructure including education, public health, social affairs, integrated development and environment (16 %); the basic services consisting of water supply, wastewater and solid waste (22 %) and the productive sectors and others including agriculture and irrigation, ports and airport, government buildings, management and implementation (26 %). Sectors relevant to water resources management (water supply, wastewater and irrigation) account for 12.7 percent of all the CDR projects, and their progress (53 %) is much slower than the average (68 %). Sector wise performance is tabulated in Table 2.8-5.

CDR is managed by a 7-member board of directors, whose members the Council of Ministers nominates from the private and the academic sectors. It maintains a 223 existing staff against 270 assumed positions in two major departments (Planning and Programming, and Project Management). All employees are hired by contract bases and not protected by the civil service status. Although CDR is a public institution, it is not bound by the civil service codes.

Table 2.8-5: Contracts Awarded by Council of Development & Reconstruction
1992 - 2001

Sector	Total			Completed			In progress		
	No.	Amount	%	No.	Amount	%	No.	Amount	Progress
Physical infrastructure									
Electricity	65	1,385.1	22.3%	57	920.5	29.9%	8	464.6	95%
Telecommunication & Post	88	776.6	12.5%	85	502.3	16.3%	3	274.3	93%
Roads & public transport	232	876.5	14.1%	139	513.0	16.7%	93	363.5	56%
Social infrastructure									
Education & sports facilities	671	506.7	8.2%	563	265.3	8.6%	108	241.4	50%
Public health	184	217.6	3.5%	122	77.5	2.5%	62	140.1	67%
Social affairs	15	2.5	0.0%	14	2.5	0.1%	1		45%
Integrated development & environment	51	36.5	0.6%	28	18.5	0.6%	23	18.0	26%
Basic services									
Water supply	145	437.1	7.0%	85	136.2	4.4%	60	300.9	66%
Wastewater	145	278.0	4.5%	104	167.7	5.4%	41	110.3	16%
Solid wastes	60	650.8	10.5%	36	103.9	3.4%	24	546.9	52%
Productive sectors and others									
Agriculture	93	14.2	0.2%	44	6.3	0.2%	49	7.9	24%
Irrigation	62	71.1	1.1%	28	24.5	0.8%	34	46.6	52%
Ports and airport	68	663.4	10.7%	43	116.6	3.8%	25	546.8	84%
Government buildings	144	104.1	1.7%	129	92.2	3.0%	15	11.9	62%
Management & implementation	325	179.6	2.9%	261	126.7	4.1%	64	52.9	39%
Other sectors	31	9.4	0.2%	28	5.1	0.2%	3	4.3	84%
Total	2,379	6,209.2	100.0%	1,766	3,078.8	100.0%	613	3,130.4	68%
Subtotal for Water Sector (Water, Wastewater & Irrigation)	*352*	*786.2*	*12.7%*	*217*	*328.4*	*10.7%*	*135*	*457.8*	*53%*

Source: CDR Progress Report , May 2002

Ministry of Environment

Ministry of Environment (MOE) was created by law 216 of April 2, 1993 to be the Government institution responsible for the development of a national strategy for sustainable development. It set standards for drinking water and wastewater and control over the wastewater facilities. Recently in July 2002, the National Assembly approved the Environmental Codes proposed by the Ministry.

Ministry of Public Works and Transport

Meteorological division of Civil Aviation department, Ministry of Public Works and Transport is collecting meteorological data. It used to maintain 150 meteorology stations all over Lebanon in 1978. Most were abandoned and damaged during the war. It now has 48 recovered and reconstructed stations.

Other Actors in the Lebanon's Water Sector

Water users, consisting of households, farmers and other industrial users, who are also producing various wastewaters, are most important actors in the water resources management sector. Most of households or domestic water users except those in Saida are not equipped with water meters and paying fixed water tariffs and nominal tax for sewer services once in a year, and hence not motivated to conserve water. Fixed tariffs per household per year varies from US$ 43 to 162 (Table 2.8-6). Affordability to pay seems to be much higher taking into consideration the average household income being approximately US$ 12,000. Under the rationed and intermittent supply of water, however, they have to store as much of water as possible to their water tanks for self

protection at the time supply is available. Private and community owned wells were extensively developed to address the basic needs even during the war, and without legal licence. With water quality being unsuitable, most of urban dwellers have to resort to bottled waters for drinking and cooking purposes.

Table 2.8-6: Water Tariff 1995 - 2002

Unit: LL/1cu m

Water Authority	1995	1996	1997	1998	1999	2000	2001	2002
Kobayat	100,000	100,000	100,000	134,000	134,000	160,000	160,000	160,000
Akkar	100,000	100,000	125,000	125,000	151,000	151,000	151,000	154,000
Deniye	-	65,000	65,000	75,000	75,000	75,000	75,000	77,000
Becharre	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
Zghorta	142,000	142,000	142,000	142,000	142,000	142,000	160,000	165,000
Tripoli	90,000	132,000	132,000	132,000	132,000	132,000	165,000	165,000
Koura	120,000	120,000	120,000	120,000	150,000	150,000	150,000	157,000
Batroun	110,000	130,000	140,000	150,000	180,000	160,000	160,000	165,000
Jbeil	110,100	110,100	134,100	134,100	180,100	180,100	180,100	187,100
Kesrouan	108,000	129,000	161,000	197,500	197,500	197,500	197,500	204,000
Metn	107,100	127,100	152,500	180,100	210,100	231,100	231,100	242,100
Beirut	135,000	161,000	176,000	203,000	243,000	243,000	243,000	243,000
Ain El Delbe	110,000	110,000	132,000	132,000	165,000	165,000	165,000	165,000
Barouk	110,000	110,000	110,000	121,000	152,000	152,000	162,000	165,000
Saida	99,000	99,000	114,000	146,000	146,000	148,500	148,500	151,250
Nabeh El Tasseh	99,100	99,100	99,100	136,100	136,100	158,100	158,100	159,600
Tyr	90,000	90,000	121,000	121,000	121,000	143,000	153,000	154,000
Jabal Amel	99,000	99,000	99,000	130,100	130,100	130,100	130,100	132,100
Baalbeck-Hermel	-	110,000	132,000	132,000	132,000	132,000	132,000	132,000
Zahle	110,000	110,000	110,000	130,000	130,000	130,000	130,000	130,000
Chamsine	110,000	110,000	110,000	110,000	132,000	132,000	132,000	132,000

Source: DGO, MEW, August 2002

Farmers, the thirstiest, in terms of volume, water users in the dry season and even in the rainy season, resort to the public and private irrigation schemes. Irrigation waters produced from private wells are bought by a few farmers, who are able to grow profitable cash crops. While water saving irrigation through trickling, dripping or sprinkling is partially applied to the comparatively market competitive crops, vast majority of irrigation is through furrows. Most of pubic irrigation projects do not levy water tariff with only partial exceptions where tariff is fixed according to the extent of land. Farmers have no serious incentives to save water. As control over agrochemicals is not enforced, pollution of harvested products, soils and drainage is widespread.

Larger industrial users are reportedly taking recourse to groundwater wells. Largest consumption is in the food processing industries. Volume of consumption would be marginal when compared with that of domestic and irrigation users and taken into account the scale of industries in Lebanon. Disposal of industrial wastewater, however, would be more significant than consumption.

Donors and international organizations are also playing important roles in the water resources management. United Nations' Economic and Social Commission for Western Asia (ESCWA) held series of seminars and workshops on institutional issues of this sector. Most recently, pricing of

domestic and irrigation water as well as wastewater disposal services was a theme of workshop in June 2002, where approaches to the pricing water were discussed in view of the present status of the sector.

The World Bank has been working on the institutional reform of this sector. When the Bank appraised the Irrigation Rehabilitation and Modernization Project in 1994 and again the Coastal Pollution Control and Water Supply Project in 1997, the sector reform was an important conditionality (see details in section 3.5.4 of the present report). The National Assembly was reluctant to approve the latter, and its loan was eventually cancelled. Later, the Water Law 221 was ratified to bring about an only part of the sector reform originally envisaged. Now the Bank seems to have wavered a creation of a National Water Resources Authority and a Finance Regulatory Commission (policy setting and coordinating bodies at the national level) insofar as appeared in the Appraisal of a Baalbek Water and Wastewater Project in May 2002.

France, through French Agency for Development, has been avidly supporting a private sector participation (PSP) into operation and management of WA's. A management contract was introduced to Tripoli water supply with a French assistance. A detailed study to enable PSP into more of WA's is under way.

United States Agency for International Development (USAID) is also trying to help enhancement of institutional capacity of the sector. "A Proposed Program of Policy Initiative" prepared in December 2001 proposed a water sector program consisting of the following:

- Build awareness and reach consensus on PSP policy and action plans,
- Develop scenarios for pricing water services and restructuring tariffs,
- Facilitate local level participation and collaborative planning in water management,
- Support the establishment of a shared water resources database, and
- Frame policies and procedures for the decentralization and restructuring of water and wastewater services

2-8-3 Reform of the Water Resources Sector

A decree in 1972 was intended to integrate the then 19 autonomous water authorities and 210 water committees into five regional water authorities. The purposes of this integration were mainly to reinforce technical staff and reduce administrative expenses. As early as 70's, lack of technical resources and overstaffing (in quantity) of water authorities and committees were issues to be addressed by the decree. The integration, however, did not take effect due mainly to occurrence of civil war from 1975.

In May 1993 when Lebanon was about to launch the National Emergency Recovery Program to recover infrastructure damaged during the war, "Water and Sanitation Sector Policy and Strategy"

Paper (Kalbermatten[2] Paper) was prepared by the inter-ministerial "Water and Wastewater Task Force Working Group," which consisted of staff from MEW (the then Ministry of Hydraulic and Electrical Resources), Ministry of Environment, Ministry of Housing and Cooperatives, CDR and consultants assisted by UNDP. The paper, after addressing remarks of municipal and Water Authority officials that told devastated situations of the water supply and sanitation sector, summarized the basic institutional problems, most still unsolved after 10 years, as follows:

- Excessive centralization, which requires time consuming approval from the tutelage ministry for even for minor decisions; this has engendered excessive dependence on central authorities for financial and technical assistance;
- Divisions of responsibility between many organizations, beginning at the central level (with several ministries sharing responsibility for water and sanitation), and continued with the division into (the then) 19 water authorities and 209 local water committees without adequate coordinating mechanism;
- Intermingling of policy/regulatory functions with executive functions at the central level, resulting in deficiencies in policy direction, institutional and technical guidance and strategic planning in respect of the development of water resources, sanitation and environmental protection;
- Division of responsibility for water supply (water authorities and committees) and sanitation (municipalities), without effective communication on operational matters of joint planning and prioritizing of investments; and
- Lack of financial resources at every level, resulting from a lack of a comprehensive cost recovery policy for the water, antiquated real estate valuations (on which the tax for sanitation is based), and lack of clear and transparent investment and financial support criteria (which results in arbitrary decision making and in confusion at implementation level).

The paper farther says, "the present assignment of responsibilities for environmental services (water supply, sanitation, solid waste and drainage) is of a bewildering complexity. The situation is further complicated by the apparent lack of an effective coordinating mechanism between those organizations with executive functions and those with planning, monitoring and regulatory responsibilities." It also pointed out duplication of responsibilities among the public organizations as in the following table:

[2] John M. Kalbermatten stayed in the World Bank throughout 1980's as an influential water supply engineer. After retirement, he came to Lebanon as a consultant hired by the Bank/UNDP, and assisted the working group in preparation of this paper.

Table 2.8-7 Distribution of Responsibilities before Law 221

Organization	Sector				
	Water supply	Irrigation water	Wastewater	Storm drainage	Solid wastes
Ministry of Energy and Water	P, I	P, I	P, I *	P, I	
Water Authorities	O				
Water Management Committees	O	O			
Litani River Authority	P, I, O	P, I, O		P, I, O **	
Ministry of Interior and Municipalities			P		P
Municipalities			O	O	O
Ministry of Public Works and Transport			P	P	
Ministry of Agriculture			P		
Council for Development & Reconstruction	P, I	P, I	P, I	P, I	P, I
Ministry of Public Health	M		M		M
Ministry of Environment			P, I		P, I
Council for Scientific Research			M		M

Legend: P = Planning; I = Implementation; O = Operation; M = Monitoring

* Decree 6650 of Dec.6,73 established MEW Environment Department with responsibility for stormwater and wastewater disposal, but this proposal was never implemented.

** Rural drainage schemes, principally for soil drainage.

Source: Water and Sanitation Sector Policy and Strategy - May 1993 and amended by the present JICA study

To attain satisfactory level of services in the water and sanitation sector and its sustainability through financial sufficiency, it proposed restructuring of the sector organizations through:

i) Separating regulatory from executive functions in order to eliminate conflicts of interest and inefficiencies caused by the same organization evaluating its own effectiveness;

ii) Delegating all project planning, implementing and operating functions to the lowest (closest to the user) institutional level which can successfully manage them, while reserving policy development and strategic and program planning function to newly-created National Water Resource Authority and National Water and Wastes Authority; these authorities would also be responsible for providing technical assistance to the proposed Regional Water and Wastes Authorities, which will be responsible for project planning and implementation and, where delegation to local units is not feasible, for operation and maintenance;

iii) Establishing a Finance Regulatory Commission, which will be responsible for setting finance and cost-recovery criteria and policies and empowered to review and approve tariffs in all public utility sectors to ensure both the adequacy of financial resources and the fairness of tariffs;

iv) Combining responsibility for water supply and sanitation in order to ensure environmental protection by making the supplier of water also responsible for the subsequent disposal of wastewater, improve the efficiency of both services with joint management, billing and collection, and enable municipalities to use tax revenues for

activities which cannot easily be recovered through service charges; and

v) Establishing a National Water Resources Authority to provide overall guidance on water resource development, allocate water resources equitably amongst all sector requiring a supply of water, and assume responsibility for multi-purpose or inter-basin water resource development and transfer programs.

The World Bank Initiative

With some modification by adding the irrigation sector, these proposals were reiterated, when the World Bank appraised Irrigation Rehabilitation and Modernization Project for an US$ 57 million loan in June 1994. A draft letter of irrigation sector policy attached to a World Bank appraisal report emphasizes that the Government of Lebanon (GOL) has developed a policy and strategy framework for the water and sanitation sector and is working on the preparation of a National Water Management Master Plan. All costs of water supply, sanitation and irrigation services (operation and maintenance, loan amortization) should be borne by the users through the payment of tariffs, fees and taxes in principle, to ensure the long-term sustainability of services. Sector policy and regulatory functions should be assigned to national organizations, while executive functions should be the responsibility of regional and local operating organizations, which may be publicly or privately owned, but should operate on a commercial basis, following a business plan to ensure the organization's financial viability. The sector policy would be implemented through a National Water Resource Authority, a Finance Regulatory Commission, four Regional Water and Sanitation Authorities and four Regional Water Irrigation Authorities. Whereas a National Water and Wastes Authority or a National Irrigation Authority is dropped to avoid duplication of layers under the ministry's administrative supervision.

Thus the principles of cost recovery, financial autonomy of operating organizations, and separation of regulatory from executive functions were conditionality of a World Bank loan to irrigation sector in 1994. They were again reiterated in an appraisal of a World Bank loan to Coastal Pollution Control and Water Supply Project in January 1997. The project was intended to address water supply service in Kesrouan and Nabatiya, and wastewater service in Kesrouan, Saida, Sour and Nabatiye. The total project costs were US$ 308 million and jointly to be financed by the World Bank (US$ 53 million), European Investment Bank (EIB) (US$ 62 million), Japan's Overseas Economic Fund (OECF, now Japan Bank for International Cooperation, or JBIC) (US$ 124 million), Euroean Union (US$ 17 million) and Lebanese Government (US$ 52 million). The World Bank portion included conditionality for the sector restructuring as briefed in the previous paragraph. This implied transfer of jurisdiction over the wastewater facilities from the Ministry of Housing and Cooperatives to MEW. It was possibly a cause of reluctance on the side of the Government. Ratification of the loan agreement was delayed over 18 months, and the World Bank eventually cancelled the loan and so did the EIB and EU.

As a consequence, the conditionality of the 1997 loan is not effective, but theoretically that of the 1994 irrigation loan is still valid. While the draft letter of irrigation sector policy attached to the

1994 appraisal was not so articulated to the extent that the 1997 appraisal reached, the principles and the ground are definitely set. A copy of sector reform policy paper from the 1997 appraisal is attached at the end of this section, whereby it is clearly indicated that the Government shall create a National Water Resource Authority and a Financial Regulatory Commission at the national level, and, at the regional level, regional water supply, sanitation and irrigation companies for North Lebanon, Beirut/Mt. Lebanon and North Bekaa, and regional water supply and sanitation companies for South Bekaa and South Lebanon.

Law 221 and the Next Step

As late as May 2000, Law No. 221 titled as Organization of Water Sector was eventually approved by the National Assembly, and amended repeatedly. As of now in August 2002, it stays without mentioning to creation of a National Water Resources Authority or a Finance Regulatory Commission. Although a financial autonomy of four regional water authorities (Public Water and Wastewater Establishments, or RWA's) were legalized and role of Litani River Authority (LRA) was redefined, their regulations, operational plans, budgets (financial plans?) and proposal on revision of tariffs are to be approved by the Council of Ministers through MEW and Ministry of Finance, thus disabling their full autonomy. Their performance will be evaluated by a Performance Evaluation Committee, which shall be organized under MEW with members consisting of the Minister as the president, the Director General from the Ministry of Finance, the DG, Operations and DG, HER from MEW, a hydraulic engineer, an economy graduate and a law graduate. This committee, however, is not yet in existence.

On the other hand, the Law limited the role of MEW to policy, bulk water supply, regulatory functions, and strategic planning including preparation of a national water resources master plan. With absence of that National Water Resources Authority, the MEW would be an only national organ to address issues in the water sector, which includes water supply, wastewater disposal and supply of irrigation water, or more globally, management of supply and demand of water resources. Up to now it is also an only entity to help creation and growth of regional WA's, which apparently need a plenty of help with technical and financial resources. The question is how the MEW shall restructure the water sector to address these missions. It is its decision whether it shall restructure itself to accommodate these missions, or it shall delegate them to a National Water Resources Authority and a Finance Regulatory Commission to be created as originally envisaged in the Kalbermatten Paper.

2.9 Environmental Consideration

2.9.1 Law and Legislation

(1)Environmental Policy

Ministry of Environment (MOE) has been preparing "Environmental Strategy Frameworks (ESF)" under the assistance of IBRD since 1996. ESF is the basic strategy plan for environmental protection. The final draft of "Environmental Strategy Frameworks Paper (ESFP)" was prepared in January 1998, which is under the process of bringing it up to the relevant ministries and collecting their advice from the institutional, economical and technical viewpoints. The followings are the priorities related to water resource management.

- Development of landuse planning: 1) Reduction of environmental impact on beaches and improvement of coastal water quality, 2) reduction of environmental impact caused by real estate development in coastal area and Mount. Lebanon, 3) reduction of environmental impact on groundwater resources and control of well development, 4) development of landuse planning and incentive framework for urban and industrial activities, 5) assistance for conservation and protection of high quality and architectural values of urban and rural areas

- Water resource management focusing on: 1) capacity building on water resource management, 2) integrated management including pricing, mobilization and long-term supply, inter-sectoral allocation and conservation, 3) reversal of saline intrusion, soil salinity and excessive abstraction of irrigation.

- Control of soil erosion focusing on rehabilitation of degraded terraces and rangelands: 1) quantitative assessment and mapping of the degraded areas and prioritization of remedial actions based on careful assessment of cost and benefit, 2) reinforcement of institutional structure within Ministry of Agriculture, 3) policy development including incentives to reduce grazing, promote sustainable management practices for soil conservation.

(2) Environmental Administration

Various ministries have direct or indirect involvement in environmental management in Lebanon. Especially, Ministry of Environment (MOE) takes a leading part for environmental administration. MOE was established based on Law 216 in 1993 to authorize MOE to 1) formulate of general environmental policy and implementation in coordination with relevant agencies, 2) protect the environment related to public health and 3) control and prevent pollution. Other ministries and institute also have the responsibility for environmental management. The relevant agencies responsible for environmental management in each sector are listed in Table 2.9-1.

Table 2.9-1 Relevant Agencies and Environmental Management

Sectors	Name of Ministries
Wastewater	MOE, CDR, Ministry of Energy and Water, Ministry of Public Health, Ministry of Public Works and Transport, Municipalities
Solid / Hazardous Waste	MOE, CDR, Ministry of Public Health, Ministry of Public Works and Transport
Water Resources	CDR, MOE, Ministry of Energy and Water, Ministry of Public Health, Ministry of Public Works and Transport
Landuse	MOE, CDR, Ministry of Public Works and Transport, Ministry of Agriculture, Ministry of Tourism, Ministry of Public Health
Forests and Agriculture	MOE, Ministry of Agriculture
Pollution	MOE, Ministry of Public Works and Transport, Ministry of Industry, Ministry of Energy and Water
Cultural Heritage	MOE, Ministry of Tourism

Source: Environmental Strategy Framework Paper (ESFP), January 1998, MOE

MOE is the only agency to overall environmental matters. However, the following issues are pointed out related to environmental administration:

- Lack of enforcement power due to the insufficient legislative system (e.g. the EIA decree has not been enacted to control projects from environmental management)
- Shortage of budget for environmental management
- Lack of administrative capability for environmental monitoring and management due to limited number of staffs

(3) Law and Legislation

Existing laws and regulation related to environmental management trace back to 1925. For example, the protection of ground and surface water was regulated by Order No.144 dated June 1925, which covered the major springs that supply the country's potable and irrigation demands.

However, these environment-related laws are characterized by 1) behind the times and needed to be updated, 2) lack of accountability for implementation, 3) overlapping/disorder between the newly enacted and the pre-existed legislation, 4) lack of provisions for enforcement and 5) low enforcement power.

The environment-related law was firstly regulated by Decree No. 8735 dated October 1974 for the public hygiene in terms of disposal of raw sewage, infiltration from cesspits and the use of sewage for irrigation of vegetables and fruits. Decision No. 52/1 dated July 1996 was introduced to deal with the pollution of the air, water and soil including national standards for drinking water, bathing water and wastewater quality.

The National Code for Environment (NCE) (Law 444) proposed by MOE as basic law for reservation of environment was approved/enacted in the Government Council in July 29th 2002.
The major laws and regulation related to environmental protection especially for water resource

management is listed in Table 2.9-2.

Table 2.9-2 List of Major Laws/Decree/Order related to Environmental Management

Legislation	Date	Subject
1. Pollution and Protection of Water Resources		
Order No. 144	10/6/1923	Public Domain
Order No. 320/26	26/5/1926	Protection and Utilization of Public Water
Decree No. 639	26/3/1942	Protection of Nabaa Al Assal Spring, Faraya
Decree No. 10276	07/10/1962	Protection Zones for Water Sources and Recharge Areas
Decree No. 14438	02/5/1970	Protection and Utilization of Groundwater
Decree No. 8735	23/8/1974	Pollution including Solid and Liquid Wastes
Law No. 64	18/8/1988	Pollution from Hazardous Wastes
Decision No. 2528/C	28/5/1996	Protection of Ground Water at El Kneisse
Decree No. 680	15/9/1998	Preservation and Protection of Boreholes
Decree 1039	2/8/1999	Permissible Standards for Drinking Water Parameters
2. Protection through Planning, Landuse and Exploitation		
Decree No. 113	09/8/1933	Mining Exploitation
Order No. 69	9/9/1983	Code of Urbanism
Order No. 2/89	5/1/1989	Urban Development
Law No. 98	9/9/1989	Excavation in Public Streets
Law No. 58	29/5/1991	Land Expropriation
Law No. 85	7/9/1991	Flora and Fauna Protection
Decree No. 10121	1992	Excavation of Sand from the Foreshore
Law No. 360	1/8/1994	International Convention on Biodiversity
Decree No. 8801	4/10/2002	Quarry Expropriation
Law No. 558	24/7/1996	Forest Protection
Decision No. 185/1	7/11/1997	Marble Quarries and Concrete Block Works
3. Protection from Pollution		
Decree No. 8735	23/8/1974	Pollution from Solid Waste and Liquid Waste
Law No. 64	18/8/1988	Pollution from Hazardous Waste
Decision No.52/1	29/7/1996	Air, Water and Soil Pollution
4. Protection of Archaeological and Historic Sites		
Law No. 166	7/11/1933	Historic and Archaeological Sites
Law No. 30/82	14/9/1982	World Heritage Sites
Law No. 19	30/10/1990	World Heritage Sites

Source: Project Appraisal Document on a Proposed Loan in the Amount of US$ 43.35 Million to the Lebanese Republic for a Baalbeck Water and Wastewater Project, May 6, 2002, World Bank

(4) EIA System

1) Law and Legislation related to EIA

Environmental Impact Assessment (EIA) system has been applied for the projects financed by the international donors such as World Bank and European Investment Bank based on their own EIA guidelines in Lebanon. The draft EIA decree was prepared in consultation with relevant authorities such as line ministries, public agencies, private consulting firms and universities. The Government Council is currently reviewing the draft decree. However, the

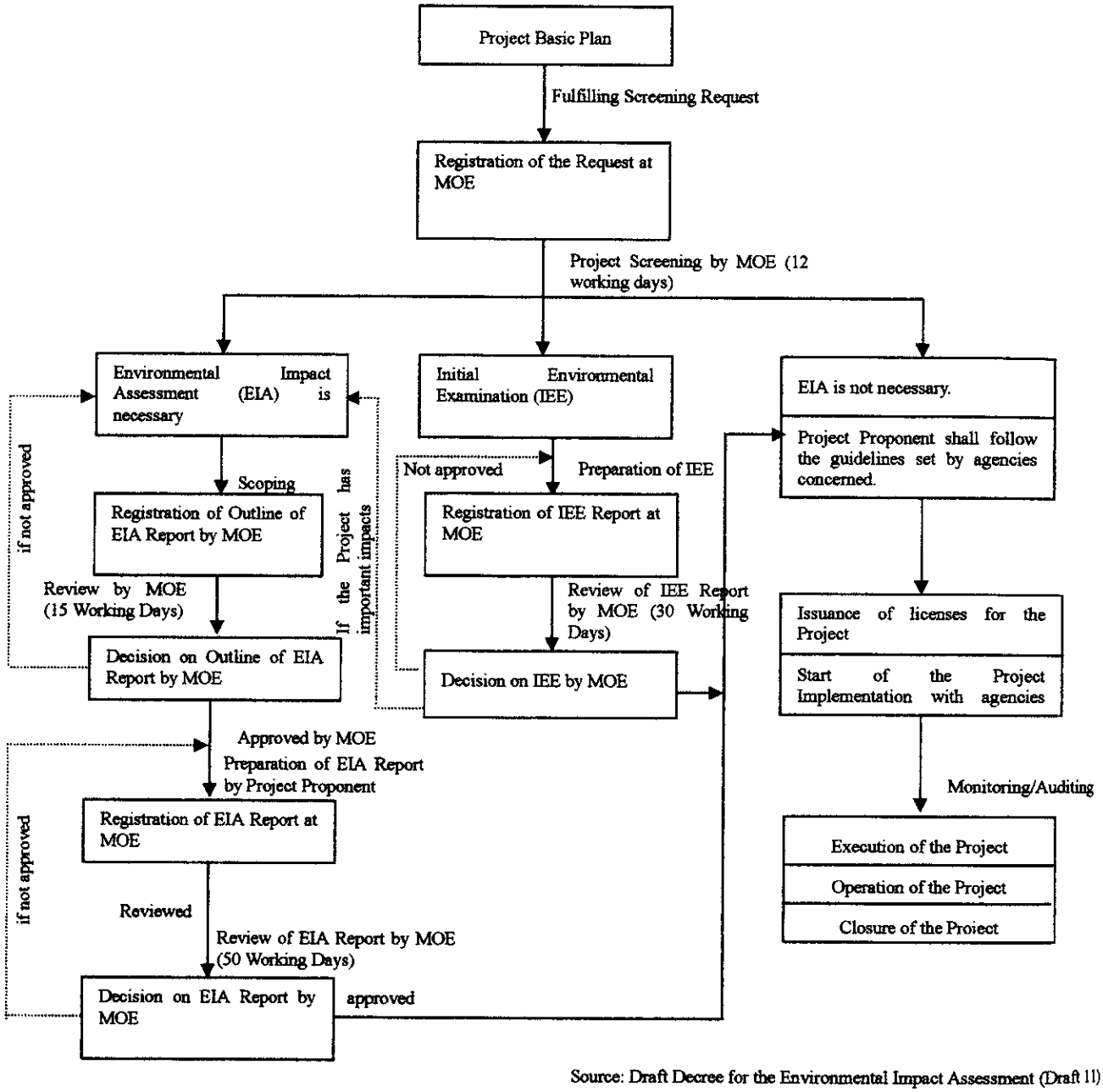
decree has not yet been approved in the Council. The draft decree and draft EIA system was prepared based on various guidelines to be applied in the donors such as World Bank.

2) EIA Procedure

The draft of EIA procedure is proposed based on "Draft Decree for the Environmental Impact Assessment (Draft No. 11)" prepared by MOE in 31 May 2002. This decree has not been approved in the Parliament, nor enacted. The flow of the EIA procedure proposed by MOE is shown in Figure 2.9-1. The procedures are divided into three flows according to the scale/type of the projects, namely, the case which does not require EIA procedure, the case which requires IEE (Initial Environmental Examination) and the case which requires EIA.

3) Projects to require EIA

According to "Proposal of Decree for the Environmental Impact Assessment (Draft No. 11)", the projects to require EIA are listed in Table 2.9-3. The projects related to water resource management such as construction of dams should require EIA procedures.



Source: Draft Decree for the Environmental Impact Assessment (Draft 11)

Figure 2.9-1 Draft EIA Procedure proposed by MOE

Table 2.9-3 List of Projects that require EIA

Sectors	Project Description
Irrigation	• Construction of dams, artificial lakes and marshes • Irrigation projects that have the scales over 500 hectares
Water Supply	• Construction of dams, reservoirs, ponds and artificial lakes • Construction of desalination plants • Projects increasing the water supply for potable water
Wastewater	• Construction of wastewater treatment plants • Construction of maritime flow channels • Wastewater projects
Solid Waste	• Construction of solid waste management and treatment facilities
Agriculture and Forestry	• Development of lands for agriculture by surface alteration, reclamation, clearing and chemical material usage • Deforestation projects
Transportation	• Construction of roads, bridges, railways and tunnels
Airport and Harbor	• Construction of airports and harbors
Energy	• Construction of energy supply facilities • Construction of energy distribution lines
Petroleum and Gas Supply	• Construction of pipeline • Excavation activities of facilities for gases and petroleum • Construction of oil refinery plants • Construction of drilling facilities • Construction of reservoirs
Mining	• Mining, quarries, gravel digging and sand clearing
Tourism	• Construction of skiing ground
Land Reclamation	• Land reclamation /reformation
Marine	• Public use of rivers and ponds
Fish Raising	• Fish raising in land and coastal area
Zoo	• Construction of zoo
Factory	• Development of industrial park • Construction of factories designated by MOE

Source: Environmental Strategy Framework Paper (ESFP), January 1998, MOE

(5) Standard / Guideline

The standards for drinking water, bathing water and wastewater quality were regulated by Decree No. 52/1 of July 1996. The major standard values regulated in the decree are shown in Table 2.9-4. The wastewater standard have been reviewed by Decision No.81 dated March 2001 to cover the permissible effluent limit of wastewater to the sea, surface water and sewerage system. As for the standard for drinking water, two types of standard, the standard for potable water and bottled water, are regulated based on Decree 1039 dated 2/8/1999. The effluent limit for wastewater is shown in Annex.

Table 2.9-4 Water Quality Standards (Decree No. 52/1 of July 1996)

Standards for Drinking Water

Parameter	Unit	Guideline Value	Maximum Admissible Value
1. Physical & Chemical			
Color	Alpha	1	15
Turbidity	JTU	0.4	4
Temperature	°C	12	25
Electrical Conductivity	µS/cm	400	-
pH	-	6.5 – 8.5	9
Calcium	mg/l	100	-
Magnesium	mg/l	30	50
Sodium	mg/l	20	150
Potassium	mg/l	10	12
Chloride	mg/l	25	200
Nitrate (NO_3^-)	mg/l	25	50
Nitrite (NO_2^-)	mg/l	-	0
Iron	µg/l	50	200
Ammonia (NH_4^+)	mg/l	0.05	0.5
Total Solids	mg/l	-	1,500
Oxidability	mg/l	2	5
Fluoride	mg/l	-	1.5 at 8 - 12 °C or 0.7 at 25 - 30°C
2. Bacteriological Parameters			
Total Coliforms	100 ml	0	0
Faecal Streptococcus	100 ml	0	0
Sporluated Sulphite-Reducing Bacteria	20 ml	0	1
Faecal Coliforms	100 ml	0	0
Salmonella	5 liters	0	0
Thermotolerant Coliforms	100 ml	0	0
Pathogenic Staphylococcus	100 ml	0	0
Faecal Bacteriophagus	50 ml	0	0
Intestinal Virus	10 liters	0	0

Standards for Bathing in River, Lake and Sea

Parameter	Unit	Guideline Value	Maximum Admissible Value
2. Bacteriological Parameters			
Total Coliforms	100 ml	500	10,000
Thermotolerant Coliforms	100 ml	100	2,000
Faecal Streptococcus	100 ml	100	-
Salmonella	1 liter	0	-
Intestinal Virus	10 liters	0	-

(6) Environmental Management Related to Water Pollution

The environmental management system (especially monitoring for water pollution) in Lebanon is legally regulated Code 444 enacted in July 2002, and is conducted by Ministry of Environment (MOE) in principle. However, actually, the water pollution management especially for monitoring is not practiced because of the insufficient budget/resources in MOE.

The penalty system for case of the effluents exceeding the effluent standard, is also stipulated in Code 444. According to the law, the establishments should pay the fines as the principle of polluter

payments or be sentenced to imprison when they discharge the effluent exceeding the national effluent standards (afterwards the collected fines are utilized as national fund for environmental reservation). Actually, these penalty systems are not practiced because the inspection/monitoring cannot be conducted from above situation of insufficient resources/budget in MOE

No action plan for management/monitoring for water pollution has been prepared by MOE. However, as for the hot spots related to water pollution, Tripoli, Seraaita, Jounieh, Beirut and Ghazieh have been appointed as the priority areas for water quality for sea water, while the freshwater is facing the crisis of water pollution nationwide in Lebanon. These hot spots are studied by project base, not monitored regularly.

2.9.2 Current Situation on Environment

(1) Social Environment

1) Cultural and Historical Sites

Lebanon is the signatory of the Paris Convention which protects the world's cultural and natural heritage. 5 sites were designated in Lebanon of the 690 sites on UNESCO's World Heritage lists. These are shown in Table 2.9-5. To be inscribed on the World Heritage List, the candidate sites should meet the selection criteria designated by UNESCO. The cultural heritage was the main criteria for above listed sites. Several initiatives are underway to add the valley of Nahr Ibrahim to the list.

Table 2.9-5 List of World Heritage Sites in Lebanon

Site	Designated Date	Criteria*	Description
Baalbeck	1984	C	One of the examples of Imperial Roman architecture at its apogee.
Anjar	1984	C	The ruins founded by Caliph Walid I at the beginning of 8th centry.
Tyre	1984	C	Historical remains from Roman times.
Byblos	1984	C	The site of multi-layered ruins of one of the most ancient cities in Lebanon.
Wadi Qadisha	1988	C, N	One of the most important early Christian monastic settlements in the world.

Remarks: "C" for cultural heritage criteria and "N" for natural heritage criteria.
Source: 2001 Lebanon State of the Environment Report

2) Public Health

Waterborne disease, especially diarrheal diseases is one of the leading causes of mortality and morbidity among the infants below five years old. Several cases related to waterborne diseases are reported according to Ministry of Public Health. Table 2.9-6 shows the average annual number of reported cases of major waterborne diseases such as dysentery, hepatitis A and typhoid.

Table 2.9-6 Number of Reported Cases per Year (Annual Average for 1995 – 2000)

Name of Disease	Number of Reported Cases
Dysentery	529
Hepatitis	287
Typhoid	809

Source: 2001 Lebanon State of the Environment Report, MOE

Table 2.9-7 shows the results of the reported numbers of waterborne diseases in each mohafaza. The significant geographic discrepancies are reported in the incidence of such diseases in Bekaa, North and South, etc. According to Ministry of Public Health, the untreated sewage water from households flow/seepage into the water wells in the rural areas where the sanitary sewage systems have not been developed. Above cases show that this current state of such sewage systems possibly causes the waterborne diseases.

Table 2.9-7 Results of Reported Cases of Food/Waterborne Diseases by Mohafazas

Disease	North		Bekaa		Nabatiye		South		Mount. Lebanon		Beirut		Others		Total	
	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000
Cholera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dysentery	2041	73	6	247	25	0	4	5	108	16	9	6	13	16	2306	363
Typhoid & Paratyphoid	389	396	69	132	4	7	8	38	51	112	26	32	39	30	586	747
Hepatitis A	43	139	84	38	35	2	7	17	37	16	6	19	18	16	230	247

Source: Annual Report 2000 – Frequencies & Annual Report 2001 – Frequencies, Ministry of Public Health

(2) Natural Environment

1) Flora and Fauna

9,122 species of flora and fauna (4,633 species for flora and 4,489 species for Fauna) are identified in Lebanon (MOA/UNEP, 1996). More than 80 percent of plant species in Lebanon has been identified as the terrestrial plants. 206 plant species are threatened by the human activities in which the urbanization has the largest number of species under threat. Approximately 400 species are endemic in Lebanon, Syria and Palestine, of which 92 are presumed endemic to Lebanon only (MOA/UNEP, 1996).

Abusive felling, over-grazing, urban development, fires and pests threaten Lebanese forests. Table 2.9-8 shows the forest species under these threats based on degree of severity.

Table 2.9-8 Threats to Forest Species based on Degree of Severity

Forest Species	Abusive Felling	Over-Grazing	Urban Development	Fires
Kermes Oak (*Q. calliprinos*)	3	4	3	3
Haired Oak (*Q. cerris*)	4	4	4	-
Aleppo Pine (*P. halepensis*)	3	3	4	5
Brutia Pine (*P. brutia*)	3	3	3	5
Stone Pine (*P. pinea*)	1	2	4	3
Cedar of Lebanon (*Cedrus libani*)	2	2	1	-
Fir (*Abies cilicica*)	3	4	3	-
Juniper (*Juniperus excelsa*)	4	5	2	-
Cypress (*Cupressus sempervirens*)	3	4	2	2

Source: Lebanon State of the Environment Report

52 mammal species are reported in Lebanon. 7 mammal species are already extinct including the Syrian brown bear, Persian lynx and Arabian gazelle. Bats make the largest group of mammals in Lebanon. About one third of existing mammals are rare including several species of shrews, bats, weasel otter and spiny mouse. Another is vulnerable species or species in apparent danger.

At least 372 species of birds have been reported in Lebanon. There are two extinct species of birds, which are the Lesser Crested Tern (*Sterna bengalensis*) and the Blue-cheeked Bee-eater (*Merops persicus*). The habitat environment for waterfowls such as Ammiq swamp, Yammouneh basin, Taanayel, Shekh Zennad ponds and Qaraoun lake are threatened by the urbanization.

The National Center for Marine Sciences (NCMS) has inventoried 218 sea fish species from 140 genera. 25 species of fish are confirmed to exist in freshwater in Lebanon. The marine ecosystem and organism are significantly threatened by the environmental deterioration in the coastal area such as the direct discharge of industrial effluents into the sea, waste dumping in the waterfront, the thermal discharge from power plants and the discharge of domestic wastewater. Spring water is often diverted, which causes the drying-up the surrounding aquatic habitat. The excessive use of agro-chemicals such as fertilizer and pesticides has deteriorated the composition of the water area chemically. In addition, the domestic wastewater causes the rivers and lakes eutrophication.

2) Nature Reserve

7 nature reserves have been established by the laws since 1992. The total area of the reserves covers approximately 207 km^2 (2 percent of the Lebanese territory). Table 2.9-9 shows the reserves declared by Lebanese laws.

Table 2.9-9 Nature Reserve in Lebanon

Name	Law	Date	Approximate Area (km^2)	Elevation Zone (meters)
Horsh Ehden Nature Reserve	121	9/3/1992	17	1,200 - 1,900
Palm Island Nature Reserve	121	9/3/1992	5 (marine basin)	Sea level
Shouf Cedars Nature Reserve	532	24/7/1996	160	900 - 2,000
Tyre Coastal Nature Reserve	708	5/11/1998	4	Sea level
Bentael Nature Reserve	11	20/2/1999	2	250 - 800
Yammouni Nature Reserve	10	20/2/1999	17.5	1,400 - 2,000
Tannourine Cedars Nature Reserve	9	20/2/1999	1.5	1,300 – 1,800

Source: 2001 Lebanon State of the Environment Report, MOE

(3) National Policy for Biodiversity

There is no national policy/regulation related to the river maintenance flow in Lebanon which aims at securing the minimum discharge for dry season to conserve the aquatic lives. However, MOE established a national strategy and action plan for biodiversity conservation in November 1998 with the collaboration of UNDP and GEF. Some of their action plan related to aquatic lives are shown as follows:

- To conserve freshwater biodiversity through the sustainable management and wise use of freshwater resources
- To protect Lebanon's coastal and marine biodiversity and develop their resources in sustainable manners

In addition, MOE has been conducting the on-going actions for the specific hot spots under threat. Table 2.9-10 shows the summary of their actions.

Table 2.9-10 Freshwater Hot Spots: Threats, Policies and On-going Actions

Hot Spot	Description	Threat	Policies and Actions
Lake Qaroun	Largest manmade lake which was developed for hydro-power generation and irrigation scheme in South Lebanon	Direct discharge of domestic and industrial waste effluents. Signs of eutrophication observed.	An Environmental Master Plan for the Litani River and Lake Qaroun catchment area has been completed. At least 4 wastewater treatment plants are under preparation in the Litani watershed area.
Lake Yammoumeh	Highest surface water area in Lebanon (EL. 1,450 m) surrounded by highland proclaimed legal nature reserve (February, 1999).	Endemic freshwater fish (Phoxinellus libani) will possibly extinct. Water is diverted to agricultural scheme.	The possibility of grant funding (World Bank/GEF) for the conservation is being examined.
Aamiq Marshes	Important habitat for migratory and resident bird species in wetland system.	Construction of new road system and drainage for agricultural production.	EIA for the proposed road project. Protected Areas Framework Law (in draft) will impose legal controls related to enforcing conservation on private lands.

Source: 2001 Lebanon State of the Environment Report, MOE

(4) Pollution

The Lebanon's environment was not appropriately managed during the civil war. The environmental damage of the after the war has been remained. The trees were cut for fuel or destroyed by fire. This has caused the soil erosion issues. The solid waste including hazardous and toxic waste has been dumped illegally throughout the country, which includes the water source for various kinds of use. The urbanization has increased the number of vehicles in the large cities such as Beirut and Tripoli, which has caused the air pollution, noise and traffic congestion. At the same time, the water pollution has been caused by the uncontroled/disorderd treatment of the factories and the existing unsanitary service of sewage and wastewater treatment for domestic wastewater.

Water pollution is one of key environmental problems to be settled urgently in Lebanon. The factors causing the water pollution in Lebanon are summarized as follows:

- Insufficient or no treatment of domestic/industrial wastewater
- Insufficient treatment of wastewater treatment plant
- Leakage of domestic sewage into the water source for drinking water especially in rural areas
- Discharge of the leachate caused by the unsanitary open dumping of solid waste
- Discharge of agro-chemicals such as pesticide and fertilizer from agricultural fields
- Seawater intrusion into wells in coastal areas caused by the excessive drawing-up of groundwater

Not only the direct factors causing the water pollution such as insufficient treatment of wastewater should be settled urgently, but also the surrounding situation such as the unsanitary open dumping or discharge of agro-chemicals indirectly causing the water pollution should also be improved.

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