6.5 Implementation Schedules

6.5.1 Water Supply Projects

Implementation schedule of water supply projects for domestic and industrial use in the Base Scenario-Agricultural Expansion is shown as an example in Table 6-35. The most urgent large urban water supply projects, to be implemented during the first five years, are two projects in Lusaka (Northern Lusaka Production Well Project and Chongwe Dam Project) and phase-1 of two Extension Projects in Kabwe and Livingstone. The next most urgent projects, to be implemented in the following five years, are phase-1 of Kafue Pipeline Project, phase-2 of Livingstone Extension Project, Kasama Extension Project, and Chipata Production Well Project. Other projects are to be implemented during the latter ten years.

Many projects for small urban areas should be implemented in the ten years to 2005, because of the present low service coverage in small towns. For rural water supply projects, the preparatory works, such as procurement of boring equipment and facilities, and training of staff, mean that smaller numbers of projects are planned to be implemented in the first five years. Later, projects are to be implemented at a constant pace.

Table 6-35 Implementation Schedule of Water Supply Projects for Domestic and Industrial Use (Base Scenario - Agricultural Expansion)

Project Name	Water Developed (m^3/day)	Construction Cost (mil.US$)	Construction Schedule 96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
<Large Urban Area>																						
Northern Lusaka Well Project	20,000	15.70																				
Lusaka (Chongwe Dam)	100,000	109.87																				
Lusaka Kafue Pipeline Project)	400,000	321.96																				
Ndola (Kafubu Dam)	60,000	53.50																				
Luanshya (Kafubu Dam)	5,000	8.80																				
Kitwe (Mutundu Dam)	20,000	20.58																				
Kalulushi (Mutundu Dam)	10,000	17.63																				
Mufulira (Mutundu Dam)	5,000	9.63																				
Kabwe (Expansion)	57,000	43.46																				
Livingstone (Expansion)	20,000	20.58																				
Kasama (Expansion)	14,000	12.65																				
Chipata Well Project	12,000	11.04																				
(5 year Progress Rate)	723,000	647,000	22%					23%					34%					21%				
<Small Urban Area>																						
(5 year Progress Rate)	155,908	153.03	50%					26%					17%					7%				
<Rural Area>																						
(5 year Progress Rate)	168,970	209.52	18%					26%					28%					28%				

6.5.2 Agricultural Projects

Implementation schedules of irrigation development projects, fish pond development projects and livestock development projects are shown in Table 6-36, 6-37 and 6-38, respectively.

Irrigated area is planned in accordance with the Value Added of the sector and projected demands for agricultural products. For the years up to 2000, however, implementation priority is given to the ASIP rehabilitation projects and the expansion projects. New development projects are planned to be implemented after 2000, with the exceptions of the Chongwe Dam Project and the Zambezi Left Bank Flood Plain Development Project. Dam development is planned to commence after 2005 because of the required period for training of technical staff for the design and operation.

Fish pond development is planned by determining the ponds required according to the balance between the demand and supply by capture fishery in each province. However, in the case of Lusaka, whose potential for aqua-culture is low and demands are quite large, supply after 2005 is planned from large scale fish pond developments in the Kafue Flood Plain. Eastern Province will achieve self-supply of fish products after the completion of the large scale fish pond development along the Luangwa River in 2011.

The number of livestock is planned to increase according to the population growth projected in each scenario. Regionally, in Southern Province, however, the number of cattle is planned to decrease because of the present over-grazing. Number of cattle in other provinces are distributed corresponding to the potential of the area.

Table 6-36 Implementation Schedule of Irrigation Development Projects for Base Scenario - Agriculture Development

Project	Water Developed ($1000m^3$/day)		Irrigation Area (ha)		Cost mil. US$	Implementation Schedule
	2005	2015	2005	2015		96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15
Lusaka Prov.	235	235	2,720	2,720	73.47	
Chongwe Dam	70	70	810	810	34.74	
ASIP Rehabilitation	1	1	10	10	0.09	
Expansion Project	164	164	1,900	1,900	38.64	
Copperbelt Prov.	375	875	4,340	10,120	230.67	
Kafubu Dam	0	365	-	4,220	103.49	
Mutundu Dam	0	135	-	1,560	60.09	
ASIP Rehabilitation	12	12	140	140	3.27	
Expansion Project	363	363	4,200	4,200	63.82	
Central Prov.	432	432	5,000	5,000	103.40	
New Project : P-1	432	432	5,000	5,000	103.40	
North western Prov.	224	569	2,590	6,590	203.36	
Expansion Project	25	25	290	290	2.46	
New Project : P-79	0	86	-	1,000	14.58	
New Project : P-80	199	199	2,300	2,300	33.53	
New Project : P-82	0	259	-	3,000	152.79	
Western Prov.	303	606	3,510	7,010	103.39	
Expansion Project	1	1	10	10	0.21	
New Project : P-16	86	86	1,000	1,000	16.06	
New Project : P-23	130	261	1,500	3,000	38.94	
New Project : P-84	86	86	1,000	1,000	16.06	
New Project : P-86	0	86	-	1,000	16.06	
New Project : P-88	0	86	-	1,000	16.06	
Southern Prov.	738	738	8,539	8,539	177.51	
ASIP Rehabilitation	8	8	89	89	2.42	
Expansion Project	730	730	8,450	8,450	175.12	
Luapula Prov.	272	1,050	3,144	12,144	132.77	
Lufubu Dam	0	603	-	7,000	56.96	
Expansion Project	99	99	1,144	1,144	10.80	
New Project : P-37	173	173	2,000	2,000	29.15	
New Project : P-45	0	173	-	2,000	35.86	
Northern Prov.	189	621	2,190	7,190	138.49	
Expansion Project	42	42	490	490	10.31	
New Project : P-52	147	147	1,700	1,700	24.78	
New Project : P-65	0	432	-	5,000	103.40	
Eastern Prov.	2	130	28	1,508	26.90	
Lundazi Dam	0	128	-	1,480	26.13	
ASIP Rehabilitation	2	2	28	28	0.77	
Total	2,770	5,256	32,061	60,821	1,190.0	16% 25% 40% 19%

Table 6-37 Implementation Schedule of Fishpond Development Projects for Base Scenario - Agricultural Expansion

Project	Fish Pond Area		Cost	Implementation Schedule																
	2005	2015	(mil.US$)	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Lusaka Prov.	-	-	-																				
Copperbelt Prov.	1,200	1,200	14.04			-												-					
P-2 Luswishi	1,200	1,200	14.04																				
Central Prov.	1,400	1,400	16.38																				
New Project : P-1	1,400	1,400	16.38																				
Northwestern Prov.	2,590	3,690	43.17																				
Dispersed Small Scale Development	2,590	3,690	43.17																				
Western Prov.	340	1,140	10.49																				
Dispersed Small Scale Development	340	1,140	10.49																				
Southern Prov.	0	8,425	77.51																				
Large Scale Project at Kafue Flood Plain	0	8,425	77.51																				
Luapula Prov.	4,150	4,150	37.77																				
P-43 : Samfya	2,000	2,000	18.40																				
P-44 : Bangweulu	2,105	2,105	19.37																				
Northern Prov.	2,000	2,250	26.32																				
P-64 : Mutale Mokonge	0	250	2.92																				
P-66 : Chamdamali	2,000	2,000	23.40																				
Eastern Prov.	0	7,000	64.40																				
P-70 : Luangwa	0	7,000	64.40																				
Total	11,680	29,210	290.08	16%					19%					40%					25%				

Table 6-38 Implementation Schedule of Livestock Development Projects for Base Scenario - Agricultural Expansion

Province	Water developed ($1000m^3$/day)	Cost (mil.US$)	Implementation Schedule																	
			96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Lusaka Prov.	6.92	1.35																				
Copperbelt Prov.	7.00	1.42																				
Central Prov.	30.39	4.98																				
Northwestern Prov.	9.03	2.44																				
Western Prov.	36.71	7.22																				
Southern Prov.	47.74	8.04																				
Luapula Prov.	3.90	1.07																				
Northern Prov.	15.78	4.15																				
Eastern Prov.	25.14	5.09																				
Total / Progress in 5 Years	182.61	35.75	25%					30%					25%					20%				

6.6 Evaluation of Proposed Projects

6.6.1 Economic Evaluation of Proposed Projects

(1) General Conditions

The economic worth of Master Plan projects was assessed by the rates of economic efficiency at which the present worth of both economic costs and economic benefits equalised over the project life.

The prices of internationally tradable goods and services are basically estimated on the basis of the World Bank projection to 2000, or the international market price in January, 1995. The prices of local goods and services are the normalised price in January, 1995. The transfer payments such as tax, subsidies and interests are deducted from all prices. The ratio of transfer payment to financial cost is assumed to be 10% of financial cost.

For economic evaluation, Economic Internal Rates of Return (EIRR) of respective projects are calculated to verify economic viability in the national economy. In calculation of other economic indices such as Net Present Value (NPV) and Benefit-Cost Ratio (B/C), costs and benefits are discounted at the rate of 10% for the respective project lives.

In estimating the economic cost and benefit, the economic values are estimated applying the following conditions and assumptions for every sector related to water.

(a) Price Level

For economic evaluation activities, the basic price level for cost and benefit estimates was set at the end of January, 1995. Foreign exchange rate was set at K610 to US$1.00 in accordance with the official exchange rate at the same time.

(b) Opportunity Cost of Capital

Opportunity cost of capital represents the permissible economic rate of return for development projects. In Zambia, 10% of this opportunity cost of capital is applied as a discount rate for assessing economic viability of proposed projects, which is mostly used in IBRD's reports.

(c) Economic Value

In economic analysis, all goods and services applied in the project costs and benefits are estimated on the basis of real economic value. In terms of non-tradable goods and services in local market, the following points have to be considered in the case of converting their financial values to economic ones: (a) internal transfer payment and (b) shadow wage of unskilled labour in particular because of taking unemployment and underemployment conditions into account. On the other hand, the tradable goods and services are estimated based on the international market prices, so their values reflect real economic ones. In this current report, however, economic values are estimated to be 90% of total financial values in the case of including both local portions and foreign portions.

(d) Economic Life

The economic life of the projects is taken as 50 years for water supply facilities. However, a part of mechanical facilities is considered as 20 years, so it would be replaced within the above main economic life. The economic life is considered to start just after completion of the construction works.

(2) Water Supply Projects

The basic economic benefit from water supply schemes is based on the maximum affordable value. It is generally adopted as 3 to 5 per cent of household income. In this master plan study, the benefit for water supply system are estimated to be 5% of income for domestic water supply schemes. Applying this rule, the total annual benefit in the country could be estimated at K47 billion (approximately US$77 million equivalent) in the year 1995, as shown in Table 6-39.

For municipal use, such as trade, catering, Goverenment services, etc. economic benefit is based on also the maximum affordable payment for water. In this study, a percentage of water cost to value added of all invisible services is adopted for benefit estimation. From the 1985 input-output table for Zambia, the rate of for water is assumed to be 0.28%, as shown in Table 6-39. Applying this rate to the sector performance projected in 1995, an economic flat rate of this sector was estimated K18/m³. This rate was quite small as compared with the domestic water rate of K191/m³. It would be caused that the sector does not count water charge in general expenditure since the sector gets water not only through piped water system but also through its own free water resources such as well and other personal sources. Thus, the economic flat rate of municipal water was assumed to be the same rate of K191/m³ as the domestic value. Incidentally, the water cost is calculated to account for almost 3% of the value added of the sector, applying this value for the sector. As a result, the annual economic benefit for municipal water in the country is estimated at K16 billion (approximately US$26 million equivalent) in total in 1995.

In the same manner, the rate of maximum affordable value for water is assumed to be 3%, which was the same rate as applied in the municipal sector. The annual benefit for industrial water is expected to be K10 billion (approximately US$16 million equivalent), as shown in the table.

The financial construction costs of the proposed projects in urban and rural areas are described in detail in Section 6.4. The costs are converted to economic costs by making adjustments based on the aforesaid conversion method. For economic evaluation activities, the construction schedule is assumed to be divided into two phases. The construction works of the first phase are assumed to start in 1996 and to end in 2005, of which the capacity fully covers the 2005 water demand. Those of the second phase are between 2006 and 2015, covering the 2015 water demand.

The O&M costs are annually required during the economic life of the projects just after completion of the construction works. The costs are assumed to be 5% of the total construction costs for urban water supply schemes. For rural water supply schemes, the O&M costs were estimated individually, which accounted for about 1% annually of the initial investment costs for maintenance and rehabilitation activities.

Table 6-39 Total Economic Benefit Accruing from Water Supply in Zambia

1. Domestic Water

Annual benefit(*1) in 1995

a) Annual benefit

Sector	GDP per Capita*2 (K1000 at 1993 Constant Prices)	Disposable Income per Capita *3 (K1000 at 1993 Constant Prices)	Income Ratio*1 (%)	Population Projected (1000)	Economic Benefit*4 (K'million)
Urban Schemes	340	207	5	3,227	30,101 *5
Rural Schemes	81	73	5	5,132	16,824 *5
Total	186	140	5	8,359	46,925 *5

b) Total Economic Benefit of Residential Sector (K'Billion)	46.93	
Water Consumption Volume (1000 cu.m.)		245,232
Economic Flat Rate of Domestic Use on Average (K/cu.m.)	191	

2. Municipal (Trade, Catering, Government Services, etc.) Water

a) Annual benefit in 1986 (Reference: Input-Output Table 1985)

Item	Gross Output	Gross Value Added	Gross Input	Expense for Water	Ratio of Water Exp. to Gross VA
Zambia in 1985 (Unit: K'1000 in 1985 at Current Prices)	5,539.8	3,936.8	1,603.0	10.9	0.28%
(Ref) Japanese Case (Unit: Billion Yen in 1986)	232,251	151,672	80,579	867	0.57%

Benefit = The same flat rate of Domestic Use (Maximum affordable value of water)	3.0% *4
b) Value Added of Municipal Sector in 1995 (K'Billion)	585
Total Economic Benefit of Municipal Sector (K'Billion)	15.80 *6
Water Consumption Volume (1000 cu.m./annum)	80,090
Economic Flat Rate of Municipal Use on Average (K/cu.m.)	197

3. Industrial Water

a) Annual benefit in 1985 (Reference: Input-Output Table 1985)

Item	Gross Output	Gross Value Added	Gross Input	Expense for Water	Ratio of Water Exp. to Gross VA
Zambia in 1985 (Unit: K'1000 in 1985 at Current Prices)	4,240.0	1,481.0	2,759.0	14.8	1.00%
(Ref) Japanese Case (Unit: Billion Yen in 1986)	114,525	94,443	20,082	450	0.48%

Benefit = Maximum affordable value of water	3.0% *5
b) Value Added of Manufacturing Sector in 1995 (K'billion)	370.5
Total Economic Benefit of Manufacturing Sector (K'billion)	10.00 *6
Water Consumption Volume (1000 cu.m./annum)	96,021
Economic Flat Rate of Industrial Use on Average (K/cu.m.)	104

Source: Input-Output Table in 1985, CSO (Not yet published as of March 1995)

Remark: *1 Traditional Rule of income ratio (Maximum affordable water value)

*2 Refer to Supporting Report Part A Appendix 4

*3 Estimated on the basis of Table 2-9

*4 Assumed to be 3% of value added which resulted into the same flat rate as residential one, because water expenses were not always accounted in expenditure item in the case of well users in particular.

*5 Assumed to be 3% of value added which was the same rate as municipal one.

*6 Converted to economic values, i.e., 90% of financial values.

While the economic life is assumed to be 50 years, some mechanical facilities such as pumps have shorter life than the civil and plumbing works. They are assumed to be 20 years for major mechanical equipment and 10 years for small pumps. The replacement costs are assumed to be 20% for the conveyance and treatment costs.

(a) Large Urban Areas

The twelve urban systems are examined in economic efficiency through factors of NPV, B/C and EIRR, as mentioned in Section 6.6.1(1). Table 6-40 shows the results of the examination. Of 12 schemes, four schemes resulted in exceeding 10%, the opportunity cost of capital as mentioned above. They are in order of economic efficiency: Kitwe, Kasama, Luanshya and Ndola,. In Lusaka City, although the economic efficiency of proposed projects has positive EIRR, its value seems to be comparatively low. It means to be costly to provide potable water for the people in Lusaka.

Table 6-40 Economic Efficiency of Large Urban Water Supply Projects

Code	Urban Name		EIRR*1 (%)	NPV*2 (US$million)	B/C*2
111	Lusaka	Lusaka Wells	8.4%	-1.9	0.90
	Lusaka	Chongwe Dam	3.8%	-45.9	0.61
	Lusaka	Kafue Pipeline	3.7%	-72.8	0.68
211	Ndola Township	Kafubu Dam	10.2%	1.1	1.02
251	Mufulira	Mutundu Dam	7.4%	-1.8	0.81
261	Kalulushi	Mutundu Dam	---	-12.1	0.37
271	Kitwe	Mutundu Dam	17.9%	19.2	1.77
281	Luanshya	Kafubu Dam	12.4%	1.8	1.19
311	Kabwe Township	Water Supply Extension	6.7%	-5.3	0.82
611	Livingstone		2.9%	-9.3	0.57
811	Kasama		14.0%	4.8	1.32
911	Chipata	Chipata Wells	7.0%	-2.8	0.77

Note: *1 "---" means that EIRR marks less than zero percent.
*2 Discounted at 10%

(b) Small Urban Areas

For the other 80 small town schemes, the economic efficiency was examined as shown in Table 6-41. 33 townships schemes have a positive EIRR. Of the 33 townships, three townships resulted EIRR in excess of 10%, which is the border of economic feasibility. They are Choma, Monze and Zimba in Southern province. All of them are groundwater projects. It seems to be difficult to supply potable water using surface water sources because of high water treatment costs.

(c) Rural Areas

The economic efficiency of rural water supply was examined for each province covering all the schemes in each province. Of the nine provinces, six had a positive EIRR, as shown in Table 6-42. They are Lusaka, Copperbelt, Central, Southern, Luapula and Eastern. Of the six provinces, two provinces of Copperbelt and Central resulted in EIRR in excess of 10%.

Table 6-41(1) Economic Efficiency of Small Urban Water Supply Projects

Code	Province	Code	Town	EIRR	NPV	B/C	System *3
10	Lusaka	121	Chongwe	--	-3.47	0.14	SWP
		122	Kafue	3.9%	-6.13	0.52	SWP
		123	Chilanga	--	-3.04	0.33	SWP
		124	Rufunsa	5.8%	-0.24	0.64	GP
		131	Luangwa	--	-1.09	0.13	SWP
20	Copperbelt	221	Masaiti	1.7%	-0.16	0.46	GP
		222	Mpongwe	6.4%	-0.48	0.70	GP
		262	Chambishi	4.3%	-0.67	0.56	GP
30	Central	321	Chibombo	--	-1.29	0.13	GP
		322	Chisamba	5.7%	-0.12	0.62	GP
		323	Kapiri Mposhi	2.5%	-0.94	0.50	GP
		331	Mumbwa	--	-2.07	0.32	GP
		332	Nampundwe	--	-2.07	0.32	GP
		341	Mkushi	0.7%	-1.12	0.35	GP
		351	Serenje	1.3%	-0.79	0.45	GP
40	Northwestern	411	Solwezi	1.7%	-5.61	0.35	SWP
		421	Mwinilunga	--	-1.96	0.12	SWP
		431	Zambezi	--	-2.38	0.11	SWP
		432	Chavuma	0.2%	-0.76	0.31	SWP
		441	Kabompo	--	-1.33	0.11	SWP
		451	Mfumbwe	--	-1.64	0.19	GP
		461	Kasempa	2.2%	-0.60	0.35	GP
50	Western	511	Mongu	7.8%	-0.55	0.82	GP
		512	Limulunga	1.5%	-0.59	0.43	GP
		513	Namushakande	--	-0.43	0.24	GP
		521	Lukulu	--	-0.58	0.30	GP
		531	Kalabo	--	-3.23	0.08	SWP
		532	Sikongo	--	-0.27	0.21	GP
		541	Kaoma	2.8%	-0.98	0.49	GP
		551	Senanga	--	-3.40	0.07	SWP
		552	Shangombo	--	-0.24	0.28	GP
		561	Sesheke	--	-2.32	0.08	SWP
		562	Mulobezi	--	-0.25	0.25	GP
		563	Katima-Mulilo	--	-0.32	0.07	GP
60	Southern	621	Namwala	5.4%	-0.32	0.62	GP
		622	Itezhi-Tezhi	2.9%	-0.60	0.54	GP
		631	Mazabuka	7.3%	-0.68	0.77	GP
		632	Magoye	1.4%	-0.29	0.43	GP
		633	Nakambala	5.0%	-0.39	0.62	GP
		634	Nega-nega	--	-0.33	0.33	GP

Table 6-41(2) Economic Efficiency of Small Urban Water Supply Projects

Code	Province	Code	Town	EIRR	NPV	B/C	System *3
60	Southern	635	Kafue-gorge	3.7%	-0.24	0.52	GP
		636	Chikankata	1.6%	-0.40	0.48	GP
		641	Monze	18.6%	0.52	1.53	GP
		642	Chisekesi	1.8%	-0.19	0.46	GP
		651	Choma	34.6%	1.55	1.74	GP
		652	Batoka	--	-0.22	0.35	GP
		653	Pemba	2.2%	-0.22	0.46	GP
		654	Mbabala	1.3%	-0.18	0.44	GP
		661	Kalomo	6.7%	-0.34	0.76	GP
		662	Zimba	10.8%	0.02	1.06	GP
		672	Chirundu	--	-1.10	0.13	SWP
		681	Gwembe	--	-0.37	0.34	GP
		691	Sinazongwe	--	-2.18	0.07	SWP
		692	Maamba	3.8%	-0.64	0.56	GP
70	Luapula	711	Mansa	6.2%	-1.52	0.70	GP
		721	Nchelenge	--	-4.62	0.22	SWP
		722	Chiengi	--	-1.38	0.11	SWP
		732	Mwansabombwe	9.4%	-0.03	0.94	GP
		751	Samfya	--	-2.78	0.10	SWP
80	Northern	821	Kaputa	--	-1.15	0.13	GP
		831	Mbala	--	-0.95	0.39	GP
		841	Mporokoso	--	-0.92	0.24	GP
		851	Luwingu	--	-0.35	0.37	GP
		861	Chilubi	--	-0.21	0.22	GP
		871	Isoka	--	-1.56	0.26	GP
		872	Nakonde	--	-0.66	0.30	GP
		881	Chinsali	--	-0.82	0.29	GP
		891	Mpika	--	-3.90	0.34	GP
90	Eastern	921	Chama Township	--	-1.59	0.11	GP
		931	Lundazi	--	-1.66	0.20	GP
		941	Chadiza Township	2.0%	-0.27	0.47	GP
		951	Katete Township	--	-3.07	0.12	GP
		961	Petauke	--	-3.12	0.18	GP
		962	Nyimba	--	-0.64	0.18	GP
		963	Kacholola	--	-0.20	0.36	GP

Remark: *1 "--" means that EIRR marks less than zero percent.
*2 Discounted at 10%
*3 "SWP" means a surface water project. "GP" means a ground water project.

Table 6-42 Economic Efficiency of Rural Water Supply Projects

Code	Province	EIRR*1 (%)	NPV*2 (US$million)	B/C*2
10	Lusaka	7.4%	-1.7	0.70
20	Copperbelt	18.7%	10.4	1.93
30	Central	13.5%	2.7	1.19
40	Northwestern	--	-7.3	0.32
50	Western	--	-2.3	0.61
60	Southern	9.3%	-0.5	0.97
70	Luapula	6.9%	-2.9	0.76
80	Northern	--	-11.9	0.45
90	Eastern	1.2%	-18.1	0.47

Note: *1 "---" means that EIRR marks less than zero percent.
*2 Discounted at 10%

(3) Agricultural Projects

The annual benefit of agricultural development schemes is estimated as a difference of net production values under with- and without-project conditions. The net production values for major crops are estimated as a difference of agricultural products' value and production cost at 1995 economic prices. The products' values are estimated by a product of unit price and unit yield under with- and without-project conditions. The production costs under without-project condition are derived from the production costs through the present cropping pattern. The production costs under with-project condition are estimated on the basis of projected cropping patterns.

For irrigation projects, economic farm gate price of major crops during the evaluation period is estimated in Section 3.4. Unit yield, gross value, production cost and net value are estimated by with- and without-conditions. The hectareage of newly reclaimed land and upgraded lands from rainfed cultivation to irrigated or control drained farming, single crop to double crop and minor scheme to major scheme are estimated for the future. Then the irrigation benefit is obtained as the incremental net production value.

The total benefit of the 48 irrigation schemes proposed in the agricultural development plan is expected to aggregate US$189 million per annum in economic terms by the time all the schemes reach maturity. Project costs of the 48 irrigation schemes are estimated at US$1,071 million in total at economic costs. For the rehabilitation schemes, the value of existing facilities were not included in the project costs and were considered as sunk costs.

All 48 irrigation scheme projects were examined for economic efficiency. Table 6-42 shows the results of the examination. Of the 48 schemes, the EIRR of 29 schemes exceeded 10%, the opportunity cost of capital.

For fishery projects, an economic efficiency test was examined for the national total in the same procedure mentioned above. The economic indices of EIRR, NPV and B/C were 12.7%, US$32.3 million and 1.18, respectively. Thus, the projects would be said to have high economic efficiency and to be economically viable.

For livestock projects, the economic efficiency test was also examined for the national total. The indices of EIRR, NPV and B/C were 13.1%, US$3.9 million and 1.25, respectively.

Table 6-43 Economic Efficiency of Irrigation Projects

Province	Code	Project Name	EIRR (%)	NPV (US$ Million)	B/C
Multipurpose Dam Projects					
Lusaka	D-16	Chongwe	10.5	1.75	1.05
Copperbelt	D-10	Kafubu	13.2	36.41	1.33
	D-7	Mutundu	8.8	-7.14	0.89
Irrigation Dam Project					
Luapula	D-1	Lufubu	21.3	81.84	2.44
Eastern	D-18	Lundazi	15.7	20.60	1.66
ASIP Rehabilitation					
Lusaka	N-1	Chipata	28.7	0.25	3.64
Copperbelt	N-2	Ipafu	15.3	0.99	1.55
	O-9	Chapula	12.1	0.36	1.21
Southern	O-14	Buleya Malima	12.1	0.34	1.21
	O-15	Siatwinda	11.6	0.10	1.15
	O-21	Nakadbwe	11.3	0.04	1.13
Eastern	O-28	Makungwa	12.0	0.03	1.19
	O-30	Vuu	12.2	0.08	1.22
	O-31	Lusowe	11.3	0.04	1.13
Expansion of Existing Projects					
Lusaka	O-1	Chiawa	2.5	-0.25	0.44
	O-2	Chanyanya	2.5	-9.98	0.45
	O-3	Masstock	2.4	-12.82	0.44
	O-5	Kaunga	11.8	0.13	1.20
Copperbelt	O-6	Mpongwe (G/W)	2.4	-28.20	0.44
	O-7	Munkumpu	11.3	2.52	1.14
Northwestern	O-11	Ikelenge Pineapple	11.8	0.47	1.19
Western	I-1	Nakatoya	2.2	-0.13	0.42
Southern	N-4	Chiyabi	2.2	-0.13	0.42
	O-13	Kaleya Small Holders	--	-3.74	0.45
	O-18	Nakambala Suger	3.2	-4.52	0.33
	O-20	Nanga	2.4	-80.41	0.39
Luapula	I-2	Mansa Pilot Scheme	2.2	-0.13	0.42
	N-5	Kenani Vegetable Sheme	10.8	0.00	1.09
	N-6	Chiposa Mubende Scheme	2.2	-0.13	0.42
	N-7	Chembe Vegetable Scheme	2.2	-0.13	0.42
	N-8	Chama Vegetable Scheme	2.2	-0.13	0.42
	O-22	Kawambwa Tea	2.4	-0.60	0.44
	O-24	Mulumbi Coffee	11.5	0.08	1.16
	O-25	Lukulu North	11.8	1.58	1.19
Northern	O-27	Kateshi Coffee	2.4	-6.30	0.44
Potential Irrigation Projects					
Central	P-1	Machiya	8.7	-13.60	0.88
Northwestern	P-79	Mwombeshi	12.7	4.31	1.28
	P-80	Mwinilunga	14.1	15.13	1.50
	P-82	Kabompo	0.6	-103.87	0.36
Western	P-16	Katima Mulilo	10.7	1.12	1.06
	P-23	Zambezi Floodplain	10.8	3.11	1.07
	P-84	Ngambwe Rapid	10.7	1.12	1.06
	P-86	Manto Rapid	10.7	1.12	1.06
	P-88	Sioma Rapid	10.7	1.12	1.06
Luapula	P-37	Mushota Island	12.7	8.64	1.28
	P-45	Luapula	10.0	0.06	1.00
Northern	P-52	Chinakila	12.7	7.34	1.28
	P-65	Chilbula South	8.7	-13.60	0.88

Remark: "--" means that EIRR marks less than zero percent.

6.6.2 Financial Evaluation

(1) National Financial Situation

The capital investment for water system is basically funded by the public sectors in Zambia. As discussed in Section 3.2, the public entities concerned to the system are: central government, local governments and parastatals. Besides them, non-governmental organisations (NGOs), missionaries and some private sectors are running water supply systems. However, most of schemes managed by not public sectors are in small scale system except Lusaka water and sanitation system.

In order to consider the possibility of capital investment for water resources development, it is important to figure out the framework and extent of the public budget. The future trend of public investment for the system was estimated as budgetary ceilings. The trend of public investment for water sector was estimated in Table 3-11. The future investment amounts by the central government were accumulated as: K119 billion (approximately US$0.27 billion) by the year 2005 and K275 billion (US$0.63 billion) by 2015. Even apply the total amount in 2015, the total requirement of investment costs for implementation of the master plan (us$1.01billion) corresponded with almost twice of the estimate of the public investment.

Moreover, these amounts are based on the assumption that the capital investment environment and foreign economic cooperation in the future will keep the same conditions as in the past. On the other hand, the country's total external debt stood at US$7 billion in 1992. It rated at 193% of GDP in the same year. The total arrears on principal and interest payments amounted to US$358 million. Then, a debt-service ratio became to 29%. This means that Zambia has exceeded the critical line of foreign debt. In other words, as far as the country increases more foreign exports in the future than in the past trend, it might be difficult to get more new foreign loans.

In 1992, the total ODA was aggregated to US$1.13 billion which was segregated to US$0.79 billion or 69% of grants and US$0.35 billion or 31% of loans. During the recent six years from 1987 to 1992, an average of ODA comprised 73% of grants and 27% of loans. Accordingly, since new loans will be restricted in the future in consideration of the national financial situation, the country has to rely on more grants as ODA than loans.

(2) Managing Bodies

The cost recovery policy in water resources development and use projects varies in different countries. They range from zero to full cost recovery including the payment of interest cost. In between, partial cost recoveries are widely in practice in accordance with different criteria and socio-political considerations particular to each countries.

It is said to be burdensome for financial status of water supply system to be kept in surplus condition, in general. In spite of large investment and comparatively expensive operation, it is troublesome to charge beneficiaries for water supply service on the basis of tariff corresponding to its all costs. To implement the system successfully, thus, it is imperative to procure lower cost of funds in addition to understanding of beneficiaries.

The cost recovery policy of water supply service is not clear in Zambia. At present, however, managing bodies in urban areas make all possible efforts to make both their income and expenditure meet in a same year. This endeavour is fundamentally based on "Full recovery policy". Therefore, once the income does not meet the expenditure, the bodies would try to revise the water service tariff.

On the other hand, the "O&M cost recovery policy" is to cover only operation and maintenance (O&M) costs of water supply system. In this policy, capital cost of system is customarily covered by general account of governments concerned or by grant of foreign assistance.

Water resources development in Zambia will require an accelerated and large amount of investment to keep up with rapid socio-economic development. To meet this requirement, not only effective investment but also efficient recovery of public expenditures should be pursued.

This study envisages two general criteria for formulating the water cost sharing policy.

(1) The first criterion is a leading criterion that the beneficiaries are required to share, according to the benefits they receive, the entire cost of the public facilities including construction, operation and maintenance costs if the beneficiaries are identifiable and are confined to certain sections of the community. In principal this cost should not be covered by tax revenue collected from general tax payers who include non-beneficiaries, but should be recovered from the beneficiaries themselves as a separate charge. This criterion is based on the free market economy principle and the principle of equity, which encourages the economic efficiency and optimum allocation of national resources.

(2) The second criterion is that the government grant should be provided only if it is necessary in order (a) to encourage the beneficiaries' participation in development or (b) to provide social amenities from the standpoint of subsidising low income people. Even in this case, the cost recovery policy would rather be discussed with beneficiaries. For instance, in construction period some beneficiaries might have an opportunity to share some tasks of construction works as task force. In operation and maintenance stage, some O/M works such as simple periodic inspection could be managed by some beneficiaries. By this participation works, the costs for water supply works could be saved in accordance with beneficiaries' attendance.

(3) Household Economy

The average household expenditure of the country was K5,042 in 1991 and distributed as K9,251 in urban area and K1,920 in rural area, as discussed in Section 2.1.6. Among household expenditure, housing expense accounted for 19% of the total expenditure in urban and 11% in rural. Expenditure for water was only 0.57% of the total expenditure in urban and 0.11% in rural. Since an average household monthly expenditure in 1991 was K9,251 in urban areas and K1,920 in rural areas, an average monthly expenditure for water was estimated at K53 (approximately equivalent to US$0.65) in urban areas and K2 (US$0.024) in rural areas.

In economic evaluation, the benefit from water supply for household was estimated to be 5% of household income as the maximum affordable value which is recommended in the World Bank report of " Investing in Development". This percentage was much larger than the above

research results. As analysed in economic evaluation, however, many projects were not viable from the economic point of view even applying the maximum affordable value. Thus, it is seems to be difficult to find the most suitable water value for both consumer and water supplier. It is important for the both as well as the government to understand these difficulties and to try to find rules of cost sharing.

(4) Financial Evaluation of Water Supply Projects

Construction cost of water supply projects are estimated for each scenario, and variation in construction cost by fluctuation of parameters, such as unit consumption rate and service coverage, is examined in Table 6-44. This Study assumes unit consumption rate for domestic use in large urban area, in small urban area and in rural areas as 180 lit./person/day, 150 lit./person/day and 35 lit./person/day respectively. However, the unit consumption rate in Lusaka at present is estimated at between 130 and 150 lit/person/day. The cost variations if the unit consumption rate decreases by 10% or 20% are as shown in Table 6-44, fluctuating the industrial unit consumption rate in the same way. The result of the examination shows that 10% decrease in the amount of water developed would save 20% of the construction cost.

The coverage of the water supply services in large urban, small urban and rural areas are assumed as 100%, 100% and 75% for this Study. If the coverage rates for large urban areas, small urban areas and rural areas are changed to 100% (same), 80% and 50%, the construction cost would decrease by around 10%. The construction cost varies from US$ 1,010 million to US$ 500 million when unit consumption rate is decreased by 0% to 20% and the supply coverage changes as described above, for the Base Scenario-Agricultural Expansion (medium population projection) and the Conservative Scenario (low population projection).

The cumulative capital expenditure of the central government for water supply projects during the years up to 2015 can be estimated as US$ 630 million, assuming continuous foreign assistance and government expenditure for the sector. The ratio of estimated government capital expenditure to the construction cost is calculated as 1.6 to 0.8. The gap between the two is not so wide. The estimation of cumulative government capital expenditure is made based on the past record of government investment, which might be smaller than it should be. Further, if the target of economic growth is achieved as the scenarios assumed, government investment will consequently grow. It would therefore be possible to secure the investment to cover the required construction cost as proposed in the Base Scenario-Agricultural Expansion and in the Conservative Scenario.

Table 6-44 Effect of Variations in Water Demand

Demand Decrease	Area	Unit Consumpt.	Service Coverage	Domestic Use	Industrial Use	Loss	Present Capacity	Water Developed	Const. Cost
		lit/person/day	%	1000m3/day	1000m3/day	1000m3/day	1000m3/day	1000m3/day	US$ million
Base Scenario - Agricultural Expansion									
0%	Large U.	180	100	810	362	293	989	1,048	1,010 (1.00)
	Small U.	150	100	145	85	34			
	Rural	35	75	255	0	25			
10%	Large U.	162	100	729	326	264	989	822	792 (0.78)
	Small U.	135	100	131	77	31			
	Rural	32	75	230	0	23			
10%	Large U.	162	100	729	326	264	989	706	680 (0.67)
	Small U.	135	80	104	77	27			
	Rural	32	50	153	0	15			
20%	Large U.	144	100	648	290	235	989	620	598 (0.59)
	Small U.	120	100	116	68	28			
	Rural	28	75	204	0	20			
20%	Large U.	144	100	648	290	235	989	519	500 (0.50)
	Small U.	120	80	93	68	24			
	Rural	28	50	136	0	14			
Conservative Scenario									
0%	Large U.	180	100	738	287	256	989	802	807 (1.00)
	Small U.	150	100	144	77	33			
	Rural	35	75	231	0	23			
10%	Large U.	162	100	664	258	231	989	622	626 (0.78)
	Small U.	135	100	130	69	30			
	Rural	32	75	208	0	21			
10%	Large U.	162	100	664	258	231	989	514	517 (0.64)
	Small U.	135	80	104	69	26			
	Rural	32	50	137	0	14			

6.6.3 Social Evaluation

(1) Incentive to Regional Economy and Increase of Employment Opportunity

It is obvious that commencement of construction works such as water supply and irrigation projects induces regional economy to activate in the sectors related to construction works as well as construction sector itself. According to the analysis of the input-output table of Zambia in 1985, the Leontief inverse matrix showed that one unit of construction work would induce 1.54 units of economic effects in the national economy. The regional effects could be activated by the investment in the same sense, although the regional effects could not be expected to get the same effects as the national total ones.

According to "Labour Force Survey 1986, CSO", 0.36 million or 13% of the total labour force was unemployed. Of the unemployed people, the unemployment rate for urban areas was 19.2% while that for rural areas was 10.6%. Taking into account of the economic growth of 1.2% on average during the recent eight years, it would be difficult that the present labour market was improved more than that in 1986.

The investment of the proposed projects would activate the regional economy and create a new labour market in the regions. Accordingly, it would be clear that the investment proposes new labour opportunity for the people unemployed and underemployed in the regions.

(2) Improvement of Safe Water Coverage and Public Hygiene

After the completion of the proposed projects, all urban people and 75% of rural people will be able to enjoy their living conditions with safe and sufficient potable water. Popularization of potable water decreases mobility of water-borne diseases, and accordingly provides the decrease of medical expenses and the alleviation of absence because of diseases. These effects have already intertwined into economic evaluation.

Besides, the popularization of potable water might be effective for decrease of mortality rate of water-borne diseases, infant mortality rate in particular. As a result, healthy and comfortable living conditions could be created for the people in the society, and the people could enjoy their lives under the conditions. This amenity improvement might provide them a base for social activity in the next stage.

In particular, the rural water supply projects are expected to be managed by the rural beneficiaries themselves. This activity would be useful to enlighten them regarding public hygiene and to formulate their community. The community functioning well is indispensable for better management on water facilities. Thus, the existence of good community is a key issue whether or not the water supply system is maintained and operated in good condition. In the time when the water supply system is constructed in rural areas, an organizer should arrange a water supply system with a special view to organizing a good community. In that case, the managing body could be function not only for maintenance of the system but also for better living in the community.

(3) Inducement to Participating in "Woman in Development" Activity

A cooperation of projects beneficiaries in the region where the proposed projects will be implemented, in rural areas in particular, is one of the most fundamental issues with a view to proceeding the projects effectively. It is insisted that a role of women in the region is essential for the projects to be managed favourably and to be accepted smoothly by the beneficiaries. Once that people in the beneficial areas, women in particular, participate to development activity from a planning stage, the plan could introduce an appropriate technology for the people and reflect their customs in the society. In this context, this process would cause for the people to accept the new system fully and to adopt the projects easily. From this point of view, it is essential that a planning agency formulates an organization of the people which gives advises to the agency and that the agency reflects the advises from them. Accordingly, the projects would give incentive for the people, particularly women power, to be involved, and the people could participate to the management of the projects easily. It is a basic element that the projects are managed favourably and perpetually in the region.

(4) Mitigation of Economic Disparity among Regions

There are not a few projects which were given priority to mitigate economic disparity among the regions in the country. Some irrigation projects took priority to mitigate food imbalance among regions, in spite of their less economic efficiency. In water supply projects as well, some projects were given priority to improve living conditions because of serious water deficit in the region. Thus, the schedule was established to settle the regional balance even on the way of implementation, although the completion of the projects in the target year would nevertheless give the people sufficient living conditions in the country.

6.6.4 Initial Environmental Evaluation

(1) Environmental Issues for Development Projects

As a first step in the environmental assessment of the likely development projects, "Initial Environmental Examinations" ("IEE's") have been carried out for a number of multi-purpose (for urban and irrigation supply) dam and reservoir projects, irrigation storages and their associated irrigated areas, "run of the river" irrigation schemes, aquaculture (fish pond) projects, water supply pipelines and groundwater borefields. The dam and reservoir projects met the following criteria :

1) There are no obvious environmental flaws such as the proposed construction of a diversion weir on the Zambezi River upstream of Victoria Falls, the country's most important tourist destination. Tourism must win in this case.
2) The proposed storage does produce a measurable regulated output.
3) In the absence of preliminary costing information, there needed to be a comfortable relationship between bank size and regulated output. For some storages, a "storage efficiency ratio" of bank volume to regulated output of less than 1000 ($1000m^3/m^3/s$) was used.

These assessments have been done according to JICA requirements and have followed the traditional environmental checklist approach. The checklist was based on a combination of JICA requirements and a comprehensive listing of likely issues developed by the New South Wales Department of Water Resources in Australia. As with the earlier water quality judgements, the similarities between Australian and Zambian hydrology render this a reasonable starting point.

Table 6-45 sets out the environmental issues associated with water resource, water supply and water use projects. This checklist in turn has become the basis for the preliminary assessments set out in the "Environmental Project Sheets" included in the water quality and environment supporting report. These "Project Sheets" meet the important requirements of providing a project description, a site description, a screening of key issues and lastly, a scoping response to the likely key issues. These issues are then addressed in typical draft terms of reference for EIA studies for the various kinds of project.

(2) EIA Study Typical Terms of Reference

Based on the environmental issues checklist shown in Table 6-45, Initial Environmental Examination assessments were undertaken for several of the most promising development projects. As shown in these IEE checklists included in Supporting Report Part Q, a number of special investigations and studies will be necessary during the EIA stage. To give an indication of the scope of works required for such EIA studies, the supporting report also includes typical terms of reference for the following types of project :

- Dam and reservoir projects
- Groundwater borehole projects
- Pipeline projects
- River offtake and water treatment projects

- Irrigated agriculture projects
- Aquaculture projects

Typical terms of reference for an EIA Study for a dam and reservoir development project are described briefly below. A more detailed description and similar outlines are given for the other types of project in Supporting Report Part Q.

(a) Project Description

The EIA study work must be done on the basis of preliminary engineering designs, and in some cases, detailed designs and specifications. To adequately describe the project, this new engineering work should include contoured plans for the reservoir area, land acquisition plans, embankment details covering its stability under rapid drawdown conditions, the expected source of all construction materials, particularly those occurring naturally on the site, a hydrologic analysis and details of spillway provisions, outlet works, the water management plan and an outline of the river diversion plans, landscaping plans, construction camp site plan, access roads, housing, and security fencing.

(b) Stream Channel and Catchment

This study activity should include borrow pit erosion control plans, bed and bank stability measures (both upstream and downstream of the reservoir), the introduction of silt lines in the storage and any effects on the downstream low flow stream course.

Table 6-45 Water Resource Projects - Checklist of Environmental Issues

General Requirement	Key Issues	Description
Need for IEE & EIA	Legislative power	Required by GRZ processes.
DWA Role	Establishment	Land acquisition, compensation, land use changes, land tenure, resettlement, social infrastructure.
	Farmer Issues	Farmer co-operatives, water right allocations, farmer credit, farmer training, market access, social equity.
	Water Quantity	Surface hydrology, groundwater hydrology, water demands and the impacts on; reliability of streamflow, groundwater levels and accessions, existing users and in-stream uses. Monitoring programmes and assessment of diversions.
	Water Quality	Quantity & quality of all effluents & their effect on receiving waters; license limits for all discharges; effect of & effect on land uses.
	Water Management Plan	To cover: prevention of contamination of water resources; remedial action plan; design criteria for water control; a water budget for both dry & wet seasons and the impact on aquatic ecosystems.
	System Operations	O&M funds, operations, staffing & management, water orders, payment system, monitoring.
	Stream Channel	Check erosion & sedimentation effects & their impact on aquatic & riparian biota.
	Flood Plain Management	Adequate spillway capacity; stream diversion works; no increase in flood levels nor redistribution of flood waters; check on bridge waterway openings.
	River Extraction	Check bed & bank stability, both at the site, upstream & downstream; check sedimentation effects on the storage life & behaviour; limit excavation in the low flow channel.
	Aquatic Environments	**Ecological Value** Assess impact on aquatic & semi-aquatic flora & fauna & on terrestrial fauna reliant on the water resource; establish measures to preserve the riparian strip & to sustain any wetlands & wildlife corridors. **Recreational Value** Provide for activities such as fishing, hunting, sports, bird observing & other current recreational activities. **Commercial Value** Provide for existing and future revenue sources such as capture fishing, fish breeding, stock watering, fish farming. **Scientific, Educational & Cultural Value** Check current educational uses & any areas of scientific or cultural interest.
	Legislative Requirements	Licenses will be required to discharge effluents & to divert water. Most projects will require a formal EIA study.
	Maps and plans	As well as engineering concept plans, the proposal should be illustrated by large scale air photos, by ground level photographs, by longitudinal sections & cross sections to a nominated datum.
Roles of other GRZ agencies	Licenses & approvals	ECZ for effluent licenses and for EIA assessment. Water Board for the associated diversion licenses.

(c) Effect on Other Users

The impact of the proposal on the output from other storages on the same river system and on other nearby users should be documented. Ideally, a series of hydrologic and river system operational studies covering both "before and after" scenarios should be undertaken.

(d) Groundwater Study

The possible integration of groundwater resources with the surface water proposal and the impact of the storage on local and regional groundwater levels and thus resources should also be studied. This study will include a review of waterlogging and possible soil salinisation.

(e) Aquatic Ecosystem

The aquatic flora and fauna and the flora and fauna of the riparian strip and any wetlands should be surveyed in both the wet and dry season by an experienced freshwater biologist.

(f) Vegetation Survey

The affected and surrounding vegetation should be mapped as the first part of the flora and fauna work and plans prepared for restoration and landscaping works. This survey should include a report and recommendations on the best fate of any timber resources that will be flooded by the stored waters.

(g) Land Use Changes

Any land use changes proposed for the reservoir surrounds or for the stream's catchment should be documented and discussed with the local residents and villagers.

(h) Social Impact and Social Disruption

A survey of landowners and villagers living in the affected area should be undertaken with a view to : (i) setting up local advisory groups, (ii) explaining the project through visits, discussions, letters, meetings and through the local press, (iii) outlining land resumption plans and (iv) briefing local leaders on the future after the project becomes operational.

(i) Heritage and Scientific

A survey for items of heritage and scientific value should be made and agreement reached on their value and the most appropriate way of either preserving the relic, of relocating it or more likely, of documenting its features as part of a local inventory.

(3) Initial Environmental Examinations

In the related supporting report on water quality and the environment, project descriptions and Initial Environmental Examinations (IEE's) are presented for the following projects and project types :

1) Multi-purpose Dams and Reservoirs
   - Chongwe(Site 16)

- Kafubu (Site 10)
- Mutundu (Site 7)

2) Irrigation Dams and Reservoirs
- Lundazi (Site 18)

3) Groundwater Borehole Installation
- Lusaka Urban

4) Pipeline Project
- Kafue River - Lusaka

(4) Summary of Potential Impacts

The following comments are grouped by project type. For some projects, such as Chongwe multipurpose dam, the impacts from the proposed dam and reservoir, the associated irrigation areas and long distance pipelines would all apply. Before starting on the summary comments, it should be acknowledged that no "fatal flaw" has been discovered at any of the identified projects. However, given the preliminary nature of the irrigation and fishpond proposals and also to the fact that none of these suggested sites has yet been inspected, it is not possible to offer the same assurances for these projects at this time.

(a) Dam and Reservoir Projects

Following field inspections of a number of these sites, the six nominated projects of this type are thought likely to produce important potential impacts such as :

- Land tenure, compulsory acquisition, compensation and settlement.
- Destruction of key habitats within the flooded area.
- Control of catchment and construction site erosion.
- Commitment of instream flows to downstream environmental purposes.
- Monitoring of the health of the present and future aquatic environments.
- Replacement of timber and forest resources flooded by the reservoir, particularly at both Kafubu and Mutundu storages.

(b) Groundwater Borehole Projects

The key environmental issues with the Lusaka groundwater project are thought to be :

- Checking that any withdrawals will not exceed the recharge of the selected aquifer.
- Prevention of pollution of this aquifer following any encroachment of urban land uses in outer Lusaka.
- Designing a clean effluent treatment system.

(c) Pipeline Projects

The key environmental issues associated with projects of this type are :

- Restoration of the vegetative cover (both natural and improved pasture) along the pipeline easement.
- Securing the necessary easements along the selected route.
- Avoiding any sensitive habitats along the route.

(d) River Offtake and Water Treatment Projects

The key issues with the Livingstone project are thought to be :

- Disposal of any effluent products from the adopted water treatment process.
- Impact on the works on the stream channel selected for the offtake point.

(e) Irrigated Agriculture Projects

The large landtake associated with irrigation projects, be they based on new dams or "run of the river", will produce the following key issues :

- Land tenure, acquisition, compensation and resettlement.
- Groundwater monitoring against the treat of waterlogging and land salinisation.
- Preservation of sensitive habitats and avoiding any interruption to wildlife corridors.
- Introduction of the necessary social infrastructure.
- Introduction of the support infrastructure of roads, drains, power and communication.
- Erosion control and re-vegetation of all earthwork sites.
- The collection of water use charges to set up funds to ensure professional staffing and
- adequate funds for operations and maintenance.

(f) Aquaculture Projects

The key issues with the range of projects of this type will be :

- Monitoring of the groundwater regime to check on seepage losses and the potential
- threat of waterlogging.
- The licensing and safe disposal of nutrient rich effluent from the drained ponds.
- Land tenure, acquisition, compensation and resettlement.

6.7 Laws and Institutions

Contributions to the "Water Resources Development Plan toward the Year 2015", under the heading of "Laws and Institutions", fall into two categories:-

- Changes in legal arrangements
- Strengthening the organisational structure

These proposed changes and enhancement are outlined in section 6.7.2 and 6.7.3 respectively. They are put forward to achieve the following nine (9) important targets that are described in section 6.7.1 under the heading of "Targets for Institutional Improvement".

6.7.1 Targets for Institutional Improvement

To improve the present situation for water resources development and management in Zambia, institutional restructuring should be attempted to deal with the following key issues:

1) Capacity enhancement of institutions for the implementation of development projects and their subsequent operation and maintenance
2) Comprehensive water resource planning
3) Co-ordinated operation for water resource management and administration
4) Introduction of watershed management
5) Contingency management systems for drought and flood
6) Establishment of cost recovery for water resource development, operation and maintenance
7) Decentralisation of water resource management and administration
8) Establishment of appropriate water quality standards and monitoring system
9) Encouragement of residents' participation

(1) Capacity Enhancement of Institutions

Generally, water resources are abundant in Zambia and should be exploited for beneficial use. By contrast, a stable supply of safe water is not available to many Zambians. Priorities should be put, for the moment, on the development of resources to encourage economic welfare and social equity. Emphasis in water resource development is still to acquire sufficient amount of safe water and on its easy access. Enhancement of national institutions coupled with strengthened legislation for water resources development should be an urgent task.

(2) Comprehensive Water Resource Planning

If quality water is abundantly available for all people, there is no need to make an allocation plan. There might be, however, a necessity for well planned allocation and inter-sectoral adjustment in certain areas where the amount of clean water does not meet all demands and conflict might arise among water users.

Demand for domestic use of quality water will increase with population growth as well as with rising living standards. Demand for food will also increase with the growth of population and living standards and wit boosted demands for food, in turn, will raise water demands for irrigation, livestock breeding and fishery. Industrial water demands will also grow with development of industries and may cause deterioration in quality, thus reduce available quality water.

Even though clean and safe water is nationally abundant and surpasses the demand at present, in certain areas, future demands should be taken into account. Water resource development plans should always be made for the long term by examining future demand as well as the need to conserve resources for future generations. Water resource development, once implemented, cannot be easily undone and poor execution may lead to a loss of scarce resources.

The appropriation of water resource should be made in conjunction with other resources such as human, financial, and other natural resources including lands. Maximum use of water can be achieved through comprehensive planning formulated by stakeholders from various sectors and though legal instruments that allow intervention of the Government and local authorities for the flexible allocation of water resources.

In areas where insufficiency of surface water is predicted, and in the case of drought, groundwater could provide another source of supply. Control over the groundwater aquifers and their use, as well as surface water, is important in exploitation of the two resources.

(3) Co-ordinated Operation for Management and Administration

The Government budget is insufficient to allow for any duplicated efforts. Human resources should also be allocated efficiently with clearly defined responsibilities.

(4) Introduction of Watershed Management

Watershed management can take various forms depending upon the geographic, meteorological, social and economic activities in the region.

Because of the scarce financial and human resources, especially at professional level in the Government and of the Government policy to reduce its size, it is clear that efforts in water resource management and administration should be intensified in controversial areas where the exploitation will be high, preservation of minimum flows will be threatened, and water contamination or pollution will be evident.

(5) Contingency Management Systems for Droughts and Floods

The occurrence of a drought can cause serious effects on social and economic activities in an area. Contingency management, including early warning, control of water use and operation of water facilities, requires a different management emphasis than that at ordinary times.

Definite control procedures under the strong leadership of the Minister should be established through co-operation between sectors. Hydrological and hydrogeological data, water right records and operational records from water works and facilities should be well kept for the emergency operation.

(6) Establishment of Cost Recovery

To a certain extent, water is one of basic human needs and should be subsided for people who cannot afford to pay the cost. Water is, however, one of the resources important for economic activities and the cost should be paid by beneficiaries. Tariff tables could be revised to cover,

at least, the operation and maintenance cost of the services. Tariff collection should be strictly enforced and meter installation should be promoted.

Within the course of the establishment of cost sharing system, cost efficiency could be attained through decentralisation and privatization, which is the policy of the Government. Residents would be willing to pay the cost for water supply and sanitation services only when they feel that reliable services are provided effectively and efficiently.

(7) Decentralisation of Water Resource Management and Administration

Decentralisation could be one way to secure efficiencies in the water supply and sanitation sector. Decentralisation would promote management better suited to the local conditions. For example, with poor transportation, hydrologic measurement or water quality monitoring require much time of technical staff, who are not sufficient and valuable.

Financial arrangements including tax reform, would be necessary to promote the decentralisation. Technical support, including training of local staff, is a first step to encourage decentralisation.

(8) Establishment of Water Quality Standards and Monitoring System

Environmental standards for drinking water quality and for effluent discharge are stipulated in the Environmental Protection and Pollution Control Act. Intruduction of water quality standards in water cource should be considered.

Monitoring is the first and the most important step for environmental conservation and it requires substantial numbers of staff, equipment and materials. Once water quality has deteriorated, it is very difficult to recover, especially in groundwater aquifers.

(9) Encouragement of Residents' Participation

Residents' participation will be another way to assure effectiveness and efficiency of the water resource management, especially in rural communities. Through residents' participation, rural water supply schemes or irrigation projects can be made more sustainable and suitable for local conditions. With participation, residents recognise the facility as their common property and take good care of it.

6.7.2 Legal Arrangements

(1) Establishment of Legal Hierarchy and Arrangement of Legal Instruments

Legislation without enforcement or obedience is worse than nothing even though the content of legislation is appropriate. Detailed regulation is inevitable for the proper or equitable enforcement of fundamental laws. Subsidiary legislation, such as specific regulations and standards should be established according to needs and social circumstances, and should be revised in accordance with the development of Zambian society.

Fundamental laws, which stipulate the policies of the administration, should be debated as a political process, and then approved by the Parliament or the President. Frequent changes of

principal laws will hamper reliable administration. Generally, once stipulated, any changes in fundamental laws would take a long time.

Thus, establishment of a legal hierarchy is recommendable, separating fundamental stipulations from their legal instruments.

(2) Legislation of Water Resources Development and Management

As mentioned in Section 3.11.1.(2), the proposed revisions to the Water Act by the Water Development Board have covered most of the present deficiencies. Under the revised Act, however, subsidiary regulations should be established especially for groundwater development and management.

Both in the past and today, major water resource development, which requires large investment, has been designed and constructed using international or foreign financing coupled with technical assistance. This approach is applied particularly to the hydro-power sector. For sustainable development suitable for local conditions with reliable operation and maintenance, some form of technical standardisation should be established as legal instruments.

(a) Preparation of Regulations and Technical Standards for Water ResourcesDevelopment and Management

Standards should be arranged for the following items.

- criteria for water resource planning, including maintenance of required discharge from dams for normal functions of the rivers and the existing water use
- criteria for design of water facilities, including safety standards
- procedure for water resource measurement, assessment, survey, planning and design
- forms and procedures for application and approval of planning, design and construction, including environmental impact assessment
- survey, planning and design manuals used in the above procedures
- methods and procedures for inspection and supervision of construction
- operation manuals
- forms and procedure for reporting of operation records and accidents

Technical standards might be established by a Technical Standards Committee in the Department of Water Affairs advised by the Legal Counselor of the Water Development Board.

(b) Regulations for Groundwater Management

The preparation of the following subsidiary regulations are recommended.

- Forms and procedures for application and granting of permits
- Obligations of permit holders
- Notification of abstraction or construction of borehole
- Licensing of borehole drillers
- Zoning for conditions of abstraction based on the characteristics of aquifers

(c) Classification of Rivers and Regulations for Decentralisation

There are many rivers in the country which should be managed with limited human and financial resources. All rivers do not necessarily require an equal intensity of management efforts. Rivers can be classified into several categories according their environmental unit, socio-economic importance and their hydrological characteristics.

Regulations should be set forth to provide managerial procedures for each classification, with a demarcation of duties, discretion and cost allocations for national, provincial and district levels. A manual for daily works made under the standards recommended above would help introduce a unified implementation.

(d) Water Resource Management in Traditional Lands

Proper water resource management in traditional areas could be made in conjunction with sound land tenure and land use management. Water management in traditional lands can proceed after the decision of land legislation and clarification of the roles of government, local authority and chiefs as discussed later in the Land Bill.

(e) Period of Water Right

Currently neither the period nor the maximum period of a water right are clearly defined in the Act. The period might be determined at the discretion of the Board, while maximum period can be 30 or 50 years, for example. Effective water allocation cannot be well conducted without standard or maximum limit of the periods of water rights.

For encouragement of investment in individual sectors, such as hydro-power, the period of the right could be as long as the project life in order to secure benefits of the investment. Beside, an efficient allocation of water among various sectors to realise the socio-economic development plan requires flexible allocation. Optimal allocation could change according to rapidly growing socio-economic development.

(f) Promotion of International Agreements

As referred in the draft of the National Water Policy, the "Helsinki Rules" sets forth general rules on the use of the water of international drainage basins except as may be provided otherwise by convention, agreement or biding custom among the basin states. The Rules, however, are general rules and do not provide specific terms or conditions. A protocol on the Zambezi River Basin and other shared SADC water course systems has been agreed between Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania and Zimbabwe. Agreements should be arranged, based on the Helsinki Rules or SADC's Protocol, when diplomatic conditions allow and when large diversions of water are projected to occur in the Luapula (the Congo River Basin) and the Lake Tanganyika Basin.

(3) Laws on Water Resource Conservation

(a) Review of the Natural Resources Conservation Act

Before many arrangement for the establishments of a legal system for water resources conservation, as generally stated above, conformation of fundamental laws, especially

between the Natural Resources Conservation Act and the Environmental Protection and Pollution Control Act, should be achieved. In short term, some part of the Natural Resources Conservation Act should be reviewed, whose interpretation fall difficult because of the revocation made at the time of establishment of the Environmental Protection and Pollution Control Act. The scope of the two laws should be clearly demarcated. In long term, the Natural Resources Conservation Act should contain the national policy for rational use and conservation of natural resources, including pollution control, and a framework for policy enforcement, regulations and responsible entities. Stipulations of the Natural Resources Conservation Act should be reviewed to avoid any discrepancy with the current social conditions.

Under the established conformation of fundamental law on water resources conservation, stipulation of regulations for monitoring, and water quality control activities, such as Environmental Impact Assessment, Water Quality Standards of the water courses, and regulations on effluent monitoring by enterprises themselves and on other effluent control measures, should be encouraged and promoted.

(b) Promotion of Environmental Impact Assessment

Environmental Impact Assessment (EIA), as currently drafted, would be a efficient measure for water quality control with limited finance and staff of the Government. Once quality degradation occurs, the recovery or remedy might incur more costs than those for the prevention. The introduction of EIA, however, might impose much more cost on industries, resulting in losing competing capability to the foreign industries. It could be start in a designated area, where pollution loads potentially exceed self-cleaning capabilities, for designated types of industry whose effluent might contain much polluting loads, such as pulp industries or food processing industries or some type of chemical industries. The introduction could star with large scale industries which normally discharge more effluent and can bear the burden of EIA.

(c) Zoning and Designation of Areas

Similar to the resource development and management sector, it might be irrational to put equal emphasis on all rivers and aquifers in the resource conservation activities. Therefore, some regulations might be necessary to designate specific zones for resource conservation in order to intensify the efforts against pollution and to restrict land use or industrial activities in such zones.

The degree of strictness of environmental standards could be varied according to the physical and social conditions of the area. Socio-economic acceptability and practicability might also vary from region to region. Tentative targets or standards which can be attained within the current institutional capability, could be applied within a limited period in some areas. In long term view, local authorities might set their own standards, which should be stricter than the limit set by the Environmental Council.

6.7.3 Organisational Strengthening

(1) Principles to be Applied

The proposed changes to the current Zambian organizations are aimed at achieving three principles:-

- Separation of regulatory and operational functions
- Separation of water resources management from water supply and sanitation
- Achieving a phased program of change

As well as the report sections dealing with each of the above activities, staffing and human resources and allocation of responsibilities by both task and activity are also covered.

(a) Separation of Regulatory and Operational Functions

The involvement of governments, in general, can be divided into three areas: 1) legislative, 2) regulatory and 3) operational. The legislative area includes legislation of policies, regulations and funding of basic programmes and projects determined through the legislative process, hence, ultimately, the political process.

The regulatory area is composed of:

- Policy and strategy formulation
- Overall planning
- Co-ordination with other sectors
- Guiding programme actions
- Measuring the results of actions in conformity with specified objectives (standards)
- Monitoring activities and enforcement of laws and regulations bearing on:-
  * the resource use, commonly pertaining to rights to the resource
  * real-time allocation or operation under hydrologic events, such as droughts, floods or pollution spills
  * appropriateness of resource use
  * quality effects of any use
  * facilities' configuration
  * safety of facilities and environmental impacts
- Financial aspects of water service entities
- Review of cost recovery schemes, the application of charges and financing operations

The operational area includes the followings:

- Data collection, processing and dissemination
- Project planning
- Design
- Construction and supervision
- Operation and maintenance
- Extension services including education and training of residents
- Registration

This area is conducted, with authorization invoked by the legislative bodies, by governmental line agencies at various levels as well as by semi- or non-governmental entities especially in

operation and maintenance phases. Operational functions generally involve a larger volume of activities of more specialised personnel, and thus demand more financial resources. Establishment of operational agencies might be more difficult. Upgrading performance of the operational entities, however, seems to be more important.

Currently, the Government of Zambia has a policy to promote decentralisation, so that functions discharged by the central Government would preferably transferred to the local authorities, to public or private corporations. In this institutional study, separation of regulatory and operational functions are mainly examined in the context of decentralisation, through which operational functions would be transferred to the local authorities and to river basin authorities.

Most of functions of environmental agencies can be classified as regulatory. For the discussion below, inspection and monitoring in the environmental sector, except those for measuring the performance of operational entities, are considered as operations.

(b) Separation of Water Resource Sector and Water Supply and Sanitation Sector

Each of the sectors requires a different approach even though they are closely related to one another. Water supply and sanitation sector is directly connected to the living conditions of the nation, while the water resource sector is responsible for the optimal use of the resource as a whole for the nation and for future generations. Generally water supply and sanitation schemes are managed by local authorities or communities and public corporations in many countries, while the resource management is conducted by governmental hierarchy, constituted at international, national, provincial and district levels according to the size and importance of the river. As proposed by Water Sector Development Group (WSDG), separation of the management of the two sectors is recommendable.

(c) Phased Development of Re-organisation

The application of the above two principles would require extensive institutional strengthening, involving major shifts of duties and staff. Because of the current limited human resources, major training programmes would be necessary. The implementation would require a substantial period of time and involve many sections of the Government. The implementation should be carried out step by step followed by monitoring and assessment of the progress.

The re-organisation is proposed in to phases, long term perspective and short term recommendation. Long term perspective shows the conceptual shape of the organisations when the above two principles are applied, while short term recommendation shows intermediate shape to remedy the current deficiency without major difficulty.

For some regions, sophisticated management would be required in the near future, while conventional management might be suffice for the moment for other regions.

(2) Responsibility Allocation

For the following discussion, 17 sub-management sectors listed in Table 3.11-2 are grouped into the following four sectors, according to the nature of the management and the current assignment of responsibilities.

1) Water Resource Sector
   a) Water allocation
   b) Surface water assessment and development
   c) Groundwater assessment and development
   q) Multi-purpose water facilities
   n) Drought relief
   o) Flood plain management
2) Water Supply and Sanitation Sector
   d) Domestic water supply
   h) Industrial water supply
   j) Waste water treatment
   p) Urban storm water drainage
3) Water Conservation Sector
   k) Pollution control
   l) Watershed improvement, including soil erosion and sedimentation control
   m) Eco-system conservation
4) Sectoral Water Use Management
   e) Irrigation
   f) Fishing and aqua-culture
   g) Hydro-power generation
   i) Inland navigation

A demarcation could be set between the Water Resource Sector, the Water Supply and Sanitation Sector, and the Sectoral Water Use Management in that the Water Resource Sector will be in charge of the development and management for the bulk water supply derived from large scale water facilities. Its subsequent treatment and distribution will be the responsibility of other sectors.

As for hydro-power generation, the competent authority, currently Zambia Electricity Supply Corporation can erect water facilities, if the facilities have single purpose and if the authority have the capability to plan, design, operate and maintain the facilities. The water allocation for the water sector, and approval of the project in planning and designing, however, should be made by the Resource Sector. The Resource Sector should provide hydrologic and other information, while the hydro-power sector should report on operation, and operate in accordance with the regulations and orders made by the Resource Sector.

Local authorities might be in charge of urban storm water drainage. The Water Resource Sector, however, should support District Councils in co-operation with the road construction and maintenance sector and the urban planning sector.

Responsibility allocation in long term perspective and short term recommendation is shown in Table 6-44. "Commission/Council - Department" systems, which is currently common in all levels of government where advisory functions to top management is carried out by a

commission or a council, while executing functions to implement orders from top management, are also taken into account in the Table.

In the following Table, CU's (Commercial Utilities) and the NWASCO (National Water and Sanitation Council) are organisations proposed by the Water Sector Development Group (WSDG) under the Programme Co-ordination Unit (PCU). Further discussion of these groups can be found in section 5 (6). The table deals only with the Water Resources Sector, the Water Supply & Sanitation Sector and the Water Conservation Sector.

Table 6-46 Proposed Responsibility Allocation in the Long & Short Term

Sector	Items	National Level (Administrative)	Decentralised Level (District, River Basin)
Long Term Perspective			
Water Resource Sector	Advice for Decision and Policy Formulation	Water Development Board	Water Allocation Committee of the River Committee
	Executing Branch	DWA	River Authorities
Water Supply and Sanitation Sector	Advice for Decision and Policy Formulation	National Water and Sanitation Council	District Councils
	Executing Branch	Dept. of Infrastructure and Supporting Services in MLGH	Commercial Utilities, District Engineering Dept. etc.
Water Conservation Sector	Advice for Decision and Policy Formulation	ECZ	Local Natural Resources Conservation Committee
	Executing Branch	DNR	Competent Dept. in District Council
Short Term Recommendation			
Water Resource Sector	Advice for Decision and Policy Formulation	Water Development Board	Water Allocation Committee of WDB and Kafue River Authority
	Executing Branch	DWA	DWA and/or Kafue River Authority
Water Supply and Sanitation Sector	Advice for Decision and Policy Formulation	National Water and Sanitation Council	District Councils
	Executing Branch	Dept. of Infrastructure and Supporting Services in MLGH	Commercial Utilities, District Engineering Dept. etc.
Water Conservation Sector	Advice for Decision and Policy Formulation	ECZ	ECZ, Local Natural Resources Conservation Committee
	Executing Branch	DNR, Inspectorate of ECZ	Inspectorate of ECZ

(3) Overall Management and Co-ordination

The three principles are applied to correspond increasing requirement to water resources development and management. Clarified responsibilities, their allocation and decentralisation would promote efficient discharge of the increasing responsibilities.

There are close relation, however, among the above three sectors and other sectoral water use management, and the linkage among them is increasing, especially in areas with congested water demands, such as those along the Kafue River Basin.

Comprehensive management and co-ordinated activities are necessary for water resources development and management. The Ministry of Energy and Water Development, staffed with DWA, would be responsible for overall management and co-ordination, on behalf of the Government through its technical support of NWASCO and Water Development Board, with advise from ECZ and DNR.

The proposed River Authority would be competent and responsible for overall management of the water resources of the respective region. Kafue River Authority is proposed to meet the envisaged increasing requirement in the sort term.

(4) Staffing and Human Resource Development

The most important factor to increase institutional proficiency is staffing. Adequate numbers of capable personnel are essential. A human resource development strategy can be made following clarification of the existing gap between present capability of personnel and necessary human resource to discharge the responsibilities.

Staffing and human resource development should be made after detailed assessment of required duties and present capability of the staff. The assessment will require considerable input of specialists for human resource development. Currently, the Department of Water Affairs is proposing a programme for consultancy by an international agency including the assessment of current jobs and present capability.

The DWA, MLGH, ECZ, NCSR and the Government should seek any chances of technical assistance by foreign or international agencies for human resource development of core personnel and institutional improvement. The DWA should start immediately to make a preliminary assessment of the required courses and amount of technical training necessity, while waiting for a complete assessment, in order to take measures for the critical path.

The MEWD or the DWA should establish a Human Resource Development Section in its Administrative Division. Probably, the similar section in the Ministry of Agriculture, Food and Fishery, which is a comparatively strong organisation, can be a model for the establishment. The created section should promote relations with foreign or international agencies for technical assistance which provide various courses, as well as with academic fields for the staff development for the next generation.

(5) Re-organisation of Water Resource Sector

(a) Re-organisation in the Long Term

Operational functions of the Water Resource Sector might be assigned to each River Authority in the basin, which in turn might have the following sections.

- water allocation committee
- information section (including registry services)
- planning section
- design and supervision section
- conservation section

River Authorities should be established as decentralised bodies for water resource management by river basin. After the establishment of a River Authority, DWA could be a regulatory body for the technical and administrative aspects of water resource development and management. Establishment of the River Authorities would be realised when sufficient number of staff are trained.

(b) Recommended Re-organisation

The recommended organisation is shown in the Figure 6-7. Each line section should carry out the duties as listed below in the figure.

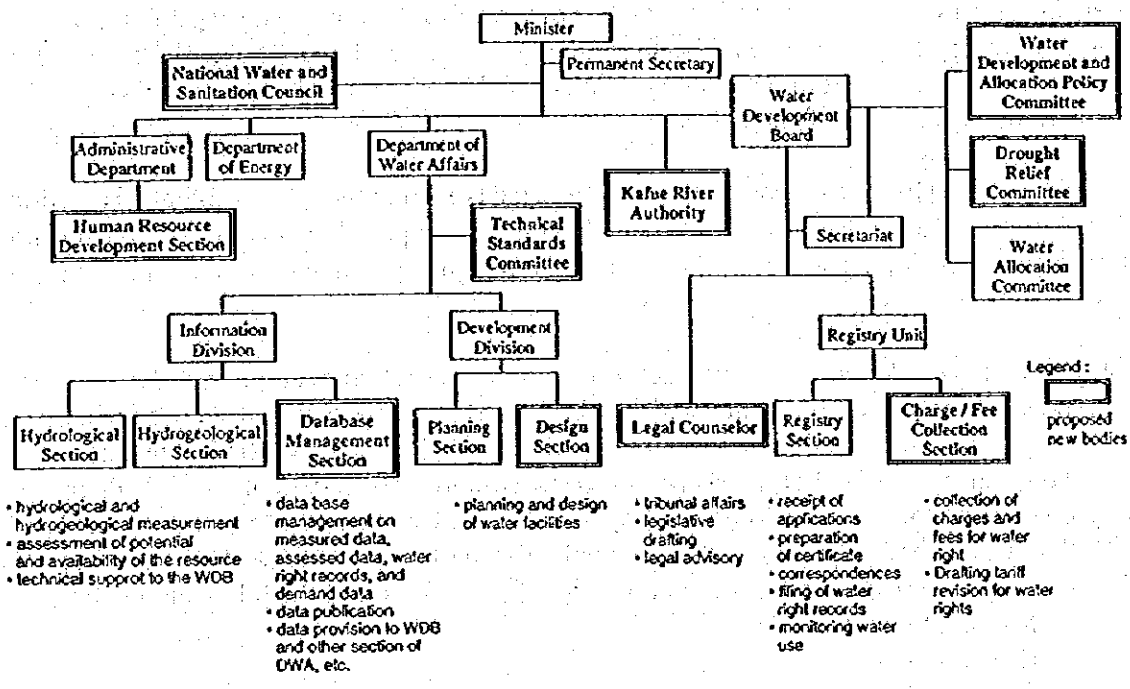

Figure 6-7 Proposed Organisational Structure for Water Resources Development and Management

Water Development Board should be extensively strengthened not only to resolve the current staff insufficiency, but also to discharge increasing responsibilities for water allocation policy formulation, and additional regulating activities on groundwater abstraction.

Water Development Board itself and Drought Relief Committee would preferably be chaired by the Minister, or the Permanent Secretary. The Water Development and Allocation Policy Committee, which might preferably be chaired by the Director or high ranked officer of National Commission for Development Planning and its members should be policy makers of all sectors that use water as well as of agencies related to the resource conservation, water resource development and allocation policy.

The Drought Relief Committee should be managed under the strong leadership of the Minister implementing the power given in the Water Act under revision. The Committee will be in charge of early warning, quick shift of water allocation, shift of water use from surface water to groundwater and relief measures for affected people. The procedure of implementation should be carefully prescribed.

The Water Allocation Committee will be in charge of the tasks which are currently carried out by the Water Development Board, such as authorising, modifying or rejecting of water rights applications under the policy and guidelines, issued by the Water Development and Allocation Policy Committee.

Inspection should be carried out by Registry Section for monitoring water use including detection of non-registered water use or the conformity of water use to the granted water right, especially for groundwater.

The recommendations for re-organisation of the Hydrological and Hydrogeological Sections are made based on the future needs for water resource development. The capabilities for the design and project planning should be strengthened. Because of shortage of skilled staff for the resource development in the country, DWA should continue to be a technical centre for the efficient engagement of valuable staff.

The Information Division could also cover water quality recommendations outlined in section 7.3 for improvements in water quality sample collection, upgrading Zambian water quality laboratories, developing and introducing new water quality guidelines and establishing a water quality database.

The Kafue River Authority should set up to attain water allocation and development objectives, which would be formulated by the Water Development and Allocation Policy Committee, and which could minimise the possible conflict, specific to the Kafue catchment area. The Authority could be in charge of water resource conservation as well. Planning, design, construction or supervision, and operation and maintenance of multi-purpose dams and other water facilities along the river would also be the duty of the Authority, but the allocation of these responsibilities can only follow the resolution of the following matters:-

- Mission Statement
- Objectives
- Responsibilities
- Membership of the Authority
- Source of Funds
- Headquarters' Location

The Kafue River Authority is recommended for the Kafue River basin management, to handle the expected conflicts in the development needs in the future. Functions of the River Authorities other than the Kafue River Authority, would be discharged by the DWA for the moment. For the period between the long term and short term tables, efforts should be made for preparing full implementation of decentralisation or separation of operational and regulatory entities.

Flood control and flood plain management could start with an assessment of necessity, such as an estimate of damages. The assessment should be carried out by planning section supported by the Town and Country Planning Commission and Land Department regarding the current and future settlement in flood prone areas.

(c) Position of the Water Development Board

The Water Development Board, after employing its own staff, could alternatively be independent from any ministry or shifted to the Office of the President. This alternative might encourage unprejudiced water allocation which better enables optimum use of water for achieving the socio-economic development of the country, as well as to promote a strong regulating power for the control of water use and to accept co-operation by other ministries or agencies for formulation of water allocation policy.

The Commission of the Inquiry into Salaries, Salary Structures and Conditions of Service in the Public Service has issued a report discussing restructuring the Public Service at ministerial level. The Commission, in the report, recommends reform of the Public Service and reduction in the number of the ministries and statutory bodies.

Under the ideas advocated in the above report, creation of a new ministry or agency is not acceptable. Although the report does not recommend a clear direction of reform of the water sector, the report classifies all public services into seven categories; 1) General, 2) Defense/Security, 3) Economy, 4) External Relation, 5) Services (social welfare), 6) Natural Resources, 7) Public Utilities. The water sector cannot be simply classified into one of the above seven categories, as it includes characteristics of Economy (Water use for industries and hydro-power generation), Natural Resources (Water Resources) and Public Utilities (Water Supply and Sanitation Sector). The recommended ministries classifications in the Report are as follows:

- Ministry of Agriculture, Food and Fisheries
- Ministry of Lands, Environment and Housing Development
- Ministry of Energy
- Ministry of Mines and Mineral Development
- Ministry of Tourism

Natural resources management could be divided to i) resources management as properties of the nation, including their conservation and ii) resources exploitation. As for the ministry in charge of field i), a new Ministry of Lands, Water and Environment, with dividing the Housing Development Sector to the Ministry of Works and Supply, might be worth to be considered. The establishment of the this ministry could promote linkage of water resources management with lands, and with natural resources conservation policies required for sustainable development and management of the resources in the future. The separation of the two fields of i) and ii) could also encourage equitable regulation of water without bias or the intervention of a specific sector. As a by-product, decentralisation of registry services for water use, as well as effluent discharge licences, could be promoted utilising the network of the existing land registry system.

(6) Re-organisation of Water Supply and Sanitation Sector

(a) Bottle Necks for the Sector Improvement

Bottle necks for the improvement of this sector are definitely scarce budget and technicians. Without establishing an equitable cost recovery and budgetary system, and training required numbers of staff, no improvement can be realised. A competent section for training could be

Chalimbana Local Government Institute. The Institute should provide technical courses for the sector.

Decision on tariff tables would be apolitical, but a prescribed determination procedure, or formulae for calculation or revision should be drafted and prepared. The prescribed procedure should be open to the public, so that efforts for efficient and reliable services by the operating entities are required. Meter installation for each household should be encouraged, starting from large users, and endeavours to decrease leakage are also necessary.

Budgetary restructuring and savings planned by the Government are expected to reduce transfer payment to local Councils, entitling its own financial revenues with a tax reform, and will lead to a greater portion in the Councils' self financing of their operation and to a greater autonomy in setting their rates and rents. The scarce budget and insufficient allocation of technical staff in local authorities will raise the needs for technical and administrative guidelines or standards on which each local Council can operate and manage its activities for water supply and sewerage services and set the rates compatible to the conditions of the communities.

(b) Re-organisation Considerations

The Water Sector Development Group (WSDG) is studying re-organisation of the water supply and sanitation (sewerage) sector. The study set forth the following seven principles for the sector improvement.

1) Separation of water resources functions from water supply and sanitation
2) Separation of regulatory and executive (operational) functions within the water supply and sanitation sector
3) Devolution of authority to local authorities and private enterprises
4) Achievement of full cost recovery for water supply and sanitation services (capital recovery, operation and maintenance) through user charges in the long run
5) Human resources development leading to more efficient institutions
6) Technology appropriate to local conditions
7) Increased GRZ priority and budget spending to the sector

All of these principles are agreeable and can be confirmed from the successful experiences around the world. The study proposes the establishment of organisations, including the National Water and Sanitation Council (NWASCO) - in charge of regulatory functions under the Ministry of Energy and Water Development (MEWD), and Commercial Utilities (CU's) - public companies whose shares are held by the District Councils, discharging operational functions under the control of the Ministry of Local Government and Housing (MLGH).

The proposal would promote a upgrading of the services. However, detailed functions and their relations of NWASCO and CU's, and of their regulatory bodies, MEWD and MLGH should be studied further. For example, strategy formulation for water supply and sanitation should also take account of township or country development planning which is discharged by MLGH. Even though design and construction are included in operational functions, it will be necessary to acquire much support from DWA for a long period, especially in the case of large scale facilities. Financing and auditing of the sector, which is one of the regulatory functions,

has a close relation to overall financing and auditing of local government controlled by MLGH.

The above recommendation includes major changes. A major change should be conducted through a phased development plan. It could be easier to shift township water supply scheme to CU's at first. As recommended in the WSDG report, Copperbelt could be the most promising province for the first transaction to CU's if ZCCM agree to participate in the scheme for capital sharing and operation. It could be advantageous for ZCCM in streamlining its organisation for water supply to its employees, which would become the responsibility of a public authority, especially when the ZCCM is privatised as currently proposed. In addition, the cost recovery for sanitation services and rural water supply should be recognized as long term target.

(c) Necessary Steps for Re-organisation

The re-organisation of Water Supply and Sanitation Sector would require many steps. The steps might include the following

1) enhance accounting function in Water Supply Division
2) establishment of proper tariff table and its preparation procedure for water supply and sewerage services, led by MLGH in co-operation with DWA and NCDP economists
3) starting co-ordination and joint-operation with the Ministry of Local Government and Housing (MLGH)
4) standards arrangement for efficient maintenance of facilities
5) technology establishment for sewerage services
6) separation of the Hydrogeological Section and the Drilling Section and attaching the Drilling Section to the Water Supply Division

(d) Sanitation Sector Research

Should sewerage treatment be thought worthy of further research, the most competent organisation might be National Council for Scientific Research, funded by MLGH, or the Ministry of Health. The Water Research Unit should start research and collecting information from international organisations and domestic entities which have some experience, such as Lusaka Water and Sewerage Company. The duties of the Unit for the moment should be to find suitable technologies to be applied, preparation of design and operation criteria appropriate to Zambia, projection of future demands and formulation of initial development policy or plans. The Unit should participate in all sewerage projects seeking technical transfer to the sector.

(7) Re-organisation of Water Resource Conservation Sector

(a) Concept of Re-organisation

The Sector should also be decentralised because environmental protection and resource conservation activities might vary by region according to geographical or hydrological conditions and to the degree of socio-economic development. Once polluted or contaminated, damaged environment directly affects people's health. Careful monitoring and equitable conservation activities require residents' participation.

Decentralisation for the Sector should also start with human resources development. Encouragement of normal functioning of Provincial or District Natural Resources Conservation Committees and establishment of competent departments within District Councils would be necessary with supports by the DNR. To realise the concept illustrated in Table 6.7-1 would require much training and efforts to close the gap between the current capacity and that required. Thus, decentralisation of the Sector, especially that of operational function to the competent departments would take long time.

The Environment Council currently has two functions legally, namely, advisory functions to the Government on the environment and operational functions, such as monitoring for environmental protection and conservation, currently discharged by the Inspectorate of ECZ. After the transfer of operational function to the River Authorities for water quality monitoring and database arrangement, and to the competent decentralised entities for other functions, ECZ could be an advisory entity.

Concerning watershed improvement, sedimentation is not a large problem in Zambia. Soil conservation could be discharged by the Department of Agriculture. This field might require major support from the Water Resource Sector, agricultural sector and forest sector.

Extension of the duties of the ECZ to eco-system conservation and socio-economic factors should be conducted, hiring ecologists, wildlife biologists, botanists, zoologists, social anthropologists, sociologists, archeologists, social planners and economists in the future. In the long term, the ECZ and the Department of Natura Resources (DNR) might have to carry out soil conservation activities staffed with soil engineers, soil scientists or agronomists, while these duties could be discharged by the Department of Agriculture in short term.

(b) Recommended Re-organisation

The DNR should have the regulatory functions of natural resource conservation and pollution control. The following units would be essential.

1) Policy and Strategy Unit; national environmental policy and strategy formulation
2) Legislative Unit; preparation of draft legislation
3) Co-ordination Unit; inter-ministerial and international co-ordination, and co-ordination with local authorities and NGO's.
4) Administrative Unit; administration and financial support to the ECZ and local committees

With a substantial shift of staff from the DNR, the ECR should be better able to fulfill the present responsibilities in short terms.

(8) Irrigation Sector

The strengthening of the Sector is proposed in "Irrigation Sub-programme in Agricultural Sector Investment Programme (ASIP) Appraisal" Report. The proposal can be analysed as well formulated. The reorganisation should be promoted as proposed in the ASIP.

(9) Water Research Unit of National Council for Scientific Research

The Council suffers from a serious staff shortage for the execution of its Water Research Unit. There might be two options for the Unit:

a) to be merged into DWA and create a Research Unit in DWA's Development Division, or into the Environmental Council
b) to be entrusted research by contract with governmental agencies and by their statutory bodies or private firms, thus ensuring financial autonomy with which the Unit or the Council can decide the salary of its staff

The principal role of the Council should be to carry out research which is new to Zambia and not allotted to a line organisation of any governmental agency.The disadvantage of option b) is that it must accompany the total change in mode of existence of the Council. The option b), however, is worthy of examination if other units in the Council also suffer the same problems. The option b) would create motivation for the researcher and consequently promote efficiency of the Council.

6.7.4 Other Institutional Arrangements

(1) Cost Recovery, Water Pricing and Cost Allocation

The cost recovery of water supply and sanitation schemes is being studied by the WSDG, and concrete proposals will appear later. Cost recoveries for water resource development projects are also to be pursued. Charging mechanism should be examined based on the following.

a) cost of services
b) ability to pay
c) opportunity cost
d) incremental cost
e) market driven forces, such as water auctions

Water pricing can also be set as means of resource allocation as well as a constraint on public expenditure. Currently, fees for water rights are collected only at the time of application, registration, and renewal, so that the right holder with long period can use much water with little fee, even though the large users are charged according to the volume of the registered rights, and the fee was revised in 1990 and 1993. There are examples that some holders has larger volume than they actually use, while new applications are not possible.

For appropriate allocation and optimal use with maximum benefits of water, and for proper estimation of water use, the charges for water rights for large users could be charged annually with revised fee table, after Water Development Board establishes the Charges and Fee Collection Section, being capable of the billing. Water pricing by estimation of opportunity cost, which is defined as the value foregone by the use of water for one purpose instead of its next best use, is recommendable, especially in areas with competitive use of water.

Currently, fees and charges for water rights are deposited into general budget. This financial flow could be modified, to include all or a part of fees or charges to be devoted to a part of the cost of water resource development and management such as an investigation fee for the engineer's comment and fees for registry services by the Water Development Board.

An equitable basis of cost allocation for multi-purpose development should be prepared and prescribed. The Japanese cost allocation, as described below, could be examined as a model for introduction. The following two are the basic principles for construction cost allocation in Japan:

- Costs of common facilities used for multiple purposes are shared by the relevant sectors.
- Facilities for a specific purpose shall constructed at the cost of the sector (separable cost).

Cost sharing for the construction of the common facilities is calculated as follows:

- Incremental cost caused by the participation of a sector shall be born by the sector.

The remaining cost for construction of the common facilities are shared with the following calculation:

- Every sector shall never bear the cost more than the cost which is incurred for the construction of its own facilities (alternative cost) with the same benefits, nor than the value of the benefits resulted from the participation (justifiable expenditure).

The above principle shows that the participation with the cost more than the one of the two is not feasible for the sector. If the total of the less cost between the alternative cost and justifiable expenditure would be less than the total of the construction costs of common facilities, although this would rarely happen, the multi-purpose project is not feasible.

The remaining cost is shared by the following portion:

- Alternative cost and justifiable expenditure shall be calculated for each sector.
- The less cost between the two shall be selected
- The cost, the less cost minus the separable cost, shall be calculated (applied cost) for each sector.
- The remaining cost shall be borne according to the portion of the applied cost of the sector to the total of the applied cost.

In case that a sector cannot receive the benefit at the commissioning of the facilities, for example the water supply sector is not necessary to intake water from the reservoir developed by the dam but definitely will be necessary within five years, the applied cost can be discounted at prescribed interest for each sector.

(2) Encouragement of Residents' Participation and Gender Issues

Resident's participation might be inevitable in rural water supply scheme and irrigation projects for small farmers, especially in operation and maintenance phases. The planning and design of water facilities should also be made in accordance with the local socio-economic structure and the opinion of the residents in the region as much as possible. Labour force and local material could be provided by the community. Many parts of operation and maintenance can also be carried out by the local community. Spare parts and materials for operation and maintenance could also be stored at provincial level.

Information dissemination and education on public hygiene and on operation and maintenance are necessary to promote residents' participation. Public awareness on water rights and

resource conservation, including saving water, should be promoted. Educational material should be prepared and provided in consultation with the relevant ministries.

Despite the important role of women in rural water supply and irrigation for subsistent agriculture, women's participation to these projects is limited by rural customs and poor co-ordination of officials.

Promotion of education for officials and relevant personnel is necessary. Manuals and texts could be prepared in co-operation with the Women In Development (WID) Section in NCDP, a Section in the Department of Policy and Planning in the Ministry of Agriculture, Food and Fisheries, and NGO's. Encouragement of women's associations might be helpful, co-operating with the Ministry of Community Development and Social Services or the above sections.

(3) Lands Acquisition, Compensation and Resettlement Scheme

The Land Acquisition Act is fair legislated and takes into account of actual land management practices, especially those in rural areas. The estimation of compensation in the Act, however, is made mainly based on evaluation of investment or improvements made in the land, not on the econimic value of the land itself.

No major land acquisition has yet occurred in Zambia. Resettlement might often damage, sometimes seriously, the living conditions of resettlers, and in some cases, of those of inhabitants who accept the resettlers near their living areas. Preparation for defining the procedure of implementation of lands acquisition and subsequent resettlement by the recommended Planning Section of Development Division in the MEWD would be necessary prior to the planning of major water resource development, involving the agricultural sector. Planning a resettlement scheme should be combined into the project planning. The cost of resettlement should also be included in the cost of the project.

In the programming of resettlement, to assure not only proper compensation but also to guarantee future incomes (equal to or more than those of enjoyed previously by resettlers), might be the most important issues. Other important issues include minimisation of the social and cultural impact and encouraging resettlers to adopt the change. Socio-economic analysis of their income generation structure and the social and cultural modes of the community should precede the planning. In principle, the less distance the settlers move, the less negative social and cultural effects occur.

The best approach for sustainable resettlement might be early participation of residents. Their participation in the planning phase of the project could promote a smooth implementation of resettlement.

(4) Investment and Maintenance of Office Equipment

Much hindrance, at present, is caused by communication troubles, poor transport and by inefficient data processing and filing. Improvements in these areas might show a large return on investment in office equipment and transport. Information is an important arm for officials especially those who work for regulatory agencies. For them, the benefit of the investment might be unaccountable.

CHAPTER 7 ACTION PLAN

Proposed water resources development plan toward year 2015, including descriptions of the water supply and agriculture projects and implementation schedules, was described in Chapter 6. In this Chapter, the action plans for the water supply sector, the agriculture sector and laws and institutions sector are described in order to execute the projects in accordance with those implementation schedules over the next twenty years.

7.1 Action Plan for the Water Supply Sector

Action Plans are formulated after selection from the proposed projects in the water supply sector, applying the following criteria:

1) Projects whose implementation is scheduled in the first 5 years of the 20 year period covered by this Study
2) Projects serving higher population
3) Projects which require longer periods for the study and design

Selected projects are Commencement of the Water Supply Project for Lusaka Urban Area, including Northern Lusaka Production Well Project and Chongwe Dam Water Supply Project, and Groundwater Development Training Centre Project.

(1) Commencement of the Water Supply Project for Lusaka Urban Area

The Lusaka Water Supply Project is the largest in scale of the large urban water supply projects and is given the highest priority. This project consists of Northern Lusaka Production Well Project, Chongwe Dam Water Supply Project and the Kafue Pipeline Project. Two proposed projects, the Production Well Project and the Chongwe Dam Project are programmed in the first five year stage up to the year 2000.

Northern Lusaka Production Well Project

The development potential of the groundwater basin in northern Lusaka is estimated at about 38,000m^3/day and is barely developed at the moment. Northern Lusaka Production Well Project, comprising 50 wells of 20,000m^3/day pumpage, corresponding to 53% of the development potential, and estimated to cost about 16 million US$, is recommended. The supervising ministry in charge of water supply projects, the Ministry of Local Government and Housing, and the implementing agencies, Lusaka City Council and Lusaka Water and Sewerage Company, should commence this project immediately.

Chongwe Dam Water Supply Project

Chongwe Dam is a multi-purpose dam project to supply domestic and industrial water and irrigation schemes. Chongwe Dam Water Supply Project will provide 100,000m^3/day potable water to the Lusaka waterworks. The estimated cost for this project is 109.87 million US$. This project is promising as a new multi-purpose source development. Feasibility Study of this project should be commenced at an early stage by the supervising ministry, the Ministry of Energy and Water Development and the implementing agency, the Department of Water Affairs.

Financial Examination of Proposed Projects

The above two projects proposed in the action plan were examined regarding project viability through financial internal rate of return (FIRR). They are (1) Lusaka water supply system of which water source comes from northern wells (Northern Wells Case); and (2) Lusaka water supply system of which water source come through Chongwe dam (Chongwe Dam Case). The items are summarized as follows:

Table 7-1 Financial Conditions and FIRR of Proposed Projects

(Unit: US$ Million)

Item	Northern Wells Case	Chongwe Dam Case
Capital Investment Cost	15.75	109.87
Annual O/M Cost *1	0.788	5.494
Revenue of Water Supply Services *2	249	1,234
- Domestic Water	67	334
- Municipal Water	84	419
- Industrial Water	98	480
FIRR (%)	10.0	5.2

Note: *1 In addition, replacement costs such as machinery and equipment in stations are added in every 20 years.

*2 Average water consumers are assumed as follows on the basis of the present water tariff. 80% of consumers was assumed to pay for their water charges.

Domestic water	Average consumption volume	Unit rate
Domestic water	115 lit/capita/day	K217 /m^3
Municipal water	50 m^3/facility/day	K338 /m^3
Industrial water	100 m^3/facility/day	K288 /m^3

FIRR of the Northern Wells Case was 10.0%, as seen in the above table. This rate corresponds to the rates of 8% to 10% applied by the World Bank and African Development Bank, although it is less than market interest rates in Zambia. Thus, as far as the water supply services are managed under the present water tariff and the investment funds are procured from the public financing organizations such as WB and AfDB, the project will be feasible from the financial point of view.

FIRR of the Chongwe Dam Case was 5.2%. The project will not be feasible from the financial point of view, in the case that the project funds are procured even from the public financing organizations. Although detailed countermeasures may be discussed in the next stage analysis of feasibility study, the following proposals could make the project acceptable as a viable project in the future.

(1) approximately 40% (around US$44 million) of the capital investment cost is granted;
(2) a loan at an annual interest rate of less than 5.2% is available; and
(3) water consumers have a willingness to pay of 25% higher charge for potable water.

Actually, the above countermeasures could be mixed in the case that one measure could not be applied fully for the case. In any case, these countermeasures are considered to be affordable.

At present, LWSC has the following management problems on its water supply and sewage services.

1) Net worth is too small and excessively relies on long-term liabilities for capital investment. At present, an interest burden seems to be relatively low but this

condition causes cash flow difficulty in the future when the repayment of loan will begin. Thus, LWSC would rather increase net worth as much as possible, which comprises own capital, internal reserves and contribution in aid of construction from beneficiaries. In addition to that, the company should try to find favourable terms of loans for supplemental funds of construction works.

2) In 1993, the company spent the large amount of K2.37 billion for administrative expenses. This lies heavy on the management. The heaviest component was bad debt losses. Thus, the company has to exert all possible efforts to charge water tariff correctly and to recover uncollected charges.

3) The improvement of operation and maintenance is a key issue to keep the plant machinery and piping network in good condition. This would extend their economic lives and decrease not only O/M costs but also depreciation of the facilities hopefully. It could make water tariff keeping low and steady. As a result, this management policy would get people's dependence on the water supply system and finally recover their reliance on the company.

To implement the aforesaid projects, LWSC has to improve its own management characteristics in addition to the favourable loans mentioned above. For pursuance of the projects, every body concerned to the projects including the central and local government, LWSC and beneficiaries has to co-operate to make the projects implement.

(2) Establishment of Groundwater Development System

For the smooth implementation of the future groundwater development, the promotion projects for groundwater development are proposed in the Master Plan for the water supply sector. The projects are composed of the Drilling Centre Projects and the Groundwater Development Training Centre Project. Priority shall be given to these projects.

Drilling Centre Projects

The objective of the drilling centre is to promote the implementation of groundwater development in whole Zambia, by increasing the capacity of drilling through the centre established in each province. The groundwater development plan proposed in the Master Plan will be realised through these centre. The functions of the centre are: 1)Preparation of drilling plan 2)Selection of well field 3)Drilling 4)Construction of water supply facilities 5)Improvement of existing well 6)Repair and maintenance of drilling equipment 7)Instruction of rural water supply and so on. The drilling centre projects are summarised as shown in Table 7-2.

Table 7-2 Drilling Centre Projects

(1) Centre Location, Trainees, Establishment Schedule

Province	Town	Party and Trainees (P:party, T: trainee)					Establishment Sche.	
		Well Location	Well Drilling	Equipment Maintenance	Rural/W/ S Instructor	Total	Centre	New Rigs
Lusaka	Lusaka	P=1,T=8	P=2, T=16	P=2, T=10	T= 8	T=42	New	
Copperbelt	Ndola	P=1,T=8	P=3, T=24	P=2, T=10	T=14	T=56	New	2
Central	Kabwe	P=1,T=8	P=3, T=24	P=2, T=10	T= 20	T=62		
N/western	Solwezi	P=1,T=8	P=3, T=24	P=2, T=10	T= 12	T=54	New	2
Western	Mongu	P=1,T=8	P=2, T=16	P=1, T=5	T= 20	T=49		
Southern	Monze	P=2,T=16	P=5, T=40	P=3, T=15	T= 26	T=97		
Ruapula	Manza	P=1,T=8	P=3, T=24	P=2, T=10	T= 12	T=54	New	2
Northern	Kasama	P=2,T=16	P=5, T=40	P=3, T=15	T= 20	T=91	New	3
Eastern	Chipata	P=3,T=24	P=6, T=48	P=4, T=20	T= 28	T=120	New	4
Total		P=13,T=104	P=2, T=16	P=2, T=10	T= 160	T=625	6 Centres	13 rigs

(2) Operation and Maintenance

Cost	Initial Cost (Drilling Equipment, Construction of Centre)	41.64 Million us$
	Well Drilling(1,200 wells/year), Maintenance of Centre)	7.32 Million us$ /year
Income	Selling of Production Wells (1,200 wells/year)	10.12 Million us$ /year
Balance	Selling Profit of Production Wells = 2.80 Million us$ /year. 15 years after the centre establishment, total selling profit of production wells and initial cost will be balance.	

Groundwater Development Training Centre Project

The objective of the groundwater development Centre is to train groundwater engineers for the smooth and effective implementation of the groundwater development projects proposed in the Master Plan. The training courses include hydrogeology, well drilling, mechanics, rural water supply instructors and so on. This project is composed of three phases. The first phase of the project should be promoted in co-operation with MLGH and MEWD. Project description is summarised in Table 7-3.

Table 7-3 Groundwater Development Training Centre

Items	Stage-1	Stage-2	Stage-3
(1) Period (2) Targets of Stage (3) Job Description	1996 - 1998 (3 years) - Establishment of Centre - Initial Training < Centre Establishment > a) Construction of Centre -Building: 3,000m2 b) Equipment Supply - 2 rigs (DTH type) etc. c) Staffing 30 Zambian Staffs < Initial Training > a) Objectives -Training for Zambian Staff -Feasibility Study of Northern Lusaka Well Fields -Arrangement of O/M system b) Trainers 4 Foreign experts dispatched by consultant c) Trainees Zambian staff who are key persons in Stage-2	1999 - 2003 (5 years) - Training of Zambian trainers by foreign experts - Training of engineers a) Trainers - 3 long term experts - Several short term experts - Qualified Zambian staffs b) Trainees 470 mon-month Zambian trainees covering - Hydrogeology Course: 10 persons/year (10 persons/yr x 1 cycle) - Drilling Course: 10 persons/year (10 persons/yr x 1 cycle) - Mechanical Course: 20 persons/year (10 per./ 6 mon.x 2cycles) - Village Instructor Course: 110 persons/year (10 per./mon. x 11 cycles)	2004 - - Training of Zambian trainees a) Trainers - Qualified Zambian experts b) Trainees 470 mon.month Zambian trainees covering - Hydrogeology Course: 10 persons/year (10 persons/yr x 1 cycle) - Drilling Course: 10 persons/year (10 persons/yr x 1 cycle) - Mechanical Course: 20 persons/year (10 per./ 6 mon.x 2 cycles) - Village Instructor Course: 110 persons/year (10 per./mon. x 11 cycles)
(4) Financial Status			
(Cost)	a) Initial Input 16.400 mil.us$ - Center Establishment 14.800 mil.us$ - Initial Training 1.600 mil.us$ b) Ope.and Maintenance 0.100 mil.us$	a) Initial Input 0.000 mil.us$ b) Ope.and Maintenance 0.264 mil.us$/yr	a) Initial Input 0.000 mil.us$ b) Ope.and Maintenance 0.264 mil.us$/yr
(Income)	a) Initial input is to be donated b) 0.073 mil.us$ through production wells completed in initial training	a) Cost for foreign trainers is to be donated b) Cost for spare parts: 0.164 mil.us$/yr is to be donated. c) 0.100 mil.us$/yr through production wells completed in initial training	a) 0.094 mil.us$/yr (200 us$/man.month) through training charge b) 0.170 mil us$/yr through production wells completed in initial training
(Balance)	a) Zambian Government bears cost for land acquisition b) O&M cost: 0.027mil.us$/yr is to be born by Zambian Government	Level	Level

7.2 Action Plan for the Agricultural Sector

Investment for agricultural development should be made with the initiative of the private sector. The role of the government is to regulate, induce, encourage and support the private sector's investment in accordance with the national agricultural policy. Although the Study proposes agricultural development plan for crop production, fishery and livestock breeding, the national food security relied most on crop production. Investment for fishery and livestock breeding development should basically be carried out by the private sector corresponding to changes in standards or preference of the food consumption of the people. Supporting services by the government to the private sector, such as the fish breeding centre project and the technical assistance programme to the field of veterinary science, donated by the Government of Japan is important and should be promoted further. The most important subject for the Zambian agricultural sector is to establish drought resistant point, agricultural action plans are selected from the irrigation projects applying the following criteria:

1) Economically feasible projects (EIRR > 10%) which contribute the economic growth of the agricultural sector and are expected to be invested by private sectors
2) Projects whose technical knowledge is accumulated for implementation and realisation is confirmed technically
3) Projects to improve the regional disparity of income of farmers and food Balance within the region
4) Projects contributing to improvement of the balance of payments of the country by production of export crops or materials for agro-processing industry

(1) Implementation of ASIP Rehabilitation Project

It is recommended to implement the ASIP Rehabilitation Project at the earliest possible date. This project is evaluated as high priority, because quick realisation of effect is expected. Rehabilitation of projects is recommended to be completed by the year 1999 within the first Phase of the ASIP programme. The Rehabilitation Project is composed of 9 individual projects, totalling 267 ha of beneficial area. The construction cost will amount to 6.55 million US$. It is proposed to introduce double cropping of vegetables aiming at peri-urban agriculture. Benefit of this Project is expected to be 1.71 million US$/year, with average EIRR of 14%. The features of each project are as follows:

Table 7-4 ASIP Rehabilitation Projects

Project (code)		Location	Area (ha)	Cropping	Facility	Cost* (US$ million)	Benefit* (US$ million per annum)	EIRR (%)
1. Chipapa	(N-1)	Lusaka	10	Vegetable	Diversion Weir	0.09	0.064	28.7
2. Ipafu	(N-2)	Copperbelt	80	Vegetable.	Pump, Pipeline	1.66	0.513	15.3
3. Chapula	(O-9)	- ditto -	60	Vegetable	- ditto -	1.61	0.385	12.1
4. Buleya Malima	(O-14)	Southern	57	Vegetable.	- ditto -	1.53	0.365	12.1
5. Siatwinda	(O-15)	- ditto -	22	Vegetable	- ditto -	0.61	0.141	11.6
6. Nakandabwe	(O-21)	- ditto -	10	Vegetable.	- ditto -	0.28	0.064	11.3
7. Makungwa	(O-28)	Eastern	5	Vegetable.	- ditto -	0.14	0.032	12.0
8. Vuu	(O-30)	- ditto -	13	Vegetable	- ditto -	0.35	0.083	12.2
9. Lusowe	(O-31)	- ditto -	10	Vegetable.	- ditto -	0.28	0.064	11.3
Total			267			6.55	1.711	14.0

Note: * Estimated at market prices.

(2) Chongwe Dam Irrigation Project

Chongwe Dam is proposed for Lusaka Water Supply Project to be implemented in 1998 and completed in 2000. Since the Chongwe dam is close to the large market of Lusaka, high value crops, such as vegetables, can be grown in the project. It will be necessary to implement the feasibility study in parallel with the water supply project study. The Project features, investment cost and EIRR are as follows:

Chongwe Dam Irrigation Project	
Beneficial Area:	810 ha
Beneficial Farm:	400 firm houses
Facilities :	Intake Pump (Q=0.81m³/s, H=100m)
	Pipeline (L=10km)
	Furrow Irrigation for Vegetables and
	Drip Irrigation for Flowers
Investment Cost :	US$ 34.74 million
Crops :	Vegetables (70%), and Flowers (30%)
EIRR :	10.5 %

(3) Implementation of Zambezi Left Bank Floodplain Rice Irrigation Project

Western province is the least developed province for irrigation development due to distance from large markets, although there is high water resources potential in the form of the Zambezi River. It is proposed to start the Zambezi Floodplain Rice Irrigation Project (defined as P-23) with 1,500 ha to be implemented in the Left Bank Floodplain by 2005. This represents half of the total potential area of about 3,000 ha in the left bank flood plain, because hydrological observation will be necessary to identify the maximum potential area. Relating to this project, verification study has been conducted by JICA. The construction cost is estimated at about 19.47 million US$, with a benefit of about 4.35 million US$ annually with rice double cropping. EIRR is estimated at about 10.8%.
The Project features are outlined as follows:

Zambezi Floodplain Rice Irrigation Project		
Beneficial Area :	1,500 ha (field reparation: 1,500 ha)*	
Beneficial Farm:	1,100 firm houses	
Facilities :	Intake Canal :	75 km
	Land consolidation :	1,500 ha
	Low Lift Pumps :	3.02 m³/s
Investment Cost :	US$ 19.47 million	
Crops Wet Season:	Rice 1,500 ha	
Dry Season:	Rice 750 ha, Vegetable 750 ha	
EIRR :	10.8%	

* Land ownership should be solved for smooth project implementation

(4) Financial Examination of Irrigation Projects

The above three categories of projects proposed in the action plan were examined regarding project viability through financial internal rate of return (FIRR). They are (1) ASIP rehabilitation projects; (2) Chongwe dam irrigation project; and (3) Zambezi left bank flood plain rice irrigation project. The items are summarized as follows:

Table 7-5 Financial Conditions and FIRR of Proposed Projects

Item	ASIP Rehabilitation Projects	Chongwe Dam Irrigation Project	Zambezi Rice Irrigation Project
Capital Investment Cost (US$ Million)	6.55	34.74	38.94
Annual O/M Cost (US$ Million) *1	0.17	0.81	1.37
Revenue of Water Charge*2 (US$ Million)	0.43	4.61	7.07
- Irrigation Water (Million m^3/year)	3.28	9.96	87.45
- Unit Water Rate (Kwacha/m^3)*3	80	282	49
FIRR (%)	0.4	7.4	10.0

Note: *1 In addition, replacement costs such as machinery and equipment in stations are added in every 20 years.
*2 A product of unit water rate and annual water consumption volume
*3 Unit water rate was estimated on the basis of a capacity-to-pay of beneficial farmers. These values were estimated in Section 6.2 of Supporting Report Part-I "Irrigation".

FIRR of ASIP rehabilitation projects including nine schemes was 0.4%, as seen in the above table. The project will not be feasible from the financial point of view, in the case that the project funds are procured even from the public financing organizations. The following countermeasures would be necessary to implement ASIP schemes. (1) To enlarge an irrigation land area for a farm household, so the household would pay more water charge because of its capacity-to-pay increase. (2) To procure a construction fund of either grant or loan with terms of almost no interest rate. In fact, MAFF is going to implement a part of ASIP projects by means of procurement of no interest loans through international financing organizations. Anyhow, the central government has to make an endeavour to accomplish ASIP projects by the target year by means of various countermeasures including the same kind of fund procurement.

FIRR of the Chongwe dam irrigation project was 7.4%. The project will have some difficulty from the financial point of view, even if the project funds are procured from the public financing organizations. Although detailed countermeasures may be discussed in the next stage analysis of feasibility study, the following proposals could make the project acceptable as a viable project in the future.

(1) approximately 15%~20% of the capital investment cost is granted;
(2) a loan at an annual interest rate of less than 7.4% is available; and
(3) water consumers have a willingness to pay of 25% higher charge for potable water.

Since the unit water rate was set at the highest level taking capacity-to-pay of beneficiaries into consideration, it would be difficult to augment the water rate. Accordingly, the above two countermeasures or the both measures combined together might be effective for the implementation of the project.

FIRR of the Zambezi left bank flood plain rice irrigation project was 10.0%. This rate corresponds to the rates of 8% to 10% applied by the World Bank and African Development Bank, although it is less than market interest rates in Zambia. Then, if the water rate is kept and the investment funds are procured from the public financing organizations such as WB and AfDB, the project will be feasible from the financial point of view.

7.3 Institutional Action Plan

The Master Plan for the institutional improvement describes recommended legal arrangement and the direction of re-organisation in long term and recommended organisational structure to remedy the current problems and to correspond to the future requirements for the sector. In the action programme for the institutional improvement, actions to be taken for implementation of the recommendation as well as proposed projects in the Master Plan.

Action plans are selected applying the following criteria.

1) Implementation of the proposed projects as well as proposed institutional improvement programmes, might incur huge costs with much time of staff. Once implementation commences in a wrong way, it is impossible to cure, or fatal losses might occur to the nation. Thus the following action plans are selected:
   - general preparation for the implementation
   - plans corresponding to expanding needs in water supply sector

2) Implementation of projects proposed in the Master Plan and future water resources management will definitely require many capable staff armed with well developed information system. Human resources development and information system development will take long period of time. The implementation of the following action plan should start immediately.
   - formation of human resource development programme and its implementation
   - database arrangement

7.3.1 General Preparation for Implementation of the Programmes

(1) Programme Management and General Co-ordination

Since the institutional improvement recommended in the Master Plan and are related to the many sector of the Government, mutual discussion or consultation among the sectors, as well as the strong initiative of the prime institutes; mainly DWA/MEWD for Water Resource Sector, Water Sector Development Group (WSDG) for Water Supply and Sanitation Sector, and ECZ/DNR for the Conservation Sector. Because of the close inter-relation among the recommendations in the Master plan, general co-ordination would be necessary by leadership of the Minister or the Permanent Secretary of the MEWD, staffed with DWA.

(2) Holding Inter-ministerial Meetings Attended by the Relevant Organs with Initiative of the Responsible Body

Because of the wide relevance of water to many social and economic activities and because of the close relation among the three sectors, management of each of the sector programmes should be made with mutual consultation with the other sectors. Inter-ministerial meeting would be inevitable for concurrent operations for the implementation, while initiative of the responsible organ of each sector is necessary for firm management of each of the three sectors.

Inter-ministerial meetings should be held regularly, chaired by the leaders, of the respective sector. Two levels of the meetings should be recommendable; the upper level - participants of relevant directors, preferably chaired by the Permanent Secretary, for policy formulation, and the lower level - participants of related section managers, chaired by the Director of DWA for concurrent or joint operation of the relevant entities. The Steering Committee and the Technical Committee for this Study could be a model, respectively.

Participation of local authorities and the NGO's, as well as the opinion leaders or the community leaders of the field should be encouraged for equitable development as the subject requires.

(3) Formulation of Procedures of Re-organisation

After the responsibility assignment the relevant entities, for implementation of the re-organisation of the three sectors, detailed capacity assessment of the existing bodies should be carried out. Preparation of job description of the and human resource development programmes should be followed for each sector with an assistance of human resource specialists.

Following sequence can be recommended.

- to prepare inventory of necessary tasks
- to identify procedure for implementation of each task
- to identify monitoring procedure to secure equitable performance of each task
- to group works in the above procedures into clusters which enables effective and efficient implementation of all tasks
- to allocated works to each operational and regulatory entities
- to assess required resources, such as staff by types of specialty and grade, and finance
- to prepare training programmes of staff, extension officers and other participants
- to identify and prescribe required regulations, and standards or norms
- to prepare proposal for training and re-organisation or staff transfer and subsequent office arrangement

7.3.2 Formulation and Implementation of Training Programmes

Implementation of projects proposed in the Master Plan on the consequent operation and maintenance will require huge number of staff. The following two types of training will be necessary. The Human Resource Development Section in the MEWD, as proposed in Section 6.7 should be urgently established.

1) Training of Core Staff: for the implementation of new types of projects and programmes, for the staff for policy formulation and promotion of the enforcement, or training of trainers
2) Training of Staff for Projects and Programmes Implementation: for rapidly growing number of staff for the operation and maintenance, especially for water supply projects

(1) Training of Core Staff

The main measures for the training of core staff would be dispatching the staff to foreign countries. The Human Resources Section in MEWD or other relevant section should collect information on training courses offered by foreign countries, and seek any chances to promote the training of the core staff, who will turn to be trainers for the training mentioned below.

(2) Training of Staff for Projects and Programmes Implementation:

Massive training would be necessary for water supply and sanitation sector in order to realise decentralisation. Formulation and management of the training programmes should be the responsibility of the national level, while, after 'train-the -trainer' courses conducted by the national level, training activities for residents could be extended by local authorities. Preparation of training materials, not only for 'train-the-trainer' courses but also training for residents should be prepared by the national level with co-ordination with relevant sectors. For urban scheme, "Urban Restructuring and Water Supply Project" financed by the World Bank will include training of substantial numbers of staff in targeted local authorities. The MLGH should formulate and conduct the training programme for managers and staff of municipal schemes to extend the training to other local authorities with achievements and lessons gained through the Project.

Currently, around 10,000 boreholes are estimated to be drilled in rural areas throughout the country. The Master Plan proposed the development of around 20,000 boreholes, which will make total of 30,000 boreholes by 2015 in rural areas. Rural water supply heavily depends on groundwater, and a great deal of support for the development would be highly necessary by local authorities and the national Government. It could be estimated that each of the 51 districts should have 5 - 6 drillers or staff, or around 300 in total would be necessary for the groundwater development, while the Drilling Section of DWA has around 20 drillers or staff at present.

When including training requirement of residents or leaders of the managing communities of rural water supply project, the needs could be huge. Establishment of training programme for implementation of rural water supply and groundwater projects would an urgent task. A major arrangement by DISS (Department of Infrastructure and Supporting Services of the MLHG), Chalimbana Local Government Institute and DWA should start as soon as possible, preferably with foreign assistance.

To prepare training programme for the trainers gender issues should be included as a subject to promote awareness of the issue by the trainers, so that the issues be taken into account in preparation of training programmes for residents in order to enhance the sustainability of the projects because most of domestic water is taken care by women. Time and places of training courses for residents should be carefully arranged so that women can participate without hindrance or hesitation.

7.3.3 Database Arrangement

As clarified throughout the Study, formulation, revisions and enforcement of equitable water resources development plan or policies for the resources management, as well as

effective and efficient planning and implementation of projects or programmes require various and much information, which can be obtained through the analysis of data and records collected over long period. Database arrangement should be started immediately. Database arrangement can be started with the maintenace of database or collected information provided through the Study. At first, the data on "Demand Model" "Potential Model", and "Conservation Model" as illustrated in Figure 7-1, should be well collected and filed, physically or electronically. Checks throughout the filing and input are necessary for reliable and efficient arrangement of the database.

Currently, data on the resource, such as water right records or drawings of the existing water facilities, have been scattered and some parts might be lost. There might be disorder in measuring methods or items recorded in the existing files.

Prescribed procedures, in the form of instruction or manual, for data collection or measurement would be necessary to be prepared regarding units, measuring manner and sampling method and data format, etc., from the beginning, for effective analysis of the historic or comparison of geographical variations. The database should be arranged by the river basin. The database system should be flexible for expansion and transaction among sub-systems in order to meet the future requirements for more sophisticated and comprehensive management of the sector.

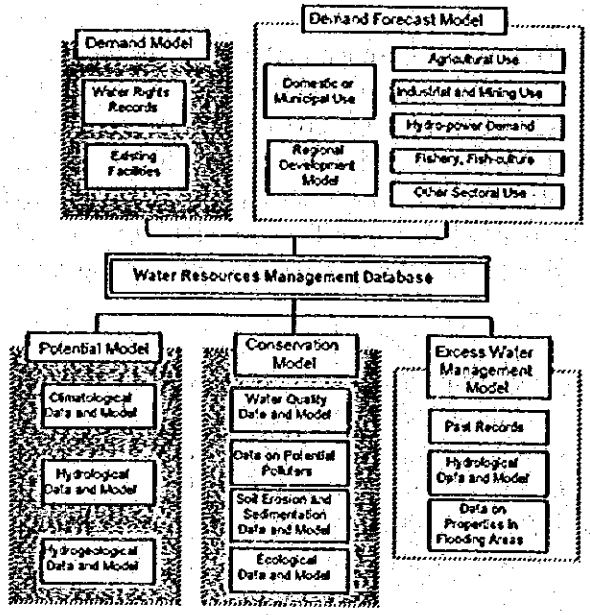

Figure 7-1 Composition of Water Resources Management Database

7.3.4 Preparation for Re-structuring the Water Supply and Sanitation Sector

The approach for the re-structuring can be divided into to ways, one way for municipal water supply and sanitation services and the other way for rural water supply. Even though the principles to be applied would be same, the approaches could be different from one another.

(1) Enactment of a Fundamental Law on the Water Supply and Sanitation for Municipal Services

After formulation of the policy on re-structuring of the sector, a fundamental law should be stipulated, including the following articles, with subsidiary legislation, which provides detail figures, instruction, or guidelines, for the execution of the scheme:

- responsibilities of the national Government and local authorities
- water quality or effluent standards from treatment plants
- design criteria and standards of the facilities
- executing bodies and licence of the scheme
- criteria and procedure for licensing
- inspection before commission
- responsibilities of executing bodies, such as stable supply of the service
- monitoring and inspection of water or effluent quality
- reports to the regulatory organs, such as those on operation records, incidents and accounting, etc.
- supervision, orders, instruction or recommendation by the regulatory organs
- procedure, licensing and recommendation on tariff setting
- financial and other support, such as promotion of research by the central Government

(2) Preparation of Prescribed Procedure on Rural Water Supply Scheme

Rural water supply projects require a different approach from those for urban areas. Sustainability is inevitable for the implementation and expansion of rural water supply projects. For sustainable development of the projects with limited financial and human resources, prescribed procedure for rural water supply projects would encourage effective and efficient expansion of the project planning and implementation.

Residents' participation, especially that of women, is indispensable for a sustainable development of rural water supply scheme. To encourage residents' participation, participation from early phase of projects is found to be effective. For promotion of residents' participation, guidelines for the implementation of rural water supply projects should be prepared, preferably prescribed in the form of instruction by the competent director. A model procedure of rural water supply projects is shown in Table 7-4. Required support in the table should be provided by local authorities and the national Government, mainly NWASCO (National Water and Sanitation Council) or Department of Infrastructure and Support Services (DISS), recently established in the MLGH.

Gradually, involvement of local authorities and the central Government should be reduced to a limited level, such as spare parts provision which the communities will purchase, other technical supports, or support in drought occasion, monitoring the achievement of self-sustainability together with communities, while evaluation of the project should be conducted with an initiative of local government and DISS, some five years laterafter the commencement of the project, to learn lessons for the future programming and to identify recommendations for continuous management efforts by the community.

Since wells or boreholes are the centres of the community, other community development programmes, mainly those for public health improvement or for women's association, could be converted into the water supply scheme. Training and diffusion activities could be jointly conducted with co-ordination of relevant sectors.

(3) Standardisation of Equipment and Facilities, Service and Treatment Level

As listed in the above and the table below, standardisation of facilities and equipment, suitable for the local conditions of Zambia, is one of important role of regulatory bodies for the increase in spare parts availability, and for equitable and sustainable operation and maintenance. The standards would be finalised by the NWASCO (National Water and Sanitation Council) with drafts prepared by the Technical Standards Committee of DWA or DISS, supported by the University of Zambia (UNZA), which is currently studies standardisation of hand pumps and promotion of local production of their spare parts, or the NCSR.

Service standards for water supply and sanitation, which have close relation with cost incurred for the service, cost recovery and affordability of consumers to pay, should be provided with a few options in order for the operational bodies, such as the CU's (Commercial Utilities) or local authorities to allow their own choices to meet their local needs.

Treatment standards are heavily dependent on the water quality, polluting conditions and the environmental standards of the basin. Standardisation should be conducted with close co-ordination with the ECZ and the NCSR as well as the relevant entities mentioned above.

Table 7-6 Model of Rural Water Supply Project

Phase	Activities	Residents' Participation	Required Support
Survey	- Preparation of inventory of the existing facilities - Survey on local natural conditions - Survey on water use and demand - Social survey of communities - Economic survey of communities - Survey on local public health	- Start of discussion - Awareness on projects	- Standardisation of equipment - Promotion of local production of equipment or spare parts - Co-ordination with donor agencies
Planning & Design	- Type of source or intake - Location of facilities - Design of facilities - Operation and maintenance plan - Responsibility allocation - Implementation plan - Training programmes	- Discussion and agreement - Awareness on owner-ship - Establishment of managing committees - Fund raising	- Promotion of spare parts availability - Co-ordination with donor agencies
Construction	- Construction - Installation of equipment and facilities - Construction of auxiliaries	- Contribution of labour force, materials, accommodation or meals	- Co-ordination with donor agencies - Finance for capital investment (whole or partially)
Operation & Maintenance	- Operation, maintenance and repair - Training on operation and maintenance, public health and other community development	- Management by the committees	- Provision of patrol services for maintenance and repair, inspection of water quality, etc. - Training of residents and extension officer for the patrol services
Monitoring	- Progress and attained benefits - Effectiveness and efficiency - Impacts Assessment - Problem identification and necessary countermeasures - Change to the original plan - Additional training - Report	- Discussion	- Co-ordination with donor agencies

(Source: "Technology and Development", Vol.10, No.1, April, 1994, JICA, modified by the Study Team)

CHAPTER 8 RECOMMENDATIONS

(1) Implementation of the Water Resources Development Plan

The Master Plan proposes water resources development projects mainly for water supply for domestic and industrial use and for the agricultural sector. For other sectors, development policies are proposed from the viewpoint of water resources development, based on the analysis of the present status and future projection. Socio-economic development plan, regional development plan and individual sector development plan related to water resources development, such as power development plan, or transportation and road network development plan, as well as the infra-structure development and project plan in the related sectors should be planned taking into account the proposals from water resources development plan.

The projects for water supply for domestic and industrial use and for the agricultural sector are planned for three scenarios of the future socio-economic framework, such as population and GDP. These three scenarios give the maximum, medium and minimum water demand projection. Water demands in the range between the maximum and the minimum will surely occur, and it will be absolutely necessary to meet the demands with construction and extension of water facilities, in order to attain better living standards for the nation and stable economic development.

(2) Review of Water Resources Development Plan

Proposed water resources development plan is formulated based on the projected population and GDP increases, for 20 years towards 2015. Socio-economic development plans are normally formulated every five years with projections of population and target economic growth. Water resources development plan should also be reviewed every five years, if necessary, using these revised projections.

Water supply in the Lusaka urban area, which is the political and economic centre of the country, is estimated to require a large volume of water to be conveyed over a long distance, 45km from the Chongwe Dam or 50km though the Kafue Pipeline. The conveyance facilities from the dam are estimated to cost 24% of the construction cost of the project, and the conveyance facilities from the Kafue River will cost 33% of the project construction cost. Construction cost of conveyance facilities for the two projects will reach US$ 134 million, comprising 13% of the total construction costs of the proposed water supply projects. The construction cost of the water conveyance facilities for both projects corresponds to 4% of Zambia's GDP in 1993. People or industries might move to other places, seeking cheaper water. When the city planning of Lusaka is revised, the water supply projects should also be reviewed.

(3) Implementation of the Action Plans

The Action Plan proposed in the previous chapter shows the action necessary to be taken now for smooth and steady implementation of the projects proposed for water supply and agricultural development in the Master Plan. Successful implementation of the projects proposed in the Master Plan depends on the achievement of the Action Plan. The Action Plan should be immediately commenced and completed.

(4) Financing the Cost

External debt of the country in 1992 reached US$ 7 billion, and corresponded to double the GDP in that year. Reimbursement for the debt in 1992 amounted to US$ 360 million and the debt service ratio was over 28%, considerably surpassing the dangerous line of 20% set by the World Bank. At present, borrowing from foreign countries would be difficult. In 1992, Zambia received US$ 1.13 billion foreign assistance, with grants of US$ 790 million sharing 69%, and loans of US$ 350 million sharing 31%. This breakdown is typical and grants averaged 73% over the last six years compared to 27% loans. Under the present conditions, the projects should be implemented with grants. In the future, however, implementation of proposed projects by borrowing should be promoted as soon as possible, by reducing external debt with the achievement of stable economic growth.

(5) Encouragement of Public Awareness of Beneficiary-to-Pay Principle and of Saving Water

Construction costs for water supply projects and for the agricultural sector are estimated as US$ 1,010 million and US$ 1,521 million, respectively, in the Base Scenario-Agricultural Expansion. Even though the Government is responsible to obtain the finance, cost recovery for water supply should be promoted to secure funds through revision of water tariffs and improvement in collection. Saving of water will reduce the demands, resulting in an overall decrease in project costs. Public awareness of Beneficiary-to-Pay principle and on Saving Water should be encouraged.

APPENDICES

Appendix-A List of Advisory Committee Members

Name	Organisation
<Chairman>	
Takeshi KADOMATU	River Bureau of The Ministry of Construction
<Members>	
1) Akira HASHIMOTO	Agricultural Structure Improvement Bureau of The Ministry of Agriculture, Forestry and Fishery.
2) Noriaki SHIOJIRI	Kyushyu Regional Office of The Ministry of Agriculture, Forestry And Fishery.
3) Hisaya SAWANO	Tohoku Regional Construction Bureau of The Ministry of Construction

Appendix-B List of Steering Committee Members

	Name	Title, Organisation
<Chairman>		
	ROMANCE C. SAMPA	Permanent Secretary, MEWD
<Members>		
1)	R.B. KHUTI	Acting Director, DWA
2)	M. SOKO	Director, Economic & Technical Cooperation, NCDP
3)	MULELE	Director, DOA, MAFF
4)	MUDENDA	Director, DOF, MAFF
5)	G.B. CHIPETA	Director, DOM, MOTC
6)	D.J. MBEWE	Director, DOE, MEWD
7)	MWANSA	Managing Director, ZESCO
8)	P. CHIPUNGUU	Director, NEC, MENR
9)	M. BANDA	Director, DNR, MENR
10)	S. C. BANDA	Senior Research Coordination Officer, NCSR
11)	G.A.C. KHONJE	Commissioner, DTCP, MLGH
12)	M. ZULU	Commissioner, Dol, Mlnr
13)	NIC. J. MONEY	Director, DGS, MOM
14)	L. BANDA	Director, DOI, MOCI
15)	J. MBOMENA	Deputy Director, Medical Services Primary Health Care, MOH
16)	MS. MWINGA	Legal Counsel, Legal Section, NEC
17)	NICHOLAS KATANEKA	Director, National Heritage, Conservation Commission, MOT
<Secretary>		
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Appendix-C List of Technical Committee Members

	Name	Title, Organisation
<Chairman>		
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2)	O. SANGULUBE	Senior Hydrologist, DWA, MEWD
3)	J. KASONDE	Scientific Officer, NCSR
4)	N.B. MWANSA	Hydrologist, NCSR
5)	W.K. SAKALA	Agro-Meteorologist, DOM, MOTC
6)	I.M. AKAYOMBOKWA	Chielf Land Use Planner, DOA, MAFF
7)	C. MAGUSWI	Chief Fishery Officer, DOF, MAFF
8)	F. MUSHIBWE	Economist, NCDP
9)	C. G. MUDENDA	Economist, NCDP
10)	I.H.M. ZANDONDA	Inspector, NEC, MENR
11)	J. CHISHIBA	Inspector, NEC, MENR
12)	ANGOLA	Senior Planner, NENC, MENR
13)	F.M. MUWOWO	Assistant Commissioner, DTCP, MLGH
14)	C. MWASILE	Hydrologist, ZESCO
15)	CHISANGA	Senior Health Inspector, Primary Health Care, MOH
16)	J. MABUKU	Senior Geologist, MOM
17)	C. MUYUNDA	Metallurgist, MOM
18)	L.H. HANGWELE	Economist, Doi, MOCI
19)	J.C. WAKE	Project Manager, ZNTB

Appendix-D List of JICA Study Team Members and Zambian Counterparts

Experts	JICA Study Team	Counterpart Team		
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		P. M. CHITUNDO	Economist	NCDP
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Ground Water	Hiroshi NAKAMURA	S. KANG'OMBA	Hydrogeologist	DWA
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Hydrologic Observation	Takeshi WATANABE	J.K. KAMPATA	Water Engineer	DWA
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		J.H. CHILO	Water Board Officer	DWA
Agriculture	Hideo HARA	H. MWANZA	Principal Agricultural Specialist	DOA
Hydroelectric Power Generation	Masayuki TAMAI	C. MWASILE	Hydrologist	DWA
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Irrigation	Yasuo MATSUBARA	I. M. AKAYOMBOKWA	Chief Agricultural Specialist	DOA
River Development	Fumio NORO	J. M. KAMPATA	Water Engineer	DWA
Dam Development	Miki SOYA	C. D. NUNDWE	Water Engineer	DWA
Geology	Yosuke SASAKI	J. MABUKO	Senior Geologist,	DGS
Dam Geology	Hisashi OHURA	N. MWANSA	Senior Geologist	NCSR
Remote Sensing	Tetsuya OHTSUKI	E. MWELWA	Deputy Officer-in charge	DWA
Topographic Survey	Kuniaki TAKAMATSU	C. CHILESHE,	Officer-in Charge Lusaka Hydrological Office	DWA
Water Quality and Environment	Donald J. MACLEOD	R.C.MULENGA	Water Quality Specialist	DWA