technology as well as irrigated farming technology, and to extend the results to farmers, it is proposed to establish "Regional Farming Technology Centre" in each side of Munyati river. In this centre, research and experiment shall be carried out irrigated agriculture (optimum cropping pattern, farming practices and water management) under development of the medium-size dams. In addition the same activities as with Scenario B-2 will be carried out. Furthermore, results obtained in the centre shall be transmitted to farmers in the area through guidance and training for AGRITEX extension staff. The activities in RFTC will expand in progress of constructing Kudu Dam irrigation system. The facility plan for the RFTC is shown in Table 5-4.

(2) Model project

In order for farmers who have no experience of irrigation to be able to immediately commence irrigated farming upon completion of the construction of a large scale irrigation system, including crop cultivation as well as water management, it is proposed that a model project should be implemented in parallel with construction of irrigation facilities so as to educate and train both AGRITEX extension workers and beneficial farmers by using RFTC as its core. Especially, due attention should be paid for AGRITEX and its staff, because they shall play a very vital role of an interface between main facilities and farmponds. In this connection, by utilizing water developed by the two medium-size dams, training on water management and O & M of facilities shall be extended not only to farmers but also to AGRITEX extension staff.

5.3.9 Preliminary Cost Estimate

(1) Condition of cost estimate

The same condition of Scenario B-2 is being applied.

(2) Project cost

The total project cost at current price is estimated at 2,598.5 million Zimbabwean Dollars and details are shown below (Refer to Table 5-5 and 5-6, and Appendix M)

(Unit: Z$ million)

Description	(At 2010)
1) Development of the Infrastructure	
- Const. and Rehabil. of Road	53.4
- Const. of Collection/Deposit Point	8.0
- Const. and Rehabil. of Boreholes	1.7
- Construction of Community Centre	1.2
Sub-total	64.3
2) Regional Farming Technology Centre	40.0
3) Construction of Medium-size Dams	52.7
4) Construction of Kudu Dam	430.5
5) Construction of Irrigation (Main & On-farm)	
- Main Facilities	1,327.6
- On-farm (Communal/Resettlement)	380.4
Sub-total	1,708.0
6) On-Farm (S.S.C.F.)	185.0
7) On-Farm (L.S.C.F.)	118.0
Total	2,598.5

(2) Operation and maintenance cost

The annual operation and maintenance cost amounts to Z$ 31.6 Million.

Table 5-1 CROP YIELDS

Crop	Present yield in "Good" season (kg/ha)	Frequency of Drought (No./10 years)	Present Yield including impact of Drought (kg/ha)	Target Yield under Irrigation (kg/ha)	Target Yield under Dryland (kg/ha)
Cotton	CA 940 RA 1,267	4	702	2,700	900
	SSCF 1,300	-	1,300	3,000	-
Maize	CA 1,646 RA 1,950	4	1,006	5,400	1,300
	SSCF 2,340	-	2,340	6,000	-
Groundnut	CA 560 RA 520	4	379	2,250	560
	SSCF 804	-	804	2,500	-
Sunflower	CA 297 RA 500	4	303	Not produced under irrigation	500
	SSCF 719	-	719	-	-
Wheat	CA/RA -	-	Impact is on area planted not yield	4,500	Only grown in winter with irrigation
	SSCF 3,500	-		5,000	
Sugarbeans	CA/RA -	-	-	1,350	1,000
	SSCF -	-	-	1,500	1,000
Green Maize	CA/RA -	-	-	4,050	Only grown under irrigation
	SSCF -	-	-	4,500	
Onions	CA/RA -	-	-	9,000	Only grown under irrigation
	SSCF -	-	-	10,000	

Table 5-2 REHABILITATION AND PROPOSED BOREHOLES IN COMMUNAL AND RESETTLEMENT

ward Name	Farm Type	Existing Boreholes Nos.	**Rehabilitation of Boreholes	Population	Boreholes Density	Proper Nos. Boreholes	Necessary Boreholes	Remarks
		①	① x 17 %	②	③=②/①	*④=②/250	⑤=④-①	
Makore I	Communal	29	5	9159	316	37	8	
Makore II	Communal	31	5	6148	198	25	0	
Chisina I	Communal	38	7	14380	378	58	19	
Chisina II	Communal	37	6	11155	301	45	8	
Mabura	Communal	16	3	5542	346	22	6	
Sidakeni	Communal	31	6	5529	178	22	0	
Sanyati Commu.	Communal	156	28	22753	146	91	0	
Sachuru	Resettlemen	-	-	4763	-	19	1	
Nyarungwe	Resettlemen	-	-	1039	-	4	1	
Muzvezve I	Resettlemen	-	-	9681	-	39	1	
Total	Total	338	60	90149	1865	361	43	

Note : * Proper Density of Borehole= 1unit / 250 persons proposed by National Rural Water Supply and Sanitation Programme(NRWSSP)

** mainly to be repaired the handpumps

Table 5-3 EXISTING AND PROPOSED COLLECTION POINT & DEPOSIT POINT AND COMMUNITY CENTER

Location	Ward Name	Deposit point		Collection Point		Community Center	Remarks
		COTTCO	GMB	COTTCO	GMB		
Kadoma		■	●				
Gokwe		□	●				
Sanyati		■	●				
Nembudziya		■	●				
Empress Mine	Sidakeni			▽	▲	○	
Everglades	Muzvezve			▽	△	○	
Mtanke	Chisina I			▽	△	○	
Marungu BC	Chisina II			▽	△	○	
Chenjiri Camp	Chnjiri S.S.F.			▽	△	○	
Nyimo BC	Sanyati Communal			▽	△	○	
	Total (Proposed)	1		6	5	6	

■、●、▲: Existing
□、▽、△: Proposed
COTTCO : Cotton Company of Zimbabwe
GMB : Grain Marketing Board

Table 5-4 PROJECT COMPONENTS FOR REGIONAL FARMING TECHNOLOGY CENTER IN EACH SCENARIO

Component		Scenario B-2	Scenario B-1	Scenario A
1. Research and improvement of rainfed agriculture technology				
Intrduction of drought resistible crop	sorghum ,millet	○	○	○
Intrduction of drought resistible variety	maize, cotton	○	○	○
Intrduction of feed crops and trees		-	-	○
Promotion of Livestock		-	-	○
2. Reinforcement of extension				
Reinforcement of extension worker		-	△	○
Procurement of Facilities & machinery		-	△	○
Retraining of extention worker		△	△	○
Training og farmers		△	△	○
3. Regional Farming Technology Center				
3.1 Building				
Site		2 ha	3 ha	4 ha
Administration office		400m²	800m²	1200m²
Guest house for lectures		80m²	120m²	200m²
Dormitory for trainee		120m²	180m²	240m²
Storage	seed,fetilizer,chemical	80m²	120m²	160m²
Garage		100m²	200m²	300m²
Warehouse for machinery & repairshop		250m²	500m²	1000m²
Total		1030m²	1920m²	3100m²
3.2 Pilot farm		10	20	30
Rainfed farm (ha)		10	6	6
Fallow (ha)		0	6	8
Sprinkler (ha)		0	4	8
Drip (ha)		0	4	8
3.3 Machinery				
Bulldozer 6t		1	2	3
Tractor-trailer 35ps		2	4	8
Disk plough		2	4	8
Disk harrow		2	4	8
Pick-uo truck 10t		3	4	8
Microbus		0	1	1
3.4 Other				
Laboratory equipment		1 Lot	1 Lot	1 Lot
Audio-Visual Equipment		1 Lot	1 Lot	1 Lot
Agri-machine & workshop equipment		-	1 Lot	1 Lot
Meteorological observation equipment		1 Lot	1 Lot	1 Lot

Table 5-5 Initial Investment in Each Target Year

(Unit: Z$ Million)

Scenario	B-2	B-1			A			
Development Stage	I	I	II	計	I	II	III	計
Target Year	2000	2000	2005		2000	2005	2010	
1. Regional Farming Technology Center								
- Main Center (Sanyati)	6.8	6.8	6.2	13.0	6.8	6.2	7.0	20.0
- Sub-center (Mutange)	6.8	6.8	6.2	13.0	6.8	6.2	7.0	20.0
- Sub-total	13.6	13.6	12.4	26.0	13.6	12.4	14.0	40.0
2. Agricultural Extension Service Program	-	-	-	-	-	-	-	-
3. Development of Marketing System								
- Road Development	53.4	53.4	-	53.4	53.4	-	-	53.4
- Collection/Deposit Point	8.0	8.0	-	8.0	8.0	-	-	8.0
- Sub-total	61.4	61.4	-	61.4	61.4	-	-	61.4
4. Farmers' Organization Support Program	-	-	-	-	-	-	-	-
5. Farmers' Participation	-	-	-	-	-	-	-	-
6. Reinforcement of Agricultural Crediting	-	-	-	-	-	-	-	-
7. Rural Infrastructure Development								
- Rehabilitation/Construction of Wells	1.7	1.7	-	1.7	1.7	-	-	1.7
- Community Center (Meeting Room)	1.2	1.2	-	1.2	1.2	-	-	1.2
- Sub-total	2.9	2.9	-	2.9	2.9	-	-	2.9
8. Irrigation Development								
8-1. Medium Dams								
- Dam component	-	-	89.4	89.4	-	-	49.1	49.1
- Irrigation facilities	-	-	8.5	8.5	-	-	3.6	3.6
- Sub-total	-	-	97.9	97.9	-	-	52.7	52.7
8-2. Kudu Dam								
- Dam component	-	-	-	-	-	-	430.5	430.5
- Main & On-Farm (Communal/Resettlement)	-	-	-	-	-	-	1,708.0	1,708.0
- On-farm (S.S.C.F.)	-	-	-	-	-	-	118.0	118.0
- On-farm (L.S.C.F.)	-	-	-	-	-	-	185.0	185.0
- Sub-total	-	-	-	-	-	-	2,441.5	2,441.5
8-3. Total	-	-	97.9	97.9	-	-	2,494.2	2,494.2
9. Land Reclamation/Soil Conservation	145.1	-	193.5	193.5	-	-	-	-
10. Management, O & M of Project Facilities	-	-	-	-	-	-	-	-
11.Grand Total	223.0	77.9	303.8	381.7	77.9	12.4	2,508.2	2,598.5

Table 5-6 Summary of Initial Investment (2010)

(Unit: Z$ Million)

Project Component	Scenario B-2	Scenario B-1	Scenario A
1. Regional Farming Technology Center			
- Main Center (Sanyati)	6.8	13.0	20.0
- Sub-center (Mutange)	6.8	13.0	20.0
- Sub-total	13.6	26.0	40.0
2. Agricultural Extension Service Program	-	-	-
3. Development of Marketing System			
- Road Development	53.4	53.4	53.4
- Collection/Deposit Point	8.0	8.0	8.0
- Sub-total	61.4	61.4	61.4
4. Farmers' Organization Support Program	-	-	-
5. Farmers' Participation	-	-	-
6. Reinforcement of Agricultural Credting	-	-	-
7. Rural Infrastructure Development			
- Rehabilitation/Construction of Wells	1.7	1.7	1.7
- Community Center (Meeting Room)	1.2	1.2	1.2
- Sub-total	2.9	2.9	2.9
8. Irrigation Development			
8-1. Medium Dams			
- Dam component	-	89.4	49.1
- Irrigation facilities	-	8.5	3.6
- Sub-total	-	97.9	52.7
8-2. Kudu Dam			
- Dam component	-	-	430.5
- Main & On-Farm (Communal/Resettlement)	-	-	1,708.0
- On-farm (S.S.C.F.)	-	-	118.0
- On-farm (L.S.C.F.)	-	-	185.0
- Sub-total	-	-	2,441.5
8-3. Total	-	97.9	2,494.2
9. Land Reclamation/Soil Conservation	300.8	286.6	-
10. Management, O & M of Project Facilities	-	-	-
11.Grand Total	378.7	474.8	2,598.5

Figure 5-1 ROAD REHABILITATION PLAN AND PROPOSED DEPOSIT AND COLLECTING POINTS

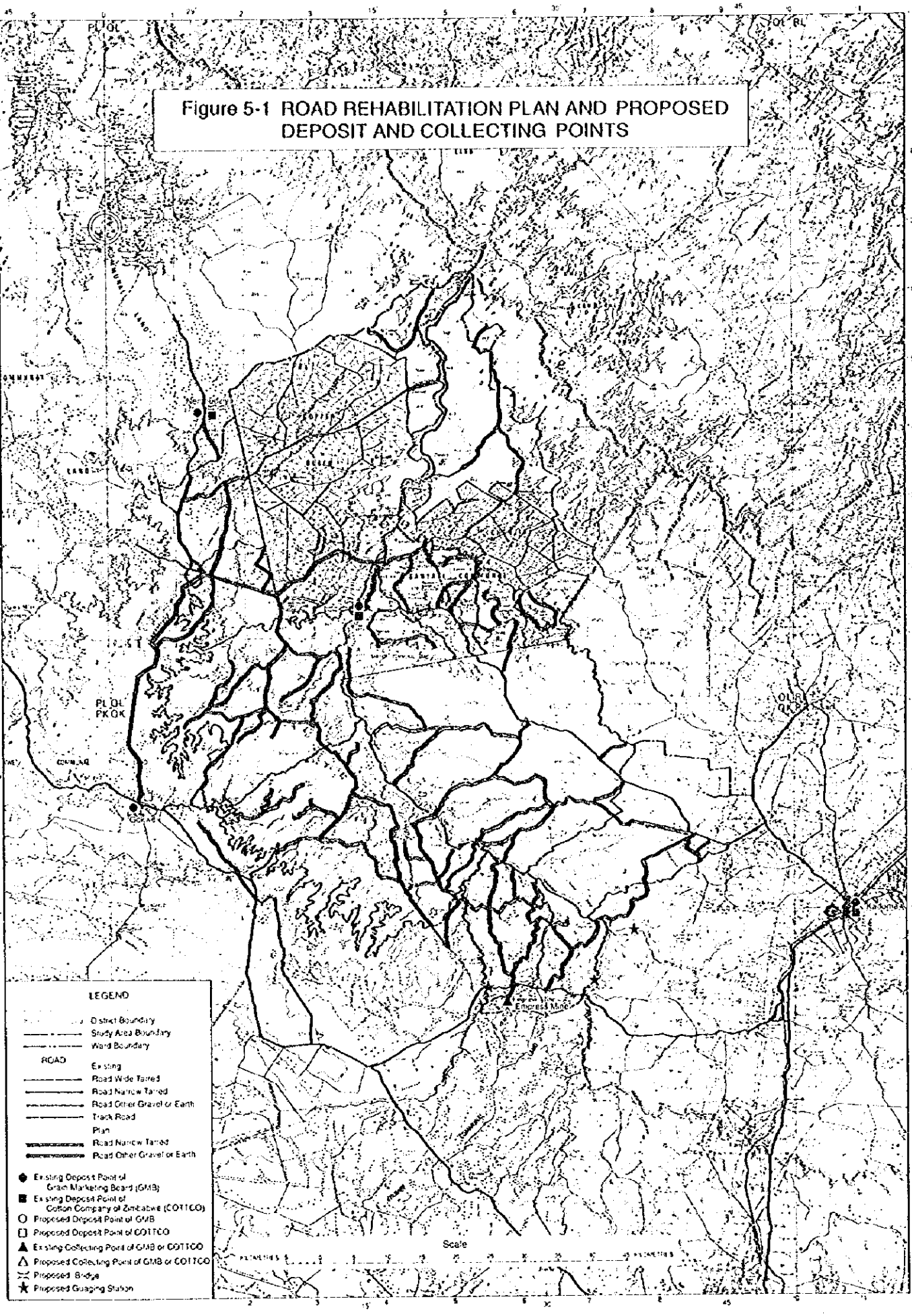
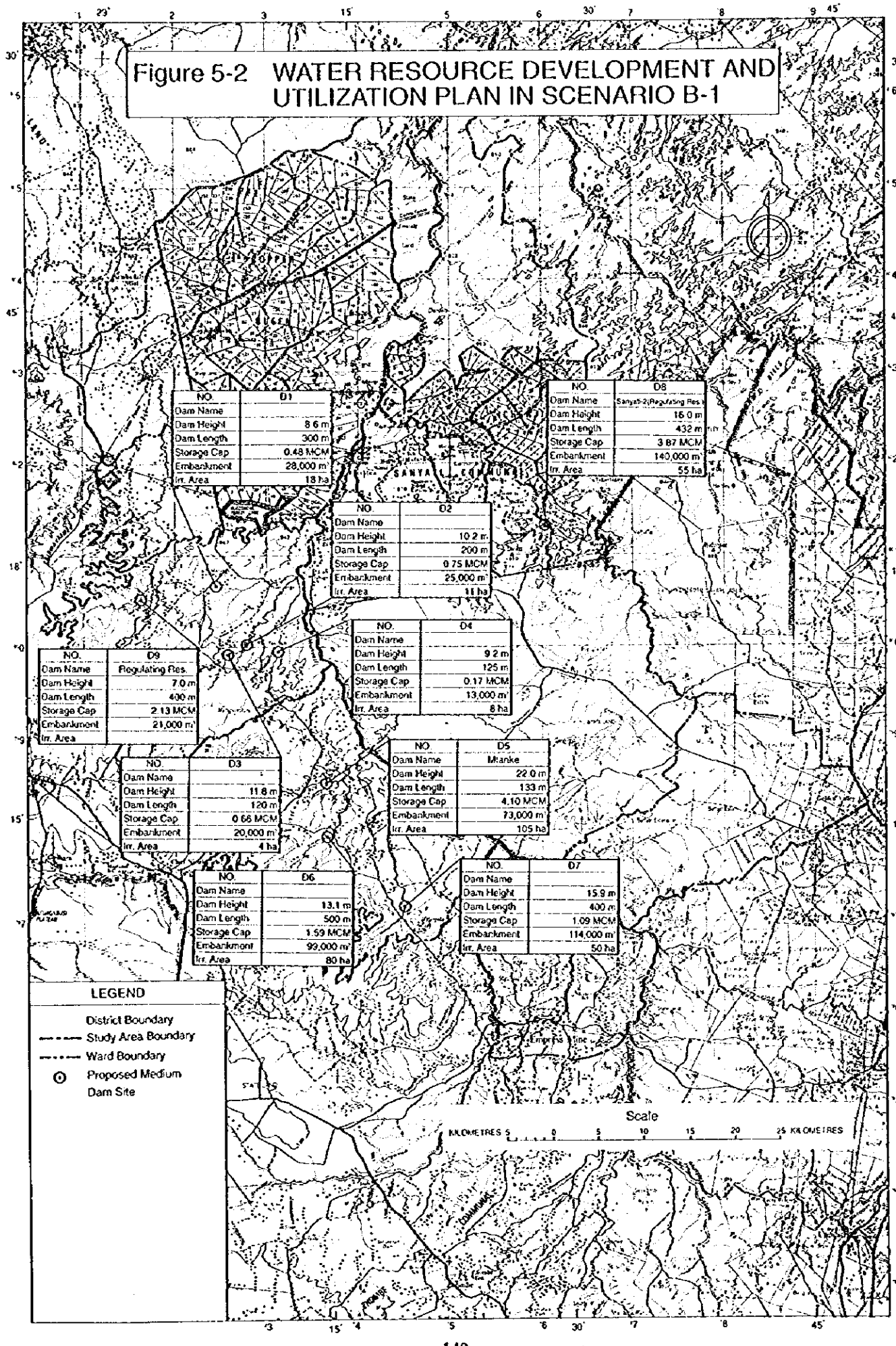


Figure 5-2 WATER RESOURCE DEVELOPMENT AND UTILIZATION PLAN IN SCENARIO B-1



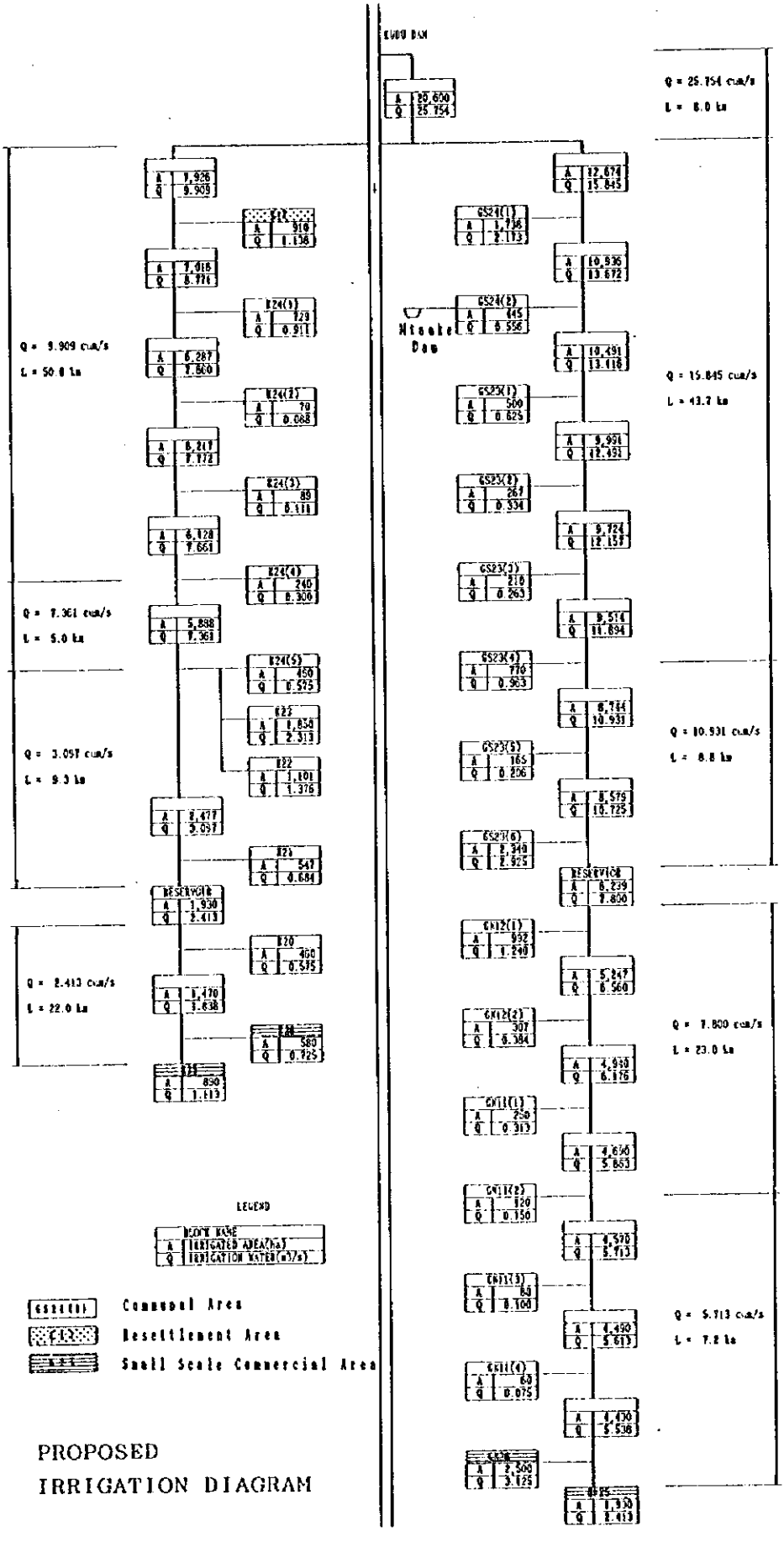


Figure 5-3 PROPOSED IRRIGATION DIAGRAM

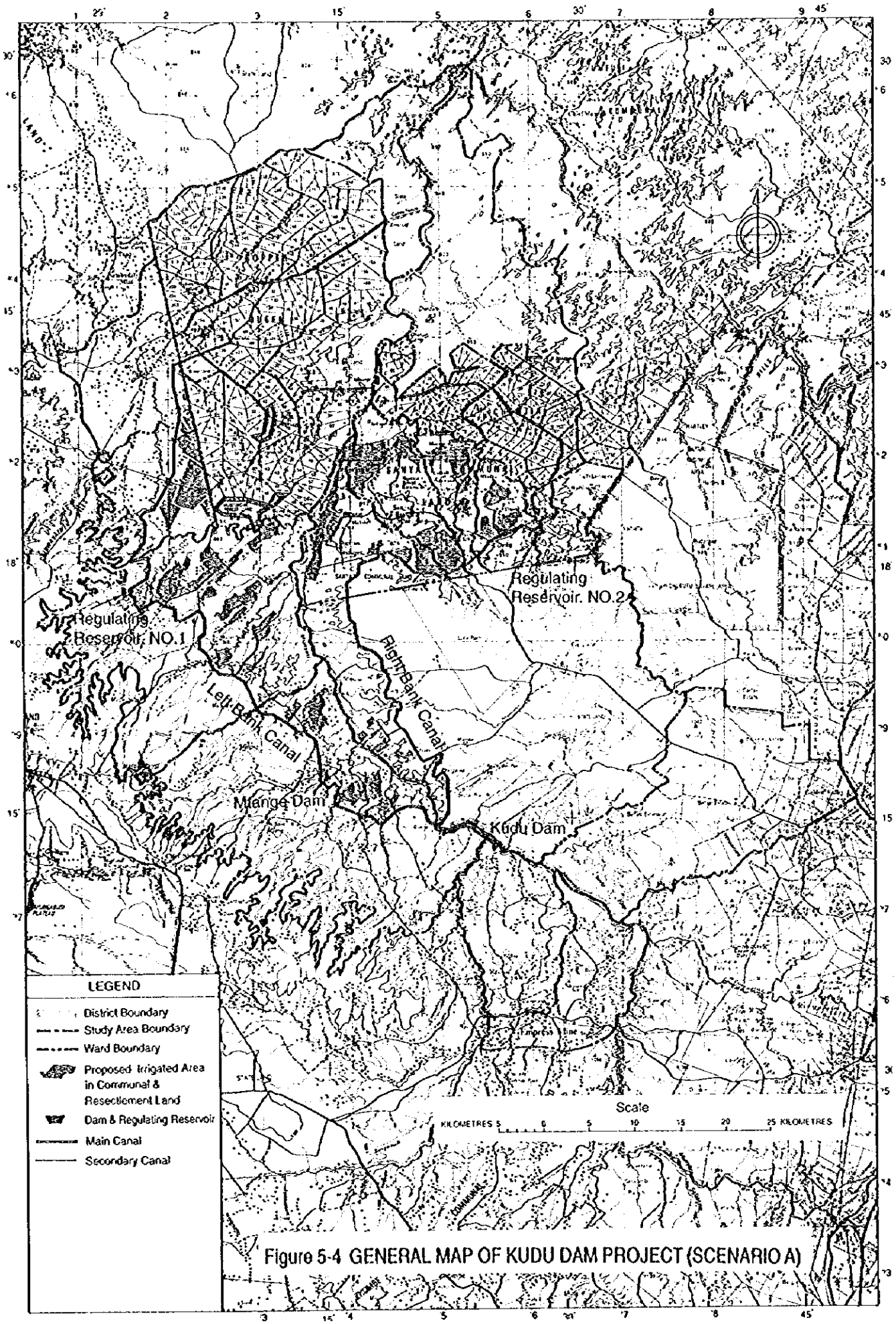


Figure 5-4 GENERAL MAP OF KUDU DAM PROJECT (SCENARIO A)

CHAPTER 6

IMPLEMENTATION PROGRAMME

CHAPTER 6 IMPLEMENTATION PROGRAMME

6.1 Implementing Organization

6.1.1 Coordinating Body

Since the specific feature of the master plan is, generally, to cover various components, AGRITEX could not solely handle all the components including implementation, management, and O & M. In the scope of irrigation development, AGRITEX and DWD will play a vital role. On the other hand, construction and rehabilitation of wells, rural road improvement and construction of community centre will be under DDF of MLGRUD, bridge construction shall be under Ministry of Transport and Energy, and regional farming technology centre be under Ministry of Public Construction and National Houses (See Table 6-1). It is, therefore, planned to establish a project coordinating committee at three levels of the government, namely, Project Executive Committee (P.E.C.), Project Coordinating Committee (P.C.C.) and Project Working Committee (P.W.C.). With the directive and guidance of these coordinating committees, AGRITEX shall be in charge of supervising progress of project implementation. Table 6-2 indicates composition of these committees and their respective responsibilities are as follows:

Project Executive Committee (P.E.C.)

- to formulate a basic policy on project implementation and to provide directives to the project coordinating committee.
- to resolve policy issues

Project Coordinating Committee (P.E.C.)

- to coordinate project activities and to approve annual working plan with budget allocation.
- to manage progress of project implementation and to report the result to P.E.C.

Project Working Committee (P.W.C.)

- to perform the current annual working programme.
- to prepare the successive annual working program with budget estimation and submit it to P.C.C.
- to monitor progress of project implementation and to report the result as well as problems/issues to P.C.C.

6.1.2 Executing Agency

Under the P.E.C., AGRITEX shall appoint a project director and shall become the direct executing body of the project. The project director will act as secretary of P.E.C. as well as a chairman of P.C.C. Under the project director, AGRITEX shall appoint a project manager, who will be chairman of P.W.C., and supervise respective role of agency allocated by the project component as shown in Table 6-1.

6.2 Implementation Schedule

In order to compare three scenario at same level, implementing schedule up to year 2010 was prepared. This schedule includes the required period for feasibility study and detailed design. Construction period varies from two years to 13 years at longest (See Figures 6-1 to 6-3).

6.3 Organization for Project O & M

6.3.1 Responsible Agency

Basically, the implementing agency will be continuously in charge of operation and maintenance of facilities, except the following component: (a) Regional Farming Technology Centre (Min. of Public Construction and National Houses to AGRITEX); (b) Land Reclamation and Soil Conservation (AGRITEX to farmers group); (c) Farm ditch and on-farm facilities (AGRITEX to farmers group).

6.3.2 O & M for Irrigation System

Role of farmers group especially in the communal and resettlement land is quite important in management, O & M of irrigation facilities and dominate sustainability of the project. Therefore, it is a prerequisite to jointly operate and maintain the irrigation facilities with farmers organization.

(1) Medium-size dams

At this stage, eight medium-size dams have been identified, out of which irrigable command area is ranging from 4 ha to 105 ha. In order to properly carry out water management and O & M of irrigation facilities, it is planned to establish water user group in each dams. However, three dams of D2 and D3 (Nyarupakwe) and D4 (Nyamachene) will be jointly managed by one water user group, because they are located very closely and have very small sizes of irrigation command area with 11ha, 4ha and 8 ha, respectively. In the Study Area, since the 1960's, Ngondoma irrigation scheme with irrigable area of 44 ha has been operated, and attaining good performance with guidance of AGRITEX extension staff. Therefore, management of the proposed water user group shall follow the same system of Ngondoma scheme.

(2) Kudu Dam (Scenario A)

In the Kudu Dam irrigation system, it is planned to basically provide a night storage for terminal irrigation area of 100 ha. In the other medium-size dam schemes, AGRITEX has enough experience to supply water from a night storage to on-farm in the communal and resettlement lands. In view of that, it is planned to establish a water user group for each night storage organized by 100 farmer beneficiaries. Each water user group is responsible for water management as well as O & M of facilities and collection of water charges after the night storage with assistance of AGRITEX.

Furthermore, to make consistent water management in the entire irrigation system easier, it is planned to establish a water user association in each secondary canal organized by water user groups.

Water management and O & M of main irrigation facilities are jointly operated by the water user associations, DWD and AGRITEX.

Table 6-1 Relation between Scenario and Project Execution, O & M Organiztion by Porject Component

Project Component	Executing Agency	O & M Organization	Scenario B-2	Scenario B-1	Scenario A
I. Infrastructure					
1.1 Road Development					
(1) Pavement and Gravel Road	D.D.F.	D.D.F.	○	○	○
(2) Bridge (Munyati river)	Min. Trasport & Energy	Min. Trasport & Energy	○	○	○
1.2 Deposit/Collection Poing	GMB/COTTOCO	GMB/COTTOCO	○	○	○
1.3 Const/Rehabili of Well	D.D.F.	D.D.F.	○	○	○
1.4 Community Center	D.D.F.	D.D.F.	○	○	○
II. R.F.T.C.	Min. of Public Construction	AGRITEX (With DR&SS's Cooperation)	○	○	○
III. Lnad Reclamation/ Soil Comservation	AGRITEX	Farmer G.(With AGRITEX/DR&SS'S Cooperation)	○	○	—
IV. Irrigation Development					
4.1 Medium-size Dams					
(1) Dam/Main Faccility	DWD	DWD	—	○	○
(2) Night Storage/Lateral Canal	AGRITEX	AGRITEX	—	○	○
(3) On-Farm Facility	AGRITEX	Farmer G.(AGRITEX's Assist)	—	○	○
4.2 Kudu Dam					
(1) Dam/Main/Regulating Pond	DWD	DWD	—	—	○
(2) Night Storage/Lateral Canal	AGRITEX	AGRITEX	—	—	
(3) On-farm Faxility					
- Communal/Resettlemnt	AGRITEX	Farmer G.(AGRITEX's Assist)	—	—	○
- S.S.C.F.	ICA	Beneficiary(AGRITEX's Assist)	—	—	○
- L.S.C.F.	ICA	Farm Owner	—	—	○

○ Necessary, — Not Necessary

Table 6-2 Coordinating Body for Project Implementation

Member	Scenario B-2	Scenario B-1	Scenario A
1. Project Executive Committee (P.E.C.)			
- Permanent Secretary, Ministry of Agriculture (MOA) as Chairman	○	○	○
- Permanent Secretary, Ministry of Land and Water Resources	--	○	○
- Permanent Secretary, Ministry of Local Government, Rural and Urban Development	○	○	○
- Permanent Secretary, Ministry of Transport and Energy	○	○	○
- Permanent Secretary, Ministry of Environment and Tourism (MET)	○	○	○
- Permanent Secretary, Ministry of Public Construction and National Houses	○	○	○
- Permanent Secretary, Ministry of Finance	○	○	○
- Commissioner, National Economic Planning Commission	○	○	○
- Governor, Mashonaland West Province	○	○	○
- Governor, Midland Province	○	○	○
- Director of AGRITEX as Secretary	○	○	○
2. Project Coordinating Committee (P.C.C.)			
- Director of AGRITEX as Chairman	○	○	○
- Director, Dept. of Water Development (DWD)	--	○	○
- Director, Dept. of Research & Specialist Services (DR&SS)	○	○	○
- Director, Dept. of Veterinary Services (DVS)	○	○	○
- Director, Dept. of Planning under MLGRUD	○	○	○
- Director, Dept. of Natural Environment (DNE)	○	○	○
- Director, Dept. of National Parks and Wild Life Management (DNPWLM)	--	○	○
- General Manager, Agricultural Financing Corporation (AFC)	○	○	○
- General Manager, Grain Marketing Board (GMB)	○	○	○
- General Manager, Zimbabwe Cotton Company (COTTOCO)	○	○	○
- District Administrator, Kadoma	○	○	○
- District Administrator, Gokwe North	○	○	○
- District Administrator, Gokwe South	○	○	○
- District Administrator, Kwekwe	○	○	○
- Project Manager of AGRITEX as Secretary	○	○	○
3. Project Working Committee (P.W.C.)			
- Project Manager of AGRITEX as Chairman	○	○	○
- Chiefs of Provincial DWD	--	○	○
- Chiefs of Provincial DR&SS	○	○	○
- Chiefs of Provincial DVS	○	○	○
- Chiefs of Provincial DNE	○	○	○
- Chiefs of Provincial DNPWLM	--	○	○
- Chiefs of District Development Fund (DDF)	○	○	○
- Representatives of MET	○	○	○
- Representatives of GMB and COTTOCO	○	○	○
- Representatives of Large Scale Commercial Farms' ICA	○	○	○
- Representatives of Small Scale Commercial Farms' ICA	○	○	○
- Representatives of GMB and COTTOCO	○	○	○
- Chief of Regional Farming Technology Center (R.F.T.C.)	○	○	○

Note: ○ Participate -- Not Participate

Scenario: B – 2

Figure 6-1 Project Implementation Schedule

Component	Pj. Quan'y	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Research on Regional Farming																
- Regional Farming Technology Center	2 places	<----	═══	═══	═══											
- Research on rainfed farming	—					═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	→
- Research on irrigated farming	N.A.															
- Research on marketing products	—					═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	→
2. Reinforce Agr. Extension Services	—					═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	→
3. Marketing System Development																
- Road Development:New 35km, Reh. 349km		<----	═══	═══	═══	═══										
- Provision of collection point	12 Places	<----	═══	═══	═══	═══										→
4. Activation of Farmers' Organization	—					═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	→
5. Farmers' Participation	—	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	→
6. Reinforcement of Agr. Crediting	—					═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	→
7. Rural Infrastructure Development																
- Rehabilitation/digging wells	103 Wells	<----	═══	═══	═══	═══										
- Provision of meeting room	6 Places	<----	═══	═══	═══	═══										
8. Water Resource/Irrigation Devlpment																
8-1 Medium dam project	N.A.															
8-2 Kudu dam project	N.A.															
- Dam construction	—															
- Main irrigation system	—															
- On-farm facilities (Comm./Reset.)	—															
- On-farm facilities (S.S.C.F.)	—															
- On-farm facilities (L.S.C.F.)	—															
9. Land Reclamation/Soil Conservation	35,500 ha	<----	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══	═══
10. Management, O & M of Project Facility	N.A.															

Legend: <----> Study/Plan ═══ Detail Design ═══ Construction/Implementation ——→ Management, O & M

.....→ Farmers' Participation

Scenario: B – 1

Figure 6-2 Project Implementation Schedule

Component	Pj. Quan'y	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Research on Regional Farming																
- Regional Farming Technology Center	2 Places	<----														
- Research on rainfed farming	–															
- Research on irrigated farming	–															
- Research on marketing products	–															
2. Reinforce Agr. Extension Services																
3. Marketing System Development																
- Road Development:New 35km, Reh. 349km		<----														
- Provision of collection point	12 Places	<----														
4. Activation of Farmers' Organization	–															
5. Farmers' Participation	–															
6. Reinforcement of Agr. Crediting	–															
7. Rural Infrastructure Development																
- Rehabilitation/digging wells	103 Wells	<----														
- Provision of meeting room	6 Places	<----														
8. Water Resource/Irrigation Devlpment																
8-1 Medium dam project (8 Places)	331 ha	<----														
8-2 Kudu dam project	N.A.															
- Dam construction	–															
- Main irrigation system	–															
- On-farm facilities (Comm./Reset.)	–															
- On-farm facilities (S.S.C.F.)	–															
- On-farm facilities (L.S.C.F.)	–															
9. Land Reclamation/Soil Conservation	33,800 ha	<----														
10. Management, O & M of Project Facility	–															

Legend: <----> Study/Plan ═══ Detail Design ═══ Construction/Implementation ———→ Management, O & M

·····→ Farmers' Participation

Figure 6-3 Project Implementation Schedule

Scenario: A

Component	Pj. Quan'y	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Research on Regional Farming																
- Regional Farming Technology Center	2 Places	<----	>													
- Research on rainfed farming	—															
- Research on irrigated farming	—															
- Research on marketing products	—															
2. Reinforce Agr. Extension Services	—															
3. Marketing System Development																
- Road Development:New 35km, Reh. 349km		<----	>													
- Provision of collection point	12 Places	<----	>													
4. Activation of Farmers' Organization	—															
5. Farmers' Participation	—															
6. Reinforcement of Agr. Crediting	—															
7. Rural Infrastructure Development																
- Rehabilitation/digging wells	103 wells	<----	>													
- Provision of meeting room	6 Places	<----	>													
8. Water Resource/Irrigation Development																
8-1 Medium dam project (2 Places)	160 ha	<----	>													
8-2 Kudu dam project																
- Dam construction	L.S.	<----		>												
- Main irrigation system	L.S.	<----		>												
- On-farm facilities (Comm./Rest.)	14,700 ha	<----		>												
- On-farm facilities (S.S.C.F.)	5,900 ha	<----		>												
- On-farm facilities (L.S.C.F.)	4,400 ha	<----		>												
9. Land Reclamation/Soil Conservation	none															
10. Management. O & M of Project Facility	—															

Legend: <----> Study/Plan ═══ Detail Design ═══ Construction/Implementation ═══> Management. O & M

------> Farmers' Participation

CHAPTER 7

ENVIRONMENTAL MANAGEMENT PLAN

CHAPTER 7 ENVIRONMENTAL MANAGEMENT PLAN

7.1 Introduction

Although considerable progress has been made since independence in 1980 to improve agricultural production and incomes within the communal farming areas, only a small proportion of those farmers living in the higher rainfall regions to the north and east of the country have benefited most. In seasons of normal rainfall, the three northern provinces of Mashonaland Central, East and West, with only about one-third of the small scale farming population, contribute 55-65% of the total maize sold to the GMB by the small farm sector. The share from these three provinces rises to over 95% in years of drought. The majority of small scale communal and resettlement farmers in the drier southern and western parts of the country are vulnerable to recurrent droughts and food shortages, and fail to produce surpluses even during years of average rainfall. Hence the need for irrigation development in order to reduce their dependence on rainfed agriculture and hence dependence on government food relief programmes.

The construction of a dam and associated irrigation development, especially a large project on the scale envisaged for the Lower Munyati basin, have considerable environmental implications, some of which can have health and other consequences on the communities living in the vicinity. It is for this reason that there is growing concern internationally about the construction of large reservoirs. Evidence has shown that these adverse impacts frequently outweigh the benefits, especially for the local communities whose lives are disrupted by the project. Of particular concern is the likely increase in water-borne and water-related parasitic diseases such as malaria, schistosomiasis and diarrhoea following the creation of the water reservoir and irrigation canals. Some of these health hazards are aggravated by borrow pits left behind after the extraction of earth and quarry materials used in the construction of the dam, access roads and irrigation works. Other problems may arise from the reduction in floods that would otherwise reduce snail and mosquito colonization through their periodic flashing effect, and by the accumulation of silt and aquatic weeds on the edges of

the reservoir and within the irrigation canals and night storage dams which encourage vector colonization at sites of frequent human-water contact (e.g. places for bathing, laundry or watering livestock). Other adverse impacts occur on the biophysical environment around and downstream of the projects.

These environmental concerns need to be recognized and accounted for in the planning and implementation of the Lower Munyati irrigation development project. The government of Zimbabwe has made it clear that while it seeks to achieve sustainable development, concerns about the protection of the natural environment should not be used to stifle investment that would benefit people within the communal areas. The proposed Munyati basin irrigation development will be the first such project in the country in which the principal beneficiaries will be small scale farmers. Hence the recent evolution of an environmental impact assessment (EIA) policy is welcome. The policy provides a framework that can enable the environmental and socio-economic costs and benefits to be properly accounted for, negative impacts avoided or mitigated, and that potential benefits are optimized.

Dam construction and irrigation development in the Lower Munyati River basin will need to recognize the close connection between development, environment and health, especially as it has impacts on semi-literate rural communities. For instance, malaria and schistosomiasis are the two most important parasitic diseases in the country and are ranked second and third respectively after AIDS in terms of public health importance. Surveys in other rural communities in Zimbabwe have shown that illiteracy increases vulnerability to water-borne and water-related diseases. It has been found that whereas a majority of the rural population are knowledgeable about the symptoms or clinical manifestations of such diseases as schistosomiasis and malaria, only a small proportion understand the causes of these diseases, and hence the appropriate measures they should take to prevent them.

Another important issue arising from dam construction and irrigation development is the displacement of people from the impoundment area and possibly from within the irrigation command area. It is the Zimbabwean government's policy to have a protective zone around any large reservoir

in order to safeguard its immediate catchment area from cultivation and the resultant soil erosion and siltation, and to prevent and control water pollution and other activities that might threaten its ecology. This zone is designated a recreational park under the Department of National Parks and Wild Life Management (DNPWLM). As a general rule, when deciding on the extent of this buffer zone, the DNPWLM considers the nature of the catchment in the vicinity of the reservoir that will ensure the best environmental protection. Where there are no clearly defined watersheds, the department considers that a zone approximately two kilometres from the edge of the water to be adequate. Final boundaries for the recreational park are gazetted after agreement with the respective rural district council and the Ministry of Local Government, Rural and Urban Development.

This report serves as a preliminary impact assessment which seeks to identify the environmental consequences of irrigation development in the Lower Munyati River basin under Scenario A, and to indicate ways to avoid or minimize negative impacts. Most of these issues will require detailed environmental impact study and the formulation of appropriate mitigating measures during the implementation and operational stages of the project.

7.2 Population and resettlement

7.2.1 Displacement and Relocation

The present distribution of population is significant for the planning and implementation of the project, firstly with respect to the displacement of people from the Munyati River basin in and around the proposed dam, and secondly in the downstream area in relation to the siting of irrigation works.

The right bank of the Munyati River down to Sanyati Communal Land falls within the Muzvezve I Resettlement Scheme. None of the villages in the resettlement scheme will need to be relocated to make way for either the dam or the recreational park. The nearest village to the dam will be Village 16 which is some 5 km east of the anticipated reservoir water line.

It is on the left bank of the Munyati River in Zhombe Communal Land, Kwekwe District, that people will be displaced. The final number to be relocated will depend, not only on the number of families at present living within the flood basin, but also on the extent of the buffer zone that will be declared around the dam.

It was estimated from field observations that some 600 families will be displaced from the flood basin, most of them from the valleys of the Koronika and Mangwarangwara Rivers (left bank tributaries of the Munyati River), plus an unknown number from within the buffer zone. In all, taking into account the criteria used by the DNPWLM outlined above, it was estimated that the final total to be displaced will be approximately 1000 families.

Discussions with the villagers, their political and traditional leaders, within the flood basin showed that they have known for several years that they are going to be displaced when construction of the dam starts. Several meetings had apparently been held in the area as far back as 1991 to discuss the project. The people consulted were in favour of relocation. The terrain within the valleys of the two main tributaries of the Munyati River is very broken with steep slopes and shallow stony soils. The respondents said that they had been settled in these valleys by the government in the early 1960s when they were moved from Masvingo and Matabeleland Provinces. They therefore see relocation following the construction of the dam as a means of acquiring more and better arable land elsewhere.

The problem at present is that, while they have known about the project since about 1991, the apparent lack of visible progress has created some uncertainty within the community. In the meantime, there has developed an understandable reluctance to improve their social well-being (e.g. investing in better housing), or to continue with community projects such as the improvement of local schools. The sites of two primary schools (Samambwa and Mangwarangwara), one secondary school, a clinic and a small business centre, all at Samambwa, will be completely flooded.

It is recommended that all the displaced families who so wish should

be resettled within the irrigation command area so that they can benefit from the water. The left bank of the Munyati River (i.e. Gokwe South District) will not be able to accommodate any significant number as much of the communal land on this side is already allocated. The best prospects for accommodating these displaced families seem to occur on the right bank within Muzvezve I Resettlement Scheme. This will involve a certain amount of re-organization and re-allocation of both arable and grazing lands between the existing villagers and the incoming settlers. With the anticipated intensification of agriculture under irrigation, it should be possible to effect some reduction in the land allocations for both crop cultivation and grazing and to increase the density of population without negatively affecting the lives of the people or putting additional pressures on the environment.

The re-planning Muzvezve I Resettlement Scheme to accommodate some of the displaced families will require further detailed studies (both technical and environmental) during the feasibility stages of the project. Further, the resettlement of these families will require close co-ordination between the offices of the respective district and provincial administrators for Kwekwe and the Midlands (where they will be coming from) and those for Kadoma and Mashonaland West (where they will be moving to).

The siting of primary and some secondary canals, night storage dams and other irrigation works is also going to displace some families within the command area. The actual numbers that will be affected will only be known when the feasibility studies are carried out and the precise locations of these works are determined. It is possible that in some cases only the homesteads will need to be relocated; in other cases some families may lose all or part of their arable lands. Again, provision will have to be made for these families to be accommodated within the irrigation area.

Additional land outside the irrigation command area will also be required to accommodate those displaced families that choose not to engage in irrigation. This could be within either Muzvezve I or II Resettlement Schemes or further away. Consideration must be given to resettle such families as communities to enable them to maintain their

social networks.

7.2.2 Compensation

Financial and administrative procedures already exist for the payment of compensation when households within communal and resettlement areas are displaced in order to make way for development projects. The relevant ministry or government department who are the project proponent (in this case the DNPWLM for the Kudu Dam and AGRITEX for irrigation development), in conjunction with the Ministry of Local Government, Rural and Urban Development, invite valuation officers from the Ministry of Public Construction and National Housing to evaluate all immovable property and improvements belonging to the families that are going to be displaced. The amount of compensation is determined at current market values. Immovable assets for which compensation will be payable include dwellings, fruit trees, as well as business premises at Samambwa service centre. The field surveys and valuation of immovable property will need to be carried out as part of the feasibility studies. The social and economic disruption of relocation could be minimized through the provision of some assistance towards the costs of construction materials, land preparation at their new homes, etc.

7.2.3 Cultural and Historical Sites

Two sites were identified as having cultural and historical significance for the people who will be displaced by the dam. The first is the Mabura guano cave, 2 km southwest of the site of the dam wall in Mabura Ward, Zhombe Communal Land. This site, which is of cultural significance to the people under Chief Samambwa, will not be flooded. But consideration should be given to its inclusion within the protective buffer zone around the reservoir, and appropriate arrangements made with the DNPWLM to allow continued access to the site for the local people. Inclusion within a protected recreational park would provide security against its desecration in the future. The other site of cultural significance that was mentioned by the local traditional leaders is the grave of the late Chief Samambwa. This is located at the homestead of his younger son, who is also acting chief in the area, 300 m from Samambwa School across the Koronika River. (The substantive Chief Samambwa lives

further away to the south of Empress Mine).

7.3 Environmental Health Issues

Several health issues are likely to emerge during both the implementation and operational stages of the project, and these require appropriate mitigatory measures if their impacts are to be avoided or minimized.

7.3.1 Water-borne and Water-related Diseases

The Blair Research Laboratory within the Ministry of Health and Child Welfare has established that the 900 metre contour line in the north of the country marks the altitudinal limits for perennial malaria, although this limit may shift upwards depending on local environmental and climatic conditions. There is therefore a high risk of malaria becoming widespread in the area around the proposed Kudu Dam whose Full Supply Level will be at 960 metres as well as within the irrigation command area downstream of the reservoir. The dam site lies just south of Gokwe South District, a confirmed malaria area. During 1994, over 30000 clinical cases of malaria were reported at rural health centres within the proposed irrigation command area from the dam site downstream to Copper Queen and Sachuru (Table 7-1). However, it should be emphasized that the actual numbers of confirmed malaria cases are generally much lower than the clinical cases that are reported for treatment at the health centres.

As the project is located within a confirmed malaria area, appropriate prophylaxis should be given to the incoming construction workers since they are unlikely to have prior immunity.

The prevalence of schistosomiasis at present is relatively low, presumably because most of the rivers become completely dry for long periods each year, thereby denying the vector snails of a suitable habitat. Other common water-borne diseases in the area are diarrhoea and dysentery, scabies and related skin ailments. These diseases are associated with either inadequate or unsafe domestic water supplies, a common problem at the present.

It will therefore be important to ensure that the increase in surface water all-year round both within the reservoir and in the irrigation works does not worsen the incidence of these water-borne and water-related diseases. Current malaria control programmes such as the spraying of homesteads and vector mosquito breeding sites by the environmental health staff of the respective districts will need to be extended. The monitoring of vector snails for schistosomiasis which has apparently been phased out will also need to be resuscitated. Fishing within the reservoir can be expected to become a major activity for the local inhabitants, whether legally or illegally. Experience from other large dams in Zimbabwe shows that illegal fishing usually occurs at night when there is a higher risk of being bitten by vector mosquitoes. People will also come into contact with the water when they are giving water to their livestock, bathing or laundering. In all cases, such contacts are likely to result in an increase in water-borne and water-related diseases.

Although water from Kudu Dam will primarily be for irrigation, the development of recreational facilities will bring a certain amount of residential and commercial development around its shores, as well as motorized boating. The effluent disposed from these houses or hotels and oils spilled from boat engines could also have adverse effects on the health of the irrigators downstream, especially as the mode of water conveyance will be gravity flow through open irrigation canals and furrows.

7.3.2 Use of Agrochemicals

The Munyati River basin is already well established as one of the leading cotton growing areas in the country, especially by small scale farmers in the communal and resettlement areas. Cotton requires considerable use of agrochemicals, unlike other crops that are currently grown by small scale farmers. This familiarity with agrochemicals will be advantageous in the development of irrigation in the area because the people are already reasonably knowledgeable about the health hazards arising from improper use, storage and disposal of the chemicals. At the same time, all-year crop cultivation under irrigation will entail increased exposure to, and hence increased risk from, these agrochemicals. There is also the danger that some chemicals may find their way into the

irrigation canals, with the attendant risks to downstream users, livestock, aquatic life and to the water quality.

Apart from increased educational programmes by extension staff, there will be a need for regular monitoring of the toxic levels in both rivers and irrigation canals, as well as in domestic water supplies (both boreholes and shallow wells). Training is particularly important so that farmers are not largely dependent for information on pesticide sales representatives or traders who have little or no technical knowledge about their safe use and whose primary motive is to boost sales by emphasizing their benefits over risks.

7.3.3 Domestic Water Supplies and Health

At present, a large number of households in the area face severe problems in obtaining safe water for domestic purposes. This may be a contributing factor for the large numbers of diarrhoea cases handled at the local health centres each year. With the construction of irrigation canals, it will be tempting to them to collect canal water for domestic uses such as laundry and bathing rather than have to travel several kilometres to the nearest functional boreholes. There is a widespread misconception among illiterate communities that if the water is flowing, it must be safe to use. It will therefore be necessary to increase the number of, as well as access to, deep boreholes in the area and to improve on current borehole maintenance programmes so that people do not have to resort to unsafe water as is the case at present.

7.3.4 Sexually Transmitted Diseases

During the construction and implementation stage, which is going to be prolonged, an unknown but large number of non-local workers will be brought into the area by the project contractors. Most of these will be males living in construction camps without their wives and families for extended periods of time. The establishment of these construction camps in the area, especially under Scenario A, can be expected to increase the incidence of sexually transmitted diseases, including HIV infection, among the local communities. It can also be expected that there will be additional pressure exerted on the local health services.

7.4 Woody Vegetation Clearance

At present the study area is well wooded, unlike other communal areas in Zimbabwe. This is mainly because of the fact that the area has been settled only since the late 1950s. Irrigation development will obviously entail the clearance of a large proportion of this woody vegetation, for land preparation or for the construction of access roads within the command area. It will be necessary to design a management plan in order to preserve as much of this vegetation as possible from unnecessary destruction. Another reason for keeping vegetation clearance to the necessary minimum is that secondary regrowth in the area is usually in the form of dense Jesse scrub and bush which becomes almost impenetrable during the wet season. The Jesse scrub is not only less valuable economically than the original tree species, but it also overshadows the growth of grass for livestock grazing.

At the same time, the Mudzongwe and Ungwe State Forests which fall within the irrigation command area as well as the Mafungabusi Forest to the west must continue to be protected.

In contrast, it is recommended that as much as possible of the woody vegetation within the flood basin should be cleared before flooding of the basin, firstly in order to minimize problems arising from increased nutrient levels and eutrophication, secondly to ensure that submerged tree stumps do not impair navigation by fishing and recreational boats, and thirdly to remove potential breeding sites for mosquitoes.

7.5 Monitoring of Mining Activities

Two of the three categories of mining operations, namely large mines and small scale mines, fall under the jurisdiction of the Ministry of Mines and are under the supervision of the local Mining Commissioner. Strict regulations are provided for the operations of these mines, including the storage of chemicals (e.g. cyanide) and the disposal of wastes. The main threat, if any, would come from illegal gold panners who operate along the Munyati River and its tributaries, particularly in the form of siltation as they do not use chemicals for extracting the

gold. However, DWD is of the view that, given the size of the dam, the amount of siltation that will occur from gold panning will be so insignificant that it can be accommodated within the reservoir's "dead" water. Overall therefore, current gold mining activities in the area are unlikely to pose significant environmental problems for the project. However, it will still be necessary to monitor both siltation levels (from mining as well as soil erosion in the catchment area) and water quality upstream as well as when it leaves the irrigation area.

Although gold panning may be said to have minimal effects of the reservoir, its impacts should also be assessed from an aesthetical perspective, especially for tourism and recreational development. Conflicts may also arise between the farmers and the panners over use of the water in the canals and the right of access to the river across irrigated lands.

7.6 Soil Deterioration

As reported earlier, over 80% of the land is relatively free of soil erosion. However, there are other impacts on the soil that will need consideration in the planning and implementation of the project, notably problems of salinization, leaching and waterlogging. These problems frequently cause irrigated soils to deteriorate, resulting in loss of productivity which in turn calls for even greater use of agrochemicals. Waterlogging can be controlled by avoiding over-irrigation and by providing adequate drainage. Some pockets within the project area appear to have sodic soils, and these could quickly become saline under irrigation. Furthermore, during the initial land development, it will be necessary to ensure that land preparation methods and equipment used do not damage the soil (e.g. through compaction by heavy machinery) or accelerate erosion along access roads, earth works, etc.

7.7 Terms of Reference for Detailed EIA within Feasibility Studies for Agricultural Development

Several significant impacts were identified in the preceding paragraphs. The project in its entirety (Scenario A) entails the construction of a large reservoir, the conversion from rainfed to all-year round irrigation farming of up to 35,000 ha of land and, during the

implementation stage, the displacement and resettlement of at least 1,000 families. Clearly, the project falls within the prescribed category in terms of the Environmental Impact Assessment Policy issued by the Ministry of Environment and Tourism (MET) in July 1994. A full and detailed EIA will need to be conducted concurrently with the feasibility studies and in close liaison with the engineering, financial and other aspects of the project (See Table 7-2).

Subject to the approval of the TOR by the MET, the detailed EIA study will seek to:

- identify, predict and assess the potential sources of impacts in terms of the material inputs, activities and outputs arising from the development of irrigation in the area under the two proposed options, Scenario A and Scenario B-1;
- identify any negative socio-cultural and biophysical impacts arising from the project;
- identify the nature, magnitude and significance of the impacts on the socio-cultural and biophysical environment, taking into account both direct and indirect, negative and positive, immediate and longer term, impacts;
- recommend appropriate and cost-effective measures to mitigate and/or manage the identified negative impacts during the implementation stages and after;
- suggest how the positive impacts could be enhanced or maximized;
- identify and recommend feasible and cost-effective measures for evaluating and monitoring the environmental impacts both during the implementation stages and after;
- recommend an appropriate medium to long term environmental management plan.

Procedures for impact assessment are provided in the said EIA Policy document. When government approval is granted for the feasibility studies to commence, the following activities pertaining to the environmental management plan will be undertaken concurrently and in close liaison with engineering, financial and other project planning works.

The first step will be the preparation and submission of a project prospectus to the Ministry of Environment and Tourism. The prospectus is a short document formally advising the Minister that a prescribed

activity is being considered for possible implementation. The prospectus will provide a basic description of the project, including proposed environmental management measures, and will indicate the status of the feasibility studies. The prospectus will also include draft terms of reference (TOR) for the EIA study (given below).

Secondly, the TOR will then be discussed and agreed upon with MET and AGRITEX and scoping, if deemed necessary, will be undertaken. The agreed TOR will specify the issues that the EIA must investigate and report upon, together with any other relevant matters.

Thirdly, a multi-disciplinary team will then be commissioned to conduct the EIA, produce a report and submit it for review and approval by MET. The final EIA report will thereafter form an integral part of the project documentation arising from the feasibility studies.

The EIA, involving detailed field surveys, will include in its study the following items or issues that have been raised in this preliminary environmental management plan:

- identify and quantify more precisely the total number of households that will be displaced by the project, including those to be displaced by the construction of irrigation works, regulating reservoirs, night storage dams, access roads and other infrastructure.

- identify, in conjunction with AGRITEX and other relevant authorities, possible areas for the resettlement of the displaced households, both within the irrigation command area (for those who want to become irrigators) and outside.

- identify the range and compile an inventory of immovable assets and improvements owned by households that will be displaced and estimate the amount of compensation to be required, including business premises, health facilities and schools.

- consult with the local inhabitants on ways of protecting the Mabura Cave and other places of cultural or historical significance and on procedures for the exhumation and reburial of the remains of the late Chief Samambwa.

- in consultation with the engineering and other project planners, identify areas and estimate the numbers of people that will be at risk of water-borne or water-related diseases due to the siting of the irrigation works and recommend appropriate mitigatory measures.

- identify and evaluate methods which are currently used by the farmers in the area for the disposal of agrochemicals.

- in conjunction with other project planners, estimate the quantities and variety of agrochemicals that are likely to be used in irrigation agriculture and evaluate the most appropriate methods for their use, storage and disposal.

- identify the areas and numbers of households where safe water supplies will need to be developed in order to ensure that the inhabitants do not resort to using unsafe irrigation water.

- identify the areas of woodland that will be lost through the development of the project, the amount of such lost vegetation as a proportion of the current woodland area, and the plant species that will be lost and their significance for biodiversity.

- investigate the current uses of woodland resources in communal and resettlement areas and how the loss of these resources will affect the inhabitants of the area.

- investigate the current uses of the Mudzongwe, Ungwe and Mafungabusi State Forests by the local communities and the likely implications on these protected forests resulting from the vegetation clearance in the medium-to-long term.

- identify all sites of small-scale mining activities within the project area, assess their current impacts on water quality, and consider the likely impacts of gold panning on the project.

- identify current areas of current serious soil erosion and control measures, identify and recommend appropriate management practices that will minimize soil deterioration during the construction phase (e.g. at construction of access roads, land preparation, etc) and after.

Table 7-1 Cases of Water-Born/Water-Related Disease Reported

(1) Kadoma

Year/Month	Diarrhoea	Dysentery	Malaria	Bilharzia	Scabies	Skin Disease
1993/Dec.	323	63	399	58	57	308
1994/Jan.	435	230	662	56	93	346
Feb.	263	37	549	56	48	187
Mar.	200	54	1,181	56	58	289
Apr.	186	38	987	57	39	275
May	201	51	543	36	11	304
June	221	35	826	55	24	173
July	311	38	1,070	47	34	209
Aug.	115	23	286	37	36	272
Sep.	236	31	266	58	30	159
Oct.	455	45	474	59	43	180
Nov.	548	91	463	83	78	195
Year's Total	3,494	736	7,706	658	551	2,897

Note: For each month, between 1 and 4 of the 12 health centres in the district did not submit their monthly statistical returns.

(2) Gokwe North and South District

Year/Month	Diarrhoea	Dysentery	Malaria	Bilharzia	Scabies	Skin Disease
1994						
Jan. - Dec.	2,984	1,514	23,863	1,592	1,183	3,591

Table 7-2 Checklist on Significant Environmental Impact

Environmental Impact	Potential Significant Environmental Impact (When the proposed project be implemented, does the following occur?)	Scenario A	Scenario B-1	Scenario B-2
1. SOCIAL ENVIRONMENT				
1.1 Socio-Economic Issues	1. Planned residential resettlement	Y	Y	N
The project significantly affects	2. Involuntary resettlement	Y	Y	N
socio-economic activities in and	3. Substantial changes in way of life	Y	Y	N
around the project site, such as	4. Conflict among communities or people	Y	Y	N
daily human life, economic activities,	5. Impact on native people	Y	N	N
transportation, community, institution,	6. Population increase	Y	Y	Y
and custom practices.	7. Drastic change in population composition	Y	N	N
	8. Changes in bases of economic activities	Y	Y	N
	9. Occupational change and loss of job opportunity	N	N	N
	10. Increase in income disparities	Y	Y	N
	11. Adjustment and regulation of water or fishing (riparian) rights	Y	Y	N
	12. Changes in social and organizational structures	Y	Y	N
	13. Changes in existing institutions and customs	Y	Y	N
1.2 Health and Sanitary Issues	1. Increased use of agrochemicals	Y	Y	Y
The project significantly affects	2. Outbreak of endemic diseases	Y	Y	N
hygiene in and around the project area	3. Spreading of epidemic diseases (schistosomiasis, malaria, onchocerciasis, elephantiasis, etc.)	Y	Y	N
or induces water related diseases.	4. Accumulation of residual toxicity of agrochemicals	Y	Y	N
	5. Increase in domestic and other human wastes	Y	Y	Y
1.3 Cultural Assets Issues	1. Impairment of historic remains and cultural assets	Y	N	N
Some historically, culturally, aesthetic-	2. Damage to aesthetic sites and landscape	N	N	N
ally or scientifically important assets	3. Impediment of mining resources exploitation	Y	Y	Y
may be located in the project site				
2. NATURAL ENVIRONMENT				
2.1 Biological and Ecological Issues	1. Changes in vegetation	Y	Y	Y
Some habitats for rare species or	2. Negative impact on important or indigenous fauna and flora (extinction of decrease in species)	Y	Y	Y
ecologically fragile areas are	3. Degradation of ecosystem with biological diversity	Y	Y	Y
located in the project or surrounding	4. Proliferation of exotic and/or hazardous species	N	N	N
areas.	5. Destruction of wetland and peatland	N	N	N
	6. Encroachment into tropical rain-forests and wildlands	N	N	N
	7. Destruction or degradation of mangrove forests	N	N	N
	8. Degradation of coral reef	N	N	N
2.2 Soil and Land Resources	1. Soil erosion	Y	Y	Y
The project significantly induces	2. Soil salinization	Y	Y	N
land devastation, soil erosion, soil	3. Degradation of soil fertility	Y	Y	N
contamination, etc.	4. Soil contamination by agrochemicals and others	Y	Y	Y
	5. Devastation or desertification of land	N	N	N
	6. Devastation of hinterland	N	N	N
	7. Ground subsidence	N	N	N
2.3 Hydrology, Air and Water Quality	1. Change in surface water hydrology	Y	Y	N
The project significantly affect	2. Changes in groundwater hydrology	Y	Y	N
hydrological regime of river, lake	3. Inundation and flood	Y	Y	N
and swamp, groundwater hydrology and	4. Sedimentation	Y	Y	N
air or water pollution.	5. Riverbed degradation	Y	Y	N
	6. Impediment of inland navigation	N	N	N
	7. Water contamination and deterioration of water quality	Y	Y	N
	8. Water eutrophication	Y	N	N
	9. Salt water intrusion	N	N	N
	10. Changes in temperature of water	Y	N	N
	11. Air pollution	N	N	N
2.4 Sensitive and Prescribed Area	1. Habitat of fauna and flora listed in CITES	N	N	N
The project significantly includes	2. Wetland designated in Ramsar Convention	N	N	N
sensitive and prescribed area.	3. National park and preserved forest	Y	Y	Y
	4. Area to be preserved under the other relevant domestic law, etc.	N	N	N
OVERALL EVALUATION	*The project has significant potential environmental impacts which require further study through detailed EIA. It falls within the GW's definition of prescribed activities.*			

Note: Y: Yes, N: No, U: Unkown

CHAPTER 8

PROJECT EVALUATION AND PRIORITIZATION

CHAPTER 8 PROJECT EVALUATION AND PRIORITIZATION

8.1 Basic Policies of Project Evaluation

8.1.1 Objectives of Project Evaluation

The major objective of the project evaluation for this master plan is to comprehensively evaluate the following three alternative development scenarios in terms of economic, financial, engineering, organizational, social and environmental points of view, thereby prioritizing these scenarios:

a) long-term development plan with Kudu Dam up to 2010;
b) medium-term development plan with medium size dams up to 2005; and
c) short-term development plan without any irrigation scheme up to 2000

In order to evaluate these scenarios with consistency, the same target year 2010 of Scenario A, has been applied to the other two scenarios.

8.1.2 Method of Project Evaluation

(1) Economic aspect

The economic evaluation judges economic viability of the project in terms of its contribution to the whole national economy as well as the regional economy. In this connection, the economic viability of each scenario shall be measured by EIRR (Economic Internal Rate of Return) and annual value added in terms of economic prices (Refer to APPENDIX L-1(1)).

(2) Financial aspect

The financial viability shall be evaluated in term of FIRR (Financial Internal Rate of Return) calculated by the project cost and benefit valued at financial prices (domestic market prices). In addition, farm economic surplus through farm budget analysis for model farms was carried out as a case study (Refer to APPENDIX L-1(1)).

(3) Engineering aspect

Since a certain scenario includes a large-size dam and medium-size dams, and syphon crossing Munyati river, the engineering aspect shall be qualitatively evaluated in considering the degree of difficulty in these construction works.

(4) Management aspect

Similar with the engineering aspect, this aspect shall be qualitatively judged considering the degree of difficulty in management and O & M of each project.

(5) Social aspect

This aspect shall be measured in terms of poverty alleviation and relief of the weak, selecting average incremental amount of crop income per farm and social internal rate of return (SIRR) as a index.

It is often the case that the income group that shall be benefited from the project is neglected in the project evaluation. As a result, in some cases, the project for a lower income group is not adopted simply because EIRR of the project is lower than the opportunity cost of capital. In order to solve this problem in this master plan, the social evaluation with SIRR (Social Internal Rate of Return) shall be introduced for the purpose of incorporating the income distribution function of the project into the project evaluation.

SIRR is one of the internal rate of return which comes from multiplication of the economic price by SBI (Social Benefit Index). SBI is an indicator which illustrates how many times of the project benefit is valued as much as that for the average beneficiaries of the whole economy (Refer to APPENDIX L-2).

(6) Environmental aspect

Out of several environmental concerns in this Study, involuntary relocation of people from reservoir, decrease in woody vegetation and

water-born disease have been selected for qualitative judgement.

8.1.3 Conditions for Project Evaluation

The following parameters are adopted as conditions for the project evaluation.

(1) Project life

The project life for the evaluation is 50 years including the construction period as well as study period starting from the feasibility one, in accordance with the longest durable years of irrigation facilities among all the project components in the three scenarios.

(2) Without project case

Usually, it is expected that the present agricultural productivity would increase as a result of improvement in farming technology and productivity, the increase in the Study Area is considered trivial and the present agricultural condition can be regarded as the without case.

(3) Cut-off rate (opportunity cost of capital)

Generally, it is rather difficult to precisely work out an opportunity cost of capital to be used in economic analysis, and it is said that a range between 8 and 10 percent is reasonably applicable to agricultural projects in developing countries. A trial calculation on the basis of the current situation of prevailing interest rates in Zimbabwe, was carried out. In Zimbabwe, the inflation rate in 1994 recorded 20.0% in spite of the introduction of the monetary stabilization schemes under the economic structural adjustment program. As a result, at present, the prime rate of the Reserve Bank of Zimbabwe (RBZ) stands at 29.5%. Therefore, the real interest rate of 9.5% (the prime rate of RBZ of 29.5% minus the current inflation rate of 20.0%) could be referred as the cut-off rate of the project evaluation to compare with the opportunity cost of capital.

(4) Currency and exchange rate

The currency for the project evaluation shall be based on Zimbabwe dollar (Z$), and the exchange rate to convert the foreign currency to local currency shall be US$1 = Z$8.3871, as of the end of January, 1995.

(5) Sunk cost

The sunk cost related to each Scenario shall not be taken into the project cost estimate.

(6) Prices and conversion factors

The financial prices in all the related project costs and benefits shall be expressed in the price level as of the end of January, 1995. The conversion factors from financial prices to economic ones are estimated by applying the following conversion factors (Refer to APPENDIX L-1(2)):

Item	Conversion Factors	Calculation Basis
Standard	0.851	Trade Statistics
Consumption	0.816	Trade Statistics
Transportation (Truck)	0.680	World Bank Estimate
Transportation (Railroad)	0.730	World Bank Estimate
Energy	0.620	World Bank Estimate
Shadow Wage Rate	0.500	World Bank Estimate

Regarding the economic prices of internationally-traded agricultural products such as cotton, maize and wheat, they are estimated by the international border prices at Durban in South Africa. As for the economic prices of agricultural inputs such as seeds, chemicals and fertilizers, they are calculated by the multiplication of the financial prices by the estimated conversion factors such as seed of 0.677, and chemical and fertilizer of 0.650. The details of these conversion factors are given in APPENDIX L (Tables L-1 to L-10).

8.2 Project Costs

The project costs for each scenario are composed of initial investment, operation and maintenance, and replacement costs. The conversion factors from financial costs to economic costs are shown below (See Table L-10 of APPENDIX L).

Cost Item	Scenario B-2	Scenario B-1	Scenario A
Initial Investment	0.740	0.749	0.781
Operation & Maintenance	0.760	0.760	0.760
Replacement	0.874	0.874	0.874

8.2.1 Initial Investment Cost

The initial investment cost is composed of (a) direct project cost, (b) administrative and engineering cost and (c) contingencies. The financial and economic prices of the initial investment costs in each scenario are summarized as follows (See Table L-11 of APPENDIX L):

(Unit: 1,000 Z$)

Scenario	Financial Prices	Economic Prices
B-2	378,700	280,095
B-1	474,800	355,531
A	2,598,500	2,027,783

These initial investment costs shall be disbursed from 1996 to 2010, and the yearly disbursement schedule of each scenario is as per Tables 8-1 to 8-3.

8.2.2 Operation and Maintenance Cost

The operation and maintenance cost includes (a) salary and wages, (b) fuel, (c)spare parts and materials and (d) other general expenses. The financial and economic prices of the operation and maintenance cost are summarized as follows (Table L-11 of APPENDIX L):

(Unit: 1,000 Z$)

Scenario	Financial Prices	Economic Prices
B-2	8,353	6,340
B-1	10,399	7,893
A	31,628	24,003

8.2.3 Replacement Cost

The replacement cost for various equipment is calculated as follows taking 10-year durability into consideration.

(Unit: 1,000 Z$)

Scenario	Financial Prices	Economic Prices
B-2	18,900	16,519
B-1	23,866	20,854
A	25,950	22,679

8.3 Project Benefit

8.3.1 Definition of Project Benefit

The quantifiable benefits generated by each scenario includes: (a) Crop product increase benefit by the introduction of irrigated agriculture; (b) Crop product increase benefit by the improvement of rainfed agriculture; (c) Road improvement benefit; (d) Industrial water increase benefit; (e) Domestic water increase benefit by rehabilitation and construction of boreholes; and (f) Livestock increase benefit or decrease negative benefit by land use conversion.

The relationship between project benefits and project components in each scenario is summarized below.

Benefit	Scenario A	Scenario B-1	Scenario B-2
(1) Agriculture (Irrigated)	O	O	–
(2) Agriculture (Rainfed)	O	O	O
(3) Road Improvement	O	O	O
(4) Industrial Water	O	–	–
(5) Domestic Water	O	O	O
(6) Livestock	Increase	Decrease	Decrease

8.3.2 Agricultural Benefit

(1) General concept

The agricultural benefit accrued from the project is divided into: (a) the agricultural benefit arising from not only increase in cropping intensity by introduction of irrigated agriculture through the construction of Kudu dam and medium size dams, but also increase in crop yields through more dosage of high yielding variety, fertilizers and chemicals; (b) the agricultural benefit arising from improved rainfed farming technology to be researched, experimented and extended to farmers by the regional farming technology centre. In both cases, agricultural benefit is basically computed as an incremental net production value of crop cultivation between without and with project cases. The net production value of crop can be obtained by deducting production cost from gross production value of respective crop which is result of multiplying yield and price of each crop.

(2) Irrigation areas

In scenario A, it is projected that 160 ha of the communal area prior to completion of Kudu Dam, and 14,700 ha (inclusive of 160 ha by the medium dams) of the communal and resettlement areas, 5,900 ha of the small-scale commercial areas and 4,400 ha of the large-scale commercial areas, totally 25,000 ha, will be irrigated by the construction of Kudu Dam. Meanwhile, in scenario B-1, it is projected that only 331 ha of the communal areas will be irrigated by the construction of medium size dams. In these areas, cropping intensity will be drastically increase to 162.5% - 175% by the introduction of irrigation agriculture. In addition to this, the yield of each crop will be also drastically improved, thereby increasing the net production value per unit area.

(3) Non Irrigation areas

In the proposed regional farming technology centre, every effort shall be carried out to research, experiment and extend improved technology for rainfed farming. By the said activities, it is expected existing rainfed farmers will be able to attain the crop production level

without drought damages. Newly increased farmers will attain the same production level as with the present farmers' in this moment. It is assumed that it would take 20 years for about 14,000 existing farms with total cultivated area of 81,940 ha to realize the production level without any drought damage through contribution made by RFTC and AGRITEX extension staff, and 10 years for each new farm to attain the respective target.

(4) Total agricultural benefit

The total incremental net production value with and without project case as the agricultural benefit can be worked out as follows (See Table L-12 of APPENDIX L):

(Unit: 1,000Z$)

	Without Project	Scenario B-2		Scenario B-1		Scenario A	
		With Pj.	Incr't	With Pj.	Incr't	With Pj.	Incr't
Comm./Rest.	71,331	134,588	63,257	135,909	64,578	179,326	107,995
S.S.C.F.*1	13,612	0	0	0	0	72,099	58,487
L.S.C.F.*1	0	0	0	0	0	60,083	60,083
Total	84,943	134,588	63,257	135,909	64,578	311,508	226,565

Note: *1 No relation in scenarios B-2 and B-1

8.3.3 Road Improvement Benefit

In the study area, improvement and construction of road are projected for the purpose to improve access to the market and the enhancement of living standard, and all the scenario include to improve 249 km of existing roads and to construct 35km of new roads. The road improvement benefits can be estimated by the savings of VOC (Vehicle Operation Cost). In general, the saving amount of VOC shall be calculated by the formula below.

$$TVOC = ADT \times 365 \text{ (days)} \times L \times VOC$$

Where,

TVOC = Annual Saving Amount of Vehicle Operation Cost (Z$)
ADT = Average Daily Traffic (unit/day)
L = Total Length of Road Improvement (km)
VOC = Saving of Vehicle Operation Cost per Unit (Z$/km/unit)

VOC is composed of the savings in fixed cost (depreciation etc) and in variable cost (fuel etc). The road improved benefit can be estimated at Z$710,000 in financial prices and Z$483,000 in economic ones (Table L-14 of APPENDIX L).

8.3.4 Industrial/Urban Water Benefit

In scenario A, the construction of Kudu dam enables to supply the urban and industrial water of 60 MCM annually. In general, the benefit is estimated by the following formula.

$$IW = WP \times \alpha$$

Where,

IW = Industrial Water Benefit (Z$)

WP = Willingness to Pay for the Industrial Water Benefit in the Industrial Sector (Z$/m3)

α = Amount of Water Supplied (mß)

The water value of the industrial water estimated by the construction cost of Kudu Dam is Z$0.144/cu.m. The Based on this water value, the willingness to pay for the industrial water benefit in the industrial sector is estimated at Z$0.2/cu.m. Accordingly, the industrial water benefit in Scenario A is calculated at Z$12,000,000 in financial terms and Z$10,424,000 in economic terms.

8.3.5 Domestic Water Benefit

In all the scenarios, the rehabilitation of 60 boreholes and construction of 43 boreholes are projected in the study area to enhance the living environment of the communal and resettlement farmers. In general, in the same manner as the industrial water benefit, the domestic water benefit is calculated by the following formula.

$$DW = WP \times \beta$$

Where,

DW = Domestic Water Benefit (Z$)

WP = Willingness to Pay for the Domestic Water (Z$ /cu.m)

β = Amount of Domestic Water Supplied (cu.m)

The amount of domestic water additionally supplied by rehabilitation and construction of boreholes is as follows.

(43 units + 60 units) × 2 m³/hour × 24 hours × 365day
= 1,804,560m³

Accordingly, assuming the willingness to pay for the domestic water as same as the water value of the industrial water at Z$0.144 , the domestic water benefit in each scenario is calculated at Z$260,000 in financial terms and Z$221,000 in economic terms.

8.3.6 Livestock Benefit

In scenario A, as a result of the conversion of presently cultivated land (about 24,000 ha) to grazing land under the introduction of large-scale irrigation farming, the sales of livestock products will drastically increase. More concretely, the cultivated land will be converted to grazing land from 2005 to 2010 for 6 years, and, in 2010, the livestock benefit is estimated at Z$13,052,000 in financial terms and Z$11,107,000 in economic terms.

On the other hand, in scenario B-1 and scenario B-2, as a result of the conversion of grazing land to cultivated land under the enlargement of rainfed farming, the sales of livestock products will gradually decrease. More concretely, grazing land will be converted to farming land from 1999 to 2010 for 12 years, and, in 2010, the negative livestock benefit is estimated at Z$7,308,000 in financial terms and Z$6,219,000 in economic terms in scenario B-1, and, in 2010, the decrease in livestock benefit is estimated at Z$7,668,000 in financial terms and Z$6,525,000 in economic terms in scenario B-2.

8.4 Individual Evaluation

In the individual evaluation, relation between evaluation indices and their ranking are simply explained in the following:

- Rank A: Best or Highest in Positive Factor and/or Least or Lowest in Negative Factor of evaluation indices;

- Rank B: Medium in Both Positive and/or Negative Factors; and

- Rank C: Worst or Lowest in Positive Factor and/or Most or Highest in Negative Factor

8.4.1 Economic Aspect

(1) Economic Internal Rate of Return

Economic internal rate of return (EIRR) is a discount rate at which the present worth value of the economic benefit is same as that of the economic cost. The result of the calculation of EIRR is summarized below, and cost-benefit streams which are the calculation basis of EIRR are as per Tables 8-4 to 8-6.

Scenario	EIRR (%)	Rank
B-2	7.5	B
B-1	6.0	C
A	8.3	A

In addition to the said EIRR, net economic present value (NEPV) are also calculated by applying a discount rate of 8% which is approximately same as the lowest level of the opportunity cost of capital. The result is shown in the following, indicating the NEPV per one farm in the communal and resettlement areas is Z$1,699:

Scenario	NEPV (Z$ 1,000)
B-2	-14,481
B-1	-60,511
A	44,413

In the calculation of the project cost for the EIRR and NEPV, a certain extent of risk is taken into consideration due to the inferior preciseness in the existing topographical map with contour intervals of 20 meters, and then Scenario A is heavily affected by the risk consideration because of its huge size of investment cost.

(2) Economic value added

Annual value added at full stage of the project in each scenario is calculated and summarized below:

(Unit: Z$ million)

	Scenario B-2	Scenario B-1	Scenario A
Output (net)			
- Agriculture (Crop)	63.3	64.6	226.6
- Domestic Water (Wells)	0.2	0.2	0.2
- Industrial Water	-	-	10.4
- Road	0.5	0.5	0.5
- Livestock	-6.5	-6.2	11.1
Sub-total	57.5	59.1	248.8
Input			
- Initial Investment	6.2	8.9	57.9
- O & M Cost	6.3	7.9	24.0
- Sub-total	12.7	16.8	81.9
Value Added	44.8	42.3	166.9
Rank	B	C	A

(3) Sensitivity Analysis

Since EIRR is based on various parameters, in case of the feasibility study, the sensitivity analysis should be carefully examined to verify negative impacts by various uncertainty of parameters in terms of (a) decrease in benefit, (b) increase in cost, (c) delay in benefit accrual and (d) delay in construction.

8.4.2 Financial Aspect

(1) Financial internal rate of return (FIRR)

Applying similar procedure with EIRR calculation, a FIRR was computed on the basis of the project cost including price escalation valued in financial prices. The result is as follows:

Scenario	FIRR (%)	Rank
B-2	-10.1	C
B-1	-8.3	B
A	3.5	A

(2) Farm budget analysis (case study)

Assuming the standard farm budget models in both irrigation areas and rainfed areas, it is examined that how much farm economic surplus will be increased by the introduction of the project in both areas.

1) Basic conditions for the standard farm model

In irrigated areas of scenario A and B-1, the standard rainfed farming area of 4 ha is transformed into the standard irrigated farming area of 1 ha. In improved rainfed areas of all the scenarios, the standard rainfed farming area of 4 ha remains unchanged. The basic conditions for the cropping pattern and the production cost are assumed to be same as the economic evaluation.

2) Farm economic surplus

Based on the above-mentioned basic conditions for the standard farm budget models, the farm disposal income will increase by Z$2,776.4 (109.9%) in irrigated areas, and it is Z$550.9 (33.2%) in rainfed areas. Although farming area per farm in the irrigated area become one-fourth, farm disposal income will be greatly improved by increase in both cropping intensity and crop yield (Refer to Table L-17 of APPENDIX L). When considering necessary burden for payment of O & M cost and average family cash expenditure derived from the 1991 rural family income and expenditure survey in terms of 1995 prices, the farm economic surplus in these model farms are worked out in the following:

Farm Economic Surplus in Standard Farm Model

	Without Project (Rainfed)	With Project Rainfed Area	With Project Irrigated Area
1. Farm Size (ha)	4	4	1
2. Disposal Income (Z$)	2,527.0	3,077.9	5,303.4
3. Cash Expenditure (Z$)	2,278.0	2,278.0	2,278.0
4. O/M Cost Payment (Z$)			
- Scenario B-2	-	372.0	-
- Scenario B-1	-	379.3	6,035.5*
- Scenario A	-	133.3	1,467.0
5. Farm Economic Surplus (Z$)			
- Scenario B-2	249.0	427.9	-
- Scenario B-1	249.0	420.6	(-)3,010.1
- Scenario A	249.0	666.6	1,558.4

(* In Scenario B-1, beneficial areas of medium-size dams are quite small in comparison to their development cost because of limitation in both topography and river discharge, O & M cost per ha or per beneficial farmer should, therefore, become considerably high.)

Judging from the above results, the farm sizes of 1 ha for irrigated farm and minimum 4 ha for rainfed farm set in the development framework of each Scenario, are considered justifiable without imposing recovery of the initial investment to beneficial farmers, except those beneficial farmer of irrigation development in Scenario B-1. However, it is a prerequisite to promote and operate the project so as to attain the medium- and long-term development target set forth in each land holding system, when the capital recovery will be imposed to beneficial farmers in future.

8.4.3 Engineering Aspect

In accordance with contents of construction works, difficulty to implement such works is qualitatively judged and ranked in the following:

Scenario	Difficulty	Rank
B-2	low	A
B-1	medium	B
A	high	C

8.4.4 Organizational Aspect

In the similar manner as with the engineering aspect, three scenarios were judged and ranked taking into consideration difficulty in management and O & M of the project as shown below:

Scenario	Difficulty	Rank
B-2	low	A
B-1	medium	B
A	high	C

8.4.5 Social Aspect

(1) Income distribution in Zimbabwean economy

The income disparity between smallholder farmers and commercial farmers is considerably large in the agriculture sector of the Zimbabwean economy. According to the World Development Report (World Bank) in 1991, while in Zimbabwe the lowest 20% income group occupies only 4% of the whole economy, the highest 20% income group occupies 62.3%, indicating the large income disparity. Under this situation, in case of the project evaluation, it is more important to examine who is benefited by the project than to calculated only EIRR.

(2) Crop income per farm

Expected crop income per farm in the communal and resettlement areas is calculated by applying financial prices:

	Unit	Scenario B-2	Scenario B-1	Scenario A
No. of Farms	no.	22,477	22,477	23,477
Return from Crop				
- Whole Area	1,000Z$	11,492	13,544	121,844
- Return per farm	Z$/farm	511	603	5,190
O & M Cost Burden	Z$/farm	268	342	1,001
Crop Income per farm	Z$/farm	243	261	4,189
Rank		C	B	A

(3) SIRR (Social Internal Rate of Return)

SIRR is a discount rate at which the present worth value of the project benefit equalizes with that of the project cost which are calculated in terms of social prices taken into consideration a shadow weight in the respective income group. As for the number of households by income group and the average household income in Zimbabwe, quotation was made to "Income Consumption and Expenditure Survey" published by CSO (Central Statical Office) and the result of the interview survey to farmers made by the Study Team. According to the data, SBI (social benefit Index) was worked out at 1.26 and 1.51 for Scenario A and Scenarios B-1 and B-2, respectively, which means that the value for the beneficiaries in the Study Area is estimated at 1.26 and 1.51 times as much as that for the average income group in the agricultural sector of Zimbabwe (Details of the social analysis is presented in APPENDIX L-2). By using the social prices, SIRR for each scenario is computed as follows:

Scenario	SIRR (%)	Rank
B-2	11.0	A
B-1	9.5	C
A	10.4	B

In similar way as the previous item "8.4.1 Economic Evaluation", net social present value (NSPV) are also calculated by applying a discount rate of 8% which is approximately same as the lowest level of the opportunity cost of capital. The result indicates that Scenario A could bring about the maximum social benefit for the poor in the Study Area.

8.4.6 Environmental Aspect

As significant environmental impact through implementation of the project, (a) fear for outbreak of water-born diseases, (b) displacement of people from the reservoir, and (c) decrease of woody vegetation, were selected for qualitative analysis. The results of the analysis are summarized below:

Scenario	(a) Fear for Outbreak	Rank	(b) Displaced People	Rank	(c) Acreage of Woody Veget.	Rank
B-2	low	A	small	A	decrease (large)	C
B-1	medium	B	medium	B	decrease (fair)	B
A	high	C	large	C	increase	A

8.5 Comprehensive Evaluation

In order to comprehensively evaluate the basic agricultural development plans (Master Plan) in each development scenario from economic, financial, engineering, organizational, social and environmental viewpoints, the respective evaluation index and its ranking are summarized in Table 8-7. Table 8-7 indicated the following evaluation:

(1) Scenario B-2

In this scenario, the rank-A is given to five indices, in engineering, organizational and environmental aspects as well as SIRR. In addition, the scenario has the rank-B in two indices and the rand-C in three indices. Judging from these ranking, the scenario could possess similar significance with Scenario A, magnitude of economic, financial and social impact for smallholder farmers is rather small in comparison to Scenario A. Therefore, Scenario B-2 is evaluated as medium ranking among the three scenarios. Furthermore, it is necessary to keep in mind that this Scenario would play an important role for improvement of the rainfed farming technology of those farmers who could not enjoy any benefit arising from the proposed water resource development.

(2) Scenario B-1

The scenario B-1 has no rank-A, but the rank-B in seven indices and the rank-C in three indices. Especially, out of five indices having numerical value, three indices are ranked as C. This is because the proposed medium-size dams would not contribute to irrigation development in comparison of required cost and expected benefit, due to topography and available river discharge at the point where these dams locate. Eventually, Scenario B-1 is given with the lowest ranking among the three scenarios.

(3) Scenario A

In this scenario A, the fact that the scenario obtains the rank-A in all indices having numerical value except for SIRR, indicates that economic, financial and social impact for the smallholders is bigger than the other two scenarios. Therefore, Scenario A is evaluated as the highest ranking, taking into consideration the Zimbabwean governmental policy which aims bottom up of smallholder farmers. However, the rank-C is given in four indices having qualitative aspect, consisting of two indices in the engineering and the management aspects and two indices in the environmental aspect, because not only AGRITEX who will be a direct implementing body of the project, but also smallholder farmers in the communal and resettlement land are facing lack of experience and know-how on a large scale irrigation development, and such large scale water resource and irrigation development project will have high possibility to bring about various environmental issues like involuntary relocation of people and water-borne diseases. And hence, Scenario A should have highest number of items and issues to be solved in future among three scenarios.

Table 8-1 Disbursement Schedule for Initial Investment Cost

Scenaio B-2

(Unit: Z$1.000)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Kudu Dam	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Comm/Rest)	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(S.S.C.F.)	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(L.S.C.F.)	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Dam	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R.F.T.C.	Fin.	52	52	6.748	6.748	0	0	0	0	0	0	0	0	0	0	0	13.600
	Eco.	44	44	5.736	5.736	0	0	0	0	0	0	0	0	0	0	0	11.560
Reclamation	Fin.	1.147	1.147	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	300.800
Soil Conser.	Eco.	840	840	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	220.184
Road	Fin.	204	204	17.664	17.664	17.664	0	0	0	0	0	0	0	0	0	0	53.400
	Eco.	149	149	12.930	12.930	12.930	0	0	0	0	0	0	0	0	0	0	39.088
Collecion	Fin.	31	31	2.646	2.646	2.646	0	0	0	0	0	0	0	0	0	0	8.000
Point	Eco.	26	26	2.249	2.249	2.249	0	0	0	0	0	0	0	0	0	0	6.799
Borehole	Fin.	6	6	562	562	564	0	0	0	0	0	0	0	0	0	0	1.700
	Eco.	5	5	478	478	479	0	0	0	0	0	0	0	0	0	0	1.445
Community	Fin.	5	5	397	397	396	0	0	0	0	0	0	0	0	0	0	1.200
Center	Eco.	4	4	337	337	337	0	0	0	0	0	0	0	0	0	0	1.019
TOTAL	Fin.	1.445	1.445	50.979	50.979	44.232	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	22.962	378.700
	Eco.	1.068	1.068	38.538	38.538	32.803	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	16.808	280.095

Fin.: Financial Cost, Eco.: Economic Cost, RFTC: Regional Farming Technology Centre

Table 8-2 Disbursement Schedule for Initial Investment Cost

Scenaio B-1

(Unit: Z$1.000)

		1 1996	2 1997	3 1998	4 1999	5 2000	6 2001	7 2002	8 2003	9 2004	10 2005	11 2006	12 2007	13 2008	14 2009	15 2010	TOTAL
Kudu Dam	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Comm/Rest)	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(S.S.C.F.)	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(L.S.C.F.)	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medium Dam	Fin.	249	249	249	13.879	13.879	13.879	13.879	13.879	13.879	13.879	0	0	0	0	0	97.900
	Eco.	191	191	191	10.673	10.673	10.673	10.673	10.673	10.673	10.673	0	0	0	0	0	75.284
R.F.T.C.	Fin.	66	66	6.450	6.450	0	0	66	6.450	6.452	0	0	0	0	0	0	26.000
	Eco.	56	56	5.483	5.483	0	0	56	5.483	5.484	0	0	0	0	0	0	22.101
Reclamation	Fin.	1.093	1.093	21.878	21.878	21.878	21.878	21.878	21.878	21.878	21.878	21.878	21.878	21.878	21.878	21.878	286.600
Soil Conser.	Eco.	800	800	16.015	16.015	16.015	16.015	16.015	16.015	16.015	16.015	16.015	16.015	16.015	16.015	16.015	209.795
Road	Fin.	204	204	17.664	17.664	17.664	0	0	0	0	0	0	0	0	0	0	53.400
	Eco.	149	149	12.930	12.930	12.930	0	0	0	0	0	0	0	0	0	0	39.088
Collecion	Fin.	31	31	2.646	2.646	2.646	0	0	0	0	0	0	0	0	0	0	8.000
Point	Eco.	26	26	2.249	2.249	2.249	0	0	0	0	0	0	0	0	0	0	6.799
Borehole	Fin.	6	6	562	562	564	0	0	0	0	0	0	0	0	0	0	1.700
	Eco.	5	5	478	478	479	0	0	0	0	0	0	0	0	0	0	1.445
Community	Fin.	5	5	397	397	396	0	0	0	0	0	0	0	0	0	0	1.200
Center	Eco.	4	4	337	337	337	0	0	0	0	0	0	0	0	0	0	1.019
TOTAL	Fin.	1.654	1.654	49.846	63.476	57.027	35.757	35.823	42.207	42.209	35.757	21.878	21.878	21.878	21.878	21.878	474.800
	Eco.	1.231	1.231	37.683	48.165	42.683	26.688	26.744	32.171	32.172	26.688	16.015	16.015	16.015	16.015	16.015	355.531

Fin. : Financial Cost, Eco. : Economic Cost RFTC: Regional Farming Technology Centre

Table 8-3 Disbursement Schedule for Initial Investment Cost

Scenaio A 1

(Unit: Z$1.000)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Kudu Dam	Fin.	821	821	821	821	85.443	85.443	85.443	85.443	85.444	0	0	0	0	0	0	430.500
	Eco.	631	631	631	631	65.706	65.706	65.706	65.706	65.706	0	0	0	0	0	0	331.054
Irrigation	Fin.	3.257	3.257	3.257	3.257	0	261.026	261.026	261.026	316.718	316.718	55.692	55.692	55.692	55.692	55.690	1.708.000
(Comm/Rest)	Eco.	2.553	2.553	2.553	2.553	0	204.644	204.644	204.644	248.307	248.307	43.663	43.663	43.663	43.663	43.661	1.339.071
Irrigation	Fin.	0	0	0	0	0	0	0	0	39.333	39.333	39.334	0	0	0	0	118.000
(S.S.C.F.)	Eco.	0	0	0	0	0	0	0	0	30.837	30.837	30.838	0	0	0	0	92.512
Irrigation	Fin.	0	0	0	0	0	0	0	61.667	61.667	61.666	0	0	0	0	0	185.000
(L.S.C.F.)	Eco.	0	0	0	0	0	0	0	47.422	47.422	47.421	0	0	0	0	0	142.265
Medium Dam	Fin.	133	133	133	16.242	17.433	17.434	1.192	0	0	0	0	0	0	0	0	52.700
	Eco.	102	102	102	12.490	13.406	13.407	917	0	0	0	0	0	0	0	0	40.526
R.F.T.C.	Fin.	76	76	6.616	6.616	0	0	76	6.616	6.616	0	0	76	6.616	6.616	0	40.000
	Eco.	65	65	5.624	5.624	0	0	65	5.624	5.624	0	0	65	5.624	5.624	0	34.004
Reclamation	Fin.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Soil Conser.	Eco.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road	Fin.	204	204	17.664	17.664	17.664	0	0	0	0	0	0	0	0	0	0	53.400
	Eco.	149	149	12.930	12.930	12.930	0	0	0	0	0	0	0	0	0	0	39.088
Collecion	Fin.	31	31	2.646	2.646	2.646	0	0	0	0	0	0	0	0	0	0	8.000
Point	Eco.	26	26	2.249	2.249	2.249	0	0	0	0	0	0	0	0	0	0	6.799
Borehole	Fin.	6	6	562	562	564	0	0	0	0	0	0	0	0	0	0	1.700
	Eco.	5	5	478	478	479	0	0	0	0	0	0	0	0	0	0	1.445
Community	Fin.	5	5	397	397	396	0	0	0	0	0	0	0	0	0	0	1.200
Center	Eco.	4	4	337	337	337	0	0	0	0	0	0	0	0	0	0	1.019
TOTAL	Fin.	4.533	4.533	32.096	48.205	124.146	363.903	347.737	414.752	509.778	417.717	95.026	55.768	62.308	62.308	55.690	2.598.500
	Eco.	3.535	3.535	24.904	37.292	95.107	283.757	271.332	323.396	397.896	326.565	74.501	43.728	49.287	49.287	43.661	2.027.783

Fin. : Financial Cost. Eco. : Economic Cost RFTC: Regional Farming Technology Centre

Table 8-4 Economic Internal Rate of Return (EIRR)

Scenario: B-2

(Unit: Z$1,000)

Project Year	Project Cost			Project Benefit	Net Benefit	Present Worth Value			
	Investment Cost	O & M Cost Replacem't	Total			D.R. = 0.07		D.R. = 0.08	
						Pj Cost	Pj Benefit	Pj Cost	Pj Benefit
1	1,068	0	1,068	0	-1,068	998	0	989	0
2	1,068	0	1,068	0	-1,068	933	0	916	0
3	38,538	0	38,538	0	-38,538	31,458	0	30,593	0
4	38,538	381	38,919	-3	-38,922	29,691	-2	28,607	-2
5	32,803	2,539	35,338	300	-35,038	25,196	214	24,050	204
6	16,808	2,916	19,724	1,892	-17,832	13,143	1,261	12,429	1,192
7	16,808	3,296	20,104	3,557	-16,547	12,520	2,215	11,730	2,075
8	16,808	3,677	20,485	5,528	-14,957	11,922	3,217	11,067	2,987
9	16,808	4,057	20,865	7,805	-13,060	11,349	4,245	10,438	3,904
10	16,808	4,438	21,246	10,387	-10,859	10,800	5,280	9,841	4,811
11	16,808	4,818	21,626	13,159	-8,467	10,274	6,252	9,275	5,644
12	16,808	5,199	22,007	16,121	-5,886	9,771	7,158	8,739	6,402
13	16,808	5,579	22,387	19,274	-3,113	9,290	7,998	8,232	7,087
14	16,808	5,960	22,768	22,309	-459	8,830	8,652	7,752	7,595
15	16,808	6,340	23,148	25,227	2,079	8,390	9,143	7,297	7,953
16	0	6,340	6,340	28,883	22,013	2,148	9,614	1,851	8,285
17	0	6,340	6,340	31,233	24,893	2,007	9,888	1,714	8,441
18	0	6,340	6,340	33,778	27,438	1,876	9,994	1,587	8,453
19	0	6,340	6,340	36,016	29,676	1,753	9,959	1,469	8,345
20	0	6,340	6,340	37,955	31,615	1,638	9,808	1,360	8,143
21	0	6,340	6,340	39,692	33,352	1,531	9,580	1,259	7,885
22	0	6,340	6,340	41,745	35,405	1,431	9,422	1,166	7,679
23	0	6,340	6,340	42,610	36,270	1,337	8,988	1,080	7,257
24	0	6,340	6,340	43,785	37,445	1,250	8,632	1,000	6,905
25	0	22,859	22,859	43,785	20,926	4,212	8,067	3,338	6,393
26	0	6,340	6,340	43,785	37,445	1,092	7,540	857	5,920
27	0	6,340	6,340	43,785	37,445	1,020	7,046	794	5,481
28	0	6,340	6,340	43,785	37,445	954	6,585	735	5,075
29	0	6,340	6,340	43,785	37,445	891	6,155	680	4,699
30	0	6,340	6,340	43,785	37,445	833	5,752	630	4,351
31	0	6,340	6,340	43,785	37,445	778	5,376	583	4,029
32	0	6,340	6,340	43,785	37,445	727	5,024	540	3,730
33	0	6,340	6,340	43,785	37,445	680	4,695	500	3,454
34	0	6,340	6,340	43,785	37,445	635	4,388	463	3,198
35	0	22,859	22,859	43,785	20,926	2,141	4,101	1,546	2,961
36	0	6,340	6,340	43,785	37,445	555	3,833	397	2,742
37	0	6,340	6,340	43,785	37,445	519	3,582	368	2,539
38	0	6,340	6,340	43,785	37,445	485	3,348	340	2,351
39	0	6,340	6,340	43,785	37,445	453	3,129	315	2,177
40	0	6,340	6,340	43,785	37,445	423	2,924	292	2,015
41	0	6,340	6,340	43,785	37,445	396	2,733	270	1,866
42	0	6,340	6,340	43,785	37,445	370	2,554	250	1,728
43	0	6,340	6,340	43,785	37,445	346	2,387	232	1,600
44	0	6,340	6,340	43,785	37,445	323	2,231	215	1,481
45	0	22,859	22,859	43,785	20,926	1,088	2,085	716	1,372
46	0	6,340	6,340	43,785	37,445	282	1,948	184	1,270
47	0	6,340	6,340	43,785	37,445	264	1,821	170	1,176
48	0	6,340	6,340	43,785	37,445	246	1,702	158	1,089
49	0	6,340	6,340	43,785	37,445	230	1,590	146	1,008
50	0	6,340	6,340	43,785	37,445	215	1,486	135	934
Total	280,090	320,653	600,748	1,599,163	998,415	229,690	243,600	200,295	195,887
							B.I.R.R. =	7.5%	

Note: Project Year 1 = 1996, D.R. : Discount Rate

Table 8-5 Economic Internal Rate of Return (EIRR)

Scenario: B-1

(Unit: Z$1,000)

Project Year	Project Cost			Project Benefit	Net Benefit	Present Worth Value			
	Investment Cost	O & M Cost Replacem't	Total			D.R. = 0.06 Pj Cost	Pj Benefit	D.R. = 0.07 Pj Cost	Pj Benefit
1	1,231	0	1,231	0	-1,231	1,161	0	1,150	0
2	1,231	0	1,231	0	-1,231	1,096	0	1,075	0
3	37,683	0	37,683	0	-37,683	31,639	0	30,761	0
4	48,166	363	48,528	-2	-48,530	38,439	-2	37,022	-2
5	42,683	2,499	45,182	277	-44,905	33,763	207	32,214	197
6	26,688	3,110	29,798	2,066	-27,732	21,006	1,456	19,856	1,377
7	26,744	3,719	30,463	4,025	-26,438	20,260	2,677	18,971	2,507
8	32,171	4,331	36,502	6,388	-30,114	22,902	4,008	21,244	3,718
9	32,172	4,941	37,113	9,092	-28,021	21,967	5,382	20,187	4,945
10	26,688	5,834	32,522	12,139	-20,383	18,160	6,778	16,533	6,171
11	16,015	6,443	22,458	15,130	-7,328	11,831	7,970	10,670	7,188
12	16,015	6,805	22,820	18,188	-4,632	11,341	9,039	10,132	8,076
13	16,015	7,168	23,183	21,313	-1,870	10,869	9,992	9,620	8,844
14	16,015	7,530	23,545	24,284	739	10,414	10,741	9,131	9,418
15	16,015	7,893	23,908	27,103	3,195	9,976	11,309	8,665	9,823
16	0	7,893	7,893	30,041	22,148	3,107	11,820	2,674	10,176
17	0	7,893	7,893	34,444	26,551	2,931	12,791	2,499	10,904
18	0	7,893	7,893	36,659	28,766	2,765	12,843	2,335	10,846
19	0	7,893	7,893	38,591	30,698	2,609	12,755	2,182	10,671
20	0	7,893	7,893	40,334	32,441	2,461	12,576	2,040	10,423
21	0	7,893	7,893	42,868	34,975	2,322	12,610	1,906	10,353
22	0	7,893	7,893	43,252	35,359	2,190	12,003	1,782	9,763
23	0	7,893	7,893	44,427	36,534	2,066	11,631	1,665	9,372
24	0	7,893	7,893	45,412	37,519	1,949	11,216	1,556	8,953
25	0	28,747	28,747	45,412	16,665	6,698	10,581	5,297	8,367
26	0	7,893	7,893	45,412	37,519	1,735	9,982	1,359	7,820
27	0	7,893	7,893	45,412	37,519	1,637	9,417	1,270	7,308
28	0	7,893	7,893	45,412	37,519	1,544	8,884	1,187	6,830
29	0	7,893	7,893	45,412	37,519	1,457	8,381	1,109	6,383
30	0	7,893	7,893	45,412	37,519	1,374	7,907	1,037	5,966
31	0	7,893	7,893	45,412	37,519	1,296	7,459	969	5,575
32	0	7,893	7,893	45,412	37,519	1,223	7,037	906	5,211
33	0	7,893	7,893	45,412	37,519	1,154	6,639	846	4,870
34	0	7,893	7,893	45,412	37,519	1,089	6,263	791	4,551
35	0	28,747	28,747	45,412	16,665	3,740	5,908	2,693	4,253
36	0	7,893	7,893	45,412	37,519	969	5,574	691	3,975
37	0	7,893	7,893	45,412	37,519	914	5,258	646	3,719
38	0	7,893	7,893	45,412	37,519	862	4,961	603	3,472
39	0	7,893	7,893	45,412	37,519	813	4,680	564	3,245
40	0	7,893	7,893	45,412	37,519	767	4,415	527	3,033
41	0	7,893	7,893	45,412	37,519	724	4,166	493	2,834
42	0	7,893	7,893	45,412	37,519	683	3,929	460	2,649
43	0	7,893	7,893	45,412	37,519	644	3,707	430	2,476
44	0	7,893	7,893	45,412	37,519	608	3,497	402	2,314
45	0	28,747	28,747	45,412	16,665	2,088	3,299	1,369	2,162
46	0	7,893	7,893	45,412	37,519	541	3,112	351	2,021
47	0	7,893	7,893	45,412	37,519	510	2,936	328	1,889
48	0	7,893	7,893	45,412	37,519	481	2,770	307	1,765
49	0	7,893	7,893	45,412	37,519	454	2,613	287	1,650
50	0	7,893	7,893	45,412	37,519	428	2,465	268	1,542
Total	355,531	399,453	754,984	1,676,743	921,759	321,660	325,649	291,066	250,597
							E.I.R.R. =	6.1%	

Note: Project Year 1 = 1996, D.R. : Discount Rate

Table 8-6 Economic Internal Rate of Return (EIRR)

Scenario: A

(Unit: NT$1,000)

Project	Project Cost			Project	Net	Present Worth Value			
	Investment	O & M Cost	Total			D.R. = 0.08		D.R. = 0.09	
Year	Cost	Replacem't		Benefit	Benefit	Pj Cost	Pj Benefit	Pj Cost	Pj Benefit
1	3,535	0	3,535	0	-3,535	3,273	0	3,243	0
2	3,535	0	3,535	0	-3,535	3,031	0	2,975	0
3	24,904	0	24,904	0	-24,904	19,770	0	19,230	0
4	37,292	0	37,292	528	-36,764	27,411	388	26,419	374
5	95,107	1,774	96,881	4,376	-92,505	65,936	2,978	62,966	2,844
6	283,757	1,774	285,531	8,743	-276,788	179,933	5,510	170,253	5,213
7	271,332	2,574	273,906	9,066	-264,840	159,822	5,290	149,830	4,959
8	323,396	2,574	325,970	11,462	-314,508	176,111	6,193	163,593	5,752
9	397,896	3,510	401,406	26,011	-375,395	200,803	13,012	184,818	11,976
10	326,569	10,751	337,320	58,168	-279,148	156,243	26,943	142,486	24,571
11	74,501	14,438	88,939	104,376	15,437	38,144	44,765	31,467	40,449
12	43,728	17,202	60,930	147,739	86,809	24,190	58,669	21,663	52,526
13	49,287	19,363	68,650	173,538	104,888	25,242	63,810	22,392	56,604
14	49,287	21,523	70,810	193,444	122,634	24,108	65,860	21,190	57,887
15	43,661	24,003	67,664	208,842	141,178	21,331	65,836	18,576	57,335
16	0	24,003	24,003	224,281	200,278	7,000	65,465	6,046	56,490
17	0	24,003	24,003	235,173	211,170	6,487	63,560	5,546	54,342
18	0	24,003	24,003	241,516	217,513	6,007	60,439	5,088	51,200
19	0	24,003	24,003	245,584	221,581	5,562	56,905	4,668	47,764
20	0	23,203	23,203	245,595	222,392	4,978	52,692	4,140	43,822
21	0	23,203	23,203	246,791	223,588	4,609	49,026	3,798	40,390
22	0	23,203	23,203	247,689	224,486	4,268	45,560	3,485	37,198
23	0	23,203	23,203	248,287	225,084	3,952	42,287	3,197	34,209
24	0	23,203	23,203	248,587	225,384	3,659	39,202	2,933	31,423
25	0	45,882	45,882	248,587	202,705	6,700	36,298	5,321	28,828
26	0	23,203	23,203	248,587	225,384	3,137	33,600	2,469	26,448
27	0	23,203	23,203	248,587	225,384	2,905	31,120	2,265	24,264
28	0	23,203	23,203	248,587	225,384	2,690	28,815	2,078	22,261
29	0	23,203	23,203	248,587	225,384	2,490	26,680	1,906	20,423
30	0	23,203	23,203	248,587	225,384	2,306	24,704	1,749	18,730
31	0	23,203	23,203	248,587	225,384	2,135	22,874	1,604	17,189
32	0	23,203	23,203	248,587	225,384	1,977	21,180	1,472	15,770
33	0	23,203	23,203	248,587	225,384	1,830	19,611	1,350	14,468
34	0	23,203	23,203	248,587	225,384	1,695	18,158	1,239	13,273
35	0	45,882	45,882	248,587	202,705	3,103	16,813	2,248	12,177
36	0	23,203	23,203	248,587	225,384	1,453	15,568	1,043	11,172
37	0	23,203	23,203	248,587	225,384	1,345	14,414	957	10,249
38	0	23,203	23,203	248,587	225,384	1,246	13,347	878	9,403
39	0	23,203	23,203	248,587	225,384	1,154	12,358	805	8,627
40	0	23,203	23,203	248,587	225,384	1,068	11,443	739	7,914
41	0	23,203	23,203	248,587	225,384	989	10,595	678	7,261
42	0	23,203	23,203	248,587	225,384	916	9,810	622	6,661
43	0	23,203	23,203	248,587	225,384	848	9,084	570	6,111
44	0	23,203	23,203	248,587	225,384	785	8,411	523	5,607
45	0	45,882	45,882	248,587	202,705	1,437	7,788	949	5,144
46	0	23,203	23,203	248,587	225,384	673	7,211	440	4,719
47	0	23,203	23,203	248,587	225,384	623	6,677	404	4,329
48	0	23,203	23,203	248,587	225,384	577	6,182	371	3,972
49	0	23,203	23,203	248,587	225,384	534	5,724	340	3,644
50	0	23,203	23,203	248,587	225,384	495	5,300	312	3,343
Total	2,027,783	1,002,828	3,030,611	9,593,058	6,562,447	1,216,992	1,258,163	1,116,341	1,029,333
							E.I.R.R. =	8.3%	

Note: Project Year 1 = 1996, D.R. : Discount Rate

Table 8-7 Comprehensive Evaluation of Agricultural Develoment Plan Under Three Scenarios

Evaluation Aspect	Evaluation Index	Factor*5	Unit	Indices B-2	Indices B-1	Indices A	Ranking B-2	Ranking B-1	Ranking A
1 Economic									
1-1 National Economy	E.I.R.R.	Positive	%	7.5	6.1	8.3	B	C	A
1-2 Regional Economy	Value Added *1	Positive	10^6 Z$	45.0	42.3	166.9	B	C	A
2 Financial	F.I.R.R.*2	Positive	%	-10.1	-8.3	3.5	C	B	A
3 Engineering	Difficulty in Construction Works	Negative	—	low	medium	high	A	B	C
4 Organizational	Difficulty in Management, O & M of Project	Negative	—	low	medium	high	A	B	C
5 Social									
5-1 Poverty Alleviation	Increment. Crop Income*3	Positive	Z$/farm	243	261	4.189	C	B	A
5-2 Relief of the Weak	S.I.R.R.	Positive	%	10.9	9.5	10.4	A	C	B
6 Environmental									
6-1 Public Health	Water-born Disease	Negative	—	low	medium	high	A	B	C
6-2 Displacement	No. of House	Negative	—	small	medium	large	A	B	C
6-3 Woody Vegetation	Acreage of Grazing Land*4	Negative	—	(1)	(2)	(3)	C	B	A

Note: *1 Total Output - Total Input (Economic Price)
*2 Including Price Escalation (Financial Prices)
*3 Communal/Resettlement Only (Deducted O & M Cost Burden)
*4 (1) Largely decreased, (2) Fairly decreased, (3) Increased

E.I.R.R.: Economic Internal Rate of Return
S.I.R.R.: Social Internal Rate of Return
Z$: Zimbabwean Dollar

*5 Rank A: Best/Highest in Positive Factor and/or Least/Lowest in Negative Factor
B: Medium in Both Positive and Negative Factors
C: Worst/Lowest in Positive Factor and/or Most/Highest in Negative Factor

CHAPTER 9

CONCLUSION AND RECOMMENDATION

CHAPTER 9 CONCLUSION AND RECOMMENDATION

9.1 Conclusion

In order to prepare a master plan for an agricultural development in the Lower Munyati basin, three independent development scenarios as a basic agricultural development concept, were formulated through comprehensive examination on development needs, potentials and constraints in the Study Area. In addition, a basic agricultural development plan for each development scenario was formulated, and each scenario was evaluated from economic, financial, engineering, organizational, social and environmental viewpoints through estimation of project cost and benefit.

In Scenario B-2, its main component is an agricultural development through improvement of rainfed farming technology, and hence it requires relatively small amount of investment resulted in shorter development period and quicker realization of project effects. The scenario shall be applicable not only to those people who could not enjoy a benefit arising from a water resource development scheme in other two scenarios, but also for the period until the other two scenarios would be realized. However, due to its partial investment, economic, financial and social impact by this scenario would be rather limited from viewpoint of the regional development in the Lower Munyati basin as well as the Zimbabwean governmental policy aiming bottom up of smallholder farmers. For the purpose of avoiding the phenomenon that increased population in future in the area would transmigrate to urban area for seeking their employment opportunity, it requires conversion of considerable acreage of existing grazing land into cultivated land in order to secure new farmland. This would badly affect supply of feedstuff which is presently placed under almost marginal condition.

Basically, Scenario B-1 has similar characteristics as Scenario B-2. It is clear that an irrigated agricultural development would provide some scale of impact on the limited irrigation beneficiaries, which could be realized through construction of medium-size dams in the tributaries of Munyati river. The expected irrigation command area is, however,

quite limited at 331 ha in comparison to the required cost to develop the proposed medium-size dams, resulted in the lower economic feasibility. Furthermore, similar situation as Scenario B-2 would happen in conversion of grazing land into cultivated land.

In Scenario A, by introducing a large-scale irrigated agriculture in communal and resettlement area for which Zimbabwean government considers main beneficiary of the development project, overall impact on the regional economy would be absolutely enough through a big scale of project benefit due to drastic improvement in crop yield and cropping intensity, resulted in increase in farm income. When comparing with other two scenarios, this scenario would contribute to the supply of urban and industrial water, and promotion of livestock production as multi-sided effect, in addition to the effects arising from improvement of rainfed agriculture as well as introduction of irrigated agriculture. In other words, Scenario A is considered best among the three scenarios in terms of efficient utilization of resource potentiality available in the Study Area. On the contrary, the scenario includes various unknown factors as well as issues to be solved in future, because the proposed Kudu Dam project including irrigation facilities would require a quite huge investment and long development period, and also because it is one of large scale irrigation development project to be firstly introduced in communal and resettlement area in Zimbabwe. For example, most of the farmers in communal and resettlement areas have no or insufficient experience and know-how on irrigated agriculture. And also it is the first case for AGRITEX as a direct executing body, to construct a large-scale irrigation scheme and to allocate irrigation water covering very wide area in communal and resettlement area. In addition, there exists several problems such as displacement of people to be submerged by Kudu Dam and outbreak of water-born diseases through water resource development.

Through comprehensive evaluation of the basic agricultural development plans, it is considered justifiable that Scenario A shall be deployed for the agricultural development in the Lower Munyati River Basin, subject to execution of a feasibility study.

9.2 Recommendation

As concluded in the above, although Scenario A which fully covers the nine items of project component formulated under the basic agricultural development concept in Chapter 4 of this report, is considered a best alternative among three scenarios so far comprehensively examined, in order to promote the agricultural development in the Lower Munyati River Basin in realistic and sustainable shape on the basis of Scenario A, due attention should be carefully considered on the following items:

(1) Project Execution System

The proposed large-scale irrigation development which places highest emphasis on smallholder farmers in the communal and resettlement area, is the first case in Zimbabwe. AGRITEX who should play an important role as an interface (hard/soft) between the dam and main irrigation facilities maintained by DWD and irrigation facilities after farmpond maintained by beneficial farmers, has not sufficient experience in planning/design/imple mentaion/O & M. It is necessary to jointly work with DWD who has enough experience and knowhow, especially in scope of hardware.

(2) Farmers Participation

Important factors to realize successful implementation of the project and its sustainability include positive participation of farmers in the project promotion and management. As far as beneficial farmers do not recognize project facilities as their own property, it is rather difficult for those farmers to voluntarily operate and maintain the facilities as well as to bear the required cost. Therefore, it is quite important to promote the project by considering farmers' opinion and by farmers' regulation on conflicts for especially relocation and/or consolidation of present cultivated land, focussing on future farmers' organization (i.e. water user group, etc) from initial stage of investigation and planning.

(3) Regulation of Interests

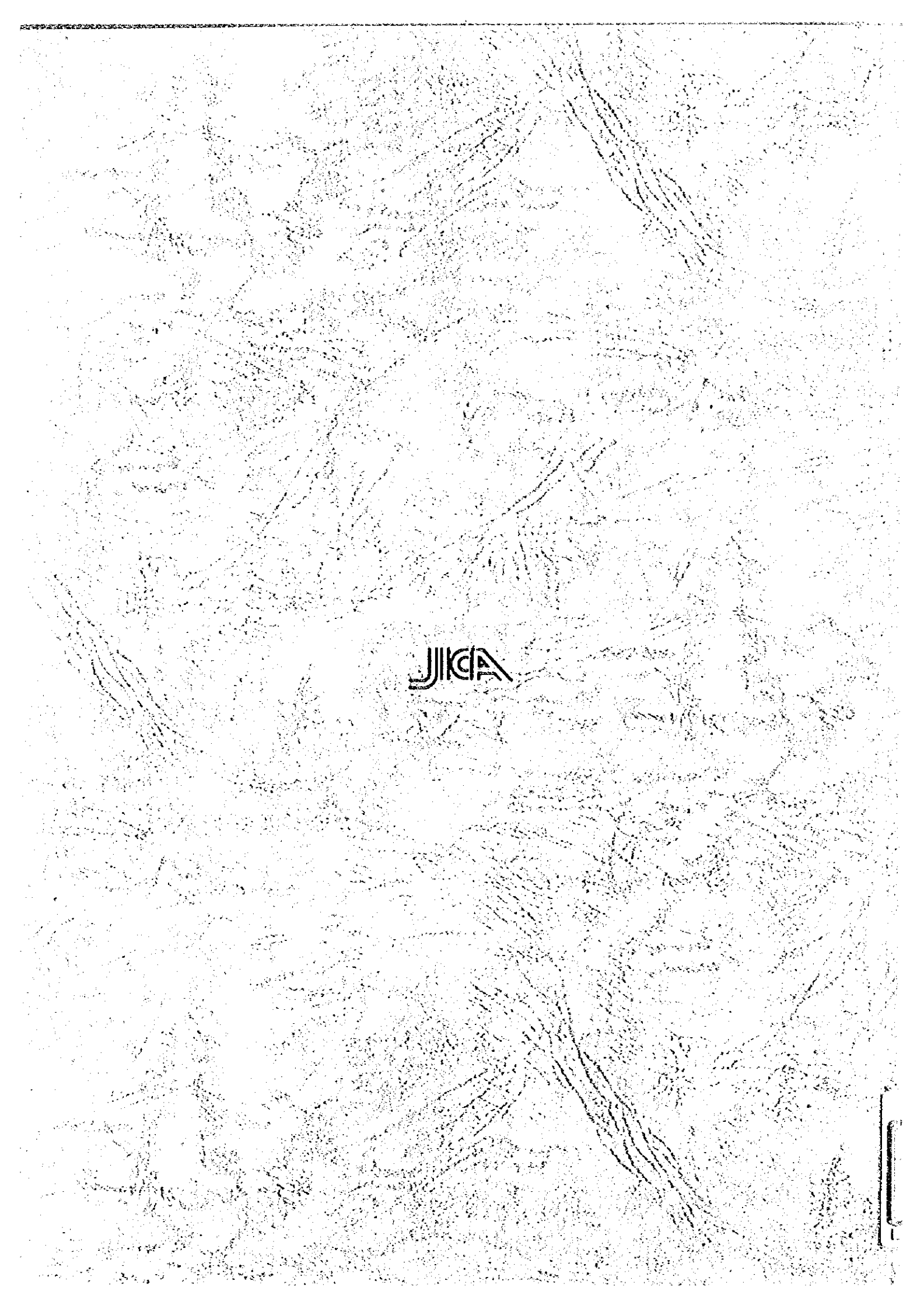
The Study Area extends Mashonaland West and Midlands Provinces, and involves four type of land holding system, forming various interest groups, and hence it will cause various and complicated conflicts among these groups, especially on allocation of developed water and project budget. Therefore, it is a prerequisite to establish a three level committee as proposed in Chapter 6 "Implementation Programme" of this report.

(4) Environmental Issues

By the construction of Kudu Dam, not only about 1,000 households including those to be submerged by the dam and those located buffer zone to be designated by DNPWLM, should be removed, but also the outbreak of water-born diseases such as malaria and schistosomiasis would cause fear through utilization of annual amount of 380 MCM for irrigation purpose, together with altitude where the Study Area is extending. Furthermore, soil erosion might become a problem for the progress of the construction of a large irrigation system and irrigated agriculture. In this regard, appropriate measures should be thoroughly studied and formulated in the succeeding feasibility study.

(5) Advanced Implementation of Model Project

As described already, beneficial farmers in communal and resettlement land have no experience and knowhow on irrigated agriculture. Therefore, it is recommended to promote a model project in advance, in which necessary technology on irrigated agriculture applicable to technical level of smallholder farmers, including operation and maintenance of facilities, selection of crop, irrigation method, farmers' organization. Through implementation of the proposed model project, it could be expected that smallholder farmers could start their irrigated farming upon completion of the construction of facilities. It is desirable to promote the model project by using the proposed "Regional Farming Technology Centre" as its core.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