5.7 Construction Plan and Cost Estimate

5.7.1 General

The following major assumption and conditions are incorporated in the construction plan and cost estimate.

(1) Procurement

Construction works of project facilities will be executed on contract basis through international competitive bidding, considering the scale of the works. Engineering works of design and supervision will be also executed on contract basis.

(2) Construction Schedule

Time and duration of construction are scheduled respecting the implementation plan proposed in the master plan study. Construction works are scheduled so that the upper located facilities should be commenced prior to the downstream facilities in principle considering the sound of economy of the project.

(3) Construction Method

Conventional and common construction methods will be introduced to the project construction works. Employment of human power will be incorporated as much as possible in the project construction works.

(4) Price Level

All the cost is estimated based on the labor wage, the material price and the unit operation cost of equipment as of June 1997.

(5) Project Cost

Initial investment cost for structural measures comprises 1) construction cost, 2) engineering service cost, 3) resettlement cost, 4) administration cost, 5) physical contingency and 6) price contingency. Initial investment cost for non-structural measures comprises 1) installation cost, 2) administration cost, 3) physical contingency and 4) price contingency.

Annual operation and maintenance (O&M) cost comprises those of structural measures and non-structural measures.

5.7.2 Construction Plan

(1) Material Source

Construction plan is prepared based on the following procurement schedule of major construction materials.

a) Earthfill material will be diverted from excavated surplus material.
b) Concrete will be purchased from a domestic concrete vendor in the Akaki Industrial Estate.
c) Form and reinforcing bar for the concrete will be imported.
d) Quarried stone for wet masonry works will be purchased through local suppliers from the quarries controlled by governmental agencies.
e) Stainless steel flap gate for regulating ponds will be imported.
f) Fuel for construction equipment will be purchased in bulk through import traders.

(2) Disposal Area

Two (2) disposal areas will be provided, 5-10 km far from the construction sites, in the suburbs of the city. One is located near to the Bole International Airport (call Bole) and the other is along the West Akaki River near to the Augusta Garment Factory (call Augusta). Those locations are shown in Figure 5.40. It is proposed to dispose the surplus materials to the Bole disposal area prior to the Augusta area, because the Bole area is remoter from residential area than the Augusta area.

The total capacity of the vacant lots for disposal is estimated more than 400,000 m^3. The volume of the surplus materials to be disposed is estimated approximately 200,000 m^3.

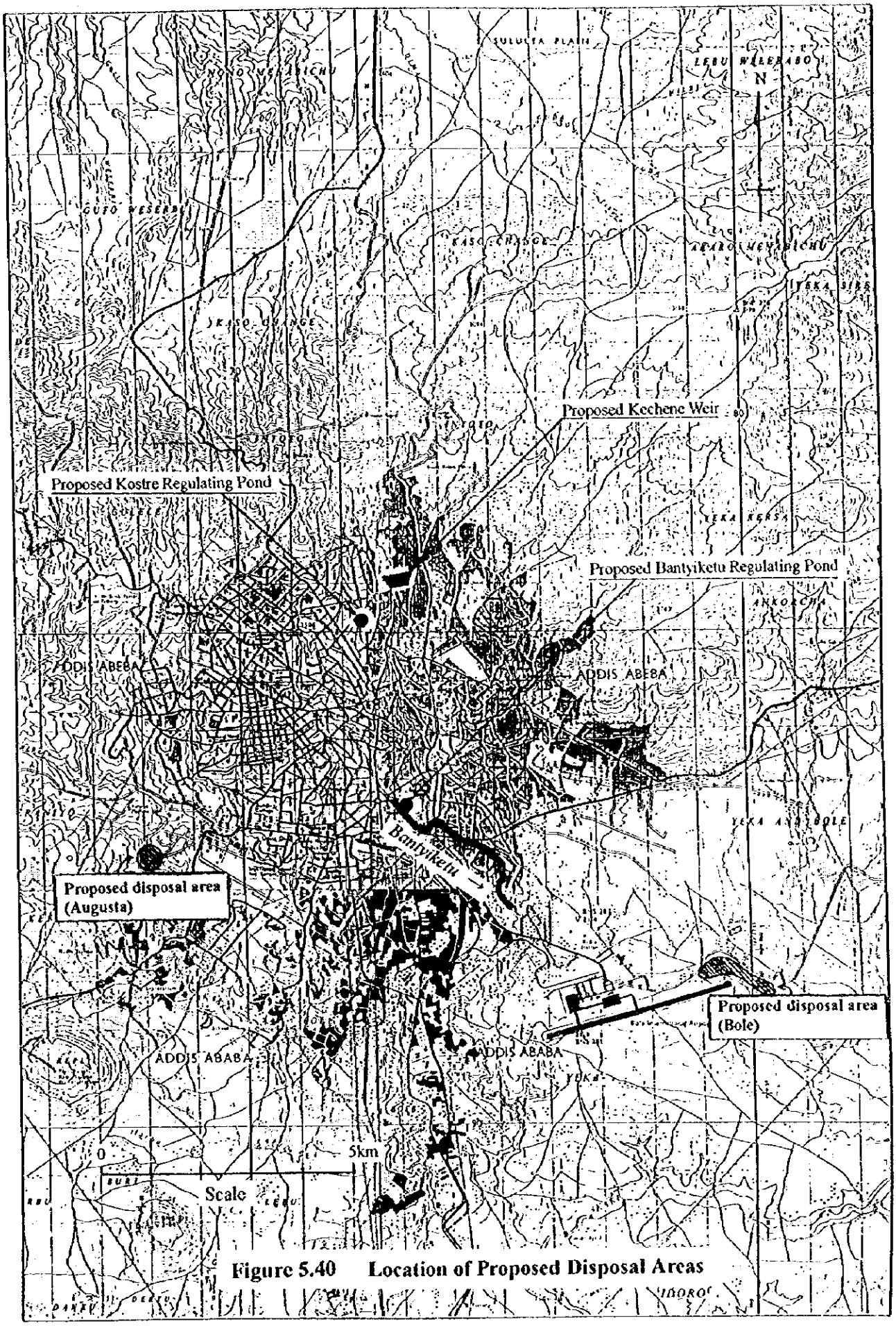


Figure 5.40 Location of Proposed Disposal Areas

(3) Workable Days

Workable days of each month for construction works are estimated as follows.

Table 5.18 Workable Days

Month	Workable Days
January	24
February	23
March	24
April	22
May	22
June	24
July	23
August	23
September	22
October	26
November	25
December	27
Total	285

The workable days are estimated deducting the number of Sunday and the National holidays and the number of days having rainfall more than 20mm from the number of calendar days in each month.

(4) Major Work Items

The following works are identified as major work items for the project.

a) Excavation work: at weir construction site, at pond construction site, at river channel improvement work site and at urban drainage development work site

b) Concrete work: at weir construction site and at urban drainage development work site

c) Wet masonry work: at pond construction site, at river channel improvement work site and at urban drainage development work site

(5) Construction Method

The excavation works, at the weir and the regulating ponds sites, will be carried out with of bulldozer and hydraulic excavator. The excavation works, at the river channel improvement work site, will be carried out by manpower. Some of excavated earth

material will be used for adjacent earthfilling works for the dike of the regulating pond work sites. And some of excavated rock material will be used for wet masonry works. Other surplus earth materials including stripped material will be hauled by dump trucks and adequately filled at the proposed disposal areas.

Ready mixed concrete will be used for the Kechene weir construction works. It is available at the Akaki Industrial Estate. Though the contractor can purchase the concrete from this plan, he is required to mobilize enough numbers of agitator trucks. At the weir construction site, the concrete will be placed with crawler crane and concrete bucket.

Wet masonry works are mainly employed for wall structure, bridge pier and abutments and some house buildings in Addis Ababa. The stones are usually obtained through local suppliers from the quarries, which are controlled by governmental agencies, located in the suburbs of Addis Ababa. The habitual method, of the procurement of materials and of the masonry works, will be taken for the project construction works.

(6) Preparatory Works

Prior to the permanent structure construction works, preparatory works including temporary works will be finished. At first, common temporary works, such as preparation of contractor's office, workshop, storehouse and access road to disposal area, will be carried out. Temporary works, such as preparation of access road and stockpile, dewatering works and relocation works of obstacles, will be carried out successively at each work site.

The relocation of the buried facilities, such as the water supply and sewerage pipe lines crossing the proposed permanent structures, will be specified as temporary works in construction work contract.

(7) Equipment Plan

The requirement of construction equipment is estimated as follows, taking work volume, production rate of equipment and implementation schedule proposed in the master plan study into account.

Table 5.19 Requirement of Construction Equipment

	Equipment	No. of Unit
1.	Bulldozer, 21 ton	3
2.	Bulldozer w/ripper, 32 ton	1
3.	Crawler drill, hyd., 150 kg	1
4.	Backhoe, 0.6 m^3	5
5.	Dump truck, 10 ton	12
6.	Agitator truck, 3.2 m^3	8
7.	Crawler crane, 50 ton	1
8.	Crawler crane, 35 ton	2

(8) Construction Schedule

Construction works are scheduled to be commenced from the upstream site as follows, since upstream structures can eliminate flood damage in the downstream site during the construction and can also bring the project benefit earlier.

a) Construction works of the Kechene weir
b) Construction works of the Kostre regulating pond
c) Construction works of the Bantyiketu regulating pond
d) Channel improvement works of the Bantyiketu River
e) Urban drainage improvement works

It is supposed that construction work contract will be concluded at the beginning of 2000 and the whole of construction works will be completed at the end of 2001. It will take 2 years to complete the construction. Construction schedule is shown in Figure 5.41.

Successively after the contract of construction works, preparatory works, such as preparation of contractor's office and procurement of construction equipment, will be carried out for two months.

Construction works of the Kechene weir will be commenced prior to the other works. It will take about 18 months form the beginning of 2000 to the middle of 2001. Natural river flow, for the beginning eight months, will be discharged with half closure of river for riverbed protection work, sub weir work and left side excavation and concrete works for main weir. For the successive concrete work of right side main weir, the river flow will be discharged through the aqueduct pipe which is tentatively

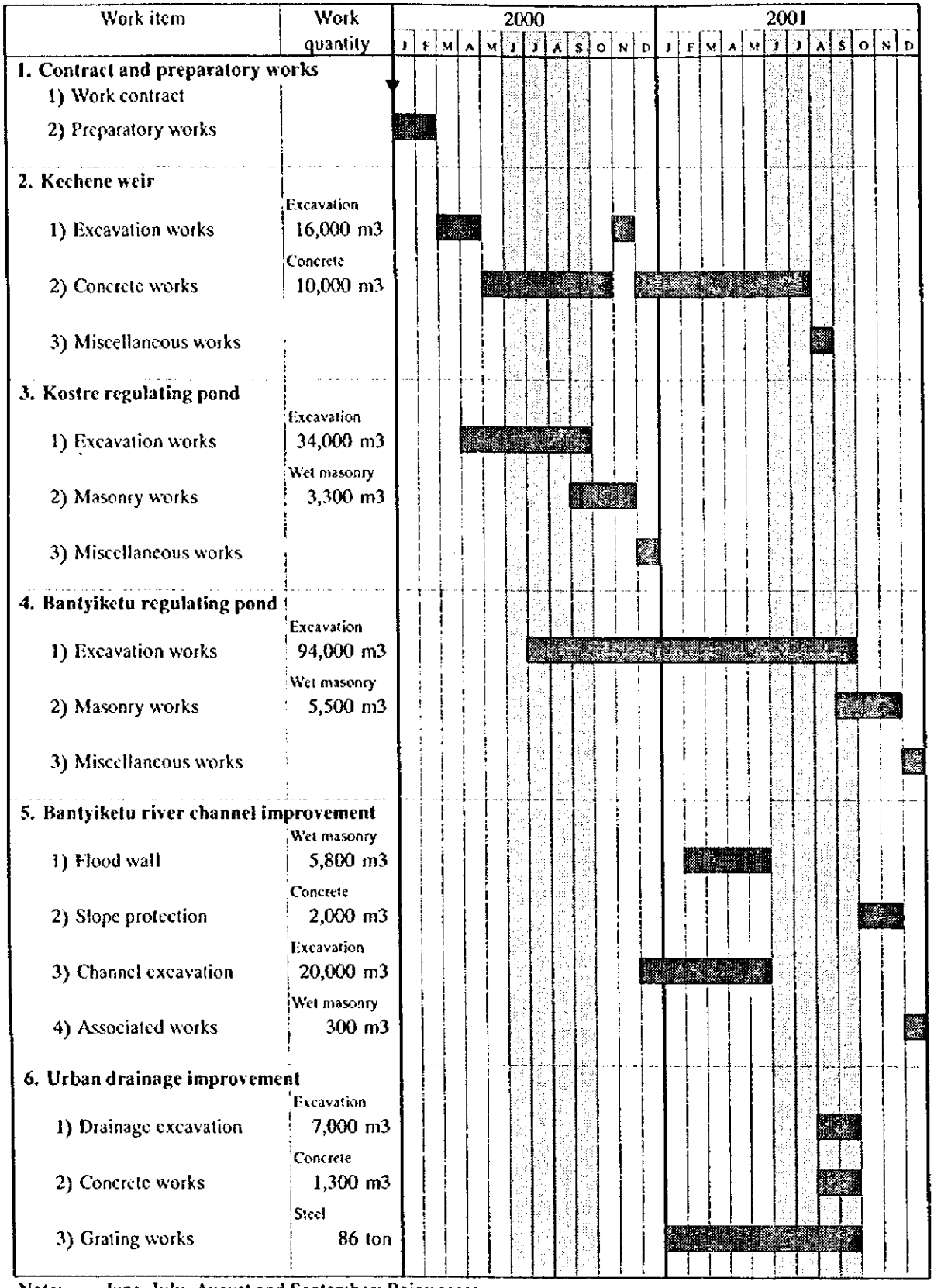
installed in the orifice section of the main weir. Ready-mixed-concrete will be purchased by contractor. The concrete will be placed into the weir body with crawler crane.

Construction works of the Kostre regulating pond will be commenced one month later from the commencement of the Kechene weir construction works. It will be finished end of 2000 after 9 months. The excavation work in the pond will be carried out by bulldozer. Embankment work can be carried out simultaneously with the excavation work by bulldozer. Wet masonry and miscellaneous works will be carried out in the latter half of the pond construction period.

Construction works of the Bantyiketu regulating pond will be commenced in the middle of 2000, and will be finished at the end of 2001 after one and half year. The excavation work in the pond will be carried out by bulldozer. Embankment work can be carried out simultaneously with the excavation work by bulldozer. Wet masonry and miscellaneous works will be carried out in the latter half of the pond construction period.

Construction works of the Bantyiketu river channel improvement will be commenced end of 2000 and will be finished at the end of 2001 after a year. The excavation and wet masonry works will be carried out by manpower applying conventional work method in Addis Ababa. Many workers will be assigned to work in river zone. The works will be carried out during dry seasons to ensure the safety and the efficiency of the works.

Construction works of the urban drainage improvement will be commenced at the beginning of 2000 and will be finished in the latter half of 2001 after 9 months. Drainage excavation work and concrete work for the construction of drainage ditches will be carried out simultaneously. The grating for drainage ditch will be fabricated in Addis Ababa.



Note: - June, July, August and September: Rainy season
- Construction of upper facilities will be commenced prior to downstream facilities.

Figure 5.41 Construction Schedule

5.7.3 Cost Estimate

(1) Conditions and Assumption for Cost Estimate

The following are the conditions and assumption for the project cost estimate.

a) Project cost is estimated at the price level as of June 1997.

b) Exchange rates used in the cost estimate are shown as follows:
US$ 1.0 = Birr 6.8 = J.Yen 114.7 (as of June 1997)

c) Construction works will be executed on contract basis through international competitive bidding. All the labor, materials and equipment required for the construction works will be provided by the contractors themselves.

d) Resettlement cost is estimated based on the rule, which is controlled by the Works and Urban Development Bureau, Region 14 Administration. Resettlement cost does not include land acquisition cost, because the whole land belongs to the government of Ethiopia.

e) Engineering services, such as design and supervision, will be executed on international contract basis.

f) Cost is estimated in foreign currency and local currency portions. The foreign currency portion includes foreign labor wages, imported materials and equipment cost, international transportation cost and contractors' indirect cost. The local currency portion includes local labor wages, local materials cost, inland transportation cost, contractors' indirect cost, resettlement cost and administration cost.

g) Physical contingency is provided 10% of the total of construction cost, resettlement cost, engineering services cost and administration cost.

h) Price contingency is calculated based on the escalation rates of 3% per annum for foreign currency portion and of 6% for local currency portion.

i) Tax is included in the project cost.

(2) Labor Wage

The net wage of a daily common worker is Birr 8 for temporary employment in Addis Ababa. The prevailing labor wages in Addis Ababa are given in Table 5.20.

(3) Price of Construction Materials

Basic prices of some major construction materials are obtained through a simple market survey and from the report on average retail prices of goods and services published by

the Central Statistical Authority. The prevailing purchasing prices of major construction materials at Addis Ababa is given in Table 5.21.

(4) Operation Unit Cost of Construction Equipment

Assuming that contractors import the construction equipment, the operation unit cost of such equipment is estimated as listed in Table 5.22.

(5) Unit Prices of Construction Works

Construction unit prices of major works are estimated through unit rate analysis and through comparison with the actual contract data. Unit prices of construction works are listed in Table 5.23.

Table 5.20 Labor Wage

No.	Particular	Unit	F.C. (US$)	L.C. (Birr)
1.	Foreman	man-day	0	80
2.	Operator	man-day	0	60
3.	Assistant operator	man-day	0	45
4.	Driver	man-day	0	30
5.	Mechanic	man-day	0	80
6.	Electrician	man-day	0	70
7.	Rigger	man-day	0	60
8.	Welder	man-day	0	60
9.	Rebar worker	man-day	0	40
10.	Plumber	man-day	0	60
11.	Carpenter	man-day	0	40
12.	Plasterer	man-day	0	40
13.	Concrete worker	man-day	0	40
14.	Mason	man-day	0	45
15.	Pavement worker	man-day	0	55
16.	Boring worker	man-day	0	40
17.	Grout worker	man-day	0	40
18.	Tunnel worker	man-day	0	40
19.	Driller	man-day	0	40
20.	Blaster	man-day	0	60
21.	Skilled labor	man-day	0	30
22.	Common labor	man-day	0	10
23.	Engineer, senior	man-month	0	1,850
24.	Engineer, junior	man-month	0	1,290
25.	Technician, senior	man-month	0	1,050
26.	Technician, junior	man-month	0	710
27.	Surveyor	man-month	0	600
28.	Draftman	man-month	0	500
29.	Typist	man-month	0	600
30.	Office clerk	man-month	0	500
31.	Cook	man-month	0	300
32.	Maid	man-month	0	250
33.	Night keeper	man-month	0	250

Note: The value indicates the prevailing wage at Addis Ababa.
Price level; June 1997, US$ 1.0 = Birr 6.8 = J.Yen 114.7

Table 5.21 Construction Material Price

No.	Materials	Unit	Net price F.C. (US$)	Net price L.C. (Birr)	Tax F.C. (US$)	Tax L.C. (Birr)	Total price F.C. (US$)	Total price L.C. (Birr)
1.	Gasoline	lit.	0.39	0	0	0	0.39	0
2.	Gas oil (=Light oil)	lit.	0.29	0	0	0	0.29	0
3.	Electric power	kWh	0	0.16	0	0.02	0	0.18
4.	Lubricant	lit.	0	8.2	0	0.8	0	9
5.	Grease	kg	0	31	0	3	0	34
6.	Portland cement	kg	0	0.45	0	0.05	0	0.5
7.	Reinforcing bar, deformed	kg	0.54	0	0.05	0	0.59	0
8.	Binding wire	kg	0	9.1	0	0.9	0	10
9.	Annealed iron wire	kg	0	9.1	0	0.9	0	10
10.	Nail	kg	0	9.1	0	0.9	0	10
11.	Steal plate	kg	0	9.1	0	0.9	0	10
12.	Channel steel	kg	0	9.1	0	0.9	0	10
13.	Angle steel	kg	0	9.1	0	0.9	0	10
14.	H-Shape steel	kg	0	9.1	0	0.9	0	10
15.	Steel sheet pile	kg	0	9.1	0	0.9	0	10
16.	Dynamite, in open	kg	18.4	0	1.8	0	20.2	0
17.	Dynamite, in tunnel	kg	18.4	0	1.8	0	20.2	0
18.	ANFO powder	kg	5.8	0	0.6	0	6.4	0
19.	Electric detonator	no.	4	0	0.4	0	4.4	0
20.	Timber, plank	m3	0	2,909	0	291	0	3,200
21.	Timber, square	m3	0	2,636	0	264	0	2,900
22.	Timber, log	m3	0	2,364	0	236	0	2,600
23.	Plywood	m3	602	0	60	0	662	0
24.	Form oil	lit.	0	7.3	0	0.7	0	8
25.	Brick	m3	0	364	0	36	0	400
26.	Galvanized iron pipe, 1/2in	m	0	7.3	0	0.7	0	8
27.	Galvanized iron pipe, 1in	m	0	14.5	0	1.5	0	16
28.	Galvanized iron pipe, 1+1/2in	m	0	23	0	2	0	25
29.	PVC pipe, 2in	m	0	7.3	0	0.7	0	8
30.	PVC pipe, 4in	m	0	22.7	0	2.3	0	25
31.	Aggregate, fine (= sand)	m3	0	76.4	0	7.6	0	84
32.	Aggregate, coarse	m3	0	91	0	9	0	100
33.	Crusher-run	m3	0	91	0	9	0	100
34.	Stone	m3	0	46	0	4	0	50
35.	Ready mixed concrete, 160kg	m3	0	498	0	50	0	548
36.	Ready mixed concrete, 240kg	m3	0	554	0	55	0	609
37.	Ready mixed concrete, 240kg, at seite	m3	0	639	0	64	0	703
38.	Water	m3	0	0.77	0	0.08	0	0.85

Note: - Total price indicates the prevailing purchasing price at Addis Ababa as of June 1997.
- US$ 1.0 = Birr 6.8 = J.Yen 114.7

Table 5.22 Unit Operation Cost of Construction Equipment

No.	Equipment	Class	Unit	Net cost*1) F.C. (US$)	Net cost*1) L.C. (Birr)	Tax*2) F.C. (US$)	Tax*2) L.C. (Birr)	Total cost*3) F.C. (US$)	Total cost*3) L.C. (Birr)
1.	Bulldoser	11ton	Hour	19.45	18.71	1.90	0.00	21.36	18.71
2.	Bulldoser	15ton	Hour	25.87	24.89	2.53	0.00	28.41	24.89
3.	Bulldoser	21ton	Hour	42.81	41.17	4.19	0.00	47.00	41.17
4.	Bulldoser	32ton	Hour	57.49	61.12	5.19	0.00	62.68	61.12
5.	Bulldoser w/ripper	21ton	Hour	45.81	47.24	4.25	0.00	50.06	47.24
6.	Bulldoser w/ripper	32ton	Hour	56.64	60.22	5.11	0.00	61.75	60.22
7.	Backhoe	0.35m3	Hour	12.31	10.97	1.27	0.00	13.58	10.97
8.	Backhoe	0.60m3	Hour	17.72	15.78	1.83	0.00	19.55	15.78
9.	Backhoe	0.70m3	Hour	22.70	20.22	2.34	0.00	25.05	20.22
10.	Wheel loader	1.4m3	Hour	15.60	15.17	1.52	0.00	17.12	15.17
11.	Wheel loader	2.3m3	Hour	23.94	24.11	2.26	0.00	26.20	24.11
12.	Dump truck	8ton	Hour	9.46	10.59	0.81	0.00	10.27	10.59
13.	Dump truck	10ton	Hour	10.85	12.14	0.93	0.00	11.78	12.14
14.	Cargo truck	4ton	Hour	5.76	6.10	0.52	0.00	6.28	6.10
15.	Cargo truck	8ton	Hour	9.07	9.61	0.82	0.00	9.89	9.61
16.	Cargo truck, w/crane	4ton/2ton	Hour	7.04	7.23	0.65	0.00	7.70	7.23
17.	Truck crane, hyd.	15-16ton	Hour	22.47	22.69	2.12	0.00	24.59	22.69
18.	Wheel crane	25ton	Hour	34.28	32.92	3.36	0.00	37.63	32.92
19.	Giant breaker, hyd.	1300kg	Day	92.60	58.89	11.33	0.00	103.93	58.89
20.	Crawler drill, hyd.	150kg	Hour	68.88	63.33	6.96	0.00	75.84	63.33
21.	Motor grader	3.1m	Hour	19.23	19.45	1.81	0.00	21.04	19.45
22.	Macadum roller	10-12ton	Hour	11.36	12.11	1.02	0.00	12.39	12.11
23.	Tire roller	8-20ton	Hour	12.84	13.69	1.16	0.00	14.00	13.69
24.	Tamper	80kg	Hour	0.94	0.74	0.10	0.00	1.04	0.74
25.	Agitator truck	3.2m3	Hour	8.81	8.56	0.86	0.00	9.66	8.56
26.	Sprinkler truck	6kl	Hour	8.43	8.49	0.80	0.00	9.23	8.49
27.	Submersible pump	50mmx10m	Day	0.96	1.25	0.07	0.00	1.03	1.25
28.	Diesel generator	5kVA	Day	4.59	4.03	0.48	0.00	5.07	4.03
29.	Diesel generator	10kVA	Day	8.38	7.37	0.87	0.00	9.25	7.37
30.	Diesel generator	25kVA	Day	17.42	16.68	1.71	0.00	19.13	16.68
31.	Diesel generator	45kVA	Day	20.73	19.84	2.04	0.00	22.76	19.84
32.	Diesel generator	100kVA	Day	30.84	29.53	3.03	0.00	33.87	29.53
33.	Diesel generator	200kw	Day	58.68	60.27	5.45	0.00	64.13	60.27
34.	Diesel generator	250kw	Day	75.52	77.57	7.02	0.00	82.54	77.57
35.	Port. concrete mixer	0.2m3	Day	24.55	26.76	2.17	0.00	26.72	26.76
36.	Concrete backet, man.	1.0m3	Day	50.66	50.32	4.84	0.00	55.50	50.32
37.	Concrete vibrator	38mm	Day	2.06	1.90	0.21	0.00	2.27	1.90
38.	Engine welder	250A	Day	9.35	9.29	0.89	0.00	10.25	9.29

Note: *1) - Cost includes depreciation cost and maintenance cost of the equipment.
*2) - Tax includes custom and sales taxes.
*3) - Cost is estimated assuming that the equipment is imported and operated by contractors.
- Price level; as of June 1997, US$ 1.0 = Birr 6.8 = J. Yen 114.7

Table 5.23 Unit Price of Construction Works

Work item	Work description	Unit	Net price F.C. (US$)	Net price L.C. (Birr)	Tax F.C. (US$)	Tax L.C. (Birr)	Total unit price F.C. (US$)	Total unit price L.C. (Birr)
1. Earthworks								
1.1 Clearing and stripping	cut.t=20cm, dozing, load , h.=7.5km, unload , spread.	m2	1.1	1.6	0.1	0.0	1.2	1.6
1.2 Excavation, common	excavation, load , haul.=7.5km, unload , spread.	m3	5.4	8.1	0.3	0.0	5.7	8.1
1.3 Excavation, rock	excavation, loading, haul.=5km, unloading	m3	12.7	14.9	0.9	0.0	13.6	14.9
1.4 Excavation, river bed	excavation, load , haul.=7.5km, unload , spread.	m3	4.5	53.3	0.2	0.0	4.8	53.3
1.5 Backfilling	spreading, compaction	m3	0.5	0.8	0.0	0.0	0.5	0.8
1.6 Embankment	spreading, compaction	m3	0.5	0.8	0.0	0.0	0.5	0.8
1.7 Tree vegetation work	purchase, hauling, planting	m2	0.1	5.5	0.0	0.2	0.1	5.7
2. Concrete works								
2.1 Mass concrete, 160kg	ready mixed, haul , placing, crane, compact., curing	m3	18.7	744.4	1.2	56.7	19.9	801.1
2.2 Ordinary concrete, 240kg	ready mixed, haul., placing, crane, compact., curing	m3	18.7	823.7	1.2	62.4	19.9	886.1
2.3 Form, for concrete	plywood, setting, oil painting, removal	m2	10.3	54.2	0.8	1.6	11.1	55.8
2.4 Reinforcing bar, deform.	deformed, cutting, bending, assebling	kg	0.9	0.4	0.1	0.0	0.9	0.4
2.5 Shotcrete	purchse, hauling, placing	m2	6.3	127.2	0.3	9.7	6.6	136.9
2.6 Filter mat	purchase, hauling, setting	m2	10.1	1.5	1.0	0.0	11.1	1.5
3. Masonry works								
3.1 Wet masonry	mortal 1:4, royalty, haul , unload., masonning	m3	0.0	393.0	0.0	24.2	0.0	417.2
3.2 Gabion mattress	incl. wire net, royalty, haul., unload , masonning	m3	9.3	201.9	0.6	11.7	9.9	213.6
3.3 Gravel metalling	crusher run, spreading, compaction	m3	0.3	152.2	0.0	11.1	0.3	163.3
3.4 Weep hole	iron pipe, dia.=50mm, cutting, setting	no.	0.0	14.7	0.0	1.3	0.0	16.0
4. Metal works								
4.1 Flap gate	stainless steel, install., paint , 1.5m x 1.5m class	kg	41.0	34.0	4.0	0.0	45.0	34.0
4.2 Structural steel works	section steel, process., assembl , weld., for bridge	kg	10.1	0.9	0.0	0.9	10.1	1.8
4.3 Iron pipe, dia.= 1,000mm	upto install., incl. piping upto valve	m	0.0	4,246.0	0.0	307.0	0.0	4,553.0

Note: Price level; June 1997, US$ 1.0= Birr 6.8= J.Yen 114.7
Tax includes custom and sales taxes.

5.8 Organization and Institution

5.8.1 Organization for Project Implementation

The priority projects would be a pilot for flood control and damage mitigation measures in not only Addis Ababa but also Ethiopia. It is expected that through implementation of the priority projects, a lot of staff who can apply the basic technologies to the flood control and damage mitigation measures be provided to the country.

Required organizations including community level as a participation of inhabitants need to be established for an implementation of the priority projects and river management, and the subsequent projects in the master plan.

Figure 5.42 shows the proposed overall organization for project implementation. Figure 5.43 shows the proposed organization of Addis Ababa River Board and Addis Ababa River Management Authority.

(1) Addis Ababa River Board

Addis Ababa River Board to be newly organized is entirely responsible.

The President of Region 14 Administration designates and authorizes Addis Ababa River Board that is entirely responsible for project implementation of long, medium and short terms structural and non-structural measures on flood prevention, urban drainage, and resettlement in Region 14 Administration.

The President chairs the board that is organized by heads of the concerned Bureaus and Authorities of Region 14 Administration. Addis Ababa River Board takes charge of coordination with all relevant governmental agencies and regional organizations in implementing the project.

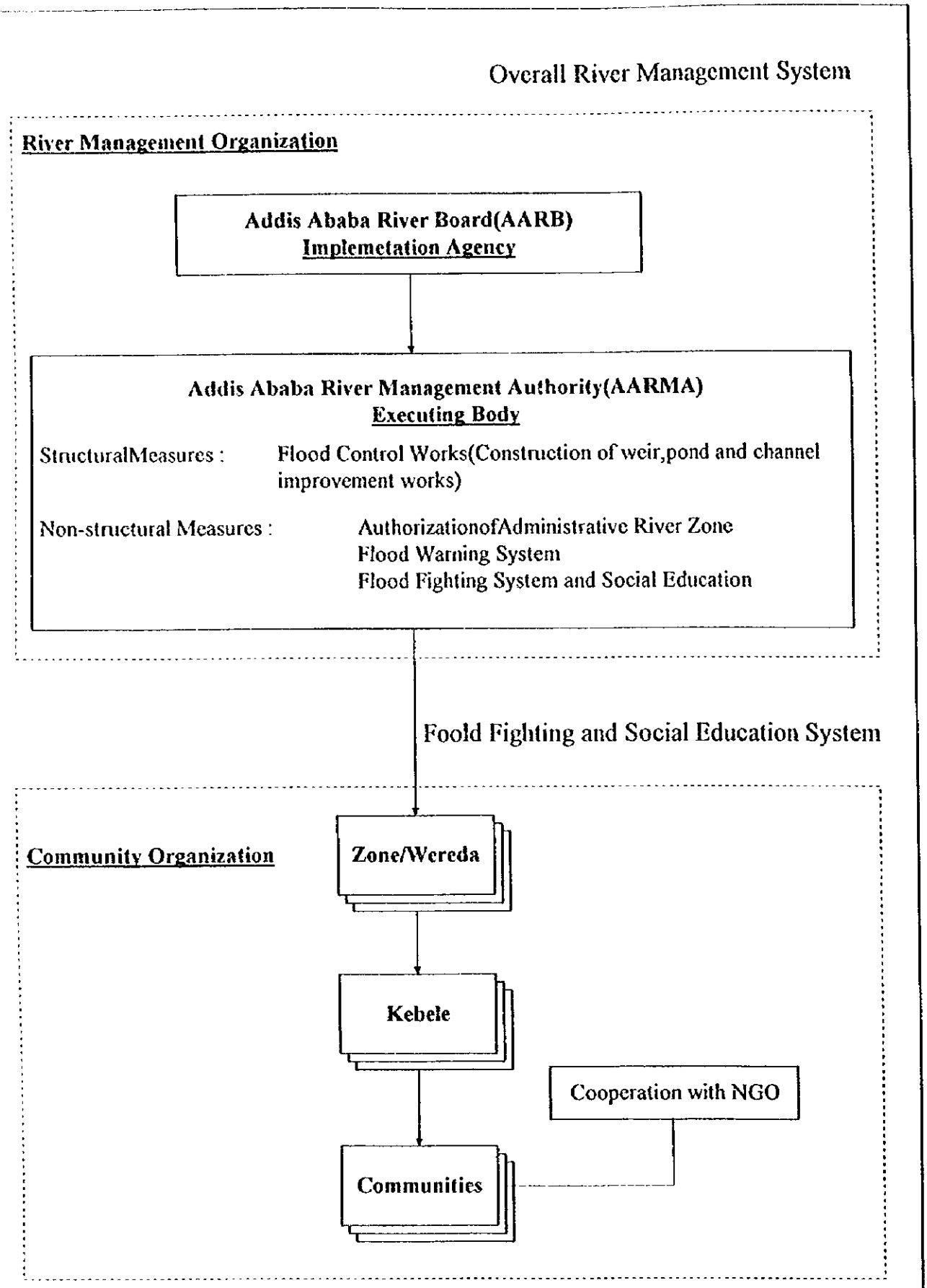
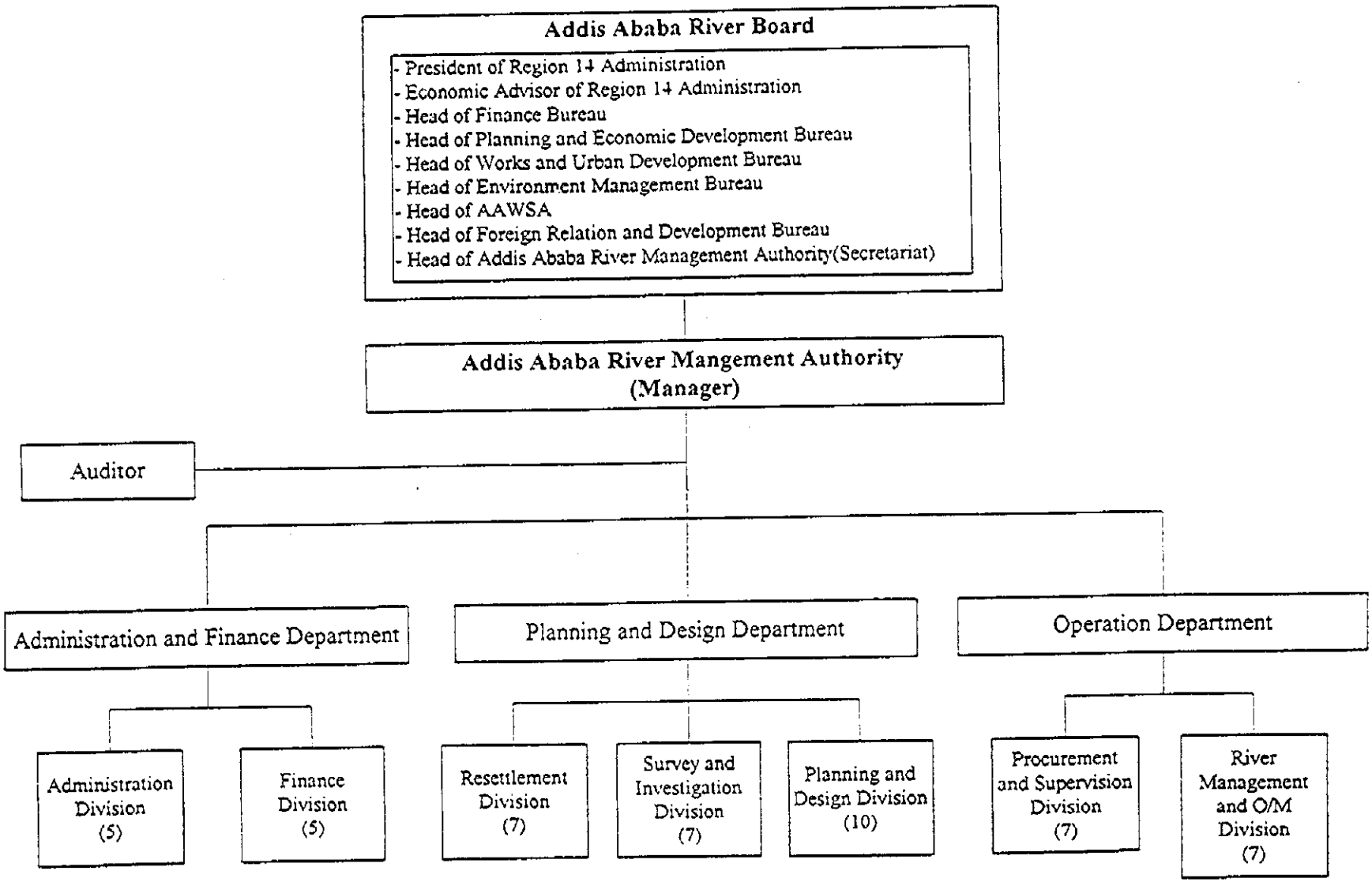


Figure 5.42 Overall Organization Chart for Project Implementation



Note; ( ) means required persons.

Figure 5.43 Proposed Organization of Addis Ababa River Board and Management Authority

(2) Addis Ababa River Management Authority

A new organization of Addis Ababa River Management Authority needs to be established by reorganizing the existing AFCPO and assigning staff required for execution of the project and river management. Under the direction of the Addis Ababa River Board, Addis Ababa River Management Authority functions as the executing body of the project.

Addis Ababa River Management Authority is designated and authorized by Region 14 Administration that is responsible for implementations of river management, flood prevention and urban drainage projects, and resettlement with administrative power.

This Authority is functionally and institutionally same with that of AARA (Addis Ababa Road Authority) in the Region 14 Administration. The budget is all covered by Region 14 Administration. Required personnel numbers will be around 50.

Consultants are to be employed to assist the implementation of the priority projects including basic design, detailed design and construction supervision. The construction system will be a full contracting basis through an international competitive bidding.

(3) Community Organizations

Available each community basically operates the flood fighting and social education systems in the non-structural measures, with guidance by AARB and AARMA. A participation of inhabitants is requisite for the system operations.

Figure 5.44 presents the organization and communication chart for the community organization. For this purpose, required institutional support needs to be established in line with the regulations of Region 14 Administration.

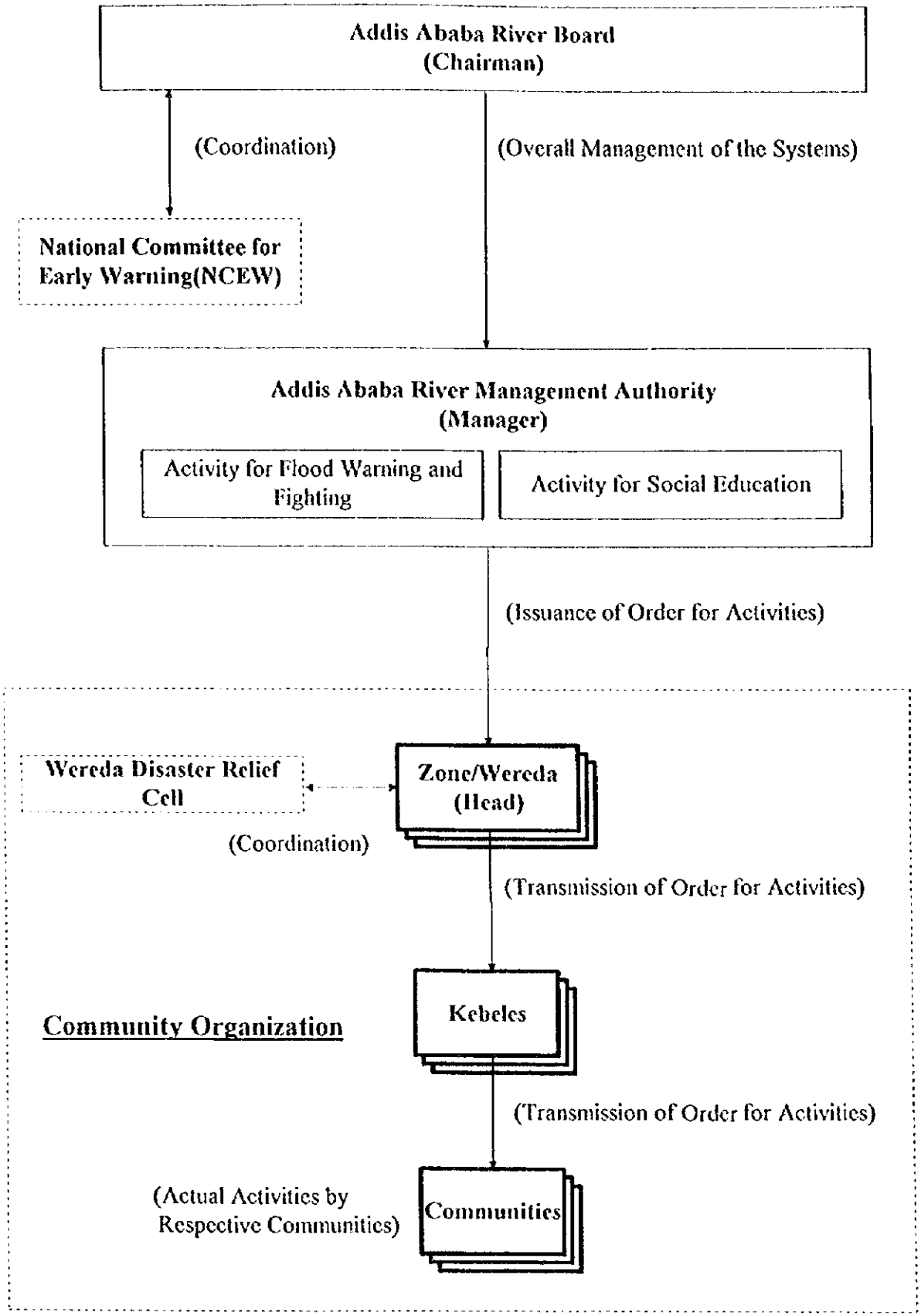


Figure 5.44 Community Organization for Flood Fighting System

5.8.2 Roles of Each Organization

Roles of each organization are specified as follows:

(1) Addis Ababa River Board (AARB)

a) Overall management and coordination with relevant organizations

- Coordination with relevant organizations,
- Formulation of institutional system,
- Establishment of required organization,
- Financial arrangement,
- Arrangement of social education,
- Land acquisition, and
- Others

(2) Addis Ababa River Management Authority (AARMA)

For implementation stage:

a) Overall river management,
b) Investigation, study and detailed design of construction works,
c) Preparation of tender document,
d) Tendering,
e) Resettlement, and
f) Construction supervision,

For operation and maintenance stage:

a) River management for structural and non-structural measures,
b) Operation and maintenance for the rivers and river structures, and
c) Direction and guidance of flood fighting and social education for flood risk mitigation.

(3) Zone and Wereda

a) Direction and supervision of flood fighting system under the direction of Investigation and Survey Division of AARMA and

b) Direction of social education for rivers and flooding under the direction of Administration Division of AARMA.

(4) Kebele and Community

a) Operation of flood fighting system (self defense by community level) and
b) Social education for rivers and flooding.

Establishment of the organization needs to be progressed with required institutional development in line with the regulations and institutions of the Region 14 Administration.

5.8.3 Institutions for Non-Structural Measures

In addition to the institutional setup for the respective organizations required for project implementation, the following institutional systems are established for the non-structural measures.

(1) Institutions for River Zone

For authorization of the river zone, an institutional support with bylaw is required for an overall river management system. The concerned law-section in the Region 14 Administration and AARMA, as executing body of the project which are directed by AARB, take charge of these institutional matters in accordance with the regulations of Region 14 Administration. The following are the required institutional support items.

a) Designation of the highest responsible administrator (President) in the river management for rivers and river structures,
b) Rivers, river stretches and river widths to be designated,
c) Regulation of land use in the riverine area,
d) Permission system for utilization and construction of facilities in the river zone, and
e) Regulation of and penalty for illegal activities such as utilization of river zone without permission, garbage and soil dumping.

(2) Institutions for Flood Warning and Flood Fighting System

To operating the flood warning system needs required institutional system in relation with flood fighting system that is to be operated by community organizations.

From the above, the following major matters are authorized by the regulations and institutions of the Region 14 Administration.

a) For Flood Warning

- System and flowchart of information and warning, and
- Relationship with related organizations.

b) For Flood Fighting

- Community organization for flood fighting,
- Communication system and flood fighting activities (flood fighting plan),
- Organization and responsibility of community (flood fighting team),
- Responsible administrator of each community (leader of flood fighting team),
- Annual training of flood fighting activities,
- Installation of storage house for flood prevention works,
- Designation of location of safety shelter and evacuation route in emergency case,
- Commendation system for outstanding community,
- Sharing of cost for activities, and
- Opening of public hearing.

c) For Social Education

- Seminar for community leaders,
- Seminar for people in each community,
- Campaign through TV and radio,
- Designation of River Day and annual River Festival (Love River),
- Annual demonstration of flood fighting activity, and
- Commendation system for outstanding community.

5.8.4 Operation and Maintenance

As described in the above section 5.8.2, AARMA under the direction of AARB is responsible for overall management for all completed river structures and established non-structural measures in the priority projects. Activity on operation and maintenance starts immediately after the completion of the priority projects. River

Management and O/M Division in AARMA takes charge of operation and maintenance for completed works and non-structural measures.

Operation is an efforts to manage river and river structures for their multi functions. Maintenance is an efforts to conserve functions of river and river structures in good condition including activities of rehabilitation works. In this regard, main task after completion of the priority projects is river management consisting of the following jobs.

a) Structural measures

- Inspection and monitoring of river channels and structures,
- Inspection and monitoring against illegal activities,
- Operation of river structures,
- Maintenance of river channel and river structures,
  - Grass cutting of river banks
  - Removal of obstacles from river courses
  - Refilling of scour pits
  - Small repair works
  - Others
- Rehabilitation works, and
- Maintenance of equipment.

b) Non-structural measures

- Inspection and monitoring of river zone and illegal activities, and
- Operation and maintenance of flood warning and flood fighting systems.

The detail operation and maintenance manual for the priority projects will be prepared in due time of the subsequent detailed design stage.

5.9 Project Cost

5.9.1 General

Initial investment cost for structural measures comprises 1) construction cost, 2) engineering service cost, 3) resettlement cost, 4) administration cost, 5) physical contingency and 6) price contingency. Initial investment cost for non-structural measures comprises 1) installation cost, 2) administration cost, 3) physical contingency and 4) price contingency.

Annual operation and maintenance (O&M) cost comprises those of structural measures and non-structural measures.

5.9.2 Project Cost

Project cost is estimated US$ 15,360 thousand (equivalent to Birr 104,448 thousand). The costs for structural measures and for non-structural measures are estimated US$ 14,736 thousand (equivalent to Birr 100,205 thousand) and US$ 624 thousand (equivalent to Birr 4,243 thousand) respectively. Breakdown of the project cost is given in Table 5.24.

The whole of initial investment cost is not always burdened by implementation body for the large scale project such as this project. Sometimes, some portion of project cost is invested based on foreign assistance. In this viewpoint, the project cost can be divided into two portions. One is the portion which may be invested by the fund of foreign assistance (foreign fund). And the other should be burdened by the side of implementation body (internal fund) even if the major portion of the project cost is burdened by the foreign fund.

In case of this project, the costs of construction of structural measures, installation of non-structural measures and engineering services are grouped into the foreign fund. Other costs of resettlement, administration and taxes included in the contract amount of construction and engineering services are grouped into the internal fund.

Out of the project cost of US$ 15,360 thousand, amount of US$ 13,306 thousand is estimated in the foreign fund and amount of US$ 2,054 thousand is in the internal fund. The breakdown of the project cost by fund is given in Table 5.25.

Annual operation and maintenance cost is estimated US$ 69 thousand (equivalent to Birr 469 thousand). The costs for the structural measures and for the non-structural measures are estimated US$ 40 thousand (equivalent to Birr 272 thousand) and US$ 29 thousand (equivalent to Birr 197 thousand) respectively.

Annual disbursement schedule is given in Table 5.26.

Table 5.24 Summary of Project Cost

(Unit: US$, thousand)

Item	F.C.	L.C.	Total
Structural measures			
1. Construction cost			
1) Kechene weir	724	1,700	2,424
2) Kostre regulating pond	405	397	802
3) Bantyiketu regulating pond	967	707	1,674
4) Bantyiketu river channel improvement			
- Flood wall	33	548	581
- Slope protection	635	495	1,130
- Channel excavation	224	128	352
- Associated works	0	103	103
Sub-total of 4)	892	1,274	2,166
5) Urban drainage improvement	1,338	321	1,659
Sub-total of 1.	4,326	4,399	8,725
2. Engineering services cost	1,780	61	1,841
3. Resettlement cost	0	30	30
4. Administration cost	269	749	1,018
Sub-total of (1. - 4.)	6,375	5,239	11,614
5. Physical contingency	635	526	1,161
Sub-total of (1. - 5.)	7,010	5,765	12,775
6. Price contingency	718	1,243	1,961
Total of (1. - 6.)	**7,728**	**7,008**	**14,736**
Non-structural measures			
1. Installation cost			
1) River zone	0	189	189
2) Flood warning system	64	92	156
3) Flood fighting system	3	79	82
4) Social education	0	5	5
Sub-total of 1.	67	365	432
2. Administration cost	3	49	52
Sub-total of (1. - 2.)	70	414	484
3. Physical contingency	7	41	48
Sub-total of (1. - 3.)	77	455	532
4. Price contingency	7	85	92
Total of (1. - 4.)	**84**	**540**	**624**
Total of structural and non-structural measures			
Project cost	**7,812**	**7,548**	**15,360**

Note: - Price level; June 1997, US$ 1.0 = Birr 6.8 = J.Yen 114.7
- Tax is included in the cost.

Table 5.25 Project Cost by Fund

(Unit: US$, thousand)

Item	F.C.	L.C.	Total
Structural measures			
Foreign fund			
1. Construction cost (Net)	5,045	5,561	10,606
2. Engineering services cost (Net)	2,105	75	2,180
Sub-total of (1. - 2.)	7,150	5,636	12,786
Internal fund			
3. Resettlement cost (incl. Tax)	0	37	37
4. Administration cost (incl. Tax)	320	972	1,292
5. Tax for 1. & 2.	258	363	621
Sub-total of (3. - 5.)	578	1,372	1,950
Total of (1. - 5.)	**7,728**	**7,008**	**14,736**
Non-structural measures			
Foreign fund			
1. Installation cost (Net)	73	447	520
Internal fund			
2. Administration cost (incl. Tax)	3	62	65
3. Tax for 1.	8	31	39
Sub-total of (2. - 3.)	11	93	104
Total of (1. - 3.)	**84**	**540**	**624**
Total of structural and non-structural measures			
Foreign fund	*7,223*	*6,083*	*13,306*
Internal fund	*589*	*1,465*	*2,054*
Project cost	**7,812**	**7,548**	**15,360**

Note:
- Price level; June 1997, US$ 1.0 = Birr 6.8 = J.Yen 114.7
- Each item includes of its physical and price contingencies.
- *Foreign fund* includes the cost which may be assisted by foreign fund in the future.
- *Internal fund* includes the cost which should be burdened by the Government of Ethiopia.

Table 5.26 Annual Disbursement Schedule

(Unit: US$, thousand)

Item	1998			1999			2000			2001			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Structural measures															
1. Construction cost															
1) Kechene weir	0	0	0	0	0	0	543	1,275	1,818	181	425	606	724	1,700	2,424
2) Kostre regulating pond	0	0	0	0	0	0	405	397	802	0	0	0	405	397	802
3) Bantyiketu regulating pond	0	0	0	0	0	0	484	354	837	484	354	837	967	707	1,674
4) Bantyiketu river channel improvement															
- 1 Flood wall	0	0	0	0	0	0	8	137	145	25	411	436	33	548	581
- 2 Slope protection	0	0	0	0	0	0	159	124	283	476	371	848	635	495	1,130
- 3 River channel excavation	0	0	0	0	0	0	56	32	88	168	96	264	224	128	352
- 4 Associated works	0	0	0	0	0	0	0	26	26	0	77	77	0	103	103
Sub-total of 4)	0	0	0	0	0	0	223	319	542	669	956	1,625	892	1,274	2,166
5) Urban development works	0	0	0	0	0	0	335	80	415	1,004	241	1,244	1,338	321	1,659
Sub-total of 1.	0	0	0	0	0	0	1,989	2,424	4,413	2,337	1,975	4,312	4,326	4,399	8,725
2. Engineering services cost	0	0	0	890	31	921	445	15	460	445	15	460	1,780	61	1,841
3. Resettlement cost	0	0	0	0	30	30	0	0	0	0	0	0	0	30	30
4. Administration cost	27	75	102	81	225	305	81	225	305	81	225	305	269	749	1,018
Sub-total of (1. - 4.)	27	75	102	971	285	1,256	2,515	2,664	5,179	2,863	2,215	5,077	6,375	5,239	11,614
5. Physical contingency	3	7	10	97	29	126	249	269	518	286	221	508	635	526	1,161
Sub-total of (1. - 5.)	30	82	112	1,068	314	1,381	2,764	2,933	5,697	3,149	2,436	5,585	7,010	5,765	12,775
6. Price contingency	1	5	6	65	39	104	256	560	816	395	639	1,035	718	1,243	1,961
Sub-total of (1. - 6.)	30	87	118	1,133	352	1,485	3,020	3,493	6,513	3,544	3,076	6,620	7,728	7,008	14,736
Non-structural measures															
1. Installation cost															
1) River zone	0	0	0	0	0	0	0	189	189	0	0	0	0	189	189
2) Flood warinig system	0	0	0	0	0	0	64	92	156	0	0	0	64	92	156
3) Flood fighting system	0	0	0	0	0	0	3	79	82	0	0	0	3	79	82
4) Social education	0	0	0	0	0	0	0	5	5	0	0	0	0	5	5
Sub-total of 1.	0	0	0	0	0	0	67	365	432	0	0	0	67	365	432
2. Administration cost	1	10	10	1	15	16	2	25	26	0	0	0	3	49	52
Sub-total of (1. - 2.)	1	10	10	1	15	16	69	390	458	0	0	0	70	414	484
3. Physical contingency	0	1	1	0	1	2	7	39	46	0	0	0	7	41	48
Sub-total of (1. - 3.)	1	11	11	1	16	17	75	428	504	0	0	0	77	455	532
4. Price contingency	0	1	1	0	2	2	7	82	89	0	0	0	7	85	92
Sub-total of (1. - 4.)	1	11	12	1	18	19	82	510	593	0	0	0	84	540	624
Total of structural and non-structural measures															
Project cost	31	99	130	1,134	371	1,505	3,103	4,003	7,106	3,544	3,076	6,620	7,812	7,548	15,360

Note: - Price level; June 1997, US$ 1.0 = Birr 6.8 = J.Yen 114.7
- Tax is included in the cost.

5.10 Project Evaluation

5.10.1 Environmental Impact Assessment

(1) General

Environmental impact assessment of the priority projects is prepared on the basis of the draft Environmental Impact Assessment Guideline prepared by the Environmental Protection Authority of the Federal Democratic Republic of Ethiopia and in consideration of the JICA guideline for the environmental impact consideration for development projects. The details on the said Environmental Impact Assessment Guideline are presented in the Supporting Report of this Report.

(2) Impact to Natural Environment

The project is evaluated that it will not have any negative impacts to natural environment. The project will not cause waste problem. The project will not affect areas with conservation-worthy fauna or flora or other especially vulnerable ecosystems since those are not existing along the objective reaches of the Bantyiketu river. The project will not affect areas with conservation-worthy objects or landscape since those are not existing. The project will not change the people's way of life. The project will not change the local people's use of other natural resources since there exist no natural resources along the river.

5.10.2 Social Impact Assessment

(1) Overall

The project is evaluated to have only positive impacts to the society during the operation stage since the project mitigates the habitual inundation conditions in the objective area reducing the inundation damage and accordingly reducing the possibility of infection to diseases and contributing to the cleanness of the city.

(2) Creation of Job Opportunity

Positive impact is also expected during the construction stage of the project. The project implementation will create job opportunity to local people. The implementation of the project needs more than 60 thousand man-day labors. Since the jobless rate in Addis Ababa is estimated at about 34.7% as of 1994 according to the Population and Housing Census of Ethiopia, this job opportunity has a significant level.

(3) Resettlement

Conceivable negative impact by the projects is resettlement mainly for the construction of the Kechene weir. Four houses are needed to move to other place since those houses area will be submerged during the design flood for retention function of the weir.

The compensation method is established in the region 14 Administration. The responsible agency for the resettlement is Addis Ababa Flood Control and Prevention Project Office.

(4) Traffic Disturbance

Other negative impact by the projects during the constructions stage will be the disturbance of the traffic. The passage of heavy vehicles between the construction site and disposal area may create the heavy traffic volume along the road. The traffic volume for dumping soil is estimated at about 4,500 car-days. The traffic volume for transporting ready-mixed concrete by mixer car for the construction of Kechene weir is estimated at about 3,100 cars.

Besides, the construction of the drainage ditch across main streets is planned in the projects. The planned streets for the said structures have usually heavy traffic volume. But those streets have more than 4 lanes and it is possible to avoid one way traffic during the construction of the facilities.

Traffic control during the construction stage should be conducted with the cooperation of the traffic police.

(5) Air Pollution

Other conceivable negative impacts are air pollution by the passage of dump trucks. It is expected that the passage of dump trucks for the construction sites will cause a serious cloud of dust especially during the dry season. The mitigation measure will be watering on the road.

(6) Others

Other pollution of water contamination, soil contamination, ground subsidence, bad smell will not be caused by the project.

5.10.3 Economic Evaluation

(1) Methodology

The methodology applied for the economic evaluation of the priority projects is same as that applied for the evaluation of the flood control master plan. The same general assets and agricultural assets have been used for estimation of the flood damages. The indirect damages and the other damages were also taken into account. The flow chart showing the process of the economic evaluation is shown in Figure 5.45 and the flood damages taken into account for the economic evaluation are shown in Figure 5.46.

(2) Flood Reduction Benefits

Benefits of flood control projects are estimated from difference of the flood damages between those with and without project. In other words, they are flood damage reduction benefits.

The assets to be protected by the project are supposed to increase both in volume and value year after year. Therefore, it is assumed that the annual damage reduction benefits will also increase from 1997 to 2020 linearly.

Even after the completion of flood control measures planned in this project, isolated flood may occur until small drainage canals are improved. The flood damage is presumed to remain about five percent of total flood damage. In other words, 95 % of the annual mean flood damage have been considered as annual flood reduction benefit of the project.

The annual flood damage reduction benefits of the priority projects are estimated at 8.43 million Birr per year in 1997 and 13.58 million Birr per year in 2020.

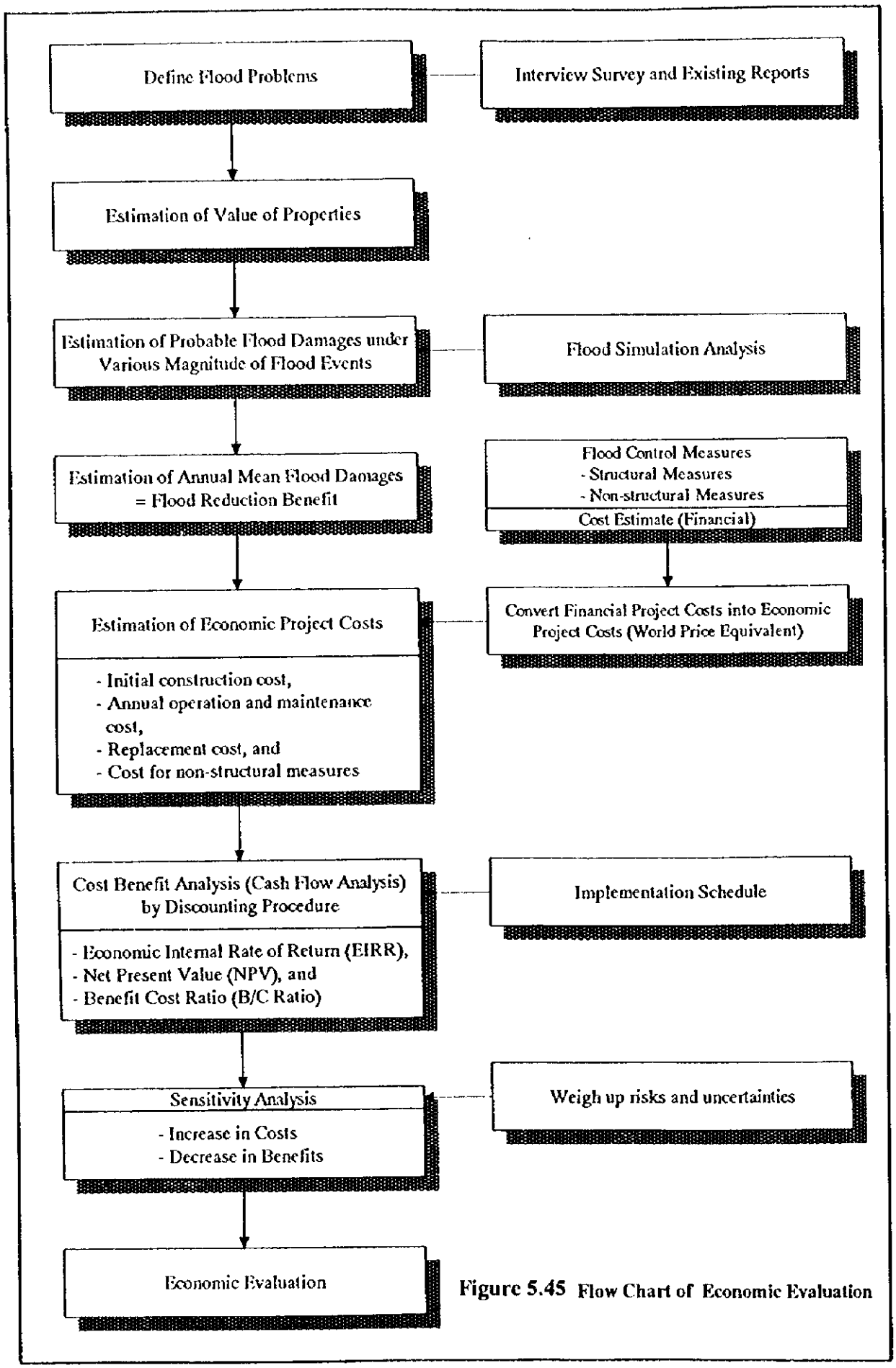


Figure 5.45 Flow Chart of Economic Evaluation

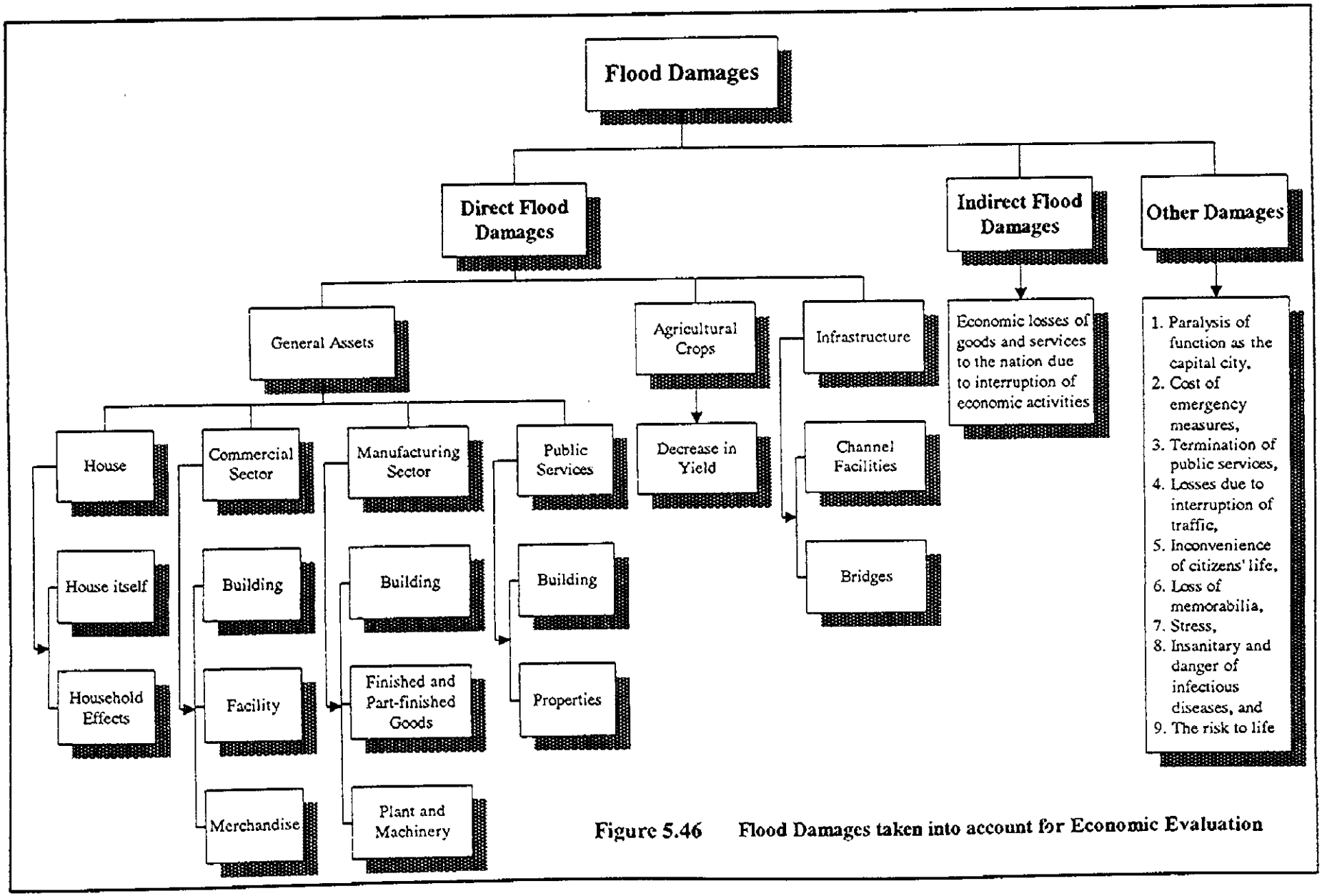


Figure 5.46 Flood Damages taken into account for Economic Evaluation

(3) Economic Project Costs

Economic project costs (accounting prices) are converted from financial project costs in the same manner applied for the evaluation of the flood control master plan.

Standard Conversion Factor (SCF) is applied to calculate the economic project costs (accounting prices) of the non-traded project cost (local currency portion). SCF is estimated at 0.87 by comparing the world price and the domestic price of a representative selection of commodities.

The economic project costs of traded goods and services (foreign currency portion) are derived by deducting 10 % of financial costs for adjustment of import duties.

The economic project costs of both structural and non-structural measures are shown below.

Table 5.27 Economic Project Cost

Cost Item	Financial Cost (US$ 1,000)	Economic Cost	
		(US$ 1,000)	Equivalent in 1,000 Birr
1. Construction Cost	8,725	7,720	52,496
2. Resettlement Cost	30	26	177
3. Engineering Service Cost	1,841	1,655	11,254
4. Administration Cost	1,018	894	6,079
5. Sub-total of (1 - 4)	11,614	10,295	70,006
6. Physical Contingency	1,161	1,030	7,004
7. Sub-total of (5 - 6)	12,775	11,325	77,010
8. Cost for Non-structural Measures	532	465	3,162
9. Total of (7 - 8)	13,307	11,790	80,172

(4) Annual Operation and Maintenance Cost

Annual operation and maintenance costs for flood control facilities are assumed to be 0.5 % of the direct construction cost.

Economic annual operation and maintenance costs for both structural and non-structural measures are estimated as shown below.

Table 5.28 Annual Operation and Maintenance Cost

Cost Item	Financial Cost (US$ 1,000)	Economic Cost	
		(US$ 1,000)	Equivalent in 1,000 Birr
1. Structural Measures	40	35	238
2. Non-structural Measures	29	25	170
3. Sub-total of (1 - 2)	69	60	408

The annual operation and maintenance cost includes annual reserve fund for replacement of mechanical and metal facilities such as gates after their lifetime (assumed 25 years) within the project life (50 years).

(5) Economic Evaluation

The cost-benefit analysis of the priority projects have been made by a cash flow analysis using three types of indicators, i.e. economic internal rate of return (EIRR), benefit cost ratio (B/C ratio), and net present value (NPV). Discount rate of 10% is assumed for calculation of B/C ratio and NPV. The economic viability of the projects is summarized below and its annual cash flow is shown in Table 5.30.

a) EIRR : 12.8%
b) B/C Ratio : 1.29
c) NPV : 16.43 million Birr

(6) Sensitivity Analysis

Sensitivity of the economic evaluation of the projects has been examined adopting increase in cost and decrease in benefit. The results of the analysis are shown below.

Table 5.29 Sensitivity Analysis

Sensitivity	EIRR (%)	B/C Ratio	NPV (1,000 Birr)
a) Base Estimate	12.8	1.29	16,434
b) Project Cost Increase of 15%	11.2	1.12	8,024
c) Benefit Decrease of 15%	11.0	1.10	5,559
d) Combination of b) and c) above	9.6	0.96	-2,852

(7) Results of Economic Evaluation

As a result of the economic evaluation including sensitivity analysis, the priority project has sufficient EIRR (12.8%), and its B/C ratio and NPV are also high. The projects can be judged economically feasible from the results.

Table 5.30 Cost-Benefit Analysis

(The Priority Projects)

- Kechene River (Kechene weir and Kostre regulating pond)
- Bantyiketu River (Bantyiketu regulating pond, channel improvement, and urban drainage)
- Non-structural measures (River zone, flood warning system, flood fighting system, and social education)

Unit: 1,000 Birr

Year in order	Year	Benefit	Cost							
			Structural measures			Non-structural measures			Total Cost	Net Cash Flow
			Initial cost	O&M	Sub-total	Initial cost	O&M	Sub-total		
1	1997	0	0		0	0		0	0	0
2	1998	0	669		669	68		68	737	-737
3	1999	0	8,391		8,391	102		102	8,493	-8,493
4	2000	0	33,974		33,974	2,992	85	3,077	37,051	-37,051
5	2001	4,776	33,976	119	34,095		170	170	34,265	-29,489
6	2002	9,552		238	238		170	170	408	9,144
7	2003	9,776		238	238		170	170	408	9,368
8	2004	9,999		238	238		170	170	408	9,591
9	2005	10,223		238	238		170	170	408	9,815
10	2006	10,446		238	238		170	170	408	10,038
11	2007	10,670		238	238		170	170	408	10,262
12	2008	10,893		238	238		170	170	408	10,485
13	2009	11,117		238	238		170	170	408	10,709
14	2010	11,341		238	238		170	170	408	10,933
15	2011	11,564		238	238		170	170	408	11,156
16	2012	11,788		238	238		170	170	408	11,380
17	2013	12,011		238	238		170	170	408	11,603
18	2014	12,235		238	238		170	170	408	11,827
19	2015	12,459		238	238		170	170	408	12,051
20	2016	12,682		238	238		170	170	408	12,274
21	2017	12,906		238	238		170	170	408	12,498
22	2018	13,129		238	238		170	170	408	12,721
23	2019	13,353		238	238		170	170	408	12,945
24	2020	13,576		238	238		170	170	408	13,168
25	2021	13,576		238	238		170	170	408	13,168
26	2022	13,576		238	238		170	170	408	13,168
27	2023	13,576		238	238		170	170	408	13,168
28	2024	13,576		238	238		170	170	408	13,168
29	2025	13,576		238	238		170	170	408	13,168
30	2026	13,576		238	238		170	170	408	13,168
31	2027	13,576		238	238		170	170	408	13,168
32	2028	13,576		238	238		170	170	408	13,168
33	2029	13,576		238	238		170	170	408	13,168
34	2030	13,576		238	238		170	170	408	13,168
35	2031	13,576		238	238		170	170	408	13,168
36	2032	13,576		238	238		170	170	408	13,168
37	2033	13,576		238	238		170	170	408	13,168
38	2034	13,576		238	238		170	170	408	13,168
39	2035	13,576		238	238		170	170	408	13,168
40	2036	13,576		238	238		170	170	408	13,168
41	2037	13,576		238	238		170	170	408	13,168
42	2038	13,576		238	238		170	170	408	13,168
43	2039	13,576		238	238		170	170	408	13,168
44	2040	13,576		238	238		170	170	408	13,168
45	2041	13,576		238	238		170	170	408	13,168
46	2042	13,576		238	238		170	170	408	13,168
47	2043	13,576		238	238		170	170	408	13,168
48	2044	13,576		238	238		170	170	408	13,168
49	2045	13,576		238	238		170	170	408	13,168
50	2046	13,576		238	238		170	170	408	13,168
EIRR=		12.8%								
B/C =		1.29 (at discount rate: 10 %)								
NPV=		16,434 (at discount rate: 10 %)								

Note: The O & M costs of the structural measures include annual reserve for replacement of gates.

5.10.4 Conclusions of Project Evaluation

It is concluded that the priority projects indicate sufficient viability for their implementation with due consideration of the previous flood damages as experienced in 1978 and 1994, flood control projects are one of the urgent requirements for Addis Ababa. It is therefore recommended that the priority projects be realized at the earliest as a part of infrastructure development in Addis Ababa.

The projects show a fairly good economic feasibility with the economic internal rate of return (EIRR) of 12.8%. The beneficial population will be 470,000 people in the year of 2020, which is equivalent to 35% of the beneficiaries expected by the implementation of the flood control master plan. The beneficial area is also extensive at 43 km^2 covering the city center of Addis Ababa in terms of public services, commercial activities and transportation.

It is therefore foreseeable that these benefits will greatly outweigh potential negative impacts including a limited number of resettlement and some aspects during construction.

The annual disbursement of the project cost is estimated at 130, 1505, 7106, and 6620 US$/year during the implementation period of 4 years. It appears to be an acceptable amount for further budget allocation to flood control projects by the Region 14 Administration.

5.11 Implementation Plan

The implementation plan of priority project is formulated respecting that of master plan study.

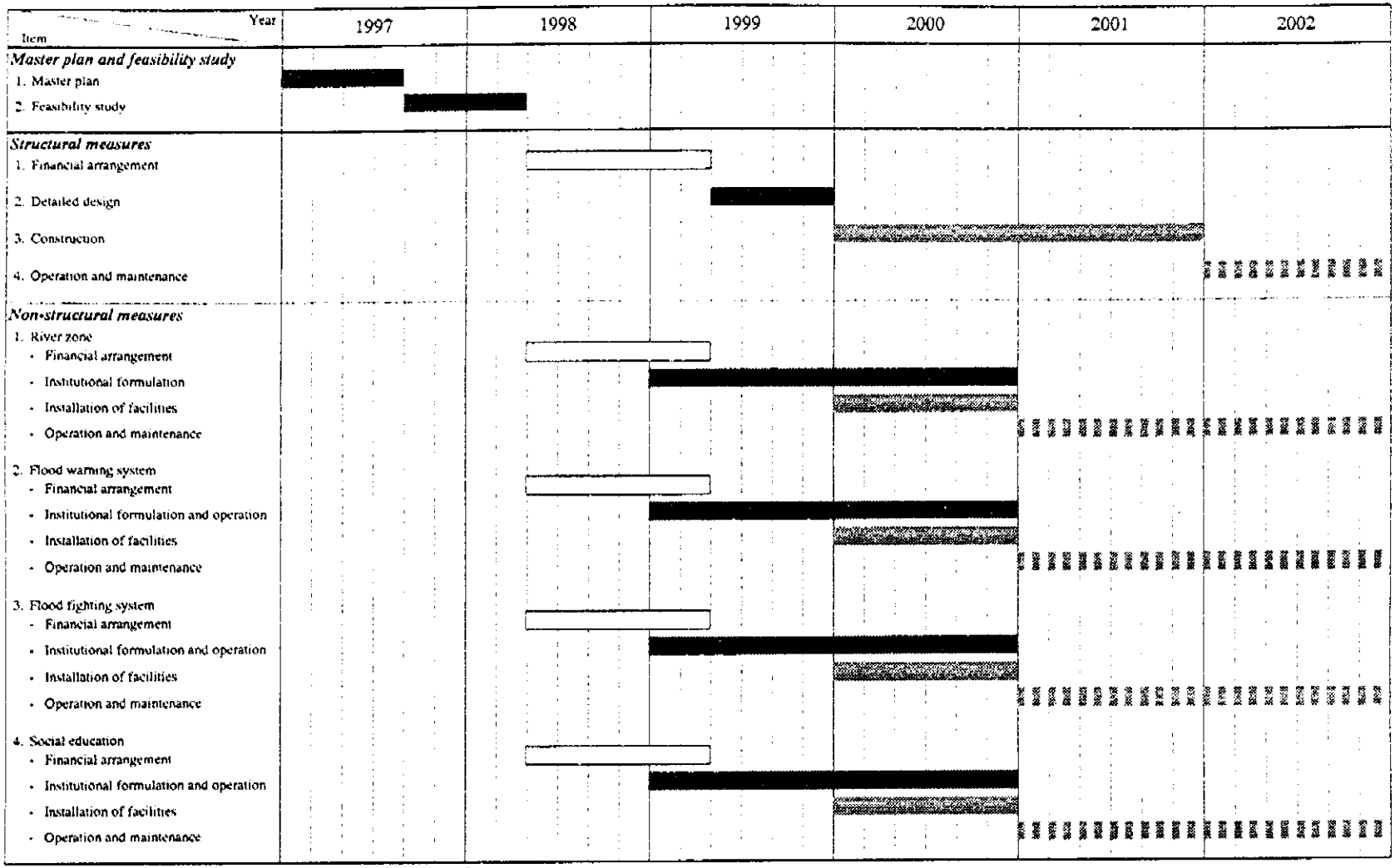
All structural measures of the priority projects must be implemented as an integrated package. This is because that flood damages against the design floods still occur because of insufficient flow capacity of river channels in both of the conceivable cases, that is, Case 1 in which the Kechene weir and the two regulating ponds are built while river channel improvement remains yet to be begun, and Case 2 in which river channel improvement is completed while the Kechene weir and the two regulating ponds are yet to be built.

Supposed that it is decided to implement the project just after this feasibility study, the implementation will be commenced from the year of 1999 after some period of financial arrangement.

Structural measures will be commenced with detailed design in the middle of 1999. The detailed design including tender for construction will be conducted for eight months. EIA (Environmental Impact Assessment), if required, and resettlement for construction works will be executed simultaneously with the detailed design. The detailed design including tender for construction will be finished end of 1999. After the detailed design, the construction works will be executed for two years. It will be commenced in the beginning of 2000 and will be completed end of 2001. Operation and maintenance will be carried out successively after the completion of the construction works from 2002.

Non-structural measures of river zone, flood warning system, flood fighting system and social education will be implemented simultaneously. The non-structural measures will be commenced with the formulation of institution in the middle of financial arrangement, under the yearly budget of present AFCPO, from the beginning of 1999. The institution will be formulated for two years from 1999. The facilities of non-structural measures will be installed within a year of 2000. The institutional formulation and the installation of facilities will be completed in the end of 2000. Operation and maintenance will be carried out successively from 2001.

Proposed implementation plan of priority project is shown in Figure 5.47.



Note: - Feasibility study includes the study on both structural and non-structural measures.
- EIA and resettlement are conducted simultaneously with the detailed design.
- Detailed design includes tender for construction.

Figure 5.47 Proposed Implementation Plan of Priority Project

5.12 Conclusions of the Feasibility Study

5.12.1 Structural Measures

(1) River Channel Improvement

• Bantyiketu River		
- Channel Excavation	20,500	m^3
- Embankment	400	m^3
- Floodwall	3,010	m^2
- Slope Protection	5,010	m^2
- Repair of Intake Weir	1	
- Improvement of Aqueduct	1	
- Protection of Water Supply Pipes	2	
• Lower Kebena River		
- Slope Protection	4,830	m^2
• Lower Kechene River		
- Floodwall	540	m^2
• Urban Drainage Improvement		
- Drainage Area	2.61	km^2
- Drainage Ditch	1,060	m

(2) Construction of Bantyiketu and Kostre Regulating Ponds

• Bantyiketu Regulating Pond		
- Reservoir Area	29,900	m^2
- Reservoir Volume	73,000	m^3
- Length of Lateral Overflow Dike	50	m
- Design Discharge of Lateral Overflow Dike	30	m^3/sec
• Kostre Regulating Pond		
- Reservoir Area	6,500	m^2
- Reservoir Volume	26,000	m^3
- Length of Lateral Overflow Dike	30	m
- Design Discharge of Lateral Overflow Dike	14	m^3/sec

(3) Construction of Kechene Weir

- Reservoir Area	20,000	m^2
- Reservoir Volume	88,000	m^3
- Weir Height : Non-overflow section	19.5	m
- Weir Height : Overflow section	16.0	m
- Crest Length	120	m
- Design Discharge of Orifice Outlet (1.2 m × 1.2 m, 3 nos.)	50	m^3/sec
- Design Discharge of Overflow Spillway (Width = 20 m)	120	m^3/sec

5.12.2 Non-structural Measures

(1) Authorization of River Zone

- Delineation of river zone covering river channel and extent of 5 m from both river banks
- Legal arrangement for river management

(2) Social Education for River and Flood

- Enlightenment of public awareness for river and flood
- Popularization of flood warning and fighting to communities

(3) Flood Warning System

- Installation of rainfall gauges (3 locations), water level gauges (10 locations), communication lines (5.3 km), and sirens (10 locations)
- Establishment of communication and information system for operation

(4) Flood Fighting System

- Institutional set-up self-defense activities by community organizations
- Establishment of communication and information system for operation
- Installation of 5 storage houses with materials required for flood fighting activities

5.12.3 Project Cost and Benefit

(1) Project Cost

- Structural Measures : 100.2 million Birr
- Non-structural Measures : 4.2 million Birr
- Total : 104.4 million Birr

(2) Benefit

- Beneficial Population : 470,000 people
- Beneficial Area : 43 km^2
- EIRR : 12.8 %
- B/C : 1.29

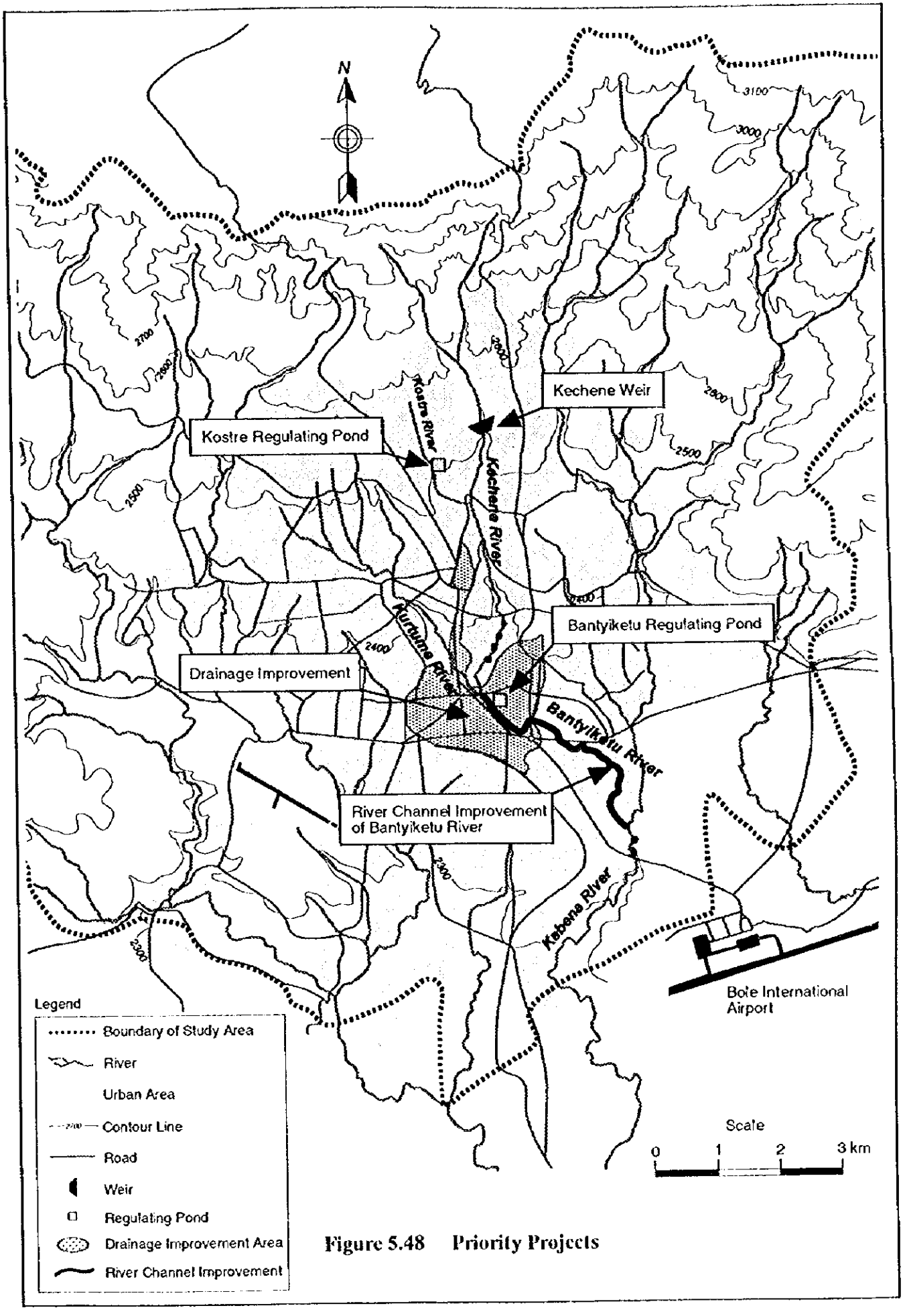


Figure 5.48 Priority Projects

CHPAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

(1) Advance toward Implementation of Structural and Non-structural Measures Contemplated by Master Plan

The amount of flood damages in the Region 14 Administration is soaring year by year with the drastic increase of population and infrastructures. It is recommended that the priority projects be first launched among projects proposed by the master plan, and that the rest of the master plan projects be continuously implemented according to the implementation plan of the master plan projects from the view point of local economic conditions and social welfare.

The master plan presumes 22 years as implementation period of the master plan projects from modest financial situation in Ethiopia. It is recommended that, with more ample budget appropriated for flood control projects, the implementation of the master plan projects be accelerated, keeping up with more rapid economic growth and improvement of infrastructures in Ethiopia.

(2) Early Implementation of Priority Projects

Flood control measures of the Bantyiketu river and the upper Kechene river are chosen for the priority projects. 11 % of total population of the Region 14 administration enjoy direct or indirect benefits created by the priority projects, and more intangible and unquantifiable benefits are expected. The priority projects indicate high economic viability with Economic Internal Rate of Return (EIRR) of 12.8 % and Benefit-Cost ratio of 1.29 and their early implementation is strongly recommended.

It is inevitable and almost compulsory that all structural measures contemplated by the priority projects are implemented as an integrated package, not stage-wise, in order to attain the anticipated goal of flood damage reduction.

(3) Early Establishment of Addis Ababa River Board (AARB) and Addis Ababa River Management Authority (AARMA) and Legislation for River Management

For the implementation of both structural and non-structural measures proposed by the priority projects, Addis Ababa River Board (AARB) and Addis Ababa River Management Authority (AARMA) are to be established as soon as possible.

Early legislation is also strongly emphasized as well as establishment of the two organizations. Especially, in connection with river management, flood warning system and flood fighting, legislation has to cover various items such as (1) the status and responsibilities of and the rights entrusted to AARB and AARMA, (2) the duties, responsibilities of and the rights entrusted to local organizations (Zone, Wereda, Kebele, communities etc.) and local people, (3) punitive measures.

(4) Reinforcement of Organizations by Foreign Experts

Not only structural measures such as construction of a weir and regulating ponds, but also non-structural measures such as river management and flood risk management contemplated by the priority projects are quite new and challenging subjects to the Region 14 Administration.

Hence, it is recommended that foreign experts be assigned to provide AARB and AARMA with fundamental know-how required for construction supervision of the proposed structural measures and efficient implementation of the non-structural measures on a long-term basis.

(5) Restriction of Land Use along the West Akaki and the Kebena rivers in Southern Part of Study Area

According to the Addis Ababa Master Plan, urban areas of Addis Ababa are expanding toward the southern border zones of the Study Area where the West Akaki and the Kebena rivers penetrate. Hence, land use and development along the two rivers have to be strictly restricted to avert impending increase of flood damages.

(6) Collection of Climatological and Hydrological Data

At present, river channel improvement such as the construction of flood walls is often launched without support of proper hydrological analyses because of the lack of hydrological data. To enforce river management, flood warning and other non-structural measures contemplated by the priority projects in an effective manner, climatological and hydrological data such as rainfall, river discharges are essential. Hence, collection of these data is extensively stressed, with budget appropriation required.