JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF AGRICULTURE, FOOD AND FISHERIES

THE REPUBLIC OF ZAMBIA

THE FEASIBILITY STUDY

ON

MONGU RURAL DEVELOPMENT PROJECT

IN

ZAMBEZI RIVER FLOOD PLAIN AREA

FINAL REPORT

(ANNEX)

JULY, 1995

TAIYO CONSULTANTS CO., LTD.

KOKUSAI KOGYO CO., LTD.

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III. GENERAL DESCRIPTION OF THE STUDY AREA

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III.1 Natural Conditions

Table III.1.1 Estimated Flooding Area and Rate by LWMP Method

B.M No.	Water Level (m) 33% Ret.Period	Width of Plain (km)	Width of Flood Area (km)	Ave. Flood Depth (m)	Block	Total Plain Area (ha)	Flooding Area (ha)	Flooding Rate (%)
1	1016.08	1.0	0.00					
2	1015.77	1.8	0.00		Limulunga	1,580	0	0
3	1015.46	2.0	0.00		Mabumbu			
4	1015.12							
5	1014.78	1.6	0.00					
6	1014.44	1.7	0.25	1.45	Lealui	1,210	260	21
7	1014.13	1.3	1.10	1.40				
8	1013.98	0.0						
9	1013.79	1.6	1.35	1.25				
10	1013.51	1.7	1.45	0.45	Katongo	1,000	890	89
11	1013.19	1.8	1.70	1.05				
12	1012.89	1.2	1.05	0.60				
13	1012.59	0.9	0.55	1.00	Yeta	1,320	510	39
14	1012.36	1.3	0.00					
15	1012.05	2.0	0.95	0.35				
16	1011.76	1.8	1.75	0.95	Namusha	1,080	750	69
17	1011.41	1.4	1.35	1.50	kende			

Table III.1.2 Result of Water Quality Survey

Parameter	Namushakende canal	Sefula Canal	Mambwe canal	Namitome canal
pH	5.4	5.8	5.8	5.8
Conductivity, umhos/cm at 25°C	13.4	17.7	27.6	18.0
Calcium, mg/l	0.4	0.8	5.6	0.8
Magnesium, mg/l	0.4	0.5	0	0.5
Fluoride, mg/l	0/017	0.019	0.018	0.026
Chloride, mg/l	9.7	<1.0	2.3	3.1
Nitrate, mg/l N	0.6	1.52	0.97	0.91
DO, mg/l	6.3	5.5	3.5	6.9
TSS, mg/l	<1	<1	<1	<1

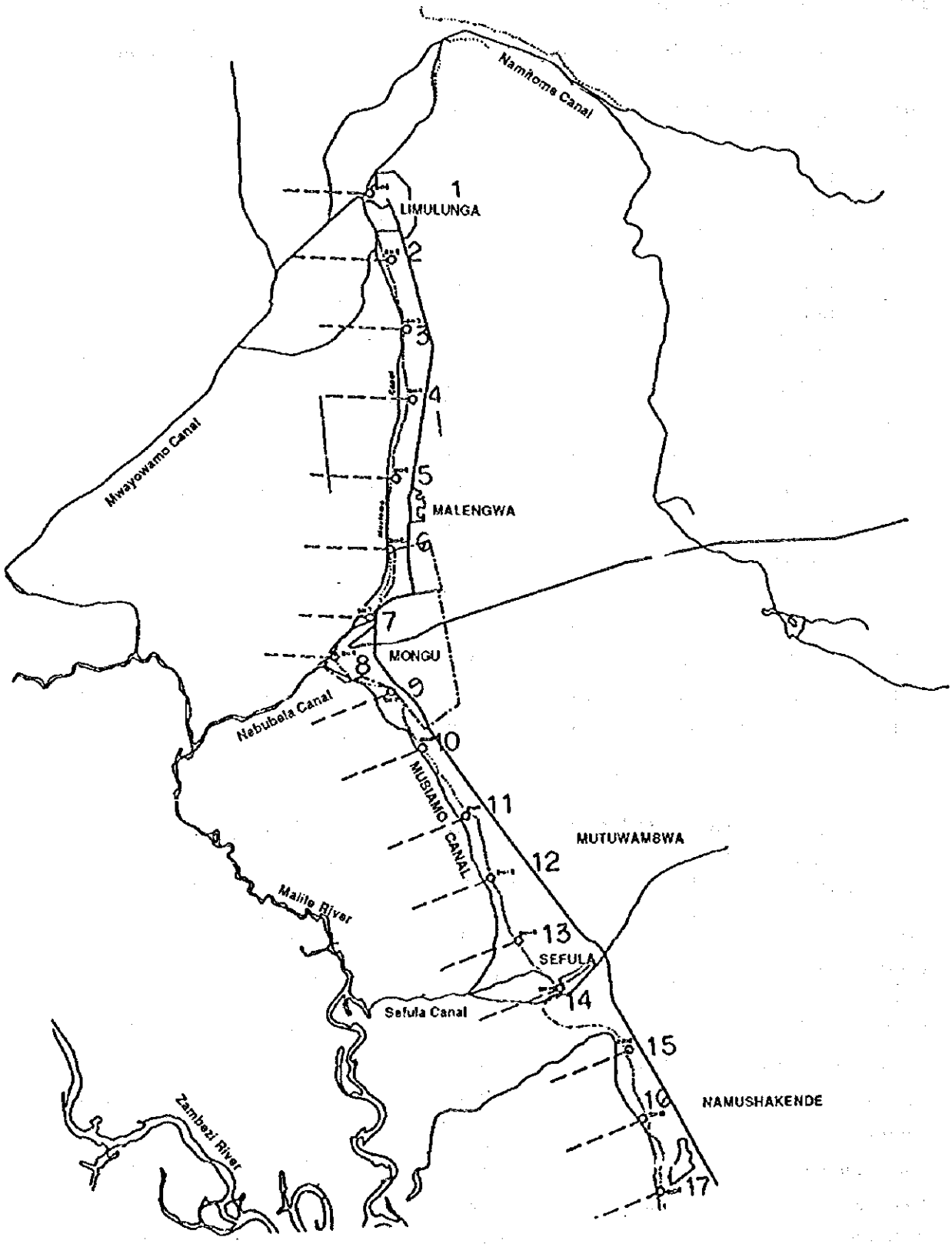


Figure III.1.1 Location of Bench Mark in LWMP

SOIL PROFILE DESCRIPTION

NO. 1

Location: Holy Cross Secondary School

FAO Classification: Haplic Podzols

Land Facet: Plateau

Slope: 0-1%

Vegetation: Degraded Kalahari woodland

Landuse: Settlement and cropping

Groundwater table: Very deep

Parent material: Karahari sand

Pale brown 10YR 6/3 pH 5.3	Ah Sand	0cm	Very weak structure; loose, none sticky/none plastic; many very fine and fine roots
Yellowish brown 10YR 5/4 pH 5.4	E Sand	18	Structureless, single grain; loose, none sticky/none plastic; many very fine, fine and common coarse roots
Light yellowish brown 10YR 6/4 pH 5.6	Bh Sand	56	Structureless, single grain; loose, none sticky/none plastic; many very fine and fine roots; many very fine, fine and medium pores.
		106	

Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ah	2.20	0.48	0.03	4	0.031
E	2.49	0.31	0.03	8	0.035
Bh	3.53	0.21	0.02	2	0.035

CEC: CATION EXCHANGE CAPACITY(cmol/kg soil) C: CARBON N:NITROGEN

P: PHOSPHORUS EC: ELECTRICAL CONDUCTIVITY

Figure III.1.2 Soil Profile Description No.1

SOIL PROFILE DESCRIPTION

NO. 2

Location: Kapota village
FAO Classification: Haplic podzols
Land Facet: Escarpment
Slope: Upper slope. Uniform 5-8%
Vegetation: Degraded Kalahari woodland
Landuse: Summer grazing, fuel wood, settlement, and cropping (cassava)
Groundwater table: Very deep
Parent material: Kalahari sands

Greyish brown 10YR 5/2 pH 4.8	Ah Sandy loam	0cm	Structureless, single grain; loose, none sticky and none plastic; many very fine, fine fine and medium pores; many very fine, fine and few medium roots
Light brownish grey 10YR 6/2 pH 5.1	E Sand	20	Structureless, single grain; loose, none sticky and none plastic; many very fine, fine fine and medium pores; many very fine, fine and few medium roots
Dark yellowish brown 10YR 4/4 pH 5.3	Bh Sand	43	Structureless, single grain; loose, none sticky and none plastic; many very fine, fine fine and medium pores; many very fine, fine, medium and common coarse roots.
		90	

Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ah	0.18	0.43	0.16	4	0.033
E	2.58	0.33	0.07	2	0.032
Bh	3.63	0.50	0.07	2	0.032

Figure III.1.3 Soil Profile Description No.2

SOIL PROFILE DESCRIPTION

NO. 3

Location: Limulunga floodplain edge, next to former Susman shop
FAO Classification: Haplic podzols
Land Facet: Upper part of seepage zone (Dry Litongo)
Slope: Concave 1-3%
Vegetation: Exotic eucalyptus trees
Landuse: Settlement and cropping (maize, cassava, sugarcanes)
Groundwater table: None
Parent material: Kalahari sands

Very dark greyish brown 10YR 3/2 pH 6.0	Ap Sand	0cm	Weak, medium subangular blocky structure; loose, none plastic and none sticky; few coarse, many very fine, fine and medium pores; many very fine and fine roots
Very dark grey 10YR 3/1 pH 6.8	Au Sand	20	Structureless, single grain; loose, none sticky and none plastic; many fine and medium pores; many very fine and fine roots
Greyish brown 10YR 5/2 pH 6.9	E Sand	37	Structureless, single grain; loose, none sticky and none plastic; many fine, medium and coarse pores; few fine roots.
		114	

Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ap	6.00	1.14	0.09	43	0.07
Au	2.99	0.55	0.20	43	0.06
E	3.18	0.25	0.01	73	0.05

Figure III.1.4 Soil Profile Description No.3

SOIL PROFILE DESCRIPTION

NO. 4

Location: JICA Agricultural Verification Study area, Namushakende

FAO Classification: Gleyic Podzols

Land Facet: Mid part of seepage zone (Wet Litongo)

Slope: Concave 1-3%

Vegetation: Eucalyptus trees

Landuse: cropping (cashewnut, mango), experimental site

Groundwater table: 110cm

Parent material: Kalahari sands

Grey 10YR 5/1 pH 5.0	Ah Sand	0cm	Weak medium crumb structure; slightly hard; many fine, and medium pores; many very fine, fine and few coarse roots
Greyish brown 10YR 5/2 pH	E Sand	47	Structureless, single grain; loose; many fine and medium pores; many very fine and and fine roots
Very dark grey 10YR 3/1 pH 4.7	Bh1 Sand	54	Weak subangular blocky; loose; many fine and medium pores; many very fine, and few coarse roots
Very dark brown 10YR 2/2 pH 5.7	Bh2 Sand	75	Weak subangular blocky; loose; many fine and medium pores.
		110	

Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ah	5.64	0.97	0.05	27	0.065
Bh1	4.96	0.91	0.04	100	0.071
Bh2	4.35	0.64	0.03	14	0.060

Figure III.1.5 Soil Profile Description No.4

SOIL PROFILE DESCRIPTION

NO. 5

Location: Namate village

FAO Classification: Terric Histosols

Land Facet: Lowest part of seepage zone (Sishanjo)

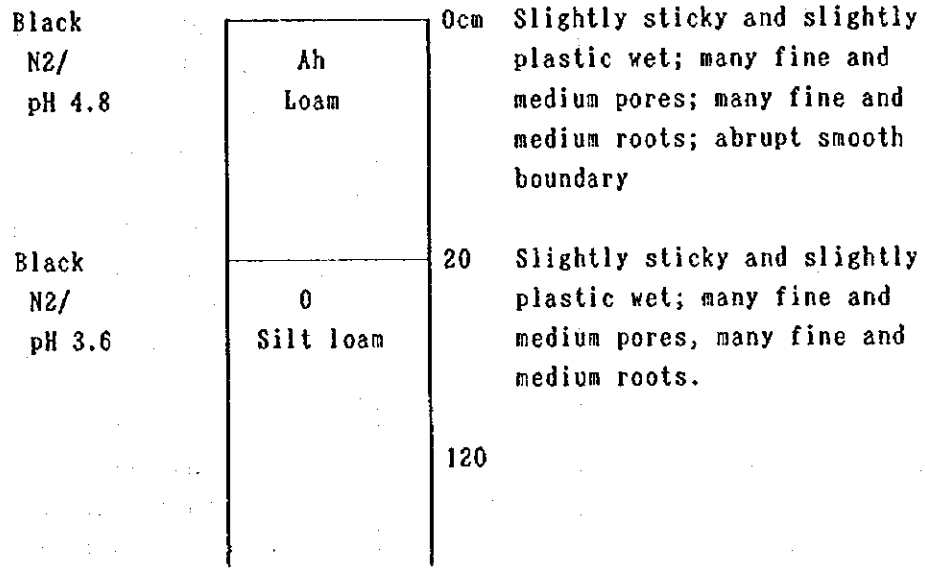
Slope: 0-1%

Vegetation: Floodplain grassland

Landuse: cropping (rice, sugarcane)

Groundwater table: Very deep

Parent material: Organic material over Zambezi alluvium



Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ah	40.13	6.22	0.03	6	0.067
0	88.82	6.17	0.04	6	0.011

Figure III.1.6 Soil Profile Description No.5

SOIL PROFILE DESCRIPTION

NO. 6

Location: Limulunga, about 2 km south-west of Litunga palace
FAO Classification: Gleyic Arenosols
Land Facet: Flat part in floodplain (Sa̧ana)
Slope: Uniform 1%
Vegetation: Flood plain grassland
Landuse: Grazing during the dry season and early wet season
Groundwater table: At 60cm
Parent material: Medium-textured Zambezi alluvium

Black 10YR 2/1 pH 5.1	Ah Loamy sand	0cm	Crumb structure; loose, none sticky and none plastic; many fine and medium pores; many fine and medium roots
Very Dark grey 10YR 3/1 pH 5.6	AB Loamy sand	9	Structureless, single grain; loose, none sticky and none plastic; many fine and medium pores; many fine and medium roots
Greyish brown 10YR 5/2 pH 6.2	C Sand	55	Structureless, single grain; loose, none sticky and none plastic; many fine and medium pores; many fine and medium roots.
		60	

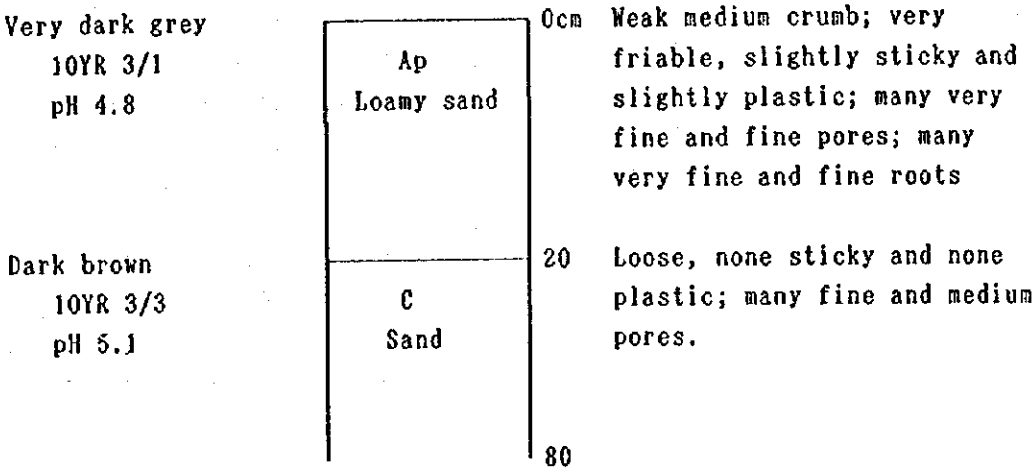
Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ah	6.40	1.86	0.05	6	0.14
AB	4.80	0.60	0.04	2	0.046
C	0.91	0.11	0.01	2	0.048

Figure III.1.7 Soil Profile Description No.6

SOIL PROFILE DESCRIPTION

NO. 7

Location: Somboho village
FAO Classification: Dystric Gleysols
Land Facet: Depression in floodplain (Sitapa)
Slope: Uniform 1-3%
Vegetation: Floodplain grassland
Landuse: Grazing and Cropping
Groundwater table: 80cm
Parent material: Alluvium



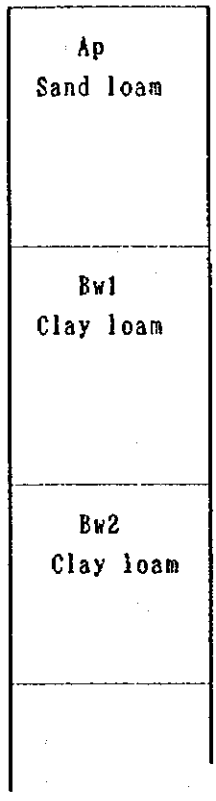
Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ap	19.41	4.04	0.02	10	0.059
C	1.98	0.33	0.04	3	0.045

Figure III.1.8 Soil Profile Description No.7

SOIL PROFILE DESCRIPTION

NO. 8

Location: Kembi village, Evans Maliwa maize field
FAO Classification: Dystric Cambisols
Land Facet: Mounds in floodplain (Mazulu)
Slope: Uniform 1-3%
Vegetation: Floodplain grassland
Landuse: Cropping (maize, sweet potatoes and pumpkins)
Groundwater table: 140cm
Parent material: Zambezi floodplain alluvium



Very dark greyish brown 10YR 3/2 pH 5.6	Ap Sand loam	0cm	Moderate medium subangular blocky; friable, slightly stick and plastic; many very fine and fine pores; many very fine and fine roots
Very Dark grey 10YR 3/1 pH 5.5	Bw1 Clay loam	24	Moderate medium subangular blocky; friable, slightly sticky and plastic; very fine and fine pores; very fine and fine roots
Very dark grey 10YR 3/1 pH 5.5	Bw2 Clay loam	64	Moderate medium subangular blocky; friable, slightly sticky and plastic; many very fine and pores; many very fine and fine roots.
		90	

Horizon	CEC	Organic C %	Total N %	Available P ppm	EC mS/cm
Ap	4.86	1.31	0.11	33	0.070
Bw	19.50	1.60	0.13	41	0.078

Figure III.1.9 Soil Profile Description No.8

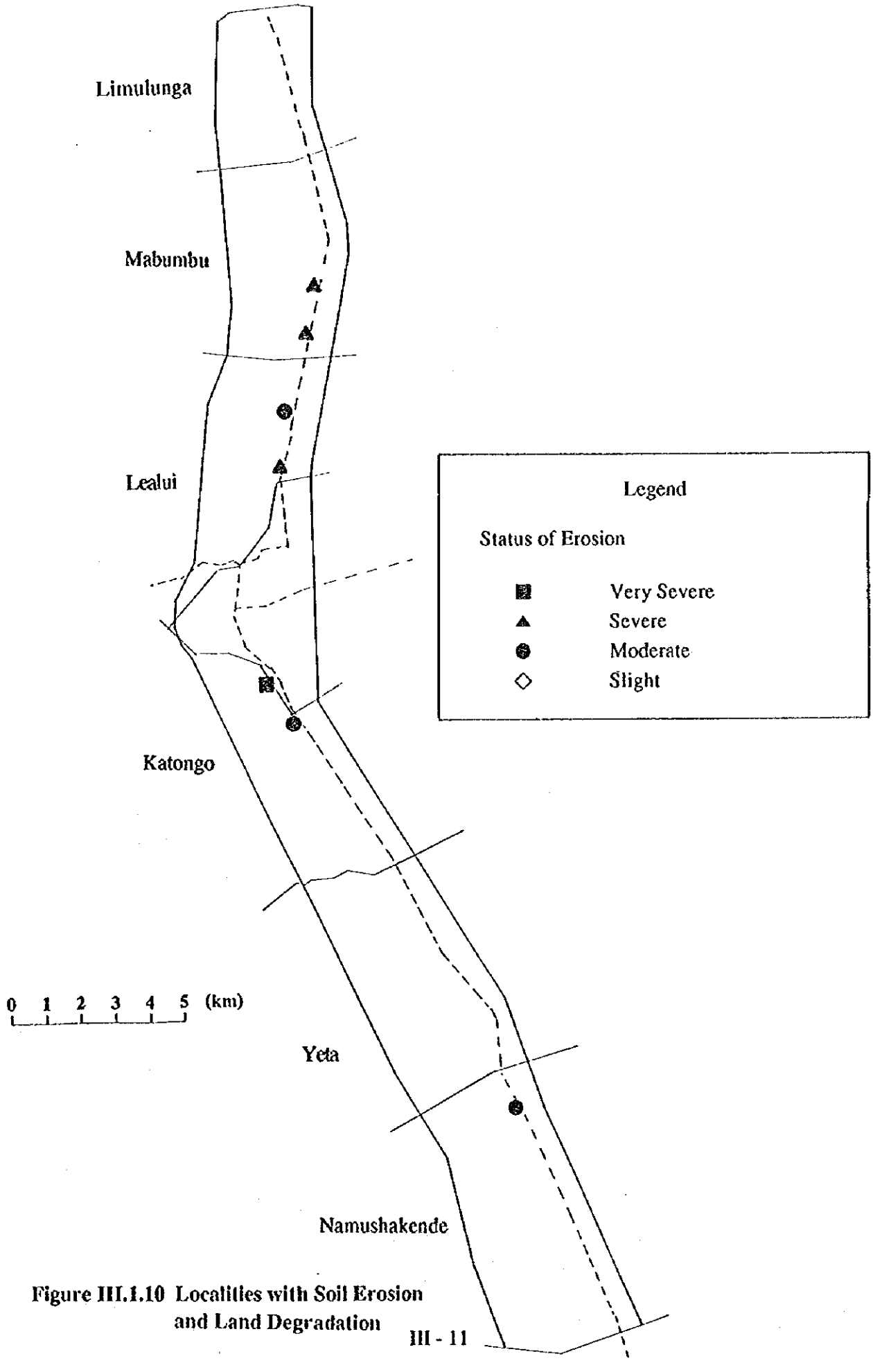
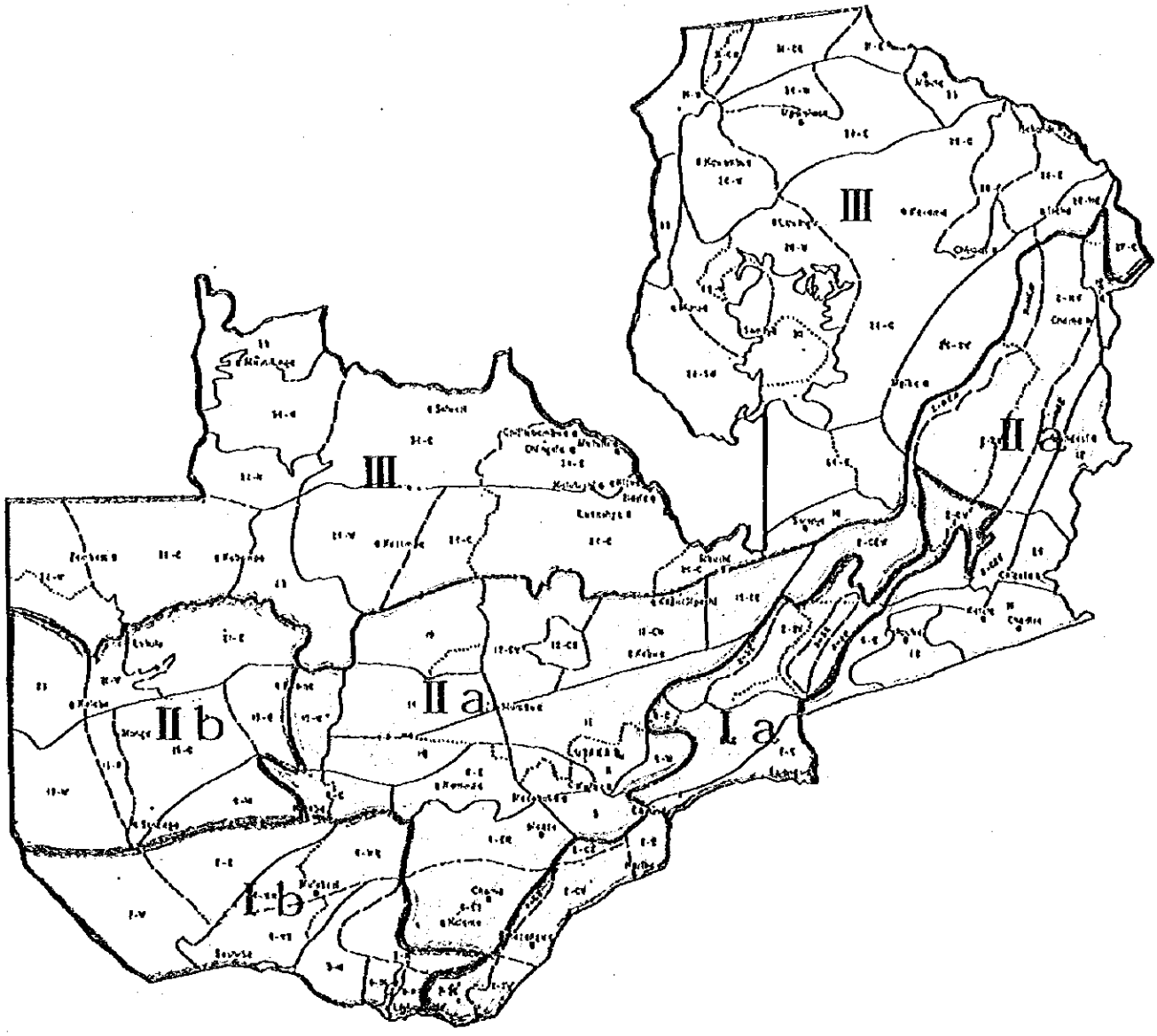


Figure III.1.10 Localities with Soil Erosion and Land Degradation

Figure III.1.11 Agro Ecological Zone Map of Zambia



The Country can be divided into three agro-ecological Zones as shown on the map

I Agro-ecological zone I comprises of the semi-arid lands and of the Zambezi Valley and the Rift Valley. This Zone occupies 14 % of the country's land area and is characterized by hot dry climate, where agricultural production is limited to sorghum, millet and extensive livestock rearing predominates.

II Agro-ecological zone II comprises of Central, Southern and Eastern Plateau and occupies about 40 % of the area. This Zone is charactarized by permanent cultivation where the production of maize, groundnuts and livestock dominates.

III Agro-ecological zone III comprises of the Northern high rainfall zone which occupies about 46 % of the Country and is characterized by acidic soils and a low population destity. Shifting cultivation (siush and burn method) is practised, while the cultivation of sorghum, cassava and maize predominates.

III.4 Agricultural Economics

Table III.4.1 Goods Marketed (1991 - 1993)

DISTRICT	MAIZE (MT)			RICE (MT)			MAIZE SEED (KG)		
	1991	1992	1993	1991	1992	1993	1991	1992	1993
Kalabo	-	-	384.0	478.9	9.0	518.0			0
Kaoma	6,945.8	4,737.8	13,684.0	256.4	6.2	161.9			243,910
Lukulu	45.8	29.9	944.0	179.2	11.6	33.0			7,970
Mongu	1.2	0.9	17.0	1,662.6	159.8	1,475.0			34,150
Senanga	138.7	26.3	255.0	307.4	41.0	123.0			6,500
Sesheke	208.2	18.4	550.0	27.0	6.3	8.0			0
Total	7,339.7	4,813.3	15,834.0	2,911.5	233.9	2,318.9			292,530

Note : (1) Figures =Calculated from the unit bag kg.
e.g. maize bag=90kg, rice bag=80kg, maize seed bag=10kg.
(2) Maize, 1991 Total = Excluding 1,710mt by ZCF

DISTRICT	FERTILIZER (MT), BASAL			FERTILIZER (MT), TOP			CATTLE (HEAD)		
	1991	1992	1993	1991	1992	1993	1991	1992	1993
Kalabo			1,603			889		-	
Kaoma			68,284			53,157		-	
Lukulu			1,287			1,378	949		
Mongu			8,806			1,272	8,716		
Senanga			1,900			605	1,251		
Sesheke			176			100	2,108		
Total			82,056			57,401	13,024		

Note : (1) Cattle, 1991 Total = Only transported live for slaughter
Excluded 7,872 heads of local slaughters' transaction

DISTRICT	FRESH FISH (K' 000)			DRY FISH (K' 000)		
	1991	1992	1993	1991	1992	1993
Kalabo	0.0	200.9	2,344.2	0.0	330.2	2,723.3
Kaoma	145.0	2,654.6	11,235.9	1,779.2	4,076.1	10,979.8
Lukulu	63.3	513.6	3,567.8	466.2	471.1	2,550.5
Mongu	1,326.0	27,942.7	79,812.2	917.8	17,974.3	116,577.3
Senanga	2.3	683.4	8,152.6	42.0	785.0	5,778.4
Sesheke	0.0	575.2	1,512.5	0.0	577.2	2,168.7
Total	1536.6	32,570.4	106,625.2	3,205.2	24,213.9	140,778.0

Note : (1) MT = metric ton; K' 000 = 1,000Kwacha

Source : (1) Department of Marketing and Co-operatives, Mongu
(2) Department of Fisheries, Mongu
(3) Department of Veterinary Services and Tsetse Control

Table III.4.2 Goods Handled by Mulambwa Harbor, MOCT

	1991 Jan	Feb	Mar	Apr	May	Jun	Jul
Mealie Meal	156,773	70,921	83,375	103,575	35,125	27,683	35,470
Sugar	5,498	8,855	15,940	3,204	3,560	25,426	2,706
Salt	350	2,440	3,120	950	300	275	2,000
Fish	20	150	150	825	750	930	14,042
Flour	140	470	360	5,075	0	50	0
Cassava	0	0	50	0	0	0	1,220
Beans	0	40	2,700	0	0	630	8,910
Maize	9,780	14,240	0	0	0	23,670	0
Sample	9,000	0	0	0	0	0	1,530
Cement	6,350	6,550	30,900	8,700	0	0	0
Groundnut	0	0	0	0	0	0	0
Rice	0	0	0	0	0	0	0
S/Feed	980	5,650	360	0	0	0	0
Millet	0	0	140	0	0	0	50
Fertilizer	50	0	0	0	0	0	0

Unit : kg

	Aug	Sep	Oct	Nov	Dec	Total	Ave
Mealie Meal	50,052	61,735	62,051	132,485	121,510	940,775	78,396
Sugar	7,460	6,020	5,620	890	5,470	90,649	7,554
Salt	720	150	5,050	2,450	150	17,955	1,496
Fish	1,260	500	0	7,290	1,750	27,667	2,306
Flour	0	89,955	50	0	0	96,100	8,008
Cassava	0	165	250	50	0	1,735	145
Beans	9,000	1,000	8,910	4,500	3,600	39,290	3,274
Maize	0	915	1,460	725	15,930	66,720	5,560
Sample	2,870	15,300	9,000	8,300	0	46,000	3,833
Cement	0	3,250	0	3,200	0	58,950	4,913
Groundnut	720	0	0	0	3,600	4,320	360
Rice	720	0	0	0	0	720	60
S/Feed	0	215	0	45	180	7,430	619
Millet	0	0	0	0	0	190	16
Fertilizer	0	9,000	11,000	0	0	20,050	1,671

Note : (1) Mulambwa Harbor handles goods from Mongu to Kalabo (District to District) and vice versa.
Source : Ministry of Communication and Transport (MOCT), Mulambwa Harbor, Mongu

Table III.4.3 Cashewnut Processing by Zambia Cashew Co., Ltd.

Unit Price : Kwacha

YEAR	RAWNUT RECEIPT (kg)	PRICE PER KG GRADE A	GRADE B	GRADE C	KERNAEL OUTTURN AT GRADING (kg)	SELLING PRICE PER KG WHOLES	LARGE	SMALL	CRUMBS
1988/89	52,710.80	5.00	4.00	2.00	-	400.00	200.00	75.00	50.00
1990	24,664.20	12.00	10.00	10.00	-	400.00	200.00	75.00	50.00
1991	54,946.01	50.00	45.00	25.00	13,410.63 (Recovery: 24.41%)	800.00	500.00	200.00	100.00
1992	66,202.65	80.00	70.00	40.00	16,142.11 (Recovery: 24.38%)	1,000.00	500.00	200.00	100.00
1993	43,296.30	170.00	115.00	60.00	12,624.03 (Recovery: 29.16%)	3,818.00	2,290.00	954.00	611.00

Note : Performance record of Zambia Cashew Co., Ltd. for last 5 years.
Source : Zambia Cashew Company Limited

III.6 Agro-Processing

Table III.6.1 Equipment Distribution by SIDO and VIS

HAMMERMILL — Unit

LOCATION	1988	1989	1990	1991	1992	1993	1994	TOTAL
Mongu								
Sefula	0	0	0	0	0	1	1	2
Township	0	0	3	0	13	5	0	21
Wenela	0	0	0	0	0	1	0	1
Limulunga	0	0	0	0	1	0	0	1
Lealui	0	0	0	1	0	0	1	2
Mweke	0	0	0	1	0	0	0	1
Sub-total	0	0	3	2	14	7	2	28
Kaoma	0	0	0	0	5	0	2	7
Sesheke	0	0	0	2	0	4	1	7
Senanga	0	0	2	2	6	3	1	14
Lukulu	0	1	1	1	2	0	1	6
TOTAL	0	1	6	7	27	14	7	62

OTHERS — Unit

Location	1988	1989	1990	1991	1992	1993	1994	TOTAL
SEWING MACHINE								
Kaoma							3	3
Sesheke							1	1
RICE MILL								
Mongu							1	1

Source : Small Industries Development Organization, SIDO
Village Industry Service, Mongu

III. 8 Environment

III.8.1 The procedure of the Environmental Impact Assessment

The Draft of the Environmental Impact Assessment Regulations is under consideration, and it is expected to be instituted in the first half of 1995. According to the Draft, the developers, any person who proposes to undertake a new project, can not implement unless the environmental impact assessment (EIA) has been concluded in accordance with this regulations. The outline of the procedure of implementation of EIA in the Draft is described for reference as under, although the Draft has possibility of amendment.

Projects Briefs

(4. Preparation of a project brief)

A developer shall prepare a project brief stating in a concise manner:

(a) the nature of the project in accordance with the categories identified in the Schedule or otherwise by the Council,

(b) the activities that shall be undertaken during and after the development of the project,

(c) the materials that the project shall use,

(d) the possible products and by-products, including waste generation, of the project,

(e) the number of people that the project will employ and the economic and social benefits to the local community and the nation in general,

(f) the environmental effects of the materials, methods, products and by-products of the project,

(g) the projected area of land , air and water that may be affected,

(h) any other matter which may be required by the Council.

Note :

Council : Environmental Council of Zambia.

Developer : Any person who proposes to undertake a new project or to repair, extend or maintain an existing project which falls within the projects provided for in the first schedule to these Regulations and includes any government Ministry or department, local authority and public corporation.

(2) In preparing the project brief the developer shall pay particular attention to the issues laid down in the Second Schedule to these Regulations.

(5. Submission of project brief to the Council)

(1) The developer shall submit six copies of the project brief to the Council.

(2) If the Council deems the project brief to be complete, the Council may transmit the project brief to the lead agency for comments within seven working days of receiving the project brief.

(6. Comments of the lead agency)

(1)The lead agency shall make comments and transmit them to the Council within fourteen working days of receiving the project brief.

(2)Where the lead agency fails to make comments and transmit them to the Council within the period specified in sub-regulation (1) of this Regulation, the Council may proceed to consider the project brief.

(7. Consideration of the project brief by the Council)

The Council shall consider the project brief and the comments made thereon by the lead agency, if such comments have been made, and make a decision within sixty days of receiving the project brief from the developer.

(8. Approval of the project)

(1) If the Council is satisfied that the project will have no significant impact on the environment, or that the project brief discloses sufficient mitigation measures to cope with the anticipated impacts it may approve the project.

(2) The Director shall issue a certificate of approval on the Council in the form provided for in the third Schedule to these Regulations.

(9. Decision to conduct an environmental impact study)

Where the Council determines that the project may have a significant impact on the environment, it may require that an environmental impact study be made in accordance with these Regulations.

Environmental Impact Study

(10. Terms of reference for the environmental impact study)

(1) An environmental impact study shall be conducted in accordance with terms of reference developed by the developer in consultation with the Council.

(2) The terms of reference shall included all matters required to be included in the environmental impact statement provided for in Regulation 14 of these Regulations and such other maters as are deemed necessary by the Council.

(11. Approval of persons to make study)

(1) The developer, shall upon the approval of the terms of reference for an environmental impact study under Regulation 10 of these Regulations, submit the names and qualifications of the persons that shall undertake the study to the Council.

(2) The Council may approve or reject the name of any person submitted to it in accordance with sub-regulation (1) of this Regulation and where it rejects, require that another name be submitted within such a period as it shall specify.

(12. Public participation in the study)

(1) The developer shall take all measures necessary to seek the views of the people in the communities which will be affected by the project prior to the completion of the study.

(2) In seeking the views of the people in accordance with sub-regulation (1) of this Regulation, the developer shall:

(a) publicize the intended project, its effects and benefits in the mass media in a language understood by the affected communities for a period not less than fourteen days.

(b) after the expiration of the period of fourteen days, hold meetings with the affected communities to explain the project and its effects.

The Environmental Impact Statement

(13. The environmental impact statement)

(1) Where the Council has determined that an environmental impact study be made in accordance with these Regulations, the developer shall make an environmental impact statement on completing the study.

(2) In making the environmental impact statement the developer shall pay attention to the issues laid down in the Second Schedule to these Regulations.

(14. Contents of the environmental impact statement)

Without prejudice to the generality of what may be included in the terms of reference specified in accordance with Regulation 10 of these Regulations, the environmental impact statement shall state:

(a) a description of the project and of the activities it is likely to generate;

(b) a description of the proposed site and reasons for rejecting alternative sites.

(c) a description of the potentially affected environment including specific information necessary for identifying and assessing the environmental effects of the project;

(d) a description of the material inputs into the project and their potential environmental effects;

(e) a description of the technology and processes that shall be used; and a description of alternative technologies and processes and the reasons for not selecting them;

(f) a description of the products and by products of the project;

(g) the environmental effects of the project including the direct, indirect cumulative, short-term and long-term effects and possible alternatives;

(h) an identification and description of measures proposed for eliminating, minimizing, or mitigating adverse impacts.

(I) an identification of gaps in knowledge and uncertainties which were encountered in compiling the required information;

(j) an indication of whether the environment of any other state is likely to be affected and the available alternatives and mitigating measures;

(k) a brief description of how the information provided for in this Regulation has been generated;

(l) such other matters as the Council may deem necessary.

(15. Executive summary of the environmental impact statement)

Environmental impact statement shall have as a component an executive summary stating the main findings and the recommendations of the study.

(16. Signature of the environment impact statement)

The environmental impact statement shall be signed under the hand of the individual persons making the study.

Review Process of the Environmental Impact Statement

(17. Submission of the environmental impact statement)

(1) The developer shall submit twelve copies of the environmental impact statement to the Council.

(2) The Director shall enter the statement submitted under sub-regulation (1) of this regulation into a Register of environmental impact statements.

(18. Comments of the lead agency)

(1) The Council shall transmit one copy of the environmental impact statement to the lead agency and request the lead agency to make comments on the statement.

(2) The lead agency shall make comments on statement and transmit them to the Council within thirty working days of receiving the environmental impact statement.

(3) Where the lead agency fails to make comments within the period specified in sub-regulation (2) of this Regulation, the Council may proceed and make a decision under Regulation 25 of these Regulations.

(4) The lead agency in considering the environmental impact statement under this Regulation, may carry out such other procedures as the Council may deem appropriate.

(5) The lead agency shall not be required to make comments if the lead agency is the developer.

(19. Invitation of general public comments)

(1) The Council shall within ten days of receiving the comments of the lead agency, and if it is satisfied that the statement is complete, invite the general public to make comments on the environmental impact statement.

(2) The invitation of the general public to make comments shall be made in a newspaper having national circulation for such a period as the Council deems necessary and shall state:

(a) the nature of the project

(b) the location of the project

(c) the anticipated impacts of the project and

(d) the proposed mitigation measures to respond to the negative impacts.

(3) The general public comments which shall be written, shall be received by the Council within a period of one month of the date of the invitation issued in accordance with sub-regulation (2) of this Regulation.

(20. Invitation of the comments of persons specifically affected by the project)

The Council shall upon receiving the comments of the lead agency in accordance with Regulation 19 (1) invite the comments of those persons who are most likely to be affected by the proposed project.

(2) The invitation of the person who are most likely to be affected by the project shall be made in a newspaper having local circulation in the area where the project shall be located and on other mass media in languages understood by the majority of the affected persons and shall state:

(a) the nature of the state

(b) the location of the project

(c) the benefits of the project to the local community

(d) the anticipated environmental impact of the project

(e) the proposed mitigation measures to respond to the negative impacts.

(3) The written comments of the person likely to be affected by the project shall be received by the Council within a period of forty five days from the date of the invitation issued in accordance with sub-regulation (2) of this Regulation.

(21. Determination to make a decision or hold a public hearing)

The Council shall consider the environmental impact statement and all the comment it has received under Regulations 18, 19, and 20 of these Regulations and determine whether the Council should make a decision according to Regulation 25 of these Regulations or hold a public hearing in accordance with Regulation 22 of these Regulations.

(22. Public hearing)

(1) The Council shall hold a public hearing on the environmental impact statement if:

(a) as a result of the comments made under Regulations 18,19 and 20 the Council is of the opinion that a public hearing will enable it to make a fair and just decision

(b) the Council considers it necessary for the protection of the environment and the promotion of the good government.

(2) The public hearing shall be held within such a period as the Council may determine but not being less than thirty days or more than 90 days of receiving comments under Regulations 19 and 20.

(3) The Council shall appoint a person who in the opinion of the Council is suitably qualified to preside over the public hearing and who shall serve on such terms and conditions as may be agreed between the Council and the person so appointed.

(4) The public hearing shall be conducted at a venue which shall be convenient and accessible to those persons who are likely to be specifically affected by the project.

(5) The date and venue of the public hearing shall be advertised in such a manner through the mass media, to bring it to the attention of persons most likely to be affected by the project and those persons making comments under Regulation 19.

(6) On the conclusion of the public hearing the person presiding at the hearing shall make a report of the views presented at the public hearing to the Council within such a period as the Council shall determine.

(23. Persons eligible to attend and prove presentations at a public hearing)

(1) Any person may attend either in person or through a representative and make presentations at a public hearing provided that the person presiding at a public hearing shall have the right to disallow frivolous and vexatious presentations which lead to the abuse of the process.

(2) The Council shall determine the procedure for the making of presentations at a public hearing under these Regulations.

Decision of the Council

(24. Parameter for decision)

(1) In making a decision regarding an environmental impact assessment under these Regulations the Council shall take into account :

(a) the validity of the predictions made in the environmental impact statement;

(b) the comments made under Regulations 18, 19 and 20;

(c) the report of the person presiding at the public hearing, where applicable;

(d) an economic analysis of the project;

(e) other factors which the Council deems crucial in the particular circumstances of the project.

(2) The Council shall make its decision in accordance with Regulation 25, within one hundred and eighty days from the date on which the environmental impact statement was submitted under Regulation 17 of these Regulations.

(25. Decision of the Council)

(1) The Council may taking into account the whole review process:

(a) approve the project

(b) require that the project be redesigned including the requiring that different technology or an alternative site be chosen or

(c) reject the project.

(2) A decision of the Council under this Regulation shall be communicated to the developer within fourteen days of the decision.

(26. Conditions of approval)

In making its decision to approve the project, the Council shall:

(a) give approval subject to such conditions as it deems necessary,

(b) state the period for which the approval shall remain valid,

(c) issue a certificate of approval of the project in the form contained in the Third Schedule to these Regulations.

(27. Reasons for rejecting the project)

(1) Where the Council makes a decision to reject a project under Regulation 25 (1) (c), it shall state its reasons in writing.

(2) The decision of the Council made in accordance with Regulation 25(1) (c) and sub-Regulation (1) of this Regulation shall be communicated to the developer within seven days of the decision.

POST-ASSESSMENT

Environmental Audits

(30. Self-auditing by the developer)

(1) In executing the project, after it has been approved by the Council, the developer shall take all practicable measures to ensure that predictions made in the environmental impact statement are complied with.

(2) Within a period of not less than twelve months and not more than thirty six months after the completion of the project or commencement of its operations, which ever is earlier, the developer shall undertake an initial environmental audit of the project.

(3) The initial environmental audit under sub-Regulation (2) of this Regulation shall be carried out by the persons who made the environmental impact study as constituted under Regulation 11 of these Regulations and where this is not possible, by persons whose names and qualifications have been approved by the Council for the purpose.

(4) Subsequent to the initial environmental audit, the Council may require the developer to carry out such audits at such times as the Council deems necessary.

(5) The environmental audit report shall be prepared after each audit and shall be submitted to the Council by the developer.

(31. Audits by the Council)

(1) An inspector appointed under the Act may at all reasonable times enter upon any land, premises or other facility related to a project for which a project brief or an environmental impact statement has been made under these Regulations to determine how far the predictions made in project brief or the environmental impact statement, whichever the case may be, are being realized.

(2) An inspector acting pursuant to this Regulation may examine and copy records and exercise all or any of powers provided for under section eighty-four of the Act.

(32. Mitigation measures)

(1) The Council may require that the developer takes specific mitigation measures to ensure compliance with the predictions made in the environmental impact statement or the project brief, whichever the case may be.

(2) The mitigation measures in sub-Regulation (1) of this Regulation shall be communicated to the developer in writing, specifying the period within which the measures shall be taken.

III.8.2 Water Right

Water use right was established based on the Water Act enacted in 1970. Water use right can be acquired by submitting an application to the Secretary of the Water Board, Department of Water Affair, Ministry of Energy & Water Development. If there are no problems in the investigation process, a 5 year water use right period can be received. This right is renewable every after 5 years. This granted with water right will have to register and pay a registration fee. The water right applies to all river surface water except for international rivers like Zambezi, Luapula and some parts of the Luangwa river. However, it is not applicable to the waters at the flood plane in the Study Area. The customs and traditions of the Lozi tribe do not restrict the water use rights.

III.8.3 Institution and Custom for Fisheries

The fisheries in Zambia are regulated by the Fisheries Act enacted in 1974. Although there is no such thing as fishing right, special fishing area can be designated by the Minister of Agriculture, Food & Fisheries in accordance with relevant statutes. Special fishing areas are designated for recreation, subsistence and research purposes and the Special Fishing Licenses with special conditions are issued. For commercial fishing, the commercial fishing areas with some regulation such as prohibiting, restricting or regulating fishing, controlling of the fishing methods, prescribing that during any period of the year or for any particular species of fish, are designated. No person shall carry on the occupation of a fisherman in any commercial fishing area unless he is registered with the Director of Fisheries in the manner prescribed by the Minister. Area designation is not carried out in the Study Area, thereby granting the residents liberty to fish anywhere. However, one of the practices of the Lozi Tribe has actually continued to present, namely "Right to Produce of the Land", handed down by the Litunga. The permission of tenants, either of breeding ponds or flooded plains, is required for fishing. Fishing or entrance fees are

mostly imposed too. If the road construction plan of the Master Plan and Development Plan runs across a private breeding pond and may violate the "Right to the Produce of the Land", the cooperation of the Provincial Land Department should be acquired to effectively settle things with the tenants before the plan is regulated.

Control of Fishing by the Fishing Act, 1974

Special Fishing Areas and Licences

6. (1) The Minister may, for the purposes of recreational, subsistence, or research fishing, by statutory order declare any area of water to be a prescribed area and shall in such order specify for which of the foregoing purposes the area is so declared.

(2) The Minister may, in respect of any prescribed area designated as such under the provisions of subsection (1), regulate the method of fishing to be used therein and may prohibit the use of nets.

7. (1) Notwithstanding the provisions of this Act, it shall be lawful for the Minister, upon such conditions as he may deem fit, and upon payment of such fee as may be prescribed, to grant to any person or persons collectively a licence to be known as a Special Fishing Licence which shall authorize the holder thereof to fish in any special area or specified waters for any of the following purposes:

(a) scientific research or the collection of specimens for aquaria, museums and similar institutions;

(b) collecting live fish for stocking specified waters;

(c) the supply of food in cases of emergency if no other adequate food supply is available;

(d) experiment subject to the direction of the Director.

(2) A special Fishing Licence may in the discretion of the Minister authorize the holder to fish by any means or method of fishing, whether otherwise prohibited or not, subject, however, to such conditions as the Minister may deem fit to impose.

Commercial Fishing

8. (1) The Minister may, by statutory order, declare any area of water to be a commercial fishing area.

(2) The Minister may, in respect of any commercial fishing area declared as such under the provisions of subsection (1), make regulations-

(a) prohibiting, restricting or regulating fishing;

(b) controlling the methods of fishing;

(c) prescribing that during any period of the year it shall be an offense to fish whether generally or for any particular species of fish;

(d) prescribing the licences which must be held by any person fishing in a commercial fishing area;

(e) prescribing the records to be kept and the information to be provided by any person fishing in a commercial fishing area.

9. (1) The Minister may, by statutory order, require that no person shall carry on the occupation of a fisherman in any commercial fishing area unless he is registered with the Director in the manner prescribed by the Minister.

(2) Any person who contravenes the provisions of sub-section (1) shall be guilty of an offense.

10. (1) The Minister may, by statutory order, require that every boat used by a fisherman for the purpose of commercial fishing shall be registered with the Director in such manner and on payment of such fee as the Minister may prescribe.

(2) Any fisherman who fails to register a boat used by him for the purpose of commercial fishing shall be guilty of an offense.

III.8.4 List of Wild Birds Flying over the Flood Plain in the Study Area

Local Name	Scientific Name
(PLAIN BIRDS)	
Wattled plover	*Vanellus senegallus*
Tree-toes sand plover	
White-bellied	
Cattle egret	*Bublucus ibis*
Spotted eagle-owl	*Bubo africanus*
Black bellied korhaan	*Eupodotis* spp.
Black-winged stilt	*Himantopus himantopus*
Hamarkop	*Scopus umbretta*
(SEASONAL FLOOD PLAINS BIRDS)	
Black duck	*Anas sparsa*
Whistling duck	*Dendrocygna viduata*
Spurwing goose	*Plectrofterus gambensis*
Red bill teal	*Anas erythrorhyncha*
Grey heron	*Ardea ptcinera*
Dwarf bittern	*Ixobrychus sturmii*
Open bill stork	*Anastomus lamelligerus*

Table III.8.1 Number of Malarious Patients in the Study Area and within its Circumference

(Number of curers in the Rural Health Centers; Average of 4 years, 1990-1993)

Sanitary Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Limulunga	1147	923	930	1096	917	728	465	563	649	759	729	851	9757
Mabumbu	367	326	283	277	313	193	688	160	200	200	282	344	3633
Liyoyelo	348	433	525	490	425	308	282	211	290	395	330	396	4433
Mulambwa	1133	1203	1191	1290	968	1014	1038	768	889	946	1249	1006	12695
Prisons	744	819	857	878	808	792	518	646	572	524	755	835	8748
Sefula	778	760	710	627	587	496	327	317	438	509	512	636	6697
Namushakende	464	411	471	423	313	280	163	123	169	212	229	293	3551
Total	4981	4875	4967	5081	4331	3811	3481	2788	3207	3545	4086	4361	49514

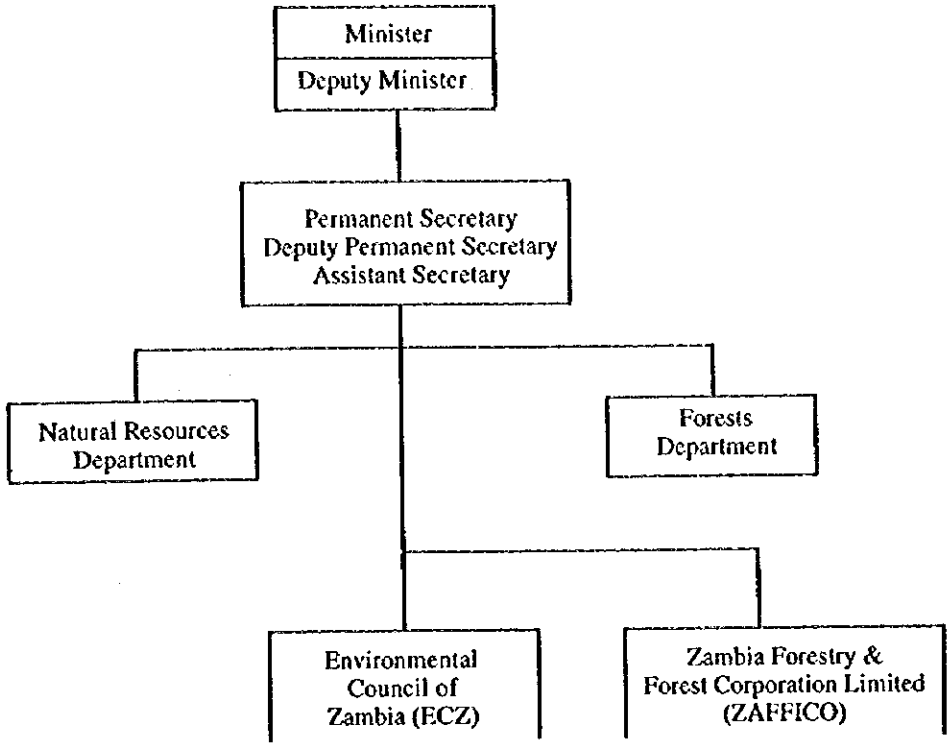


Figure III.8.1 Organizational Structure of the Ministry of Environment and Natural Resouces

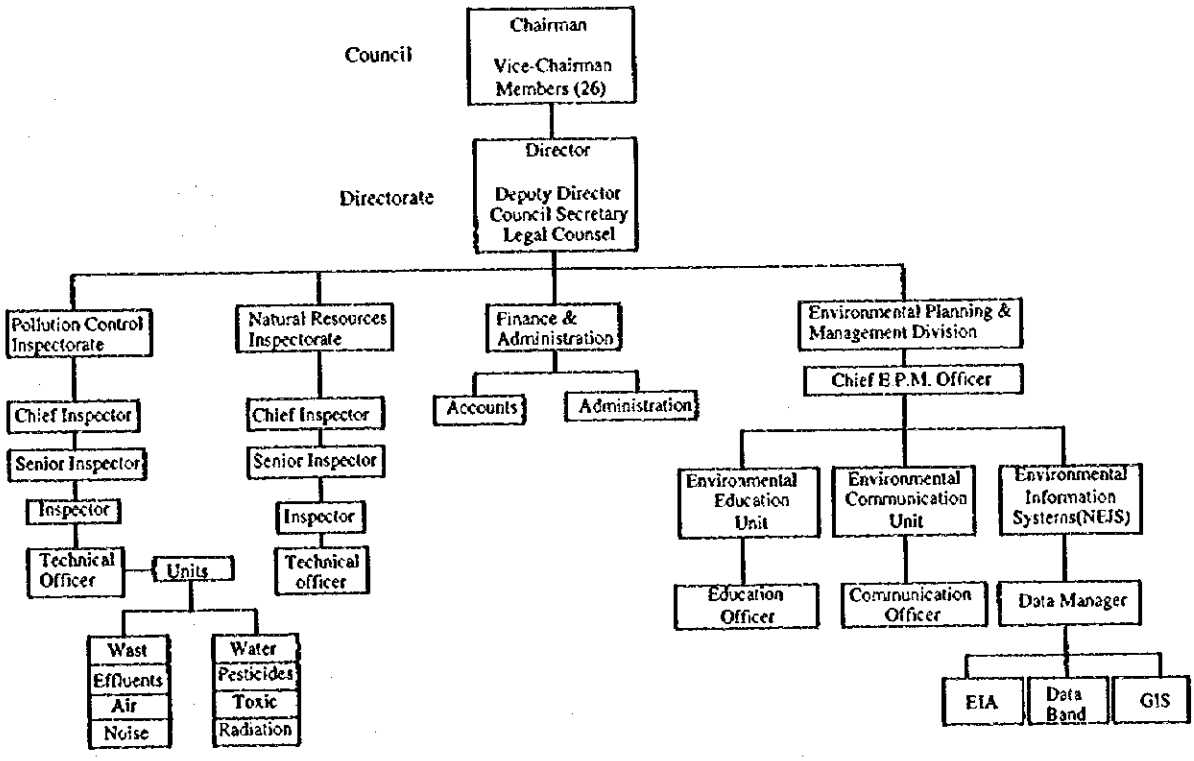


Figure III.8.2 Organizational Structure of Environmental Council of Zambia (ECZ)

IV. MASTER PLAN OF THE STUDY AREA

IV. MASTER PLAN OF THE STUDY AREA

IV.5 Irrigation and Drainage

IV.8 Agro-Processing

IV.14 Design of Facilities

IV.16 Environmental Conservation

IV.5 Irrigation and Drainage

Table IV.5.1 Monthly Gross Irrigation Requirement

Month	ET Crop day	Loss	Days	ET Crop Month	Init.Pond	Sub Total	Precipitation	Eff.Rainfall	Net I.R.	Areal percentage	Gross I.R.
1	2.7	2.0	31	145.7	112.5	258.2	197.8	158.2	100.0	100.0	117.6
2	4.8	4.0	28	246.4	37.5	283.9	144.6	115.7	168.2	100.0	197.9
3	4.8	4.0	31	272.8		272.8	160.9	128.7	144.1	100.0	169.5
4	5.9	4.0	30	297.0		297.0	46.4	37.1	259.9	100.0	305.7
5	5.6	4.0	31	297.6		297.6	2.0	1.6	296.0	100.0	348.2
6	2.3	2.0	30	129.0		129.0	0.0	0.0	129.0	100.0	151.8
7	0.0	0.0	31	0.0		0.0	0.0	0.0	0.0		0.0
8	3.8	0.0	31	117.8		117.8	0.0	0.0	117.8	50.0	69.3
9	10.2	7.0	30	516.0	112.5	628.5	0.0	0.0	628.5	50.0	369.7
10	9.4	7.0	31	508.4	37.5	545.9	17.4	13.9	532.0	50.0	312.9
11	7.9	7.0	30	447.0		447.0	53.4	42.7	404.3	50.0	237.8
12	2.6	3.5	31	189.1		189.1	193.8	155.0	0.0	50.0	0.0
Total			365						2779.7		2280.5

Premises of irrigation

Seepage Loss : Transplanting = 4.0mm, Direct Seeding=7.0mm
Initial ponding water : 150mm
Effective Rainfall Rate : 0.80
Irrigable area percentage : Transplant. = 100%, Direct Seed.=50%
Conveniency Loss : 15%

Base flow of Sefula and Namitome : 0.3 m³/sec

Irrigable area :
369.7mm/month (peak requirement) / 30day = 12.32mm/day
0.3×86,400 = 25,920 m³/day
25,920/ (100×100×0.01232) = 210ha ------ Transplanting
105ha ------ Direct Seeding

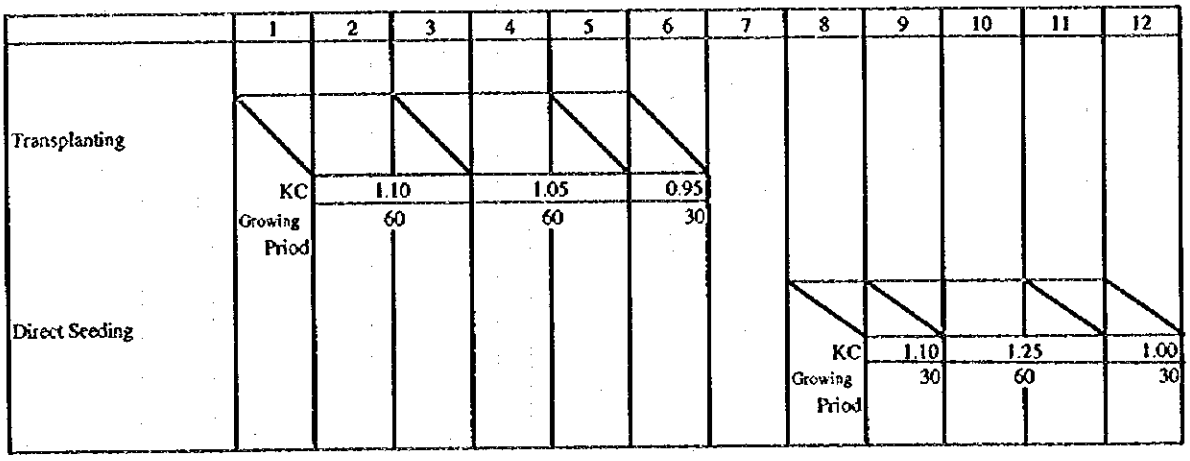
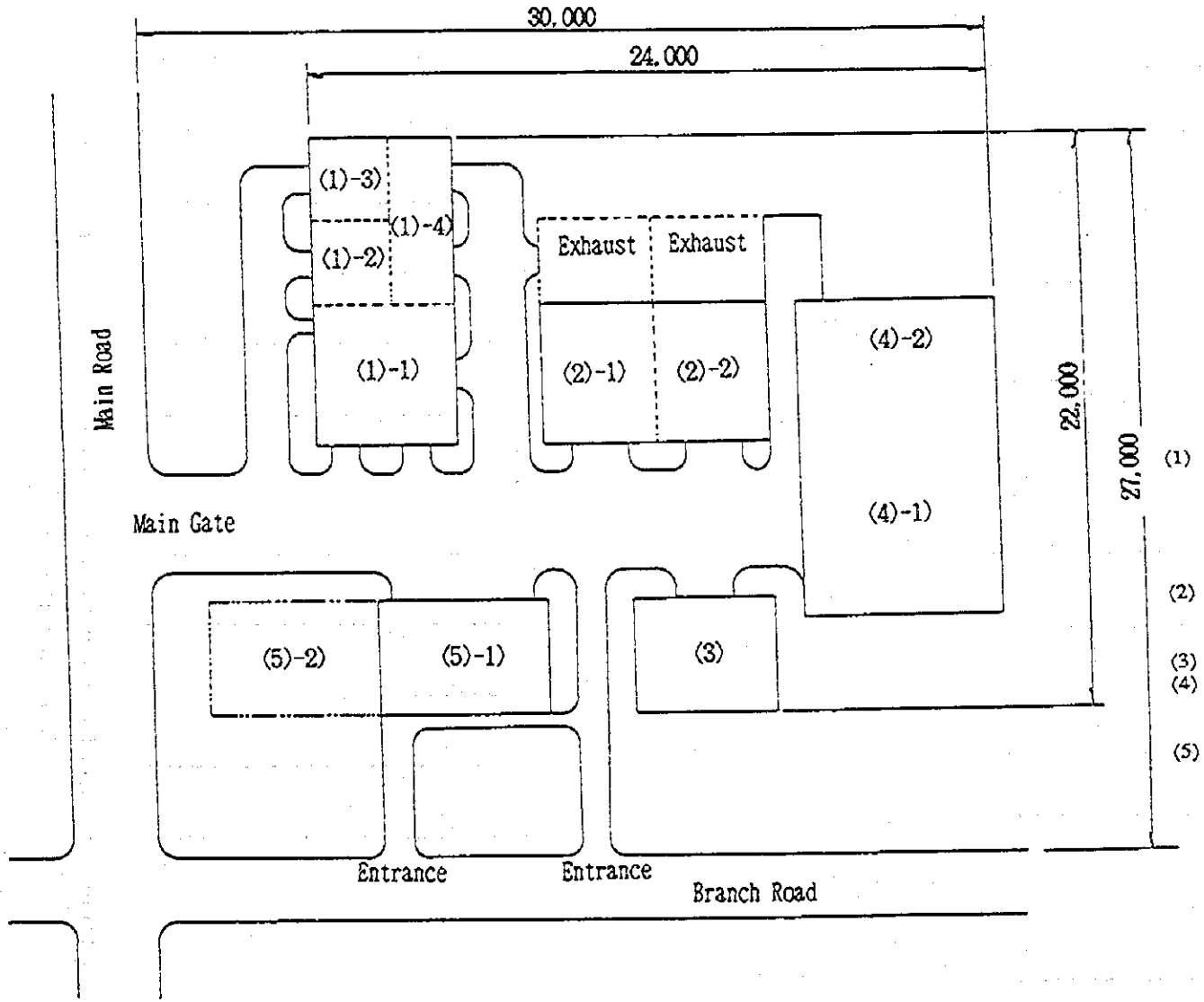


Figure IV.5.1 Cropping Pattern and Growing Period for Proposed Irrigation Requirement



(1) Inspection Room, Office. Post-Harvest Machine Building
1) Inspection Room, Office Room
2) Paddy Post-Harvest Machine Store
3) Maize Post-Harvest Machine Store
4) Tool Room

(2) Milling Machine Building
1) Rice Mill Room
2) Maize Mill Room

(3) Warehouse

(4) Drying Yard, Winnowing Yard
1) Drying Yard
2) Winnowing Yard

(5) Market Building
1) First Market
2) Second Market (Future Expansion)

Figure IV.8.1 Planed Agro-Processing Facilities A

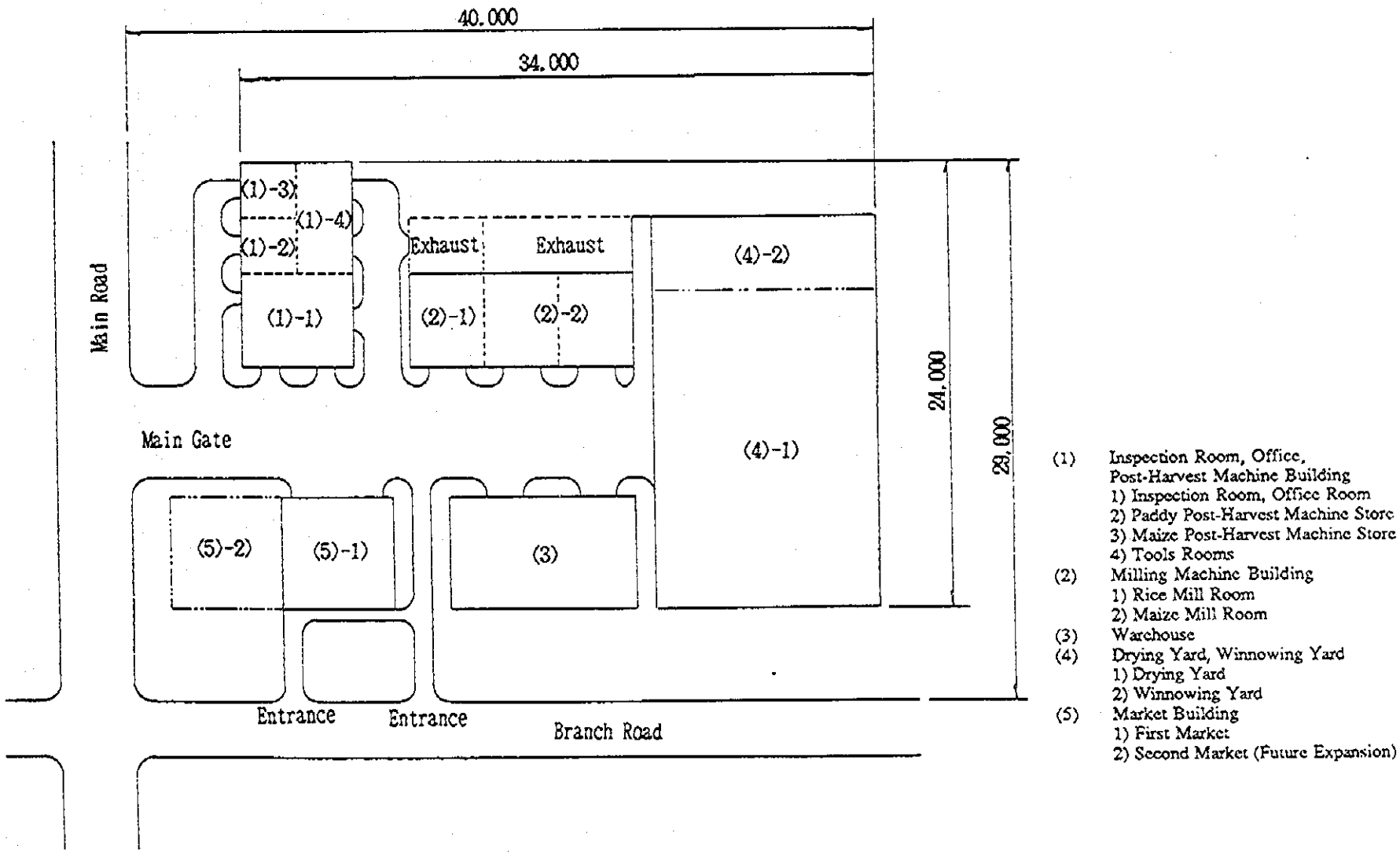


Figure IV.8.2 Planed Agro-Processing Facilities B

Table IV.14.1 Construction Cost in the Study Area (1/3)

Word	Description	Unit	Quantity	Local Currency (kw)		Foreign Currency (kw)		No.
				Unit Price	Amount	Unit Price	Amount	
Limlunga		set			1,540,000,000		951,000,000	
Mabumbu		set			1,116,000,000		597,000,000	
Lealui		set			1,237,000,000		727,000,000	
Katongo		set			1,281,000,000		766,000,000	
Yeta		set			2,296,000,000		1,425,000,000	
Namushakende		set			1,716,000,000		980,000,000	
Total		set			9,186,000,000		5,446,000,000	
Limlunga	Road							
	Feeder Road	km	0.6	52,184,000	31,310,000	36,900,000	22,140,000	A-1,2
	Village Road	km	3.3	34,680,000	114,444,000	23,053,000	76,074,000	A-3
	Peripheral Road	km	5.7	33,920,000	193,344,000	47,759,000	272,226,000	A-4
	Field Road	km	1.5	5,687,000	8,530,000	9,950,000	14,925,000	A-8
	Irrigation							
	Gravity Irrigation	ha	200		491,420,000		407,750,000	A-9~14
	Agro-processing							
	Crop Processing Facility	place	1		331,570,000		112,119,000	A-16
	Inland Fishery							
	Fry Production Farm	place	1		52,738,000		20,353,000	A-19~21
	Extension							
	Integrated Training Facility	place	1		307,920,000		20,152,000	A-22
	Animal Husbandry							
	Crash Pen	place	1		5,244,000		3,718,000	A-18
	Loading Ramp	place	1		3,955,000		1,815,000	A-17
	Sub-total				1,540,475,000		951,272,000	
Mabumbu	Road							
	Feeder Road	km	1.5	52,184,000	78,276,000	36,900,000	55,350,000	A-1,2
	Village Road	km	5.7	34,680,000	197,676,000	23,053,000	131,402,000	A-3
	Peripheral Road	km	5.4	33,920,000	183,168,000	47,759,000	257,898,000	A-4
	Field Road	km	1.5	5,687,000	8,530,000	9,950,000	14,925,000	A-8
	Agro-processing							
	Crop Processing Facility	place	1		331,570,000		112,119,000	A-16
	Extension							

Table 4.14.1 Construction Cost in the Study Area (2/3)

Word	Description	Unit	Quantity	Local Currency (kw)		Foreign Currency (kw)		No.
				Unit Price	Amount	Unit Price	Amount	
	Integrated Training Facility	place	1		307,920,000		20,152,000	A-22
	Animal Husbandry							
	Crash Pen	place	1		5,244,000		3,718,000	A-18
	Loading Ramp	place	1		3,955,000		1,815,000	A-17
	Sub-total				1,116,339,000		597,379,000	
Lealui	Road							
	Feeder Road	km	1.2	52,184,000	62,620,000	36,900,000	44,280,000	A-1,2
	Village Road	km	5.7	34,680,000	197,676,000	23,053,000	131,402,000	A-3
	Peripheral Road	km	7.7	33,920,000	261,184,000	47,759,000	367,744,000	A-4
	Field Road	km	2.6	5,687,000	14,786,000	9,950,000	25,870,000	A-8
	Agro-processing							
	Crop Processing Facility	place	1		331,570,000		112,119,000	A-16
	Inland Fishery							
	Fry Production Farm	place	1		52,738,000		20,353,000	A-19~21
	Extension							
	Integrated Training Facility	place	1		307,920,000		20,152,000	A-22
	Animal Husbandry							
	Crash Pen	place	1		5,244,000		3,718,000	A-18
	Loading Ramp	place	1		3,955,000		1,815,000	A-17
	Sub-total				1,237,693,000		727,453,000	
Katongo	Road							
	Feeder Road	km	1.7	52,184,000	88,712,000	36,900,000	62,730,000	A-1,2
	Village Road	km	7.9	34,680,000	273,972,000	23,053,000	182,118,000	A-3
	Peripheral Road	km	7.7	33,920,000	261,184,000	47,759,000	367,744,000	A-4
	Field Road	km	1.6	5,687,000	9,099,000	9,950,000	15,920,000	A-8
	Agro-processing							
	Crop Processing Facility	place	1		331,570,000		112,119,000	A-16
	Extension							
	Integrated Training Facility	place	1		307,920,000		20,152,000	A-22
	Animal Husbandry							
	Crash Pen	place	1		5,244,000		3,718,000	A-18
	Loading Ramp	place	1		3,955,000		1,815,000	A-17
	Sub-total				1,281,656,000		766,316,000	

Table 4.14.1 Construction Cost in the Study Area (3/3)

Word	Description	Unit	Quantity	Local Currency (kw)		Foreign Currency (kw)		No.
				Unit Price	Amount	Unit Price	Amount	
Yeta	Road							
	Feeder Road	km	5.2	52,184,000	271,356,000	36,900,000	191,880,000	A-1,2
	Village Road	km	7.6	34,680,000	263,568,000	23,053,000	175,202,000	A-3
	Peripheral Road	km	7.4	33,920,000	251,008,000	47,759,000	353,416,000	A-4
	Field Road	km	2.3	5,687,000	13,080,000	9,950,000	22,885,000	A-8
	Irrigation							
	Gravity Irrigation	ha	200		491,420,000		407,750,000	A-9~14
	Agro-processing							
	Crop Processing Facility	place	2		635,970,000		228,198,000	A-15~16
	Inland Fishery							
	Fry Production Farm	place	1		52,738,000		20,353,000	A-19~21
	Extension							
	Integrated Training Facility	place	1		307,920,000		20,152,000	A-22
	Animal Husbandry							
	Crash Pen	place	1		5,244,000		3,718,000	A-18
	Loading Ramp	place	1		3,955,000		1,815,000	A-17
	Sub-total				2,296,259,000		1,425,369,000	
Namushakende	Road							
	Feeder Road	km	1.9	52,184,000	99,149,000	36,900,000	70,110,000	A-1,2
	Village Road	km	8.9	34,680,000	308,652,000	23,053,000	205,171,000	A-3
	Peripheral Road	km	8.6	33,920,000	291,712,000	47,759,000	410,727,000	A-4
	Field Road	km	2.0	5,687,000	11,374,000	9,950,000	19,900,000	A-8
	Agro-processing							
	Crop Processing Facility	place	2		635,970,000		228,198,000	A-15~16
	Inland Fishery							
	Fry Production Farm	place	1		52,738,000		20,353,000	A-19~21
	Extension							
	Integrated Training Facility	place	1		307,920,000		20,152,000	A-22
	Animal Husbandry							
	Crash Pen	place	1		5,244,000		3,718,000	A-18
	Loading Ramp	place	1		3,955,000		1,815,000	A-17
	Sub-total				1,716,714,000		980,144,000	

IV.16 Environmental Conservation

Table IV.16.1 Result of Initial Environmental Examination
- Environmentally Sensitive Areas in the Study Area and Vicinity -

Environmentally Sensitive Area	Applicable or Not					
	In Study Area			Vicinity of Study Area		
	Appl.	N.A.	Unknown	Appl.	N.A.	Unknown
(1) Area under specific designation						
1. Habitat of fauna and flora listed in CITES		○			○	
2. Wetland designated under the Ramsar Convention		○			○	
3. Heritage sites listed in the World Heritage Convention		○			○	
4. National parks, nature reserves, etc.		○			○	
(2) Socioeconomically sensitive areas						
5. Areas inhabited by indigenous peoples, ethnic minorities		○			○	
6. Historical remains, cultural assets, aesthetic sites	○				○	
7. Area likely to suffer from significant negative economic impact		○			○	
(3) Environmentally sensitive natural land						
8. Arid and semi-arid lands (including savanna, rangeland etc.)		○			○	
9. Tropical rain forest and wildlands		○			○	
10. Wetlands	○			○		
11. Peat lands	○			○		
12. Mangrove forests		○			○	
13. Coral reefs		○			○	
14. Mountainous, steep-sloped, erodible or devastated lands	○			○		
15. Closed water bodies such as lakes, swamps or reservoirs		○			○	

Table IV.16.2 Result of Initial Environmental Examination
- Result of Evaluation -

(1) Social Environment

Category of Environmental Impact	Definition	Evaluation	Evaluation Bases
1) Socio-economic issues			
1)-1 Social issues			
1. Planned residential settlement	New land settlement implemented in agricultural & rural development projects such as land clearing & leveling, sea/swamp reclamation and irrigation development Exemplified by the estate project approach with settlement schems for nomad, landless farmers or shifting cultivators	D	Not applicable
2. Involuntary resettlement	Forced resettlment to move inhabitants away from their original dweling places in areas that will be submerged as development projects	D	Not applicable
3. Substantial changes in way of life	Change in the way of life of the affected people, and in particular changes in the role of women in family & society brought by agricultural and raral development	D	Not applicable
4. Conflict among communities and peoples	Friction due to conflicting interests between beneficiaries and non-beneficiaries, people in favor of and those against development, new settlers and host people, involved in development and outsiders, people in a project area and those affected in the surrounding area	D	Not applicable
5. Impact on native peoples	Adverse effects of development on local communities composed partly or entirely of indigenous peoples (including tribal groups), low-caste groups, ethnic minorities, or nomads	D	Not applicable
1)-2 Demographic issues			
6. Population increase	Significant population increase in a project or surrounding area due to development	D	Not applicable
7. Drastic change in population composition	Drastic change in population composition in a project or surrounding area due to development	D	Not applicable
1)-3 Economic activities			
8. Changes in basses of economic activities	Forced or involuntary, relocation of economic bases or means such as farmland, fishing grounds, etc., under a project due to land acquisition, changes in land use regulation, and deterioration or depletion of bases or means for economic activities	C	Mutual agreement with tenants is necessary before Road Construction Plan is regulated
9. Occupational change and loss of job opportunity	Forced or involuntary occupational change due to land acquisition and loss or deterioration of means or bases of economic activities; it includes loss of job opportunities due to farm mechanization	D	Not applicable
10. Increase in income disparities	Increase in income disparities among groups brought about by development; it implies relative impoverishment of the economically weak	D	Not applicable

1)-4 Institutional and custom related issues			
11. Adjustment & regulation of water or fishing (riparian) rights	Adverse development effects on water or fishing (riparian) rights and necessary adjustments or regulations to rectify the same	C	This concerns with above-mentioned 8
12. Changes in social and institutional structures	Changes in social and institutional structures as a result of establishment of new, or modification of existing, rural organizations caused by development	D	Not applicable
13. Changes in existing institutions and customs	Changes in existing institutions and customs involved in or induced by development activities	D	Not applicable
2) Health and sanitary issues			
14. Increased use of agrochemicals	Increased use of chemical pesticides due to intensification of agriculture; introduction of high-yielding varieties & new crops and irrigation development	D	Not applicable
15. Outbreak of endemic diseases	Spreading of endemic diseases as a result of the adverse effects of development	D	Not applicable
16. Spreading of epidemic diseases	Spreading of epidemic diseases attributable to the adverse effects of development	C	Causual relation between irrigation facilities & fish pond and malaria
17. Residual toxicity of agrochemicals	Accumulation in the natural environment (soil, water, etc.) of agrochemicals or chemical substances with high residual toxity such as organo-chloric insecticides, etc.	D	Not applicaple
18. Increase in domestic & other human wastes	Incerase in domestic and other human wastes due to the consequences of development such as population increase	D	Not applicaple
3) Cultural asset issues			
19. Impairment of historic remains and cultural assets	Direct or indirect impairment or destruction of sites, structures, and remains of archaeological, historical, religious, cultural, or aesthetic value as result of development	D	Not applicaple

(2) Natural Environment

Category of Environmental Impact	Definition	Evaluation	Evaluation Bases
4) Biological and ecological issues			
20. Changes in vegetation	Direct or indirect deterioration or degradation of vegetation due to development activities including removal of vegetation cover, alteration of land use, encroachment on forest, alteration of environmental conditions, etc.	D	Not applicable
21. Negative impacts on important or indigenous fauna and flora	Adverse effects on important or indigenous animal & plant species due to destruction of or changes in habitats	D	Not applicable
22. Degradation of ecosystems with biological diversity	Degradation of ecosystems that allows the wild species of plants and animals to withstand external stress	D	Not applicable
23. Proliferation of exotic and/or hazardous species	Introduction of pathogenic agents or spreading of hazardous species due to creation of environment conductive to their propagation	D	Not applicable

24. Destruction of wetlands and peatlands	Extinction of wetlands or peatlands due to direct destruction caused by development activities such as large-scale earth filling; or Extinction due to indirect effects such as drying and decomposition due to changes in hydrological regime	D	Not applicable
25. Encroachment into tropical rain forests and wildlands	Decrease or disappearance of tropical rain forests due to direct or indirect effects of development	D	Not applicable
26. Destruction or degradation of mangrove forests	Disappearance of mangrove forests attributable to direct destruction, or deterioration of supporting environmental conditions	D	Not applicable
27. Degradation of coral reefs	Encroachment due to direct destruction, or damage to and deterioration of the supporting environment caused by sedimentation, etc.	D	Not applicable
5) Soil and land resources			
5)-1 Soil resources			
28. Soil erosion	Washing or blowing away of soil from the earth surface by the action of water or wind	B	Soil erosion in escarpment of plain edge
29. Soil salinization	Phenomena in which soluble salts accumulate in the surface layer of soils and crops growth is consequently affected	D	Not applicable
30. Deterioration of soil fertility	Deterioration of soil productivity due to leaching and depletion of nutrients, surface soil erosion, salinization, failure in soil management, etc.	C	This concerns with above-mentioned 28
31. Soil contamination by agrochemicals and others	Accumulation of agrochemicals in soil with high residual toxity	D	Not applicable
5)-2 Land resources			
32. Devastation or desertification of land	Deterioration of land productivity or desertification caused by artificial or natural impacts	D	Not applicable
33. Devastation of hinterland	Devastation of areas surrounding a project area as a result of secondary or indirect impacts of development	D	Not applicable
34. Ground subsidence	Settlement of ground caused by the dehydration or drying of wetlands, peat swamp, or reclaimed lands, or excessive exploitation of groundwater	D	Not applicable
6) Hydrology, water quality and air			
6)-1 Hydrology			
35. Changes in surface water hydrology	Alteration of river discharge or water level as the effects of reservoir construction, irrigation water intake, or drainage	D	Not applicable
36. Changes in groundwater hydrology	Changes in the groundwater recharge mechanism or groundwater table caused by infiltration of irrigation water and exploitation of groundwater	D	Not applicable
37. Inundation and flooding	Overflowing of a river onto the surrounding land or the surging of sea water onto the coastal land. Inundation or flooding area caused by increased river or run-off discharge or poor water management	D	Not applicable
38. Sedimentation	Settlement of transported sediment in rivers, estuaries, and reservoir	C	This concerns with above-mentioned 28
39. Riverbed degradation	Degradation of riverbeds in lower basin areas due to insufficient sediment load to maintain riverbed level	D	Not applicable
40. Impediment of inland naviation	Adverse impacts on navigation due to development activities	D	Not applicable

6)-2 Water quality and temperature			
41. Water contamination and deterioration of water quality	Deterioration of water quality due to development activities	D	Not applicable
42. Water eutrophication	Accumulation in water of nutritive soluble salts such as nitrate and phosphate	D	Not applicable
43. Sea water intrusion	Intrusion of a salt water wedge along a riverbed	D	Not applicable
44. Change in temperature of water	Adverse impact of low irrigation water temperature on crops	D	Not applicable
6)-3 Atmosphere			
45. Air pollution	Diffusion of agrochemicals and sand dust and odoriferous particles such as exhaust from vehicles and machinery into the air	D	Not applicable
7) Landscape and mining resources			
46. Damage to landscape	Direct or indirect negative effects on features of landscape as a result of development	D	Not applicable
47. Impediment of mining resources exploitation	Impediment of exploitation of mining resources due to development activities	D	Not applicable

A: The subject SEI is unquestionably induced by the Project (SEI: Significant Environmental Impact)
B: The subject SEI is likely to be induced by the Project
C: The SEI is not fully known
D: There is no possibility of the subject SEI being induced by the Project

Table IV.16.3 Result of Initial Environmental Examination
- Result of Overall Evaluation -

Category of Environmental Impact	Overall Evaluation	Necessary Study Items
28. Soil erosion	B	Physical and farming soil erosion control (introduction of cover crops, afforestation etc.), appropriate land use plan
8. Changes in bases of economic activities	C	Relation with road construction plan and irrigation facilities construction plan
11. Adjustment & regulation of water or fishing (riparian) rights	C	Relation with road construction plan and irrigation facilities construction plan
16. Spreading of epidemic diseases	C	Casual relation between irrigation facilities & fish pond and malaria
38. Sedimentation	C	Countermeasures on soil loss and irrigation canal conservation, method of vegetation cover on the slope of plain edge

Criteria of evaluation
A: The subject SEI is unquestionably induced by the Project (SEI: Significant Environmental Impact)
B: The subject SEI is likely to be induced by the Project
C: The SEI is not fully known

VI. DEVELOPMENT PLAN OF THE FEASIBILITY STUDY AREA

VI. DEVELOPMENT PLAN OF THE FEASIBILITY STUDY AREA (F/S AREA)

VI.6 Rural Infrastructure

VI.7 Irrigation and Drainage

VI.9 Farming and Crop Husbandry

VI.12 Agro-Processing

VI.15 Women in Development

VI.18 Design of Facilities

VI.19 Operation and Maintenance of the Facilities

VI.21 Cost Estimation of the Project

VI.22 Environmental Consideration

VI.23 Project Evaluation

VI.6 Rural Infrastructure

VI.6.4 Health and Education

Table VI.6.1 Leading Causes of Morbidity, Sefula RHC, 1993

Causes	Total	Number of Out-Patients	
		Under 5	Over 5
Malaria	6,849	2,087	4,762
URI	1,886	605	1,281
Eye diseases	831	373	458
Skin Infections	802	162	640
Diarrhea	586	214	372

Source: Sefula RHC
Note:URI = Upper Respiratory Infection

Table VI.6.2 Leading Causes of Mortality, Sefula RHC, 1993

Causes	Total	Deaths	
		Under 5	Over 5
Malaria	5	3	2
Diarrhea	4	3	1
Anemia	2	2	0
Pneumonia	1	1	0
Tuberclosis	1	0	1

Source: Sefula RHC

Table VI.6.3 Educational Institutions in the Feasibility Study Area

School Name	No.of Classes	No.of Pupils	No.of Teachers	No.of Classroom	Classroom Pupil Ratio	No.of Desks
A. Primary and Basic School						
Mutuwambwa	14	536	13	7	1:77	169
Namachaha	7	262	8	5	1:52	72
Sefula Basic	25	762	38	11	1:69	171
Sefula Basic for the Blind	14	80	15	9	1:09	42
Sub-total	60	1,640	74	32	1:51	454
B. Secondary School						
Sefula Secondary	16	850	24	16	1:53	n.a.

Note: * Classroom-pupil ratio will be 1:68 excluding Sefula Basic for the Blind
Source: (1) Department of Education, Namushakende
(2) Interview Survey at each Institution

Table VI.7.1 Meteorogical Data at Mongu Met. Station

	AUGUST				SEPTEMBER					OCTOBER					NOVEMBER				
	Temperature (deg. C)			rainfall		Temperature (deg. C)			rainfall		Temperature (deg. C)			rainfall		Temperature (deg. C)			rainfall
Date	Max.	Min.	G. Min.	(mm)	Date	Max.	Min.	G. Min.	(mm)	Date	Max.	Min.	G. Min.	(mm)	Date	Max.	Min.	G. Min.	(mm)
1	28.0	10.6	8.2		1	31.7	13.4	10.6		1	34.1	15.0	10.6		1	29.9	17.5	16.5	
2	26.0	10.7	8.5		2	32.8	15.6			2	35.9	14.4	14.4		2	26.9	19.2	18.5	0.1
3	28.6	11.5	8.3		3	32.6	16.4	14.4		3	35.6	20.4	17.7		3	34.0	18.3	16.7	
4	28.7	13.3	11.0		4	33.2	15.5	15.0		4	36.9	19.3	16.6		4	35.7	20.0	18.2	
5	28.0	10.5	9.0		5	32.2	14.8	12.5		5	36.2	17.5	12.0		5	35.4	21.7	19.4	
6	28.8	11.8	9.5		6	31.7	16.2	13.8		6	35.2	18.6	16.6		6	37.0	20.6	19.2	
7	29.6	12.6	10.0		7	32.5	15.9	13.4		7	35.0	12.4	16.2		7	36.5	18.7	17.9	1.2
8	30.4	13.4	11.0		8	33.5	17.0	15.0		8	35.6	17.9	15.5		8	35.4	17.7	15.4	
9	31.8	14.1	11.4		9	31.0	16.5	15.0		9	37.6	19.4	17.0		9	35.4	19.5	17.5	4.6
10	32.0	15.0	12.5		10	28.7	14.7	12.5		10	38.0	22.8	19.0		10	35.7	19.8	17.0	
11	31.9	15.0	13.1		11	29.0	13.6	12.8		11	35.1	19.2	17.2		11	36.6	20.0	17.0	0.2
12	30.6	13.0	10.4		12	32.1	11.5	7.8		12	36.2	22.5	21.7		12	35.7	22.0	19.9	1.6
13	31.9	10.0	7.3		13	34.5	9.5	9.0		13	32.6	21.4	18.2		13	35.4	18.8	17.2	
14	33.6	8.9	4.5		14	35.0	16.4	13.6		14	33.0	17.6	14.5		14	37.2	20.5	18.5	
15	32.0	12.5	9.0		15	35.7	12.2	10.5		15	31.7	18.5	17.4	0.7	15	35.5	18.5	17.0	2.3
16	32.7	12.7	8.2		16	36.3	14.0	10.5		16	32.4	15.6	14.6		16	35.0	21.0	18.1	
17	33.8	18.1	12.4		17	35.4	13.4	15.9		17	30.8	14.6	12.9		17	38.0	21.6	19.2	
18	33.7	16.8	13.2		18	36.1	18.0	17.5		18	31.7	14.7	12.5		18	26.5	22.5	20.0	
19	34.9	13.7	14.5		19	36.5	17.0	14.2		19	34.5	16.8	14.5		19	37.8	22.1	20.8	
20	34.5	15.2	13.0		20	35.4	18.5	15.5		20	36.7	20.5	16.6		20	37.0	22.2	21.6	
21	29.7	13.5	10.5		21	35.2	20.0	17.8		21	34.4	22.2	21.4		21	31.3	20.8	19.6	2.3
22	31.7	13.9	11.5		22	35.4	19.9	17.3		22	28.8	21.7	20.7		22	31.3	19.6	18.1	2.2
23	27.0	13.0	10.6		23	35.2	19.9	17.5		23	33.2	18.4	16.5		23	29.8	19.6	18.3	
24	29.0	10.2	8.8		24	36.1	19.2	15.1		24	35.8	19.9	18.0		24	36.2	16.6	15.0	1.1
25	28.3	10.5	9.0		25	36.3	18.5	15.6		25	36.3	18.2	15.8		25	31.6	21.6	19.7	
26	27.8	7.3	5.0		26	37.2	22.7	20.5		26	38.2	20.0	18.0		26	34.3	17.5	15.2	
27	29.1	11.0	7.6		27	37.1	20.3	18.0		27	38.2	21.2	18.9		27	35.0	20.2	18.5	
28	29.9	10.5	7.2		28	38.1	20.4	15.8		28	38.6	21.3	19.0		28	29.5	20.7	19.4	
29	30.1	7.7	7.5		29	37.2	19.0	15.4		29	36.0	22.8	19.5	1.4	29	30.4	19.5	18.2	5.1
30	30.0	12.0	9.2		30	33.3	16.2	16.0		30	35.0	20.0	19.4	4.6	30	28.0	19.7	19.4	37.6
31	29.6	13.4	10.6							31	32.4	17.0	16.5						
	30.5	12.3	9.7	0.0		34.2	16.5	14.4	0.0		35.0	18.8	16.8	6.7		33.8	19.9	18.2	58.3

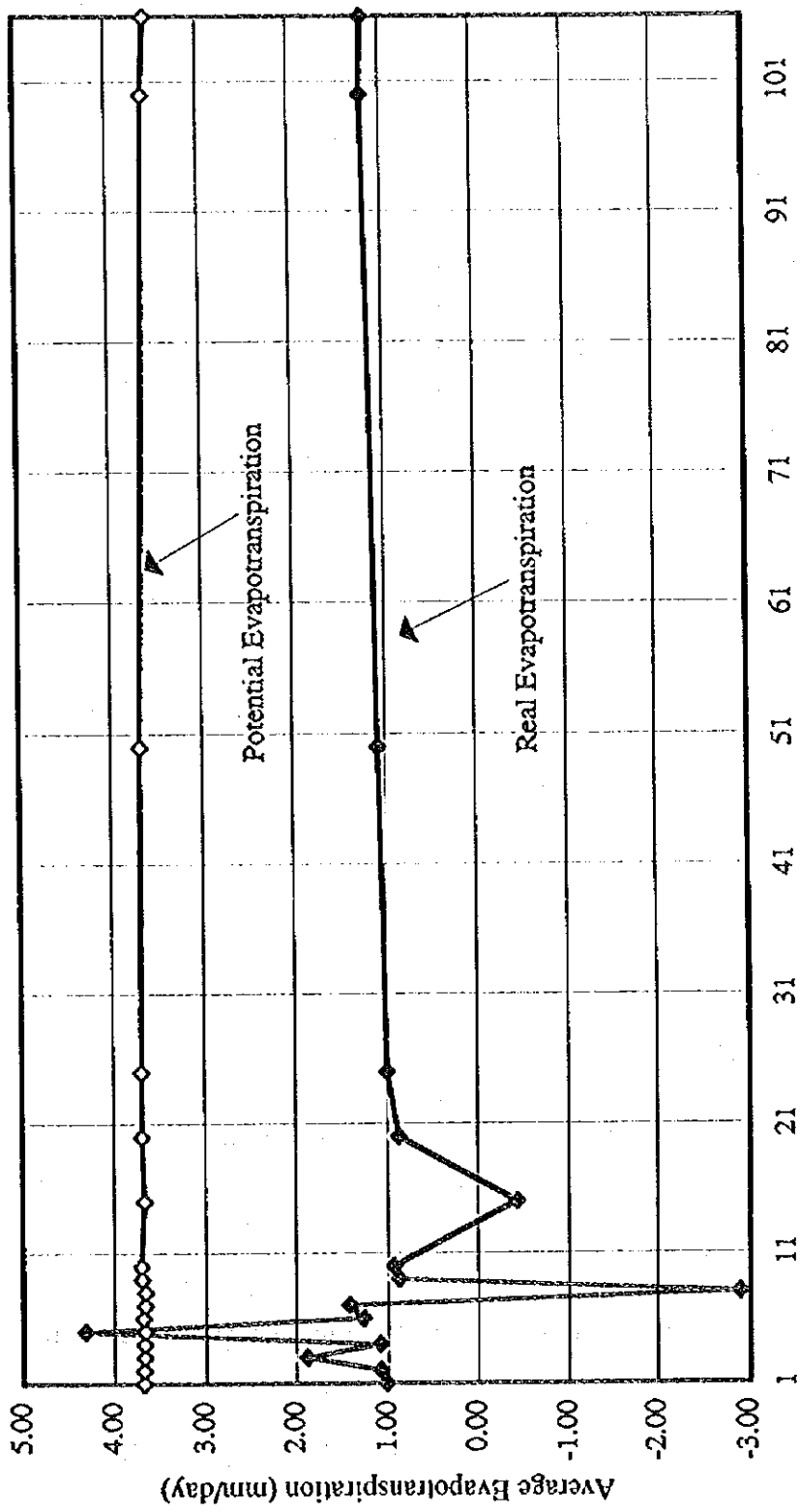


Figure VI.7.1 Evapotranspiration at Namushakende AVS Farm

Table VI.7.2 Ground Level of the Plain in the F/S Area

unit : ha

Zone	1	2	3,4	Total
Total	559	407	934	1900
Plain Area total	245	180	400	825
1010-1011	9	25	48	82
1011-1012	181	97	115	393
1012-1013	53	48	77	178
1013-1014	2	8	81	91
1014-1015	0	2	33	35
1015-1016	0	0	37	37
1016-1017	0	0	9	9

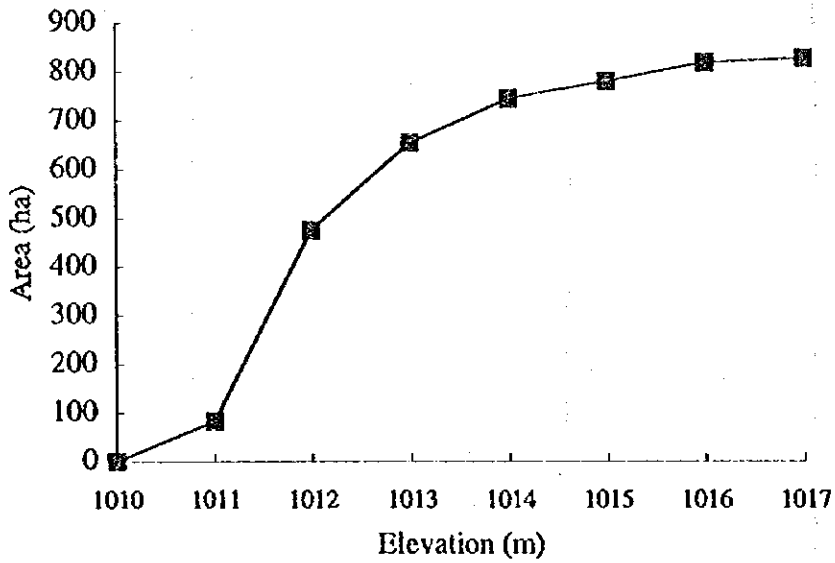


Figure VI.7.2 Relationship between Ground Elevation and Area in the Plain

Table VI.7.3 Relationship between Water Level and Flood Area (R.P. 3 years)

Period	Water Level (m)	Flood Area			
		Total ha,(%)	Zone 1 ha,(%)	Zone 2 ha,(%)	Zone 3,4 ha,(%)
Oct.1	1008.07	0 (0)	0 (0)	0 (0)	0 (0)
Oct.2	1008.06	0 (0)	0 (0)	0 (0)	0 (0)
Oct.3	1008.07	0 (0)	0 (0)	0 (0)	0 (0)
Nov.1	1008.14	0 (0)	0 (0)	0 (0)	0 (0)
Nov.2	1008.27	0 (0)	0 (0)	0 (0)	0 (0)
Nov.3	1008.46	0 (0)	0 (0)	0 (0)	0 (0)
Dec.1	1008.72	0 (0)	0 (0)	0 (0)	0 (0)
Dec.2	1009.16	0 (0)	0 (0)	0 (0)	0 (0)
Dec.3	1009.64	0 (0)	0 (0)	0 (0)	0 (0)
Jan.1	1010.14	11 (1)	1 (1)	3 (2)	7 (2)
Jan.2	1010.54	44 (5)	5 (2)	14 (8)	26 (6)
Jan.3	1010.92	75 (9)	8 (3)	23 (13)	44 (11)
Feb.1	1011.17	150 (18)	41 (17)	42 (23)	68 (17)
Feb.2	1011.56	301 (36)	110 (45)	79 (44)	112 (28)
Feb.3	1011.85	417 (51)	163 (67)	108 (60)	146 (37)
Mar.1	1012.08	490 (59)	194 (79)	126 (70)	169 (42)
Mar.2	1012.22	513 (62)	201 (82)	132 (74)	180 (45)
Mar.3	1012.36	539 (65)	209 (85)	139 (77)	191 (48)
Apr.1	1012.39	544 (66)	210 (86)	141 (78)	193 (48)
Apr.2	1012.30	528 (64)	206 (84)	136 (76)	186 (46)
Apr.3	1012.13	498 (60)	197 (80)	128 (71)	173 (43)
May.1	1011.87	426 (52)	167 (68)	110 (61)	149 (37)
May.2	1011.57	308 (37)	113 (46)	81 (45)	114 (29)
May.3	1011.20	161 (19)	45 (18)	44 (25)	71 (18)
Jun.1	1010.81	66 (8)	7 (3)	20 (11)	39 (10)
Jun.2	1010.40	33 (4)	4 (1)	10 (6)	19 (5)
Jun.3	1009.95	0 (0)	0 (0)	0 (0)	0 (0)
Jul.1	1009.54	0 (0)	0 (0)	0 (0)	0 (0)
Jul.2	1009.22	0 (0)	0 (0)	0 (0)	0 (0)
Jul.3	1008.94	0 (0)	0 (0)	0 (0)	0 (0)
Aug.1	1008.69	0 (0)	0 (0)	0 (0)	0 (0)
Aug.2	1008.56	0 (0)	0 (0)	0 (0)	0 (0)
Aug.3	1008.42	0 (0)	0 (0)	0 (0)	0 (0)
Sep.1	1008.31	0 (0)	0 (0)	0 (0)	0 (0)
Sep.2	1008.21	0 (0)	0 (0)	0 (0)	0 (0)
Sep.3	1008.12	0 (0)	0 (0)	0 (0)	0 (0)

Table VI.7.4 Relationship between Water Level and Flood Area (R.P. 5 years)

Period	Water Level (m)	Flood Area			
		Total ha,(%)	Zone 1 ha,(%)	Zone 2 ha,(%)	Zone 3 ha,(%)
Oct.1	1008.17	0 (0)	0 (0)	0 (0)	0 (0)
Oct.2	1008.16	0 (0)	0 (0)	0 (0)	0 (0)
Oct.3	1008.18	0 (0)	0 (0)	0 (0)	0 (0)
Nov.1	1008.27	0 (0)	0 (0)	0 (0)	0 (0)
Nov.2	1008.41	0 (0)	0 (0)	0 (0)	0 (0)
Nov.3	1008.64	0 (0)	0 (0)	0 (0)	0 (0)
Dec.1	1008.93	0 (0)	0 (0)	0 (0)	0 (0)
Dec.2	1009.42	0 (0)	0 (0)	0 (0)	0 (0)
Dec.3	1009.96	0 (0)	0 (0)	0 (0)	0 (0)
Jan.1	1010.52	43 (5)	5 (2)	13 (7)	25 (6)
Jan.2	1010.94	77 (9)	8 (3)	23 (13)	45 (11)
Jan.3	1011.30	201 (24)	64 (26)	54 (30)	83 (21)
Feb.1	1011.53	292 (35)	106 (43)	77 (43)	109 (27)
Feb.2	1011.90	437 (53)	173 (70)	113 (63)	152 (38)
Feb.3	1012.19	509 (62)	200 (82)	131 (73)	178 (44)
Mar.1	1012.40	545 (66)	211 (86)	141 (78)	193 (48)
Mar.2	1012.50	564 (68)	217 (88)	146 (81)	202 (50)
Mar.3	1012.64	589 (71)	224 (91)	153 (85)	212 (53)
Apr.1	1012.66	592 (72)	225 (92)	154 (85)	214 (53)
Apr.2	1012.54	571 (69)	219 (89)	148 (82)	204 (51)
Apr.3	1012.35	538 (65)	209 (85)	139 (77)	190 (48)
May.1	1012.07	488 (59)	194 (79)	126 (70)	169 (42)
May.2	1011.78	388 (47)	150 (61)	101 (56)	138 (34)
May.3	1011.44	257 (31)	89 (36)	68 (38)	99 (25)
Jun.1	1011.10	121 (15)	27 (11)	35 (19)	59 (15)
Jun.2	1010.71	58 (7)	6 (3)	18 (10)	34 (9)
Jun.3	1010.25	20 (2)	2 (1)	6 (3)	12 (3)
Jul.1	1009.81	0 (0)	0 (0)	0 (0)	0 (0)
Jul.2	1009.46	0 (0)	0 (0)	0 (0)	0 (0)
Jul.3	1009.13	0 (0)	0 (0)	0 (0)	0 (0)
Aug.1	1008.84	0 (0)	0 (0)	0 (0)	0 (0)
Aug.2	1008.71	0 (0)	0 (0)	0 (0)	0 (0)
Aug.3	1008.54	0 (0)	0 (0)	0 (0)	0 (0)
Sep.1	1008.43	0 (0)	0 (0)	0 (0)	0 (0)
Sep.2	1008.31	0 (0)	0 (0)	0 (0)	0 (0)
Sep.3	1008.22	0 (0)	0 (0)	0 (0)	0 (0)

Table VI.7.5 Relationship between Water Level and Flood Area (R.P. 10 years)

Period	Water Level (m)	Flood Area			
		Total ha,(%)	Zone 1 ha,(%)	Zone 2 ha,(%)	Zone 3 ha,(%)
Oct.1	1008.36	0 (0)	0 (0)	0 (0)	0 (0)
Oct.2	1008.35	0 (0)	0 (0)	0 (0)	0 (0)
Oct.3	1008.39	0 (0)	0 (0)	0 (0)	0 (0)
Nov.1	1008.52	0 (0)	0 (0)	0 (0)	0 (0)
Nov.2	1008.70	0 (0)	0 (0)	0 (0)	0 (0)
Nov.3	1008.99	0 (0)	0 (0)	0 (0)	0 (0)
Dec.1	1009.35	0 (0)	0 (0)	0 (0)	0 (0)
Dec.2	1009.95	0 (0)	0 (0)	0 (0)	0 (0)
Dec.3	1010.58	48 (6)	5 (2)	15 (8)	28 (7)
Jan.1	1011.27	186 (23)	57 (23)	51 (28)	79 (20)
Jan.2	1011.72	366 (44)	140 (57)	95 (53)	131 (33)
Jan.3	1012.06	486 (59)	193 (79)	125 (69)	168 (42)
Feb.1	1012.24	518 (63)	203 (83)	134 (74)	182 (45)
Feb.2	1012.59	580 (70)	221 (90)	150 (83)	208 (52)
Feb.3	1012.85	627 (76)	235 (96)	163 (91)	229 (57)
Mar.1	1013.01	654 (79)	243 (99)	170 (94)	241 (60)
Mar.2	1013.06	659 (80)	243 (99)	170 (95)	245 (61)
Mar.3	1013.19	670 (81)	243 (99)	171 (95)	255 (64)
Apr.1	1013.19	671 (81)	243 (99)	172 (95)	256 (64)
Apr.2	1013.02	654 (79)	243 (99)	170 (95)	241 (60)
Apr.3	1012.79	616 (75)	232 (95)	160 (89)	224 (56)
May.1	1012.47	558 (68)	215 (88)	144 (80)	199 (50)
May.2	1012.18	507 (62)	200 (81)	131 (73)	177 (44)
May.3	1011.92	445 (54)	176 (72)	115 (64)	154 (39)
Jun.1	1011.67	346 (42)	131 (53)	90 (50)	125 (31)
Jun.2	1011.32	208 (25)	67 (27)	56 (31)	85 (21)
Jun.3	1010.83	68 (8)	7 (3)	21 (12)	40 (10)
Jul.1	1010.34	28 (3)	3 (1)	8 (5)	16 (4)
Jul.2	1009.93	0 (0)	0 (0)	0 (0)	0 (0)
Jul.3	1009.50	0 (0)	0 (0)	0 (0)	0 (0)
Aug.1	1009.13	0 (0)	0 (0)	0 (0)	0 (0)
Aug.2	1008.99	0 (0)	0 (0)	0 (0)	0 (0)
Aug.3	1008.80	0 (0)	0 (0)	0 (0)	0 (0)
Sep.1	1008.66	0 (0)	0 (0)	0 (0)	0 (0)
Sep.2	1008.52	0 (0)	0 (0)	0 (0)	0 (0)
Sep.3	1008.42	0 (0)	0 (0)	0 (0)	0 (0)

Table VI. 7.6 Water Depth of Sefula River

Year	Water Depth (Unit : Foot) Maximum	Minimum	Base Flow	Reference
1976 / 1977	0.40	3.10	0.90	
1977 / 1978	1.00	3.75	2.20	
1978 / 1979	1.89	2.85	2.25	
1979 / 1980	0.30	1.89	0.95	
1980 / 1981	0.32	2.15	0.60	
1981 / 1982	0.33	1.35	0.61	
1982 / 1983	0.31	1.93	1.38	
1983 / 1984	0.27	1.60	0.46	
1984 / 1985	0.29	1.46	1.29	
1985 / 1986	0.33	1.50	0.80	
1986 / 1987	0.34	1.78	0.70	
1987 / 1988	0.60	2.46	1.18	
1988 / 1989	0.60	1.98	0.90	
1989 / 1990	0.31	1.32	0.66	
1990 / 1991	0.34	2.30	0.93	
1991 / 1992	0.66	3.20	1.71	

1) This is the observation data by Department of Water Affairs

Table VI.7.7 Calculation of the Discharge Corresponding to each Return Period

Return Period	Calculation of the Minimum Discharge				Calculation of the Maximum Discharge				Calculation of the Base Flow Discharge			
	Probability of Non-Exceedance				Probability of Exceedance				Probability of Exceedance			
	Water Depth			Discharge	Water Depth			Discharge	Water Depth			Discharge
	S.G. (ft.)	S.G. (ft.)	Actual (m)	(m3/s)	S.G. (ft.)	S.G. (ft.)	Actual (m)	(m3/s)	S.G. (ft.)	S.G. (ft.)	Actual (m)	(m3/s)
2	0.365	11.1	0.461	0.289	1.95	59.4	0.944	1.805	0.95	29.0	0.640	0.671
3	0.324	9.9	0.449	0.269	2.21	67.4	1.024	1.923	1.17	35.8	0.708	0.850
5	0.296	9.0	0.440	0.254	2.51	76.5	1.115	2.305	1.45	44.1	0.791	1.099
10	0.276	8.4	0.434	0.248	2.90	88.4	1.234	2.668	1.84	56.0	0.910	1.496
20					3.27	99.7	1.347	3.407				
30					3.48	106.1	1.411	3.748				
50					3.76	114.6	1.496	4.251				

1) S.G : Stuff Gauge

2) Discharge was estimated by using Manning formula based on the measuring of cross section, river bed slope, and coefficient of roughness

VI.9 Farming and Crop Husbandry

VI.9.1 Farming Practice under "Present Condition"

(1) Crops

1) Rice Cropping under Rainfed

a. Yield level: 1.08 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	60 kg		
Jute bag	14 bags		
Farm Operation	Man/Day	Hired	
Oxen Plowing		8	
Sowing (broadcasting)	2		
Weeding (2 times)	20		
Birdscaring	3		
Harvesting	28		
Threshing & Winnowing	16		
Sacking & Storing	2		
Total	71		

2) Maize (Mazulu Garden)

a. Yield level: 0.68 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Kraal manure	10,000 kg		
Seeds	40 kg		
Jute bag	25 bags		
Farm Operation	Man/Day	Hired	
Oxen Plowing		8	
Sowing (Spot)	5		
Weeding (2 times)	20		
Harvesting	10		
Shelling & Winnowing	12		
Sacking & Storing	5		
Total	52		

3) Cassava

a. Yield level: 0.36 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Cuttings	12,000 kg		
Jute bag	8 bags		
Farm Operation	Man/Day	Hired	
Bush cleaning	30		
Land preparation (Man power)	10		
Planting	33		
Weeding (first)	10		
Pruning	10		
Weeding (2nd)	10		
Earthing up	5		
Weeding (third)	10		
Harvesting	50		
Processing	25		
Transport	10		
Total	203		

4) Sorghum (Mazulu Garden)

a. Yield level: 0.64 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	7-10 kg		
Jute bag	7 bags		
Farm Operation	Man/Day	Hired	
Plowing		8	
Sowing (spot)	3		
Weeding (2 times)	20		
Birdscaring	60		
Harvesting	4		
Threshing & Winnowing	4		
Sacking & Storing	1		
Total	94		

5) Sorghum (Dry Litongo Garden)

a. Yield level: 0.64 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	7-10 kg		
Jute bag	7 bags		
Farm Operation	Man/Day	Hired	
Hoeing	10		
Sowing (spot)	5		
Weeding (2 times)	20		
Birdscaring	60		
Harvesting	4		
Threshing & Winnowing	4		
Sacking & Storing	1		
Total	104		

6) Pearl Millet (Dry Litongo Garden)

a. Yield level: 0.64 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	8.0 kg		
Jute bag	7 bags		
Farm Operation	Man/Day	Hired	
Hoeing	10		
Sowing (spot)	6		
Weeding (2 times)	20		
Birdscaring	50		
Harvesting	4		
Threshing & Winnowing	4		
Sacking & Storing	1		
Total	95		

(2) Tree Crops

1) Management of Mango orchard (15 years tree)

a. Yield level: 0.23 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Jute bag	200 bags		
Farm Operation	Man/Day	Hired	
Harvesting	32		
Total	32		

2) Orange Orchard (Management of the existing trees: 6-8 years)

a. Yield level: 0.015 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Harvesting bag bag	105 bags		
Farm Operation	Man/Day	Hired	
Weeding	17		
Harvesting	14		
Total	31		

3) Guava (Management of Existing trees)

a. Yield level: 0.008 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Jute bag	26 bags		
Farm Operation	Man/Day	Hired	
Cutting grass under trees	6		
Harvesting	2		
Total	8		

VI.9.2 Farming Practice under "Without Project"

(1) Crops

1) Rice Cropping under Rainfed

a. Target yield: 1.19 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	80-120 kg		
Jute bag	15 bags		
Farm Operation	Man/Day	Hired	
Oxen Plowing (cross-plowing)		8	
Broadcasting	2		
Weeding (2 times)	20		
Birdscaring	3		
Harvesting	28		
Threshing & Winnowing	16		
Sacking & Storing	2		
Total	71		

(Yield slightly increases by improving sowig depth and weeding practice)

2) Maize (Mazulu garden)

a. Target yield: 0.75 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	20-30 kg		
Manure	10,000 kg		
Jute bag	9 bags		
Farm Operation	Man/Day	Hired	
Kraaling (Once per every 3 years to drop manure)			
Oxen Plowing (cross-plowing)		8	
Sowing (Line)	5		
Weeding (2 times)	25		
Harvesting	10		
Shelling & Winnowing	12		
Sacking & Storing	5		
Total	57		

(Yield slightly increases by improving sowig depth and manure application)

3) Cassava

a. Target yield: 0.4 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Cuttings	13,000 kg		
Jute bag	8 bags		
Farm Operation	**Man/Day**	**Hired**	
Bush cleaning	30		
Land preparation (Man power)	10		
Planting	35		
Weeding (first)	10		
Pruning	10		
Wedding (2nd)	10		
Inter-cultivation	5		
Weeding (3rd)	10		
Harvesting	50		
Processing	25		
Transport	10		
Total	205		

(Yield slightly increases by improving the plant density)

4) Sorghum (Mazulu Garden)

a. Target yield: 0.7 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	7-10 kg		
Jute bag	7 bags		
Manure	10,000 kg		
Farm Operation	**Man/Day**	**Hired**	
Manuring (Kraaling on every 3 years to drop manure)			
Oxen Plowing (cross-plowing)		8	
Sowing (spot)	5		
Weeding (2 times)	20		
Birdscaring	60		
Harvesting	4		
Threshing & Winnowing	4		
Sacking & Storing	1		
Total	94		

(Yield slightly increases by improving sowing depth and plant density with application of manure)

5) Sorghum (Dry Litongo Garden)

a. Target yield: 0.7 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	10-15 kg		
Jute bag	8 bags		
Farm Operation	**Man/Day**	**Hired**	
Sowing (spot)	5		
Weeding (2 times)	20		
Birdscaring	60		
Harvesting	4		
Threshing & Winnowing	4		
Sacking & Storing	1		
Total	94		

(The yield increases by improving a planting density)

6) Pearl Millet (Dry Litongo Garden)

a. Target yield: 0.68 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	8.0 kg		
Jute bag	8 bags		
Farm Operation	**Man/Day**	**Hired**	
Hoeing	10		
Sowing (spot)	3		
Weeding (2 times)	20		
Birdscaring	50		
Harvesting	4		
Threshing & Winnowing	4		
Sacking & Storing	1		
Total	92		

(Building soil fertility should be done via intercropping with leguminous crops)

(2) Tree Crops

Under "Without Project" condition, only the existing tree crops are managed as usual.

1) Management of Mango orchard (15 years tree)

a. Target yield: 0.25 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Jute bags	219 bags		
Farm Operation	Man/Day	Hired	
Harvesting	35		
Total	35		

2) Orange Orchard (Management of the existing trees: 6-8 years)

a. Target yield: 0.017 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Jute bag	120 bags		
Farm Operation	Man/Day	Hired	
Weeding	17		
Harvesting	16		
Total	33		

3) Guava (Management of Existing trees)

a. Target yield level: 0.012 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Jute bag	39 bags		
Farm Operation	Man/Day	Hired	
Cutting grass under trees	20		
Harvesting	8		
Total	28		

VI.9.3 Farming Practice under "With Project"

(1) Crops

1) Rice Cropping in the Dry Season with irrigation

a. Target yield: 4.5 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	250 kg		
Urea	100 kg		
Seeds	60 kg		
Jute bag	57 bags		
Farm Operation	**Man/Day**	**Hired**	
Oxen Plowing (cross-plowing)		8	
Oxen Harrowing		3	
Sowing (Line sowing)	2		
Basal Dressing	15		
Weeding (2 times)	30		
Top dressing 1	4		
Top dressing 2	4		
Water management	7		
Birdscaring	120		
Harvesting	30		
Transportation	5		
Threshing & Winnowing	30		
Sacking & Storing	4		
Total	251		

2) Rice Cropping in the Wet Season with supplemental irrigation

a. Target yield: 4.0 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	250 kg		
Urea	100 kg		
Seeds	60 kg		
Jute bag	50 bags		
Farm Operation	Man/Day	Hired	
Nursery Management	10		
Oxen Plowing		8	
Oxen Harrowing (Puddling)		4	
Basal Dressing	6		
Uprooting Seedlings & Transplanting	70		
Weeding (2 times)	20		
Top dressing 1	4		
Top dressing 2	4		
Water management	7		
Birdscaring	100		
Harvesting	30		
Threshing & Winnowing	30		
Sacking & Storing	6		
Total	287		

3) Rice Cropping under Rainfed

a. Target yield: 3.5 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	200 kg		
Urea	100 kg		
Seeds	60 kg		
Jute bag	44 bags		
Farm Operation	Man/Day	Hired	
Oxen Plowing		8	
Oxen Harrowing		4	
Sowing (Line)	2		
Basal Dressing	6		
Weeding (2 times)	20		
Top dressing 1	4		
Top dressing 2	4		
Birdscaring	100		
Harvesting	23		
Threshing & Winnowing	30		
Sacking & Storing	6		
Total	195		

4) Maize (Mazulu Gargen)

a. Target yield: 2.5 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	200 kg		
Urea	160 kg		
Seeds	40 kg		
Jute bag	25 bags		
Farm Operation	Man/Day	Hired	
Oxen Plowing		8	
Oxen Harrowing		4	
Sowing (Line)	3		
Basal Dressing	6		
Weeding (2 times)	35		
Top dressing 1	4		
Harvesting	15		
Shelling & Winnowing	15		
Sacking & Storing	5		
Total	83		

5) Maize (Sitapa/Bucket Irrigation)

a. Target yield: 2.5 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	200 kg		
Urea	160 kg		
Seeds	40 kg		
Jute bag	25 bags		
Farm Operation	Man/Day	Hired	
Oxen Plowing		8	
Oxen Harrowing		3	
Sowing (Line)	3		
Basal Dressing	6		
Bucket irrigation (4 times)	120		
Weeding (2 times)	35		
Top dressing 1	4		
Harvesting	15		
Shelling & Winnowing	15		
Sacking & Storing	5		
Total	203		

6) Cassava

a. Target yield: 1.5 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Cutings	13,000 kg		
Manure	10,000 kg		
Jute bag	20 bags		
Farm Operation	Man/Day	Hired	
Bush cleaning	30		
Manuring (Manured via kraaling on every 3 years)			
Land Preparation (Man power)	10		
Planting	35		
Weeding	40		
Pruning	10		
Harvesting	50		
Processing	25		
Transport	10		
Total	210		

7) Sorghum (Mazulu Garden)

a. Target yield: 1.0 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	10-15 kg		
Manure	10,000 kg		
Jute bag	11 bags		
Farm Operation	Man/Day	Hired	
Manuring (Manured via kraaling on every 3 years)			
Oxen Plowing		8	
Harrowing		3	
Sowing (Line)	3		
Weeding (2 times)	20		
Birdscaring	60		
Harvesting	6		
Threshing & Winnowing	15		
Sacking & Storing	2		
Total	106		

8) Sorghum (Dry Litongo Garden)

a. Target yield: 1.0 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	10-15 kg		
Manure	10,000 kg		
Jute bag	11 bags		
Farm Operation	Man/Day	Hired	
Manuring (Manured via kraaling on every 3 years)			
Hoeing	10		
Sowing (Line)	3		
Weeding (2 times)	20		
Birdscaring	60		
Harvesting	6		
Threshing & Winnowing	15		
Sacking & Storing	2		
Total	113		

9) Pearl Millet (Dry Litongo Garden)

a. Target yield: 1.0 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	8.0 kg		
Manure	10,000 kg		
Jute bag	11 bags		
Farm Operation	**Man/Day**	**Hired**	
Manuring (Manured via kraaling on every 3 years)			
Hoeing	10		
Sowing (Line seeder)	3		
Weeding (2 times)	20		
Birdscaring	50		
Harvesting	4		
Threshing & Winnowing	10		
Sacking & Storing	2		
Total	103		

10) Bulb Onion

a. Target yield: 20 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	6.0 kg		
D'mix	525 kg		
Urea	100 kg		
Chemicals	2.0 kg	(Dithane M45 : 80 % WP)	
Manure	5,000 kg		
Jute bag	223 bags		
Farm Operation	**Man/Day**	**Hired**	
Nursery Preparation	20		
Seeding	6		
Nursery bed management	20		
Hoeing Main field	50		
Harrowing and Leveling	10		
Ridging	34		
Transplanting/Basal dressing including manure	50		
Bucket irrigation	200		
Weeding (4 times)	80		
Topdressing	5		
Chemical spray (2 times)	20		
Harvesting	50		
Transport	15		
Total	560		

11) Cabbage

a. Target yield: 25 t/ha

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seeds	0.6 kg		
D'mix	500 kg		
Urea	200 kg		
Chemicals	3.0 kg	(Malathion 25 % powder)	
Manure	5,000 kg		
Jute bag	500 bags		
Farm Operation	**Man/Day**	**Hired**	
Nursery Preparation	15		
Seeding	6		
Nursery bed management	20		
Hoeing Main field	50		
Leveling & making planting hole	10		
Transplanting/Basal dressing including manure	50		
Bucket irrigation	200		
Weeding (2 times)	45		
Topdressing	5		
Chemical spray (2 times)	20		
Harvesting	20		
Transport	8		
Total	519		

(2) Tree Crops

Basically a policy of the tree crop development is finalized that orange and guava tees are established by planting seedlings with existing trees, and mango is confined to management of the existing trees only.

1) Management of Mango orchard

a. Target yield: 0.29 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	249 kg/ha	(1.5 kg x 2 times/tree)	
Jute bag	270 bags		
Farm Operation	**Man/Day**	**Hired**	
Cutting grasses under trees	6		
Fertilization	10	(2 times/year: onset and end of rainy season)	
Harvesting	40		
Total	56		

2) Orange (Newly established orchard)

a. Target yield: No yield up to 5 years from planting

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seedlings No.	625 ha		
D'mix	175 kg/ha	(280 g/tree)	
Urea	76 kg/ha	(120 g/tree)	
Manure	3,125 kg	(5 kg/tree)	
Chemicals	10 liters	(Malathion 50 % EC)	
Supporting Pole	625/ha		
Manual sprayer	1		
Farm Operation	**Man/Day**	**Hired**	
Land clearing	10		
Holing & applying fertilizer	15		
Filling hole	15		
Planting	15		
Bucket watering	180		
Weeding	40		
Chemical spraying	9		
Total	284		

3) Orange Orchard (Management of the existing trees: 6-8 years)

a. Target yield: 0.04 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	125 kg/ha	(200 g/tree)	
Urea	300 kg/ha	(480 g/tree)	
Chemicals	12.5 liters	(Malathion 50 % EC)	
Harvesting bag	280 bags		
Farm Operation	**Man/Day**	**Hired**	
Weeding	40		
Fertilization	9		
Chemical spraying	9		
Harvesting	100		
Total	158		

4) Guava (Newly established orchard)

a. Target yield: No yield up to 5 years from planting

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
Seedlings No.	278 ha		
D'mix	112 kg/ha	(400 g/tree)	
Manure	1,390 kg	(5 kg/tree)	
Supporting Pole	278/ha		
Farm Operation	**Man/Day**	**Hired**	
Land clearing	18		
Stumping	18		
Leveling & Marking	20		
Holing & applying fertilizer	8		
Filling hole	64		
Planting	8		
Bucket watering	80		
Weeding	24		
Total	234		

5) Guava (Management of Existing tres)

a. Target yield: 0.025 t/tree

b. Amount of the Input and Farm Operation

Materials	Amount/ha	Unit Price	Total Price
D'mix	556 kg/ha	(1 kg x 2 times/year/tree)	
Jute bag	80 bags		
Farm Operation	Man/Day	Hired	
Cutting grasses under trees	20		
Fertilization	20		
Harvesting	12		
Total	52		

VI.9.4 Labour Forces

(1) No. of FHHs and Available Labor Forces/each Formulated Cropping Pattern based on the related Zone

Cropping Patten		Type-I		Type-II	Type-III	Total
Zone No.		3	4	1	2	
No. of FHHs	FHH	33	38	30	32	133
	MHH	55	52	42	51	200
Total		178		72	83	333
Available LF		605.2		244.8	282.2	1132.2
Workable Days/Y		176,718(MD)		71,481(MD)	82,402(MD)	330,601(MD)

Note: Mean available self-labor forces/FHH are calculated as 3.4. Furthermore, available workable days/year are calculated as 80 % of 365 days.
FHHs: Farm Household, FHH: Female Headed Household, LF: Labor Forces, Y: Year, MD: Man Day

(2) Mean Cultivated Area/FHH for the Formulated Cropping Pattern and Required Labor Forces

Cropping Pattern		Type - I		Type - II		Type - III	
Formulated C/Area		512 ha		141 ha		150 ha	
Farm Land (ha)		399 ha		170 ha		178 ha	
Crop Intensity (%)		128.3 %		82.9 %		84.3 %	
[Garden type & Crop]		C/Area (ha)	Required/L (MD/FHH)	C/Area (ha)	Required/L (MD/FHH)	C/Area (ha)	Required/L (MD/FHH)
MAZ	Maize	0.045	3.7	0.056	4.6	0.048	4.0
SIT	Maize	0.28	23.2	0.35	71.3	0.30	24.9
SIT	Rice (Dry/Irri.)	0.56	140.6	-	-	-	-
	Rice (Rain/Sup.)	1.12	321.4	-	-	-	-
	Rice (Rainfed)	-	-	0.56	109.2	0.60	117.0
MAT	Cassava	0.73	153.3	0.76	159.6	0.66	138.6
W/LIT	Onion	0.017	9.5	0.056	31.4	0.036	20.2
W/LIT	Cabbage	0.017	9.5	0.056	29.1	0.036	18.7
W/LIT Fruits (ha/FHH)		0.10		0.125		0.12	
1) Existing Tree							
* Mango (No/FHH)		7.4	2.8	7.4	2.8	7.4	2.8
* Guava (")		0.6	0.1	0.6	0.1	0.6	0.1
* Orange (")		0.6	0.15	0.6	0.15	0.6	0.15
2) Newly Planted							
* Guava (No/FHH)		5.4	3.1	5.4	3.1	5.4	3.1
* ORANGE (")		5.4	2.1	5.4	2.1	5.4	2.1
Total (ha/FHH)		2.87 ha	669.5	1.96 ha	413.5	1.8 ha	331.7

Note: Mean working hours/day in Zambia is employed as 7 hours based on the "Resource Guide Data in Agriculture/Zambia, 1977".
Required/L: Required Labor, C/Area: Cropping Area, FHH: Farm Household, MD: Man Day

(3) The difference between the required labor forces/every 10 days/farm household in the formulated cropping pattern and the available self-labor forces/farm household.

M	No. of	Type - I		Type - II		Type - III	
	10 days	Labors/10d	Self-L	Labors/10d	Self-L	Labors/10d	Self-L
1	1	-	27.2	-	27.2	-	27.2
	2	45.9	27.2	-	27.2	-	27.2
	3	43.1	27.2	2.2	27.2	2.4	27.2
2	1	18.8	27.2	9.0	27.2	9.4	27.2
	2	3.2	27.2	3.4	27.2	3.4	27.2
	3	18.2	27.2	8.8	27.2	7.9	27.2
3	1	4.9	27.2	9.5	27.2	7.5	27.2
	2	0.2	27.2	0.62	27.2	0.38	27.2
	3	0.27	27.2	0.84	27.2	0.9	27.2
4	1	0.27	27.2	1.6	27.2	0.18	27.2
	2	22.2	27.2	26.7	27.2	26.0	27.2
	3	13.7	27.2	31.9	27.2	29.7	27.2
5	1	36.2	27.2	32.6	27.2	28.0	27.2
	2	30.5	27.2	17.1	27.2	15.1	27.2
	3	31.5	27.2	27.2	27.2	12.8	27.2
6	1	20.9	27.2	17.1	27.2	22.7	27.2
	2	33.9	27.2	3.0	27.2	4.8	27.2
	3	24.9	27.2	27.2	27.2	14.7	27.2
7	1	7.6	27.2	10.6	27.2	13.4	27.2
	2	16.6	27.2	20.8	27.2	16.5	27.2
	3	25.9	27.2	9.3	27.2	18.4	27.2
8	1	22.0	27.2	9.3	27.2	12.9	27.2
	2	17.5	27.2	17.3	27.2	13.0	27.2
	3	22.9	27.2	20.9	27.2	6.1	27.2
9	1	24.8	27.2	19.7	27.2	7.5	27.2
	2	16.8	27.2	15.5	27.2	1.8	27.2
	3	9.8	27.2	17.6	27.2	7.1	27.2
10	1	8.4	27.2	10.5	27.2	0.54	27.2
	2	6.0	27.2	1.4	27.2	1.2	27.2
	3	-	27.2	6.3	27.2	5.3	27.2
11	1	0.1	27.2	10.3	27.2	8.9	27.2
	2	19.1	27.2	0.34	27.2	0.3	27.2
	3	17.6	27.2	10.5	27.2	11.0	27.2
12	1	25.4	27.2	12.0	27.2	12.8	27.2
	2	28.4	27.2	5.6	27.2	6.0	27.2
	3	35.8	27.2	3.2	27.2	3.2	27.2
	Total	669.5	979.2	412.9	979.2	331.7	979.2
Total Labor Requirement/ Year		103,251 MD/Year		20,173 MD/Year		21,244 MD/Year	

Note: Available self-labor forces/every 10 days is calculated based on the following formula:
3.4 persons/FHH x 10 days x 80% = 27.2 Man Day
M: Month, Self-L: Self Labor, 10d: 10 days, MD: Man Day

VI.12 Agro-Processing

Table VI.12.I Required Number of Equipment for the F/S Area

Equipment Name	Description (t/day)		Season	Working Day (day)	Target Area (ha)	Target Yield (t/ha)	Target Prod'n (ton)	Req. Q'ty
(1) HARVESTING								
1) For Paady Rice								
a-1. Sickle	Blade length: 20cm	0.2	D	20	100	4.5	450	113
(Local made)	Approx. 5 t/164hr x 7hr		W	30	200	4.0	800	133
			Rainfed	35	90	3.5	315	45
a-2. Thresher	Manual, 100kg/hr	0.7	D	20	100	4.5	450	32
	100/1000 x 7hr=0.7 t/day		W	30	200	4.0	800	38
			Rainfed	35	90	3.5	315	13
a-3. Winnower	Manual, 100 kg/hr	0.7	D	20	100	4.5	450	32
	100/1000 x 7hr=0.7 t/day		W	30	200	4.0	800	38
			Rainfed	35	90	3.5	315	13
b-1. Reaper	Gasoline Engine,20 a/hr	1.4	D	20	100	4.5	450	16
	20 x 1 t/100a x 7hr=1.4 t/day		W	30	200	4.0	800	19
			Rainfed	35	90	3.5	315	6
b-2. Thresher	Motor driven (0.75kw)	4.2	D	20	100	4.5	450	5
	600 kg/hr		W	30	200	4.0	800	6
	600/1000 x 7hr=4.2 t/day		Rainfed	35	90	3.5	315	2
b-3. Winnower	Motor driven (100w),	2.1	D	20	100	4.5	450	11
	300 kg/hr		W	30	200	4.0	800	13
	300/1000 x 7hr=2.1 t/day		Rainfed	35	90	3.5	315	4
c-1. Generator	Diesel, 3KVA		D					3
	w/one cord reel		W					6
	(operable 1 thresher and		Rainfed					2
	2 or 3 winnowers)							
2) For Maize								
a-1. Corn Sheller	Manual, 100 kg/hr	0.7	D	30	100	2.0	200	10
	100/1000 x 7hr=0.7 t/day		W	60	16	2.5	40	1
a-2. Corn Sheller	Motor driven (0.75kw)	5.6	D	30	100	2.0	200	1
	1.0 t/hr, Efficiency 80%		W	60	16	2.5	40	1
	1.0 x 7hr x 0.8=5.6 t/day							
(2) PROCESSING								
1) Rice Mill	Onepass type, 0.5 t/hr	2.1	D	90	100	4.5	450	2
	Motor driven (22kw)		W	90	200	4.0	800	4
	Efficiency: 60%		Rainfed	90	90	3.5	315	2
	0.5 x 7hr x 0.6=2.1 t/day							
2) Hammer Mill								
a-1. Manual Mill	Manual, 16 kg/hr	0.08	D	90	100	2.0	200	29
(British made)	16/1000 x 7hr=0.1 t/day		W	90	16	2.5	40	6
a-2. Motor driven	Hammer mill type,	1.26	D	90	100	2.0	200	2
(Local made)	0.3 t/hr. Motor driven (15kw)		W	90	16	2.5	40	1
	Efficiency: 60%							
	0.3 x 7hr x 0.6=1.26 t/day							
(3) TRANSPORTATION								
a-1. Tiller	Diesel engine, 8 ps	3.5	D	35	100	4.5	450	4
w/0.5 ton trailer			W	30	200	4.0	800	8
	0.5 x 1 time/hr x 7hr		Rainfed	35	90	3.5	315	3
	=3.5 t/day							
a-2. Rear Cart	Loading size: 3m x 1.5m		1 ha=17000 bandles; 5ha=85000 bandles					10
	one bandle=0.1m x 0.1m x 0.8m (length)=0.008m^3 85000 x 0.008=680 m^3(5ha)							
	680 m^3/1.5m (height)=453.3 m^2 453.3m^2/(3m x 1.5 m)=100.7 times							
	100.7 (times)/5 (ties/days)=10 (units)							

Note: (1) Target such as area, yield and production will be referred to the Section 6.9 Plan of Farming and Crop Husbandry in the Main Report.

Table VI.12.2 Proposed Number & Selection Method

Equipment Name	Description	Highest Production Seaspm	Operation Capacity (t/day)	Operation Day (day)	Operation Production (ton)	Pro Req. Q'ty	Capable Volume (ton)
(1) HARVESTING							
1) For Paady Rice							
1. Sickle (Local made)	5t/164hr x 7hr, manual	W	0.2	30	800	150	900
2. Thresher	100 kg/hr, manual	W	0.7	30	800	10	210
3. Thresher	600 kg/hr, Motor 0.75kw	W	4.2	30	800	4	504
4. Winnower	300 kg/hr, Motor 100w	W	2.1	30	800	14	882
2) For Maize							
1. Corn Sheller	100 kw/hr, manual	D	0.7	30	200	4	84
2. Corn Sheller	1.0 t/hr, Motor 0.75kw	D	5.6	30	200	2	336
(2) PROCESSING							
1) Rice Mill	0.5 t/hr, Motor 22kw	W	2.1	90	800	4	800
2) Hammer Mill							
1. Manual Mill (British made)	15.75 kg/hr		0.08	(for model)		6	
2. Motor driven (Local made)	0.3 t/hr, motor 15kw		1.26	(for home consumption for one site only)		1	
(3) TRANSPORTATION							
1. Rear Cart	Loading size; 3m x 1.5m						

Note: (1) For paddy rice, wet season will be chosen for necessity of the highest quantity of the equipment.
(2) Manual harvesting will be selected, because engine equipment has some difficulties such as supplies of fuel and spare parts.
(3) In case that the field is wet, threshing and winnowing cannot be done on the field. Straw with rice should be transported in the dry land. So, motor driven threshing and winnowing will be selected. Manual type equipment will be used for only one third of the harvested rice.
(4) Some manual corn shellers will be introduced for easy access on small volume of raw material.
(5) Manual type hammer mill will be for model and training, and motor driven type will be for home consumption.
(6) Figures are referred to the ANNEX Table VI.12.1.

Table VI.12.3 Size of Proposed Buildings

Facilities	Sefula Facilities	Namaenya Facilities
1. Inspection, Office, Post-Harvest Machine Building	66 m^2 (6 x 11 m)	66 m^2 (6 x 11 m)
1) Inspection Room, Office Room	(6 x 5 m)	(6 x 5 m)
2) Paddy Post-Harvest Machine Store	(3 x 3 m)	(3 x 3 m)
3) Maize Post-Harvest Machine Store	(3 x 3 m)	(3 x 3 m)
4) Tools Room	(3 x 6 m)	(3 x 6 m)
2. Milling Machine Building	40 m^2 (8 x 5 m)	60 m^2 (12 x 5 m)
1) Rice Mill Room	(8 x 5 m)	(8 x 5 m)
2) Maize Mill Room	-	(4 x 5 m)
3. Warehouse	120 m^2 (15 x 8 m)	120 m^2 (15 x 8 m)
1) Raw Product, 30 ton holding	(10 x 8 m)	(10 x 8 m)
2) Produce, 15 ton holding	(5 x 8 m)	(5 x 8 m)
4. Drying Yard	2009 m^2 (49 x 41 m)	2009 m^2 (49 x 41 m)
1) Drying Yard	(44 x 36 m)	(44 x 36 m)
Grain Shed	(44 x 5 m)	(44 x 5 m)
2) Winnowing and Threshing Shed	(36 x 5 m)	(36 x 5 m)
5. Market House	-	40m^2
6. Guard House	6 m^2 (3 x 2 m)	6 m^2 (3 x 2 m)
Total: 6 facilities	2,241 m^2	2,301 m^2
Required Site Area	3,927 m^2 (77 x 51 m)	3.927 m^2 (77 x 51 m)

Note: (1) Ware House Size: Calculation formula
1) 2.1 t/day x 2 units/0.65 (recovery)/0.58 (specific gravity)=11.1 ton/day
11.1 ton/day x 7 days (one week)=78 ton (paddy)
78,000 kg/80 kg/8 stages=122 bags
122 bags x 0.5 m^2=61 m^2
61 m^2 x 1.3 (30% allowance)=80 m^2
Size (Raw Product): 10m width, 8m length, 8 stages
2) 2.1 t/day x 2 units x 7 days (one week)=30 ton (white rice)
30,000kg/80kg(bag)/8 stages=47 bags
One bag = 1.0m x 0.5m =0.5 m^2
47 (bags) x 0.5 m^2 = 23.4 m^2
23.4 m^2x 1.7 (70% allowance) = 40 m^2
Size (Produce): 5m width, 8m length, 8 stages

(2) Drying Yard Size: Calculation formula
1) 100ha (dry season)/20 days(harvesting days)=5 ha/day
5ha/day x 4.5t/ha (yield) = 22.5 t/day (14% moisture content dried paddy)
22.5 t/day x (1-0.14)/(1-0.2)=24.2 t/day (20% moisture content paddy)
41.7 m^3/day/0.1 (spreaded paddy height)=417 m^2/day
41.7m x 10m x 3 days (darying days)=(44-2 m) x (12-2 m)x 3=(44-2 m) x (36-6m)
Size: 44m width, 36, length, 10cm spreaded paddy height 3 days drying

Table VI.12.4 Proposed Number of Equipments (1/3)

EQUIPMENT NAME	DESCRIPTION	QUANTITY		TOTAL
		Sefula	Namaenya	QUANTITY
(1) AGRICULTURAL MACHINE				
1) Drill Seader	Manual, For rice & maize 10 a/hr, =0.7 ha/day	5	5	10
2) Knapsack Sprayer	Manual, 18 litre Plastic tank	3	3	6
Total (AGRICULTURAL MACHINE):		8	8	16
(2) HARVESTING MACHINE				
1) For Paddy Rice				
-1. Sickle	Blade length: 20cm Approx. 1 t/10 pcs/day	75	75	150
-2. Thresher	Manual, 100 kg/hr 100/1000 x 7 hr= 0.7 t/day	5	5	10
-3. Thresher	Motor Driven (0.75k2), 600kg/hr 600/1000 x 7hr=4.2 t/day	2	2	4
-4. Winnower	Motor driven (100w), 300 kg/hr 300 /1000 x 7 hr= 2.1 t/day	7	7	14
Sub-total (For Paddy Rice):		89	89	178
2) For Maize				
-1. Corn Sheller	Manual, 100 kg/hr 100/1000 x 7 hr=0.7 t/day	2	2	4
-2. Corn Sheller	Motor driven (0.75kw), 1.0 t/hr Efficiency 80% 1.0 x 7 hr x 0.8=5.6 t/day	1	1	2
Sub-total (For Maize):		3	3	6
Total (HARVESTING MACHINE):		92	92	184
(3) PROCESSING MACHINE				
1) Rice Milling Machine	Onepass Type, 0.5 t/hr Motor driven (22 kw), Efficiency 60% 0.5 x 7 x 0.6=2.1 t/day	2	2	4
2) Maize Milling Machine				
-1. Manual Mill (British made)	Manual, 16 kg/hr 16/1000 x 7 hr=0.1 t/day	3	3	6
-2. Hammer I Mill (Local made)	Hammer Mill Type, 0.3 t/hr Motor driven (15kw), Efficiency 60% 0.3 x 7 hr x 0.6=1.3 t/day	0	1	1
Total (PROCESSING MACHINE):		5	6	11
(4) TRANSPORTATION EQUIPMENT				
1) Rear Cart	Loading size, 3m x 1.5m	10	10	20
2) Carrier (Local made)	Manual, one wheel type Loading pan: Approx. 900mm x 600mm	5	5	10
Total (TRANSPORTATION EUIPMENT):		15	15	30
(5) ACCESSORIES & MAINTENANCE TOOLS				
1) Maintenance Tools				
1. Open End Wrench	6 pcs/set	1	1	2

Table VI.12.4 Proposed Number of Equipments (2/3)

EQUIPMENT NAME	DESCRIPTION	QUANTITY		TOTAL QUANTITY
		Sefula	Namaenya	
2. Gear Puller	Max. spread: 206.7mm	1	1	2
3. Tinner Scissors	Cut 1.2mm, Right curve	1	1	2
4. Tinner Scissors	Cut 1.2mm, Straight	1	1	2
5. Screw Plate Set		1	1	2
6. Offset Wrench	6 pcs/set	1	1	2
7. Adjustable Wrench	250mm	1	1	2
8. Combination Plier	150mm	1	1	2
9. Ball Peen Hammer	450g	1	1	2
10. Copper Hammer	450g	1	1	2
11. Wooden Mallet	45mm Head Dia	1	1	2
12. Chisel & Punch	6 pcs/set	1	1	2
13. Torque Wrench	15 -120 kgf.cm	1	1	2
14. Socket Wrench	mm size, 11 sockets/set	1	1	2
15. Hexagon Wrench	6 pcs/set	1	1	2
16. Abrasive Paper	Cloth, #80, #120; each 10 pcs/s	1	1	2
17. Wire Brush	245mm, 3-row, brass	2	2	4
18. Tool Cabinet	680 x 335 x 380mm	1	1	2
Sub-Total (Maintenance Tools):		19	19	38
2) Electric Tools				
1. Radio Pench	150mm	1	1	2
2. Side Cutting Plier	200mm	1	1	2
3. Cutting Nipper	150mm	1	1	2
4. Screw Driver (-)	75mm, 100mm & 150mm; 3 pcs/set	1	1	2
5. Screw Driver (+)	75mm, 100mm & 150mm; 3 pcs/set	1	1	2
6. Vinyl Tape	15mmW, 10m	5	5	10
7. Soldering Iron	80w, 8 x 95mm, 300mm	1	1	2
8. Solder	Thread type, 1.0 kg/roll	1	1	2
Sub-Total (Maintenance Tools):		12	12	24
3) Guage & Measuring Tools				
1. Measuring Tape	Steel, 0-5m, amm range	1	1	2
2. Vernier Caliper	150mm	1	1	2
3. Thermometer	0-100°C, Alcohol	2	2	4
4. Spring Balance	12kg	1	1	2
5. Platform Scale	100kg	1	1	2
6. Tachometer	Handy, 0-1000rpm, 0-10000rpm	1	1	2
7. Tester	Multitester, A, V & Ohm	1	1	2
Sub-Total (Guage & Measuring Tools):		8	8	16
4) Grinding Tools				
1. Disc Sander	100mm dia., 0.59w	1	1	2
2. Grinding Wheel	100mm, #24, 25 pcs/s	1	1	2
3. Bench Grinder	205mm dia., 510w	1	1	2
4. Pedestal	for Bench Grinder	1	1	2
5. Eye Shield		1	1	2
6. Grinding Wheel	205mm, #36	3	3	6
7. Grinding Wheel	205mm, #60	2	2	4
Sub-Total (Grinding Tools):		10	10	20

Table VI.12.4 Proposed Number of Equipments (3/3)

EQUIPMENT NAME	DESCRIPTION	QUANTITY		TOTAL
		Sefula	Namaenya	QUANTITY
5) Welder and Accessories				
1. DC Arc Welder	11.1 KVA, 5-200A, 40% duty cycle	1	1	2
2. Welding Shield	Hand type	1	1	2
3. Secondary Cord	Earth Cord, L10m, 22mm dia.	2	2	4
4. Safety Holder	Capa. 150-250A	1	1	2
5. Earth Clip	Capa. 150-300A	1	1	2
6. Chipping Hammer	Double end	1	1	2
7. Leather Glove		3	3	6
8. Electrode	3.2mm dia. 20 kg/box,	6	6	12
Sub-Total (Welder & Accessories):		16	16	32
6) Drilling Machine & Accessories				
1. Electric Drill	Handy, Max. 10mm, 550w	1	1	2
2. Bench Drill Press	Max. 13mm, 200w	1	1	2
3. Drill set	25 pcs/set	1	1	2
4. Drill set	6 pcs/set; 2,3,4,6,8,10mm	2	2	4
5. Vise	Jaw: W110mm, D28mm, Opening: 100mm	1	1	2
6. Press Table	1200 x 800 x 740	1	1	2
7. Work Bench	1800 x 750 x 740	1	1	2
Sub-Total (Drilling Machine & Accessories):		8	8	16
7) Inspection Measures & Tools				
1. Grain trier	12 dia, 300mm	5	5	10
2. Sample Container	50 dia., 80mmH	50	50	100
3. Moisture Testing Kit				
1. Crusher: L70 x W80 x H180mm, roll type		1	1	2
2. Dry Oven: 150 °C, L410 x W380 x H530mm		1	1	2
3. Descicator: 250mm dia., 250mmH		1	1	2
4. Triple Beam Balance: 0.1g range		1	1	2
4. Moisture Meter				
1. Capa. type,6-30%, Rice, Corn		1	1	2
2. Resis type, 11-30%, Rice		1	1	2
3. Infrared type, 0-100%, 0.1 range		1	1	2
5. Grain Crack Inspector	L78 x W100 x H25mm	2	2	4
6. Whiteness Meter	White, 15-60%, Mill deg:0-9.99%	1	1	2
7. Grain Shape Tester	0-20mm, 0.01mm range	2	2	4
8. Sample Pan	Black, 180mm dai.	20	20	40
9. Sieve Set	8 pcs/set, 120mm dia.	1	1	2
Sub-Total (Inspection Measure & Tools):		88	88	176
Total (ACCESSORIES & MAINTENANCE TOOLS):		161	161	322
GRAND TOTAL (EQUIPMENT):		281	282	563

Note: (1)Prices : as of December, 1994

(2)Prices are not included fees of installation, testing, inspection etc.

(3)Prices are not included taxes, levies and any other regulation fees.

Table VI.15 Women in Development

Table VI.15.1 Group Activity in the F/S area

	Name	year form -ed	Zone	by	Name of Group-leader (sex, age)	No. of Member					Age					Main activity						Crop (area and yield)																Condition	Saving
																						maize		rice		cassava chips		millet		sorghum		sw potato		pumpion		tomato			
						F	M	Total	PHH	MHH	10-	21-	31-	41-	51-	farming	hand	fishing	sewing	beer	other	(ha)	(kg)	(ha)	(kg)	(ha)	(kg)	(ha)	(kg)	(ha)	(kg)	(ha)	(kg)	(ha)	(kg)	(ha)	(kg)		(k)
1	Belekela Kamuso	1994	1	VEG	K.S.walubita(Mr. 57)	10	7	17	6	7	0	9	6		2	○	○	○		○		5	3600	7	4480	8.5	2125	1	360	0.5	270	0.1	500		100		50	active	
2	Beleka Kaata	1994	1	VEG	M. Walubita (Miss 40)	20	3	23	14	3	0	14	7	2	0	○	○	○		○		7	5040	9	5760	10	2500	2	720	1	540		600		120			very active	
3	Bupolo Kimasunda	1994	1	VEG	P. Kafungwa (Miss 42)	12	8	20	8	8	0	6	5	5	4	○		○		○		6	4320	8	5120	10	2500	1	360	0.5	270							active	
4	Tukongote	1994	2	VEG	V.M. Kabuka (Mrs. 52)	14	7	21	8	7	1	5	4	3	8	○				○	○	6	5120	8	5760	10	2500	1.5	540	0.5	270	0.1	500		100	0.01	100	very active	7000
5	Liyoyelo	1994	2	VEG	J.M. Sinambeko (Miss 40)	17	8	25	12	8	4	1	5	2	13	○		○		○		7.5	4240	8	5120	9	2250						300		200			active	
6	Kwacha	1994	2	VEG	M.Lyamba (Miss 55)	13	3	16	8	3	0	6	3		7	○		○		○	○	4	2880	6	3840	4	1000						50				10	active	
7	Lwaipilisa	1994	3	VEG	C.S.Kwibisa (Miss)	22	8	30	15	8	2	10	6	3	9	○		○		○	○	10	7200	8	5120	3	75						200		500		50	active	
8	Sipai	1994	3	VEG	M.Wamundila (64)	21	3	24	14	3	1	3	7	3	10	○				○		7	4480	8	5760	12	3000											fairly active	
9	Swalisano	1994	4	VEG	G.S.Zaza(Mr.)	25	7	32	18	7	0	6	7	9	10	○		○		○		8	5120	20	14400	4	1000												
10	Kubuwa	1994	4	VEG	E.N. Muchelo (Miss 36)	6	17	23	10	6	0	6	12	1	4	○						8	5120	10	7200	9	2250	1	360									active	
11	Wilumuwa	1994	4	VEG	R.M. Mukelabai(Miss)	17	4	21	12	4	3	6	7	3	2	○				○		5	3840	6	4320	2	500											fairly active	
12	Kulikafela	1993	2	DCD	P. Kafunguwa (Mrs.)	10		10	5		1	1	5	1	2	○						2	1280	4	2880	2	500											fairly active	10000
13	Sefula	1991	3	DCD	E.N. Yembe (Miss)	15		15	9		0	0	5	8	2				○			4	2560	5	3600											50	fairly active	30000
14	Nutrition club		2	NGO		10		10			1	1	5	1	2	○																						
					TOTAL (only VEG)	177	75	252	125	64	11	72	69	31	69																									
						70%	30%	100%	66%	34%	4%	29%	27%	12%	27%	100%	15.4%	53.8%	0.0%	76.9%	21.3%	Average of VEG																	
																						6.7	4633	8.9	6080	7.4	1790.91	1.3	468	0.6	338		358		204		52.5		

* There are more two Village Extension Groups in the F/S area. However, these groups are still very new. These two groups are not included in this table.
* VEG : Village Extension Group, DCD : Department of Community Development, NGO : Non Government Organization

VI.18 Design of Facilities

VI.18.1 Design Discharge of on-farm Level

Design discharge of on-farm level is calculated using rational formula mentioned below.

$Q = 1/360\ frA$

Where,

Q : Runoff discharge (m^3/s)

f : Runoff percentage, this value is determined as 0.30 based on Table VI.18.2.

r : Average rainfall intensity(mm) = 3.33 mm
Daily rainfall corresponding to 3 ~ 5 years return period is estimated as 80 mm according to Table VI.18.3.
The concept of drainage requirement is based on 24 hours rainfall and 24 hours drainage. Therefore average rainfall intensity is determined as 3.33 (80/24) mm

A : Catchment area (ha)

$Q = 1/360 \times 0.30 \times 3.33 \times A$

$= 0.00278\ m^3/s/ha$

Table VI.18.2 Standard Peak Runoff Coefficient

Land & Vegetation		Soil Texture		
		Sand	Clay - Silt	Hard Clay
Forest				
	Flat Land	0.10	0.30	0.40
	Sloping Land	0.25	0.35	0.50
	Steep Land	0.30	0.50	0.60
Pasture				
	Flat Land	0.10	0.30	0.40
	Sloping Land	0.16	0.36	0.55
	Steep Land	0.22	0.42	0.60
Farm Land				
	Flat Land	0.30	0.50	0.60
	Sloping Land	0.40	0.60	0.70
	Steep Land	0.52	0.72	0.82
		Impermeable grand Surface		
		30 %	50 %	70 %
Urban Land				
	Flat Land			
	Sloping Land			

1) Source : Engineering Manual for Farm Land Conservation
Published by the Japanese Institute of Irrigation and Drainage

2) Flat Land as 0 ~ 5 %, sloping land as 5 ~ 10 % and Steep Land as 10 % ~ 30 % of ground slope

Table VI.18.1 Construction Cost of Case (1) and Case (2)

Item	Description	Unit	Quantity	Local Currency (kw)		Foreign Currency (kw)		No.
				Unit Price	Amount	Unit Price	Amount	
Case 1								
Main Irrigation Canal		m	2,280	24,730	56,384,000	11,490	26,197,000	
Secondary Irrigation Canal		m	10,380	15,220	157,983,000	5,540	57,505,000	
Division Works		place	8	3,988,510	31,908,000	2,301,440	18,411,000	
Embarkment		place	1	8,060,000	8,060,000	17,522,480	17,522,000	
Intake Works		place	1	7,428,140	7,428,000	4,129,120	4,129,000	
Spillway		place	2	6,624,510	13,249,000	3,814,800	7,629,000	
Connection Canal		place	1	6,238,300	6,238,000	3,554,200	3,554,000	
Main Drainage Canal A		m	6,000	3,140	18,840,000	7,220	43,320,000	
Main Drainage Canal B		m	6,000	3,140	18,840,000	7,220	43,320,000	
Lateral Canal		m	9,860	2,700	26,622,000	6,190	61,033,000	
Overhead		set	1		138,220,000		113,048,000	
Total		set	1		483,772,000		395,668,000	
Case 2								
Main Irrigation Canal		m	5,000	19,950	99,750,000	13,890	69,450,000	
Secondary Irrigation Canal		m	10,380	15,220	157,983,000	5,540	57,505,000	
Division Works		place	16	3,988,510	63,816,000	2,301,440	36,823,000	
Embarkment		place	1	8,060,000	8,060,000	17,522,480	17,522,000	
Intake Works		place	1	7,428,140	7,428,000	4,129,120	4,129,000	
Main Drainage Canal		m	5,300	5,770	30,581,000	13,410	71,073,000	
Lateral Canal		m	9,860	2,700	26,622,000	6,190	61,033,000	
Overhead		set	1		157,696,000		127,014,000	
Total		set	1		551,936,000		444,549,000	
Main Irrigation Canal	Excavation	m3	2	260	520	630	1,260	
	Compaction	m2	3	20	60	70	210	
	Filling(Sand)	m3	2.25	1,160	2,610	2,700	6,070	
	Trimming of Surface	m2	5.90	440	2,590	990	5,840	
	Cement Block	m3	0.24	59,070	14,170	2,130	510	
	Total / m				19,950		13,890	
Main Drainage Canal	Excavation	m3	6.9	320	2,200	790	5,450	
	Surplus Soil	m3	6.9	130	890	280	1,930	
	Trimming of Surface	m2	6.1	440	2,680	990	6,030	
					5,770		13,410	

Table VI.18.3 Correspondence to each Return Period of Daily Rainfall

Year	Month	Date	Daily Rainfall (mm)
52/53	Feb.	12	52.6
53/54	Dec.	14	50.8
54/55	Jan.	29	50.0
55/56	Apr.	20	51.1
56/57	Feb.	22	108.0
57/58	Jan.	24	84.6
58/59	Nov.	30	71.1
59/60	Dec.	23	48.8
60/61	Mar.	19	52.3
61/62	Jan.	13	81.8
62/63	Dec.	30	83.1
63/64	Dec.	6	79.5
64/65	Dec.	7	34.3
65/66	Jan.	11	67.8
66/67	Jan.	22	37.8
67/68	Apr.	16	104.4
68/69	Feb.	17	224.0
69/70	Oct.	18	53.3
70/71	Jan.	22	61.7
71/72	Jan.	6	74.4
72/73	Feb.	13	65.0
73/74	Feb.	17	103.5
74/75	Dec.	28	49.9
75/76	Mar.	22	66.5
76/77	Mar.	5	59.5
77/78	Dec.	20	85.5
78/79	Jan.	28	45.9
79/80	Dec.	14	101.3
80/81	Feb.	23	97.7
81/82	Feb.	27	56.6
82/83	Nov.	27	48.1
83/84	Jan.	12	35.5
84/85	Dec.	13	37.8
85/86	Dec.	2	66.4
86/87	Dec.	9	48.2
87/88	Mar.	5	66.5
88/89	Feb.	21	81.7
89/90	Jan.	12	64.5
90/91	Feb.	9	89.2
91/92	Jan.	22	68.9
92/93	Apr.	12	106.4

Formula $\text{Log}(X+22.383)=1.95186+0.17336 \times Ksi$

R. P.	Ksi	Log(X+22.383)	X (mm/day)
2 years	0.0000	1.9519	67.1
3 years	0.3045	2.0046	78.7
5 years	0.5951	2.0550	91.1
10 years	0.9062	2.1090	106.1
30 years	1.2967	2.1767	127.8
50 years	1.4520	2.2036	137.4