

## 6.6 Rural Infrastructure

### 6.6.1 Roads

#### (1) Present Condition

In the F/S Area, the most important roads for the economic activities are the tarred road namely Senanga road running east of the F/S Area and the gravel road connecting Sefula church area to Sefula secondary school, Sefula market, and RHC. However, except for these roads, most of the existing ones are footpaths only cleared grasses and trees. The surfaces of these footpaths are covered by deep loose sand making it very hard to even walk on them, and only 4 wheel drive vehicles have the possibility of running especially during the dry season. This defective nature of existing facilities constitutes serious development constraints.

#### (2) Development Plan

The roads needed to be improved or constructed are divided into the following four categories.

- 1) The roads connecting the tarred roads and villages (Feeder Roads)
- 2) The roads connecting villages in the plain edge (Village Roads)
- 3) The roads to be constructed in the Plain (Peripheral Roads)
- 4) The roads to be constructed for the maintenance of the irrigation and drainage facilities (Maintenance Roads and Field Roads)

**Table 6.6.1 Outline of the Proposed Road**

Item	Length (km)	Width (m)	Pavement	Reference
Feeder A	1.7	4.0	Laterite	From tarred road to Mupolota vil.
Feeder B	2.2	4.0	Laterite	From tarred road to Sefula market
Village Road	4.1	3.0	Laterite	From Mupolota vil. to Nalikolo vil.
Peripheral Road	6.0	3.0	Laterite	From Sefula market to Namaenya vil.
Maintenance Road A	2.0	3.0	Laterite	Maintenance for main irrigation canal
Maintenance Road B	0.3	3.0	Laterite	Maintenance for main irrigation canal
Maintenance Road C	0.6	3.0	Laterite	Maintenance for main drainage canal B
Field Road	10.7	3.0	Sand	Along sec. irri. canal / lateral canal
<b>Total</b>	<b>27.6</b>			

#### 1) Feeder Roads

The roads connecting the public facilities such as schools, health care center and market should be emphasized for improvement as mentioned in the Master Plan. This

improvement contribute to increase not only agricultural benefit but also social benefit. From these viewpoints, the existing road connecting Mupolota village and Mutuwambwa primary school running near the north side boundary of the F/S Area (Feeder A) and the existing road connecting Sefula Church area and RHC, Sefula secondary school and the market running along Sefula river (Feeder B) are scheduled to be improved.

As these roads are the subject of surface erosion caused by runoff of rainwater, some drainage facilities must be installed. In steep slope section, the proposed route should be arranged within eight percent longitudinal slope, from the viewpoint of the erosion protection and smooth traffic.

This category of roads will be expected to accommodate heavy caliber vehicles that will be used for the conveyance of agricultural products, material and other necessities which are expected to increase after implementation of the project. Accordingly road width will be four meters, and passing lines will also be provided.

## 2) Village Roads

The existing road from Mupolota village to Nalikolo village is improved and connects both Feeder Roads. Village Roads also require drainage facilities to prevent the runoff of rainwater from the escarpments.

The width of existing roads ranges between two and three meters, and in some places cassava fields and mango trees disturb the traffic. As Village Roads will be used for ox-carts or light vehicles to convey agricultural and fishery products, the proposed road width is designed as three meters. The route should avoid cassava fields and mango trees.

## 3) Peripheral Roads

A Peripheral Road is constructed in the Plain around the proposed irrigable area at the south side, and along the 1,012 meters contour line at the north side reaching Namaenya village. This road connects the Village Road and Feeder B. The elevation of the road surface are determined according to the water level in the Plain and should be set up higher than the water level. The water level in the Plain corresponding to the three years return period value (probability of exceedance) is around 1,012.40 meters (Annex-Table VI.7.3). Considering the freeboard value, the elevation of surface is determined as 1,013.00 meters, therefore the maximum height of banking becomes around 2.00 meters. The proposed road width is planned at 3 meters, because this road will be used for ox-carts and light vehicles to convey agricultural and fishery products and material similar to the Village Road.

#### 4) Maintenance Roads and Field Roads

Maintenance Roads are constructed for the purpose of irrigation and drainage. The proposed routes of the Maintenance Roads A, B will run along the main irrigation canal and will connect the sand trap. Maintenance Road C will run along the main drainage canal B from the sand trap to the Peripheral Road. The width of this road will be three meters.

Field road is made in the proposed irrigable area for the purpose of managing and maintaining the irrigation and drainage facilities as same as maintenance road. On the both sides of field road, secondary irrigation canal and lateral canal are installed. The width of this road will be three meters.

Figure 6.6.1 shows the proposed routes of these roads.

### 6.6.2 Rural Water Supply

#### (1) Present Condition

In the F/S Area, there are two types of wells as sources of rural water supply. These consist of a shallow type and a deep type. People living along the plain edge get drinking water from one meter diameter shallow wells which are dug in wet Litongo. People living along Sefula river also get water from such shallow wells which are dug beside the river. In addition, there is another type of shallow well, windlass, in the plain edge which is provided by the Department of Water Affairs. This type of shallow well is relatively deep and is made of concrete to protect against clogging. However some of these wells have been useless for a long time because the bucket and/or chain have stolen.

On the other hand people living in the high ridge get drinking water from boreholes which are operated by hand pumps, electric or diesel pumps. Boreholes operated by hand pumps are provided by the Department of Water Affairs under the NORAD funded programme. In the F/S Area, two boreholes were installed this year. In Sefula church area, one borehole operated by an electric pump is installed between the secondary school and RHC and water is supplied through a pipeline system. In addition, a new pumping station beside Sefula river is completed, but this pumping station is not yet operated as electricity is not connected.

**Table 6.6.2 Present Condition of Water Point**

Zone	Shallow well		Borehole			Total
	Windlass	Others	Hand Pump	Electricity	Diesel	
1	1(1)	6	1(1)	0	1(1)	9(3)
2	1(1)	2	0	0	0	3(1)
3	0	6	0	2(1)	0	8(1)
4	2	0	9	0	0	11(0)
Total	4(2)	14(0)	10(1)	2(1)	1(1)	31(5)

( ) shows number of not in use

**(2) Development Plan**

In Mutuwanbwa area, a borehole operated by diesel engine has installed at the plain edge in order to supply drinking water to people living in the high ridge including Mutuwambwa primary school through pipeline. However, this pumping station has not been working for a long time due to break down and high maintenance and repair costs of the diesel engine. Afterwards a borehole operated by hand pump was also installed near the primary school. This borehole also does not work due to silting. At present, people living in the area go down to the plain edge to get drinking water, which constitutes a great burden on women's housework. Also, there is no water supply in Muruwanbwa primary school though more than 500 pupils are registered.

Namaenya area located in the central part of the F/S Area has also a scarce water points, in spite of the existence of many villages in the area. One windlass is installed by the Department of Water Affairs but is not in use. People living in this area get their drinking water from rudimentary shallow wells which they dug themselves. In this type of shallow well, the pollution caused by livestock excreta and surface water is somewhat feared.

To ensure a clean drinking water is very difficult except for only a small number of villages in the F/S Area. With these considerations, two sites need drinking water urgently. Therefore, boreholes operated by hand pumps similar to the ones installed by the Department of Water Affairs are planned for these two sites. In the integrated training facility, boreholes will be installed for the people living near the facility to operate the facility and to supply water for the Fry production farm.

Mutuwanbwa primary school, Namaenya agro-processing facility, and the integrated training facility are responsible for the maintenance of the borehole.

**Table 6.6.3 Outline of Installation of the Boreholes**

Area	Type	Beneficiary	O/M
Mutuwanbwa area	Borehole operated by hand pump	Inhabitant Primary school	Primary school
Namaenya area	ditto	Inhabitant Agro-processing Facility	Agro-processing facility
Sefula rural area	ditto	Inhabitant Integrated training facility Fry production farm	Integrated training facility

Figure 6.6.2 shows the location of the existing and the proposed wells.

### 6.6.3 Rural Electrification

Electric power line with capacity of 11KV has been installed along Sefula road up to RHC. Only Sefula church area, secondary and tertiary lines are extending, but most of the F/S Area is not covered. (Figure 6.6.2)

In this project, integrated training facility, agro-processing facility and fry production farm are installed in the F/S Area, therefore electricity power line is scheduled to be extended with the progress of implementation of each facility.

### 6.6.4 Health and Education

#### (1) Present Health Situation and Improvement Plan

##### 1) Health Services Infrastructure

Health services in the F/S Area are delivered by Sefula RHC (Rural Health Center). Main facilities of Sefula RHC consist of one registry room, three screening rooms, one treatment room, one laboratory, fore wards for in-patients, five sleeping rooms and one meeting room for trainees, one kitchen and so on. Although electricity is provided to this RHC, water supply system is not properly functioning.

Sefula RHC is staffed with two Clinical Officers, one Environmental Health Engineer (formerly Health Assistant), five nurses and three classified daily employees.

## 2) Major Activities in Sefula RHC

Main services provided by this RHC are medical consultation and treatment, environmental services, mother and child health services and delivery services. Specific services provided by this RHC is to train students from Chainama College who are expected to become Clinical Officers and Environmental Health Engineers(EHT). Every year this RHC receives a total of approximately 80 trainees for practical training.

## 3) Morbidity and Mortality

Malaria is the leading cause of morbidity in catchment area of Sefula RHC. Number of out-patients (first attendance) accounted for 6,849 in 1993 with the total deaths of 5 in the same year.

Upper respiratory infections (URIs) are ranked the second in leading causes of morbidity, with a total out-patients of 1,886 in 1993. Eye diseases are ranked the third (831), skin infections are ranked the fourth (802) and diarrhea diseases are ranked the fifth (586). Leading causes of morbidity and mortality in catchment area of Sefula RHC during 1993 are presented in Annex-Table VI.6.1 and VI.6.2.

## 4) Major Issues and Improvement Plan

One of the major issues which Sefula RHC is facing is poor facilities for the trainees including bedrooms and a meeting room. Improvement of bedrooms including replacement of beds and renovation of a meeting room will be urgently needed. Another issue is lack of transport. This RHC is extending its services with only one motorcycle and two bicycles. In order to improve access to the villages, it is needed to increase the number of transport facilities. At least, provision of three units of motorcycles for two COs and an EHT will be necessary.

### (2) Present Educational Situation and Improvement Plan

#### 1) Educational Infrastructure

There are two primary schools (Mutuwambwa and Namachaha), two basic schools (Sefula Basic and Sefula Basic for the Blind) and one secondary school in the F/S Area.

The total number of classes, enrollment and teachers of primary and basic schools are 60, 1,640, and 74, respectively in 1993, with classroom-pupil ratio of 1:51. Excluding Sefula Basic School for the Blind, the average classroom-pupil ratio becomes 1:68.

The total number of classes, enrollment and teachers of Sefula Secondary School are 16, 850 and 24, respectively in 1993.

Statistics on educational infrastructure in the F/S Area are presented in Annex-Table VI.6.3.

## 2) Major Issues and Improvement Plan

Major issues in education sector identified in the F/S Area are poor school buildings, inadequate toilet facilities, shortage of school furniture and equipment, and lack of general maintenance cost in schools. Therefore, improvement plan should include the renovation of school buildings, replacement of school desks, and improvement of toilet facility for primary, basic and secondary schools.

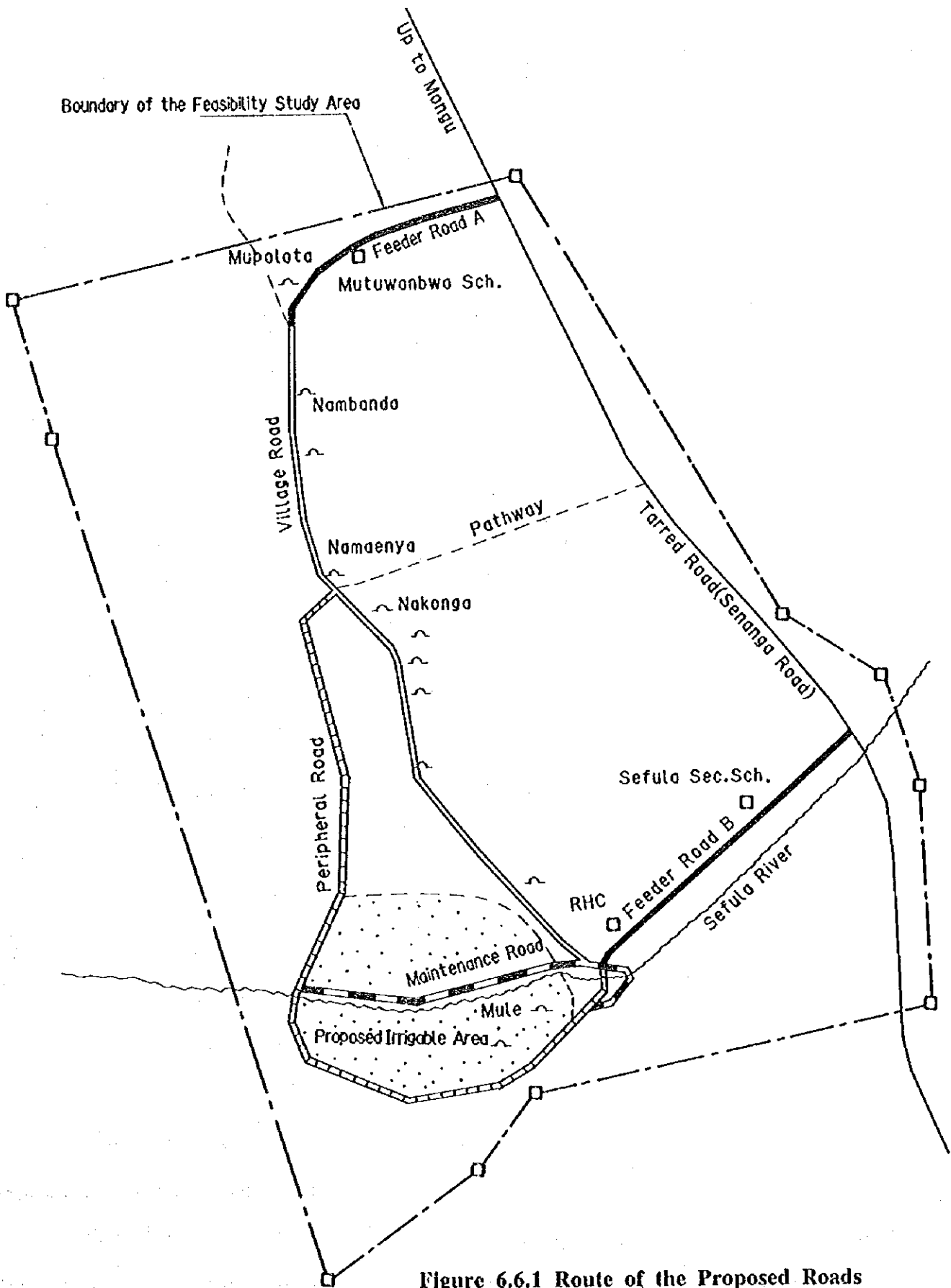
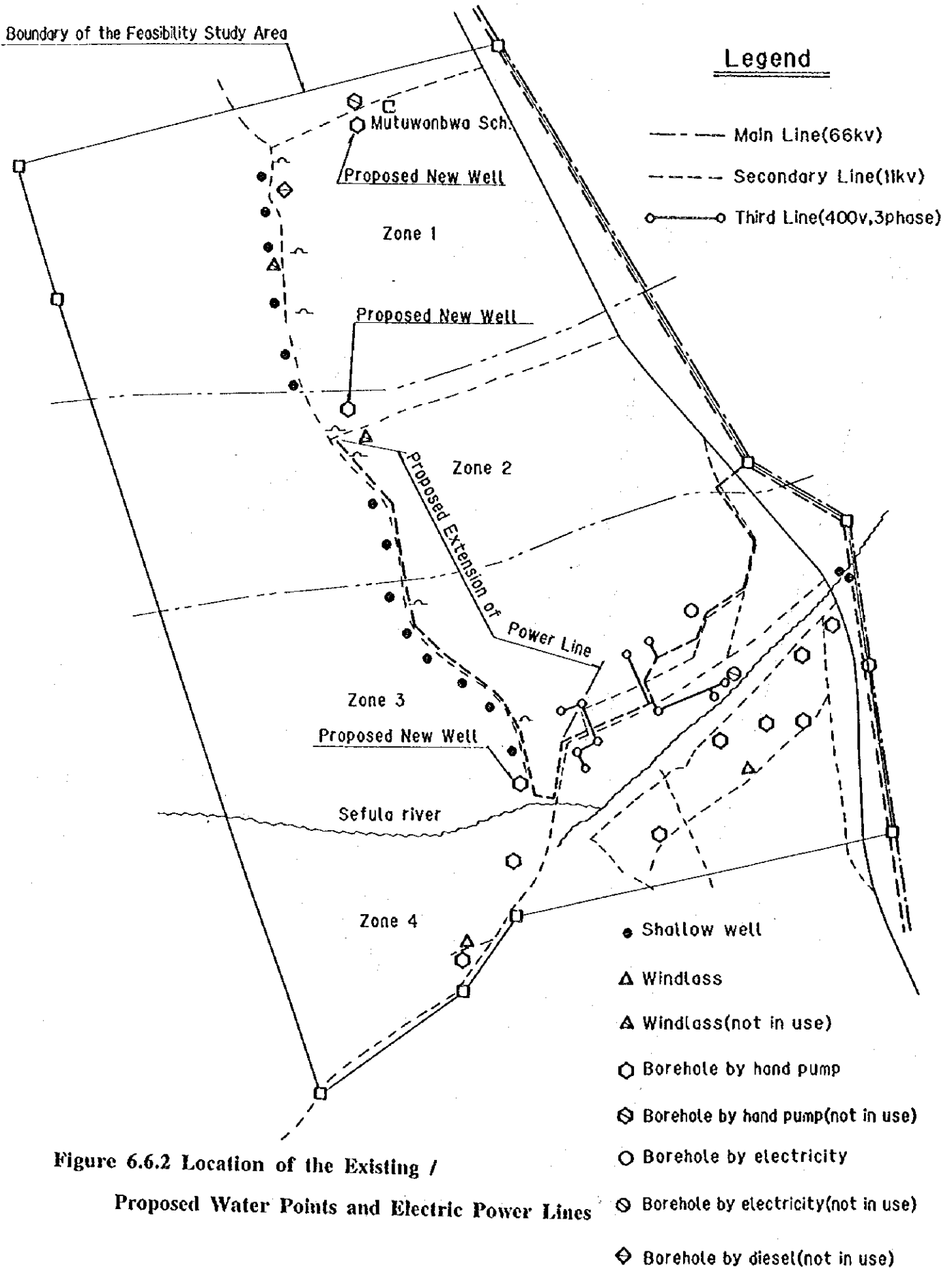


Figure 6.6.1 Route of the Proposed Roads





**Figure 6.6.2 Location of the Existing / Proposed Water Points and Electric Power Lines**

## **6.7 Irrigation and Drainage**

### **6.7.1 Present Situation**

#### **(1) Meteorological Condition**

##### **1) Precipitation**

Based on the meteorological data of the Mongu meteorological station, the first rainy day of 1994 was October 15th with 0.7mm rain fall, after that there were only two days having more or less 5mm per day before November 28. On November 29th and 30th, 5.1mm and 36.7mm rainfalls were recorded respectively and after that frequent rainy days were recorded showing the beginning of rainy season. The first rainy day of the Namushakende Farm Institute was October 13th with 1.5mm per day, and after that there were no rainy days with more or less 5mm per day except 9th with 15.5mm and 14th with 13.0mm up to November 27th and total precipitation during this period was 39.5mm. After recording 22.0mm on November 28th and 23.5mm on 30th, almost every day rainfall was recorded as same as Mongu (Annex - Table IV.7.1).

##### **2) Cold and frost damages**

Almost all over the area of the Western Province, mango trees were damaged by low temperature and frost on June 30th, 1994. The minimum air temperature and the minimum soil surface temperature were 2.6°C and 0.0°C respectively at Mongu meteorological station on that day. The air temperature 40cm above the soil surface on Namushakende Verification Study Field between 2a.m. and 5a.m. was 0°C and below with minimum -1.4°C and the frost was confirmed by hearing with farmers. In the F/S Area, the cold and frost damages of mango trees were slighter than other area, and concerning other perennial crops except cashew the damages were not reported.

##### **3) Evapotranspiration**

For the purpose of obtaining real evapotranspiration the F/S Area during the cold dry season, from March to June, the demanding maximum gross irrigation requirement and the evapotranspiration of the Namushakende Verification field bordering the F/S Area were measured. The possible potential evapotranspiration by Penman method was 3.6mm/day and the real evapotranspiration by heat balance Bowen ratio method was 1.2mm/day (Annex - Table VI. 7.2).

## (2) Hydrological Conditions

### 1) Flood water level of the flood plain

The flood water level of the F/S Area was calculated corresponding to each return period year probability based on the water level data during 30 years from 1961/62 to 1991/92 at Senanga and Matongo. Using the 1/5,000 topographical map, the altitude-wise area of the F/S Area was calculated and it was realized that zone 3 and 4 are relatively higher than other zones. It is confirmed the maximum flood level occurs between the end of March and the beginning of April, and the water levels equivalent to three years and five years return period values (probability of exceedance) are 1012.39 m (66% the flood plain in the F/S Area and 48% of the flood plain in zone 3 and 4 are flooded) and 1012.66 m (72% of the flood plain in the F/S Area and 53% of the flood plain in zone 3 and 4 area flooded) respectively (Annex - Table VI.7.2~5).

## (3) Irrigation and Drainage

### 1) Irrigation

In the F/S Area farmers are seldom practicing irrigation. There are only a few examples, an example which is irrigating padding fields located along the Sefula River by cutting the bank and the other is practicing bucket irrigation for raising vegetables.

### 2) Drainage

In the F/S Area, there are some drainage facilities like Musiyamo canal, Namaranga canal, Feeder canal, and other small streams flowing from upland edge into the above mentioned canals. As these canals and streams have not been maintained with any of weeding, dredging, and bank repairing, some points are completely blocked resulting in ill drainage during the rainy season. There are no insisted drainage operated by machine. The flooded areas calculated from the flooding level and altitudes are shown in figure 6.7.1 and 6.7.2.

### 3) Runoff of Sefula River

From 1970/71 to 1991/92, the water level measurement was practiced by the Water Affair at the point of 100m upper from the culvert on the Mongu-Senanga road. However, water level-discharge curves are not compiled, so that, cross section of the river, slope of the riverbed, and coefficient of roughness were measured at the staff gauge set point in order to get the converted discharge by the Manning's formula. From the results of these calculation, water level and discharge corresponding to each year return period probability were obtained which are shown in Annex, VI.7.6. From these results, discharge for three years and five years return period probability were

0.27m<sup>3</sup>/second and 0.25m<sup>3</sup>/second respectively which were obtained from probability of non exceedance and 1.02m<sup>3</sup>/second and 1.12m<sup>3</sup>/second respectively which were obtained by probability of exceedance at the staff gauge set point. The discharge calculated by probability non exceedance will be used for irrigation programming and the one which were calculated by probability of exceedance will be used for drainage programming respectively. From the 1/50,000 topographical maps the catchment area of the staff gauge set point and that of the proposed intake point were estimated about 40 km<sup>2</sup> and 44 km<sup>2</sup> respectively. Owing to the conception of the specific discharge the discharge correspond to each year return period probability at the proposed intake point will be estimated 10% increase of the discharge measured at the staff gauge set point, for instance, the discharge at the proposed intake point for three years return period probability of non exceedance will be estimated as 0.27m<sup>3</sup>/second × 1.10 = 0.30m<sup>3</sup>/second.

**Table 6.7.1 Runoff of the Sefula River for each Return Period (at staff gauge)**

return period year	non-exceedance		exceedance	
	water level (m)	runoff (m <sup>3</sup> /s)	water level (m)	runoff (m <sup>3</sup> /s)
2	0.46	0.29	0.99	1.81
3	0.45	0.27	1.02	1.92
5	0.44	0.25	1.12	2.31
10	0.43	0.24	1.19	2.67
50			1.50	4.25

**(4) The Intention of the Farmers Living in the F/S Area**

A workshop was held by the persons concerned and farmers in the F/S Area for the purpose of explaining the outline of the developing program and getting the farmers' intention for the program, and the following points became clear.

**1) The problems of the irrigation program area**

- Technical know-how on irrigation is deficient.
- Agriculture in the area is almost rainfed.
- Due to lack of regulation for Sefula River water use, unfairness will occur between farmers for water use.
- Water supply is insufficient for the farmland located in the lower area of Sefula River.
- Expanding farmland is difficult owing to traditional land system
- The productivity per unit area is low.

2) The schematic figure for the problems

The problems proposed at the irrigation workshop are schematically summarized in figure 6.7.1.

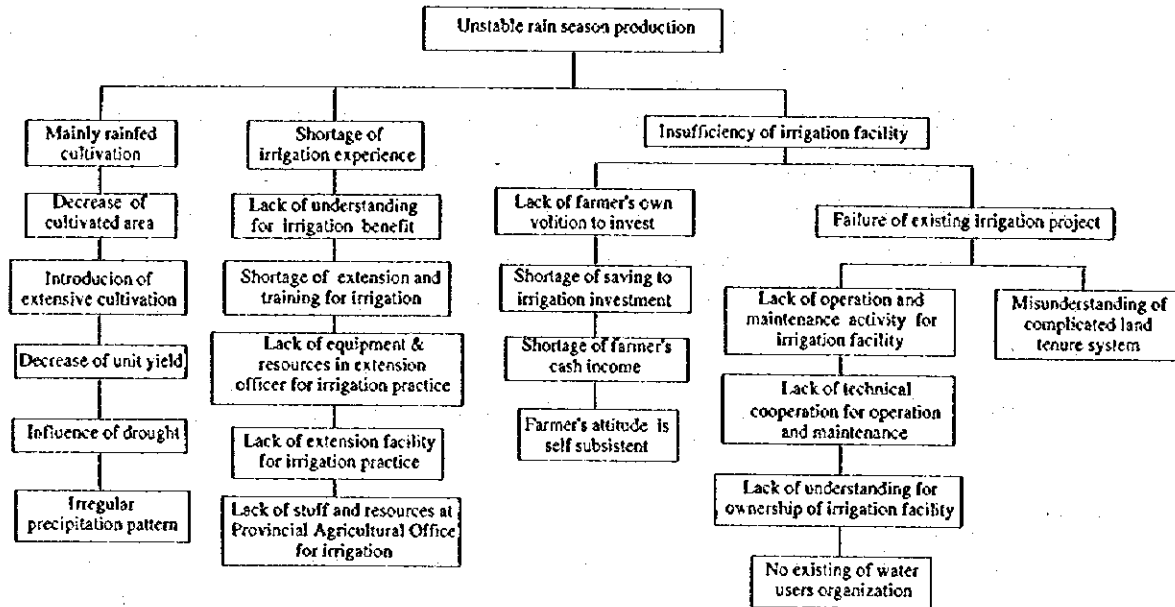


Figure 6.7.1 Problem Tree for Irrigation

3) The countermeasures for the proposed problems

Several countermeasures are proposed for the problems. Among them, improvement of irrigation scheme, installment of water management organization and organizing the preparing committee for supporting above organization are the main ones.

(5) Cadastral Survey for the Irrigation Programming Area

For the purpose of identifying beneficial farmers, grasping their characteristics, confirming their cultivation right and referring to secondary irrigation plan, a cadastral survey was proceeded. As the result of the cadastral survey, the permanent leasehold of 17 land owners and village heads who are given land from Induna are confirmed, and their each boundary of their rented land are shown on the 1/5,000 topographical maps (Annex Drawings). Most of land owners distribute their land to the farmers called borrowers with stable cultivation right. However, some land owners do not distribute any land to the borrowers.

## 6.7.2 Irrigation Plan

The irrigation program in the F/S Area is shown as follows based on the basic developing plan.

### (1) Irrigation System

#### 1) Gravity irrigation system

The gravity irrigation system does not use pumps and, therefore, has the advantaged which necessitate not only small amount of primary investment but also little maintenance cost. In this program, the system will be applied to double cropping of rice in the area bordering the Sefula River in the third and fourth zones. From the maximum water requirement per unit field per day (Table 6.7.4) and the base flow of the Sefula River, 200 ha of paddy field can be supplementary irrigated in the rainy season, and 100 ha of paddy field can be irrigated in the dry season. The water distributed from the Sefula River will be supplied from the secondary canal to the paddy fields bordering to the canal with siphon tubes and then to the lower fields by field to field irrigation. The rice in the rainy season will be cultivated by transplanting method, and in the dry season by direct seeding method, so that, the irrigation water requirement is calculated owing to the cultivation and cropping system as mentioned in the following paragraph.

#### 2) Bucket irrigation system

This can be applied to the whole wet Litongo area and some part of Mazulu and Sitapa areas having advantageous condition of getting water easily even in dry season. However, it is desirable to be applied to the systems requiring not so much water like vegetable cultivation considering the labor requirement. Apart from wet Lingo area, this method can be applied to the maize and upland rice cultivated in the area between wet Litongo and Musiamo canal located in the first and second zones.

### (2) Unit Water Requirement for Paddy Field

#### 1) Evapotranspiration

Based on "FAO Irrigation and Drainage Paper No. 24", ten-day average data of the Mongu meteorological station in 1985/86 as irrigation base year is calculated by Penman method, and get the crop evapotranspiration multiplying the reference crop evaporation by the crop coefficient obtained from the coefficient of paddy rice in North Australia with the same altitude of Zambia. The ten-day meteorological data of the irrigation program base year and the reference crop evaporation are shown in Annex, Table IV. 7.6. The growth stage of paddy rice is roughly divided into three stages, and each crop coefficient corresponding to each stage is 1.10 (just after transplanting is 1.00), 1.05, and 0.95 respectively in case of transplanting method, and 1.10, 1.25, and 1.00 respectively in

case of direct seeding method on well drained field. In case of direct seeding method on well drained field irrigation is not applied during early growth stage (up to 3 or 4 leaves stage). However, water supply is accounted and crop coefficient in early stage is determined as 1.10, considering the supplemental water supply for germination and increasing of water requirement owing to change of cultivation method.

## 2) Percolation

As the paddy rice is cultivated under submerged condition, keeping submerged water level is required. Considering this condition, percolation loss must be accounted apart from the water consumption by plant. The percolation loss consists of vertical loss and horizontal loss through levee changing with the condition of ground water level, soil condition, puddling condition, level coating, water level of bordered paddy field and so on. In this program, based on the results of the Verification Study, 7.0mm loss in case of dry season paddy rice (direct seeding on well drained field), 4.0mm loss and in case of wet season paddy rice (transplanting) are considered.

## (3) Seasonal Change of Unit Water Requirement for Paddy Field

The unit water requirement per ten-days for paddy field is determined based on the following elements. Every ten-days gross water requirement is shown in the Table 6.7.2. From this table the maximum gross water requirement per day is  $0.30\text{m}^3/\text{sec}$  in rainy season and  $0.28\text{m}^3/\text{sec}$  in dry season respectively, and come out on the first ten-days of February and on the third ten-days of September respectively.

### 1) Water Requirement on Nursery

The plan is made based on 10 ha nursery area as 1/20 of paddy fields, 7.0mm of water loss, 1.00 of crop coefficient, and the same as paddy field in other water requirement condition.

### 2) Water requirement for puddling and for early stage irrigation

Puddling will be practiced during 20 days with 150mm/day water requirement estimated. Transplanting will be practiced on the following day of the puddling, and the water required for early stage will be supplied from the day of transplanting. Early stage water supply of the direct seeding on well drained field will begin 30 days after seeding, three or four leaves stage, and continue for 30 days and so, 150mm/day water requirement is estimated as same as transplanting method.

### 3) Water requirement for ordinary stage

This water requirement is determined by multiplying crop coefficient corresponding to growth stage by reference crop evapotranspiration of every ten-days and adding percolation loss. Effective rainfall is determined as 80% of the rainfall, and net water requirement is determined by reducing every ten-days effective rainfall from every ten-days water requirement. In this program, gross requirement is determined by assuming water conveyance loss is 15%. The gross water requirement is shown in Table 6.7.2.

**Table 6.7.2 Gross Irrigation Requirement**

Decade	KC	ET Crop mm/day	Loss mm/day	Irriga Area ha	Pad flnd Ar. ha	Days day	ET Crop m3/decade	Init Pond m3/decade	Sub Total m3/decade	Prcipitation mm/decade	Eff Rainfall m3/decade	Net I.R. m3/decade	Gross I.R. m3/day	Gross I.R. m3/sec
1.1	1.00	3.7	7.0	10.0		10	10,710		10,710	70.1	5,608	5,102	600	0.007
1.2	1.00	4.9	7.0	5.0		10	5,965		5,965	70.2	2,808	3,157	371	0.004
1.3	1.00	3.9	4.0	100.0	100.0	11	79,300	150000.0	229,300	87.5	70,000	159,300	17,037	0.197
2.1	1.00	3.6	4.0	200.0	100.0	10	144,590	150000.0	294,590	47.0	75,200	219,390	25,811	0.299
2.2	1.10	4.8	4.0	200.0		10	186,040		186,040	53.7	85,920	100,120	11,779	0.136
2.3	1.10	4.2	4.0	200.0		8	137,920		137,920	43.9	70,240	67,680	9,953	0.115
3.1	1.08	4.9	4.0	200.0		10	185,192		185,192	27.5	44,000	141,192	16,611	0.192
3.2	1.08	4.6	4.0	200.0		10	179,144		179,144	60.8	97,280	81,864	9,631	0.111
3.3	1.05	4.2	4.0	200.0		11	185,020		185,020	72.7	116,320	68,700	7,348	0.085
4.1	1.05	6.4	4.0	200.0		10	213,350		213,350	18.1	28,960	184,390	21,693	0.251
4.2	1.05	5.7	4.0	200.0		10	199,490		199,490	0.0	0	199,490	23,469	0.272
4.3	1.05	6.3	4.0	200.0		10	211,450		211,450	28.3	45,280	166,180	19,551	0.226
5.1	1.00	6.9	4.0	200.0		10	218,800		218,800	0.0	0	218,800	25,741	0.298
5.2	1.00	6.7	4.0	200.0		10	214,600		214,600	0.0	0	214,600	25,247	0.292
5.3	0.95	6.9	4.0	200.0		11	232,001		232,001	2.0	3,200	228,801	24,471	0.283
6.1	0.95	6.2	4.0	100.0		10	98,425		98,425	0.0	0	98,425	11,579	0.134
6.2		5.9		0.0		10	0		0	0.0	0	0	0	0.000
6.3		6.0		0.0		10	0		0	0.0	0	0	0	0.000
7.1		5.9		0.0		10	0		0	0.0	0	0	0	0.000
7.2		4.8		0.0		10	0		0	0.0	0	0	0	0.000
7.3		5.9		0.0		11	0		0	0.0	0	0	0	0.000
8.1	1.00	6.3	7.0	50.0		10	66,600		66,600	0.0	0	66,600	7,835	0.091
8.2	1.00	6.9	7.0	100.0		10	139,300		139,300	0.0	0	139,300	16,388	0.190
8.3	1.00	7.1	7.0	100.0		11	154,550		154,550	0.0	0	154,550	18,529	0.191
9.1	1.13	6.8	7.0	100.0	50.0	10	132,461	75000.0	207,461	0.0	0	207,461	24,407	0.282
9.2	1.13	6.9	7.0	100.0	50.0	10	140,357	75000.0	215,357	0.0	0	215,357	25,336	0.293
9.3	1.13	6.6	7.0	100.0		10	144,806		144,806	0.0	0	144,806	17,036	0.197
10.1	1.25	6.9	7.0	100.0		10	156,250		156,250	0.0	0	156,250	18,382	0.213
10.2	1.25	5.7	7.0	100.0		10	141,250		141,250	0.0	0	141,250	16,618	0.192
10.3	1.25	5.3	7.0	100.0		11	150,013		150,013	17.4	13,920	136,093	14,555	0.168
11.1	1.25	5.6	7.0	100.0		10	140,375		140,375	16.0	12,600	127,775	15,009	0.174
11.2	1.13	5.6	7.0	100.0		10	132,715		132,715	5.2	4,160	128,555	15,124	0.175
11.3	1.13	4.7	7.0	100.0		10	123,223		123,223	33.8	27,040	96,183	11,316	0.131
12.1	1.00	4.7	7.0	50.0		10	58,550		58,550	69.8	27,920	30,630	3,604	0.042
12.2	1.00	3.2	7.0	5.0		10	5,110		5,110	88.9	3,556	1,554	183	0.002
12.3	1.00	4.2	7.0	10.0		11	12,265		12,265	63.5	5,240	7,025	751	0.009
To/Ave.		198.8			300	365	4,199,831		4,649,831		739,452	3,910,379	453,966	0.146



(4) Proposed Irrigation Block

Terminal fields irrigated by secondary canal are collected and grouped six blocks. The proposed irrigation block is shown in Figure 6.7.2.

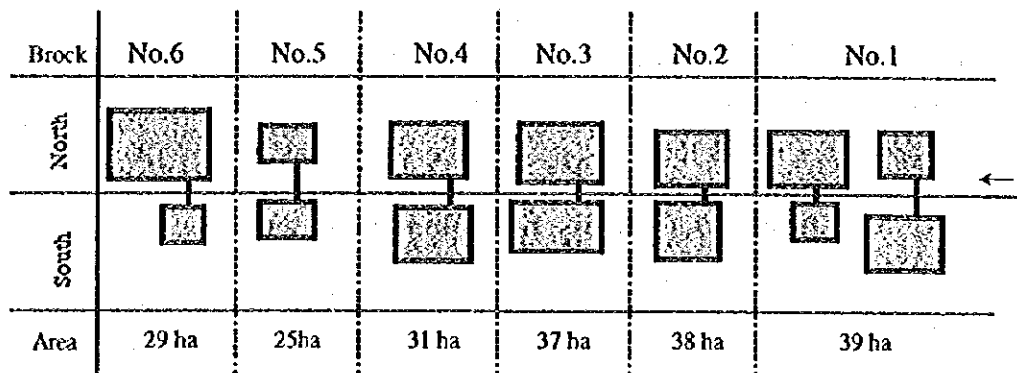


Figure 6.7.2 Proposed Irrigation Block

(5) Irrigation Method

Based on the Verification Study, the irrigation method is determined as intermittent irrigation with seven days.

(6) Drainage System

For the drainage of surplus water by the irrigation drainage system for planning area will be needed. Considering the construction cost, the drainage will be proceeded by repairing existing drainage canal such as Feeder and Namaranga canal.

## **6.8 Water Management**

### **6.8.1 Present Situation of the Water Management**

#### **(1) Weeding of the Sefula River**

Every year, from August to October (end of the hot dry season), the farmers cultivating the fields along the river are practicing weeding of riverbed and banks in cooperating with each other. For the weeding the government paid formerly, and this payment is considered to be the cause of obstructing the cooperative operation of the farmers. Recently, weeding is not practiced thoroughly because of no paying by government. Under such a condition, the stream of the Sefula River is damaged resulting in ill drainage in rainy season on upper part and shortage of surface stream in dry season. At the time of the second field survey, farmers were practicing weeding operation subsidized by the Mongu Nutrition Group.

#### **(2) Water Right of the Sefula River**

There is no water right concerning Sefula River water use. Everyone can use water freely by cutting the bank showing no regulation and systems concerning the water use. At the time of irrigation workshop, it was reported that one farmer's selfish taking in of water by cutting the bank caused the ill drainage of his neighbors' fields. At the time of execution of the irrigation plan, water right must be given by the Water Management Bureau for sufficient water supply to complete the irrigation plan. It is also necessary to get the permission of the Induna who control the area including Sefula River. If the plan is executed without completing above mentioned procedures, there will be a possibility of losing function of the irrigation facilities when new water right is created in the upper area of the river after the completion of the plan.

### **6.8.2 Water Management Plan**

#### **(1) Establishment of Water Management Organization**

##### **1) Preparing committee for water use organization**

At the time of irrigation workshop, the problems and countermeasures for irrigation and water management were discussed. As one of the decision of the meeting, it was decided that the organizing and the beginning of activities of the "Preparing Committee for water use organization" (hereafter: Preparing Committee) was proposed for the purpose of proceeding the farmers' cooperative water management. In the Preparing Committee, the management policy of the water use organization, plan for facilities maintenance and their expenditure, and regulation for organizing construction will be discussed under the condition of traditional customs and systems of the area. The Preparing Committee will consist of the representatives of the beneficial farmers of the planning area (the representative of the farmers joined in the irrigation workshop), village headmen of the

planning area, PAO, and manager of the Water Affair. It is desired that PAO will be the chairman and Induna and water management expert will be the advisors of the committee.

## 2) Activity plan for the Preparing Committee

The activity items of the Committee are as follows :

- To hold the Committee meeting periodically and make plans of articles, rules, and regulations necessary for the establishment of the water use organization.
- To determine the supporting manpower and budget systems of the Agricultural Department for the facilities operation, maintenance, and management, and administration activity based on the irrigation plan.
- To apply and get permission of water right for proceeding the plan.
- To advise the cultivation right to the owners concerning the effective utilization of his or her unused land located in the irrigation planning area.
- To confirm the beneficiaries in the irrigation planning area and make their list.
- To advise the relevant village head to distribute his cultivation right in case that the number of beneficiaries concerning a planned secondary irrigation canal is too small, and if he does not agree to the advice, omit that secondary canal area from the planning area, and apply to the Agricultural Department for the exchange of that amount of area for substituted area (lower part of the irrigation planning area).
- To advise the establishment of the water use organization promptly, when the planning is decided, and make guidance for the members of the organization until the establishment.

## (2) Program for Water Management Training

The training for the beneficial farmers who have little experience for the irrigation and water management and Agricultural Department staffs who make the technical guidance for the farmers, will be held as follows:

### 1) Irrigation and water management course for beneficial farmers

- Objectives: The farmers with little experience in irrigation and water management will be trained for real irrigation methods and necessary knowledge in water management.

- **Goal of objectives:** To learn of actual methods and knowledge in the practice of irrigation and water management according to the program and to recognize the importance of the cooperative operation.
- **Training items:** Irrigation and drainage (Lecture 2 days, practice 2 days)  
Water management (Lecture 2 days, practice 2 days)  
Water use organization (Lecture 2 days)
- **Joining rule:** One person from one beneficial farm household, 30 persons per one training.
- **Practicing system:** Two lecturers
- **Training place:** Integrated Training Institute and planning irrigation area field
- **Training items plan:** Table 6.8.1.

**Table 6.8.1 Proposed Training Items (for general)**

<b>Irrigation and Drainage</b>	<b>Water Management</b>	<b>Water User's Group</b>
Necessity of irrigation and drainage	Importance of irrigation and drainage	Necessity of people's participation
Function of paddy field	Growth of rice and seasonal irrigation requirement	Regulation of water user's group
Evapotranspiration from paddy field	Resource of the region and water use	Roles and function of water user's group
Proposed irrigation facility	Counter measure of drought	Solution of water use dispute
How to use the irrigation facility	Concrete practice of water management	

**2) Training course for leaders**

- **Objectives:** Extension workers, and water use organization staffs are trained in irrigation practicing methods and applicable knowledge for water management.
- **Goal of objectives:** Learning of actual methods and knowledge in the practice of irrigation and water management according to the program and recognizing the importance of the cooperative operation.
- **Training items:** Irrigation and drainage (Lecture 2 days, practice one day)  
Water management (Lecture 2 days, practice one day)  
Water use organization (Lecture 2 days)

- **Joining rule:** Extension workers, other Agricultural Department staffs, and water use organization staffs, 5 persons per one training.
- **Practicing system:** Two lecturers
- **Training place:** Integrated Training Institute and planning irrigation area field
- **Training items plan :** Table 6.8.2.

**Table 6.8.2 Proposed Training Items (for leader)**

<b>Irrigation and Drainage</b>	<b>Water Management</b>	<b>Water User's Group</b>
<b>Outline of irrigation and drainage plan</b>	<b>Facility Operation and maintenance plan</b>	<b>Support of water user's group</b>
<b>Paddy field irrigation plan</b>	<b>Water management of paddy field</b>	<b>Collection and operation of water charge</b>
<b>Upland irrigation plan</b>	<b>Water management of upland field</b>	<b>Settling of water use dispute</b>

## 6.9 Farming and Crop Husbandry

### 6.9.1 Present Condition of the F/S Area

#### (1) Traditional farming type

The rural society in the F/S Area is an agropastoral society of a mixed farming system based on a family unit basis, more or less involving a self-subsistent farming of crop cultivation for maize, cassava, sorghum and rice, combined with livestock and fishery. Cattle is playing an important role for the family farming to supply manure, milk, as well as animal traction power for plowing and transporting, and also functioning a security property for emergency cases. Fishery is mainly confined to small canals of the surrounding area for fishing tilapia and catfish which is a vital source of supplying protein for the villagers.

#### (2) Crops and Agriculture Production

##### 1) Traditional Cropping Pattern

Rice is the chief crop cultivated in Sitapa-matapa seepage zone in the rainy season. Maize is also widely planted in Sitapa-matapa garden.

Mazulu garden suited for maize cultivation is relatively small in the F/S Area. Vegetable cultivation, which is relatively small scale compared to the other agricultural camps, is mainly confined to the plain edge of wet Litongo. Vegetable cultivation from the cool dry season to the onset of rainy season is usually irrigated using bucket from near the drainage canal or shallow well. Sweet potato is also widely observed on raised mounds(Mukomena) in wet Litongo, Sishanjo, and Mazulu gardens in both rainy and dry seasons according to the water regime. Cassava is the chief crop planted in dry Litongo and Matema gardens after clearing bush and harvested one to three years later. However, shifting cultivation is not common in the F/S Area and majority of the cassava growers cultivate continuously in the same site, by uprooting tubers followed by filling gaps with cuttings.

Most of the tree crops is confined to wet Litongo garden along the plain edge. Major fruit trees observed are mango, cashew, guava followed by citrus, pine apple and banana. However, some draught tolerant fruit trees like cashew, mango are distributed to the bush area where is widely extended with Karahari sand soils. Fruiting habitat is mostly confined to the rainy season. However, banana bears fruit throughout the year.

##### 2) Current Farming Practice in the F/S Area

The farming practice in the F/S Area is summarized in Table 3.3.3 and Table 3.3.4. Generally the traditional farming practice prevailed among the self-subsistent farmers is

primarily oriented to an extensive way with low inputs, which results in a lower yield level.(Annex VI.9.2.)

a. Crop Seeds and Seedlings of Tree crops

- Maize : More than 70 % of the maize growers procure the certified F1 maize seeds every year from Hunger Project(HP), WPCU and MNG.
- Rice : Most of the rice growers supply seeds by themselves.
- Vegetable : Most of the vegetable growers procure the commercially sold seeds from WPCU, PHC.
- Fruit : New variety of mango, guava, orange, banana seedlings are generally procured from the Western Province Nursery Center at Namushakende.

b. Fertilizers and Agro-chemicals

- Chemical fertilizer: About 40 % of the farm households use chemical fertilizers for maize, rice and vegetables by procuring from the WPCU.
- Kraal Manure: About 80 % of the vegetable growers applies kraal manure, while more than 50 % of the farmers applies it to the food crops.
- Agro-chemicals: Only a handful farmer uses for vegetables.

c. Major farm operations

i. Plowing operation combined with burning grasses

Table 6.9.1 shows the present condition of the ADP in the F/S Area, and indicates a quite low diffusive rate. Thus most of the small scale farmers owing no oxen are facing a severe frustration of their land preparation. Introduction of ADP for each garden type is referred to 3.3.3 (2)-3). Sishanjo is mainly plowed by hoe due to low bearing capacity. Common practice prevailed in Sishanjo garden is burning the dried soil clods with grasses after hoeing operation. This practice is quite effective to suppress severe weed infestation and to supply P, K, and Ca for amendment of the soil acidity through ash. Vegetable garden is mostly small scale and plowed by hoe. Winter plow practice in Mazulu and Saana gardens appears to suppress weed infestation. Due to lack of animal traction power, however, it is not common among the small scale farmers and only plowed before sowing operation.

ii. Sowing operation

Sowing operation exclusively depends on manual work and the sowing method is referred to 3.3.3 (2)-4). Other cereal crops like sorghum and

bulrush millet are usually sown in spot. Vegetables are mainly sown on the nursery bed and transplanted to the field.

**Table 6.9.1 Summary of the Animal Traction Power in the F/S Area**

Implements	Yeta Ward				Total
	Zone 1	Zone 2	Zone 3	Zone 4	
No. of Farm HHS	72	83	88	90	333
No. of Village	19	11	10	21	61
No. of Kraals (*)	5	4	3	9	21
No. of Oxen span	9	6	3	8	26
No. of Ox-carts	0	0	2	1	3
No. of Plows	5	4	6	9	24
No. of Sledge	2	3	4	7	16
No. of harrows	0	0	0	2	2
<b>Total (Implements)</b>	<b>16</b>	<b>13</b>	<b>15</b>	<b>27</b>	<b>71</b>

Note: This data is based on the hearing survey done in November 1994 and the numbers of the kraal are those in the rainy season

### (3) Crop Production and Cultivated Area

Table 6.9.2 shows the numbers of farm households, cultivated area and crop production of the 1993-1994 cropping season in the F/S Area. The production was estimated by multiplying the acreage collected by CEOs and yield/unit area quoted from the 1993/1994 Crop Forecasting Survey Results. This table indicated that an area devoted to cassava was the highest followed by rice and maize. But production of the rice was outstanding among them. Thus, this area is characterized to a rice-oriented farming type. Concerning vegetables, no quantified data was available, but a hearing survey result from the CEO estimated that the total acreage for the vegetables was less than one hectare based on the number of about 70 farm households growing vegetables with average of 0.01 ha/household in the F/S Area. Mango production was estimated by the average number of trees/household times yield/tree quoted from the result of the Farm Economic Survey done in the Master Plan Survey. As a result, total output is annually estimated at 570 t in the F/S Area. Similarly, cashew production is annually around 3.2 t, but due to poor management, the raw nut production is decreasing. Meanwhile, citrus production is quite small, and estimated at 2.8 tons, and guava is around 1.5 tons annually.



#### (4) Processing and Marketing

Concerning mango fruit processing, the mango pulp plant formerly managed by Zambia Horticulture (ZAMHORT) is now reorganized as an independent firm named as MANGOLD Ltd., and carrying out a rehabilitation and upgrading program. Thus, marketing of the mango fruits heavily relies upon the progress of the said rehabilitation schedule. Meanwhile, Zambia Cashew Company Limited(ZCCL) is now encountered with a severe financial problem due to a transitional process of privatization. Therefore, the cashewnut growers in the F/S Area are discouraged because of no purchase being made by ZCCL at present.

#### 6.9.2 Development Plan for Farming and Crop husbandry

##### (1) Plan of Crop Production

###### 1) Selection of Target Crops

Rice, maize, vegetable and fruits(mango, guava and citrus) were selected as the major target crops for the F/S Area based on the said development plan for the Study Area in conjunction with consideration of natural and socio-economic conditions of the F/S Area.

###### 2) Cropping Plan

The allocation of the crops over the various garden types, which are locally classified by soil, water regime and topography, is made based on the following policy.

###### a. Matema Garden

Soils of this garden type is dominantly of Kalahari sand with poor water retentivity and nutrients. Thus, the crop which can grow in this poor soil is suitable for the deep root crops like bulrush millet, cassava, cowpea and bambara nut as an intercrop of cashew or mango trees with organic mulch.

###### b. Dry Litongo Garden

This garden type is quite sandy soil with poor water retentivity and nutrients. Permanent crops like mango and cashew are suitable. Cassava, bulrush millet are better to be intercropped with cowpea, pigeon pea and bambaranut. Mulching practice with organic matter is also necessary.

###### c. Wet Litongo Garden

This garden type keeps a favorable moist condition through the year with fair humus content. Permanent crops like mango, orange and guava are suitable. Vegetable

production by bucket irrigation combined with a rotation of leguminous crop like ground nut, cowpea and bambaranut is also preferable.

d. Sishanjo Garden

Muck-peat soils are dominantly extended with a regular water-logging condition through the year, and farming is directly subject to a function of the catch-drain existed. Rice cultivation requires a heavy labor force in terms of weeding and plowing because of inability of introducing ADP, thus this garden is not much cultivated. But rice or vegetables on the high ridge is considered if the land demand is high.

e. Sitapa-matapa Garden

This garden is a fertile sandy to loamy sand soils because of being exposed to annual flood which plays a role to supply minerals into the soil. It is possible to grow rice in the both rainy and dry seasons by irrigation. Maize is also cropped by the bucket irrigation method.

f. Mazulu Garden

This garden is a mound shaped land with rich bases formed on anthill of old river bed levees, and seldom flooded. A rotation of maize, and sorghum (intercropped with cowpea) is suitable for a sustainable cropping system in conjunction with a manuring practice on every three years.

(2) Category of the Farming Systems

Based on the present hydrological regime and the irrigation scheme of the F/S Area, the following three farming types are formulated according to the said cropping plan.

1) The Farming Type-I

This system consists of double cropping of rice in the both dry and wet seasons with upland crop, vegetable and fruit. Zone 3 and 4 where the irrigation water is available from the Sefula canal are suitable for this farming type. But vegetable production is better to be mainly allocated in Zone 3 where wet Litongo garden is available.

2) The Farming Type-II

This system consists of single rice cropping under rainfed condition with maize irrigated by bucket method at initial growth stage, vegetable and fruit. Zone 1 is applicable to this type because of the several catch-drains are available for the bucket irrigation method.

### 3) The Farming Type-III

This system consists of single rice cropping under rainfed condition with maize, vegetable and fruit. Zone 2 is applicable to this type because of some difficulties to get water during the dry season for upland crops.

In the above-mentioned 3 farming types, mango is confined to proper management of the existing trees only, while guava and citrus are planed to establish new orchard beside the proper management of the existing trees. Planting the seedlings is favorable at onset of the rainy season.

#### (3) Formulated farming practice

##### 1) Dry season rice with irrigation

###### a. Plowing operation

Implementing plowing and harrowing practice by ADP, an expansion of the cultivable area coupled with labor reduction is promoted. When the field is too dry in the hot dry season, an operation of moistening the fields prior to plowing should be made so as to get seeds germinate under suitable moisture condition.

###### b. Sowing operation

The water-screened seeds(thermal sensitive variety: IR-64) should be sown on August by a manual seeder in line at 30 cm apart.

###### c. Fertilizer dosage

Combined with the first weeding practice, 250 kg/ha of D'mix(10-20-10) are broadcasted before the emergence. Urea for top dressing can be applied at tillering and meiosis stages at a rate of 50 kg/ha respectively.

###### d. Field management

Insect control should be timely managed, of which method is mainly oriented to the biological/physical method. Weed infestation becomes serious especially during the upland condition, thus weeding practice should be timely carried out by hand. Flooding the field should be practiced at 20 cm height stage. Water should be kept thoroughly during the tillering, panicle formation and flowering stages, because water demands are high in those stages.

**e. Draining of residual water**

Following the flowering stage, the rice field is apt to be waterlogged due to the progressive rainy season, thus release ponding water two to three weeks prior to harvest so as to make a harvest operation easy.

**f. Harvest operation**

Cutting rice stalks down at panicle base by sickle, and thresh and winnow the paddy by the motor-drive machines in the sheltered drying place to avoid unexpected rain.

**2) Wet season rice with supplemental irrigation**

**a. Plowing operation**

Following the harvest operation of December, plowing by ADP should be immediately carried out. Sitapa-matapa garden has an enough bearing capacity to make an oxen-plowing operation possible in the rainy season.

**b. Nursery bed**

Seeds via screened by water are sown on a well prepared dry nursery bed on mid December. Size of the nursery bed is approximately 5 % of the field size and 70 g seeds/m<sup>2</sup> density.

**c Transplanting operation**

Three seedlings per hill should be transplanted with a plant density of 22.2 hills per m<sup>2</sup>(15 cm x 30 cm).

**d. Fertilizer dosage**

Same as the dry season rice.

**e. Field management**

Deep water management is necessary to promote rooting of the transplanted seedlings after transplanting. After this stage, the management is the same as the dry season rice.

**f. Draining of residual water before harvest**

Same as the dry season rice.

**g. Harvesting operation**

Cutting rice stalks down at panicle base by sickle, and threshing and winnowing of some portion of the harvested paddy by the manual type machine in the field during the dry season.

**3) Rainfed rice**

Single rice cropping under rainfed condition is carried out with line sowing method on dry bed and the other practice is the same as the aforementioned practice.

**4) Maize**

**a. Maize in Mazulu garden**

**i. Plowing operation**

Plowing by ADP at onset of the rainy season is carried out to promote the area expansion with labor saving.

**ii. Sowing operation**

Focusing on the wet season of Mazulu maize, a hybrid variety (MM603 or 604) of the late mature is sown by using one line type seeder at about 40,000 plants/ha with 40 kg seed rate/ha.

**iii. Fertilizer dosage**

Basal dressing of 200 kg D'mix(10-20-10)/ha is broadcasted within three weeks after sowing. Top dressing is applied five to six weeks later after sowing at a rate of 160 kg urea/ha.

**iv. Field management**

Weeding practice needs to be done twice through a cropping season at four weeks and knee high stages, respectively after sown in conjunction with hoeing operation.

**vi. Harvest and storage**

Drying cob under the sunlight followed by harvesting is stored in a storage bin with husk to avoid insect problems, or sacked and kept in the farmhouse.

**b. Sitapa maize irrigated by bucket method**

**i. Plowing operation**

Plowing by ADP at onset of the hot dry season is carried out to promote the area expansion with labor saving.

**ii. Sowing operation**

Focusing on the wet season of Mazulu maize, a hybrid variety (MM603 or 604) of the late mature is used with about 40,000 plants/ha or 40 kg seed rate/ha.

**iii. Fertilizer dosage**

Basal dressing of 200 kg D'mix(10-20-10)/ha is broadcasted within three weeks after sowing. Top dressing is applied five to six weeks later after sowing at a rate of 160 kg urea/ha.

**iv. Bucket irrigation practice**

The initial growth stage of about one month after emergence is difficult to absorb soil moisture from the water table at around 60 cm below the soil surface. Therefore, conducting the bucket irrigation practice once a week, plant water stress should be mitigated to promote an initial growth.

**v. Field management**

Weeding practice needs to be done twice through a cropping season at four weeks and knee high stages, respectively after sowing in conjunction with hoeing operation.

**vi. Harvest and storage**

Drying cob under the sunlight followed by harvest is stored in a storage bin with husk to avoid insect problems, or sacked and kept in the farmhouse.

**c. Sitapa maize under rainfed condition**

This is the cropping type to utilize soil residual moisture as usual. A fertilizer dosage is 200 kg/ha of D'mix for basal dressing and 100 kg/ha of Urea for topdressing. Other practice except for the bucket irrigation method is just the same as above mentioned one.

## 5) Vegetables

A cropping pattern over the cool dry season is managed by employing the bucket irrigation method according to the soil moisture condition. Fertilizer is applied by using both kraal manure and chemical fertilizers. The both bulb onion and cabbage are relatively of less damage in a continuous cropping. But rotating both crops alternatively, a yield of bulb onion is severely decreased when planted after cabbage. Thus, each crop should be individually cropped in conjunction with a rotation of leguminous crops in order to build soil fertility and suppress an occurrence of disease and pest problems. According to the need of crop condition, chemical spray is conducted.

## 6) Fruit crops

Planting seedling into a hole should be done after applying 5 kg of kraal manure into a planting hole by mixing them with soils thoroughly with ample time for decomposition. After planting, organic matter for mulching should be placed around the seedling to protect the soil desiccation, and promote rooting by watering properly. Increasing a yield level, an annual fertilization is strongly recommended.

## (4) Mechanization

In order to expand the cultivable area in conjunction with reduction of burden work by labor, an introduction of ADP is indispensable for plowing, harrowing and transporting in the F/S Area. However, the number of available ADP does not meet a present demand, thus the farmer faces some difficulties to conduct a land preparation on time. In this plan, promoting an ADP extension work over the small scale farmers via borrowing or hiring method, a possibility of some farming practice like weeding is also examined with the Animal Draught Power Project. The prevailing sowing operation in the F/S Area relies on manual operation, but it needs to be improved in terms of sowing depth, and density. Thus, a manual type of seeder is planned to introduce for the formulated plan. Preferable mechanization and a method of its possession are as follows.

### 1) Paddy rice

- a. ADP and its implements(plow and harrow): Possessed by the farmers group
- b. Manual type of seeder: Possessed by the farmers group
- c. Foot pedal type thresher and manual winnower: Possessed by the farmers group
- d. Motor drive thresher, winnower and milling machine:  
Possessed by the Department of Agriculture in the Western Province

2) Upland crop and Tree crop

- a. ADP, plow and harrow: Possessed by the farmers group
- b. Manual shoulder type sprayer: Possessed by the farmers group
- c. Manual type seeder(one line type): Possessed by the farmers group

(5) Labor Forces

Annual required labor force of the said farming types were 670 man-day for the farming type-I, 414 man-day for the type -II and 332 man-day for the type-III, respectively. Checking the required labor force per every 10 days, it was projected that the type-I generated at least a short of 18.7 man-day during December-January for the harvesting and transplanting operations against an available self-labor of 27.2 man-day/every 10 days.

However, the average size of the farm household in the F/S Area has some supplemental labor force like school children which is around 1.46 man-day per farm household. Assuming that the said labor force available during the busy farming season, this shortage of labor force becomes 7 man-day/10 days and this short is managed by employing labors. The criteria of "man-day" used here is referred to the guideline issued by Zambia as 7 hours per day. Therefore, provided that "8 hours per day" is applied, a maximum shortage of the labor force is only 1.3 man-day/10 days in a corresponding period, thus it is justified that no burden imposition is assigned to the small scale farmers.(Annex VI.9.2)

(6) Yield projection and crop production plan

Crop yield is expected to increase by introducing an irrigation method and improving the farming practice after implementation of the formulated plan in the future. Also, the crop yield under rainfed condition is expected to increase slightly by improving of the cultural practice. The projected yield in the future is shown in Table 6.9.3.

(7) Training Program

Accomplishing the said target of the formulated development plan, it is indispensable to carry out the training program for the beneficial farmers in accordance with each training item. The projected training items are shown in Annex VI.9.



**Table 6.9.3 The Projected Yield Level**

Crop	Present (t/ha)	Without Project (t/ha)	With Project (t/ha)
<b>Paddy rice</b>			
Wet season	1.08	1.19	4.0
-rainfed area	1.08	1.19	3.5
Dry season	-	-	4.5
<b>Upland crop</b>			
Maize	0.68	0.75	2.5
Cassava	0.36	0.40	1.5
B/millet	0.62	0.68	1.0
Sorghum	0.64	0.70	1.0
<b>Vegetable</b>			
Onion	-	-	20.0
Cabbage	-	-	25.0
<b>Tree crop</b>			
Mango*	0.23	0.25	0.29
Guava	0.008	0.012	0.025
Orange*	0.015	0.017	0.04

Note: Fruit crops refer to the yield per tree, not per ha.

The plan of the crop production after implementing an irrigation scheme is projected in Table 6.9.4 based on the above table.

**Table 6.9.4 Crop Production Plan**

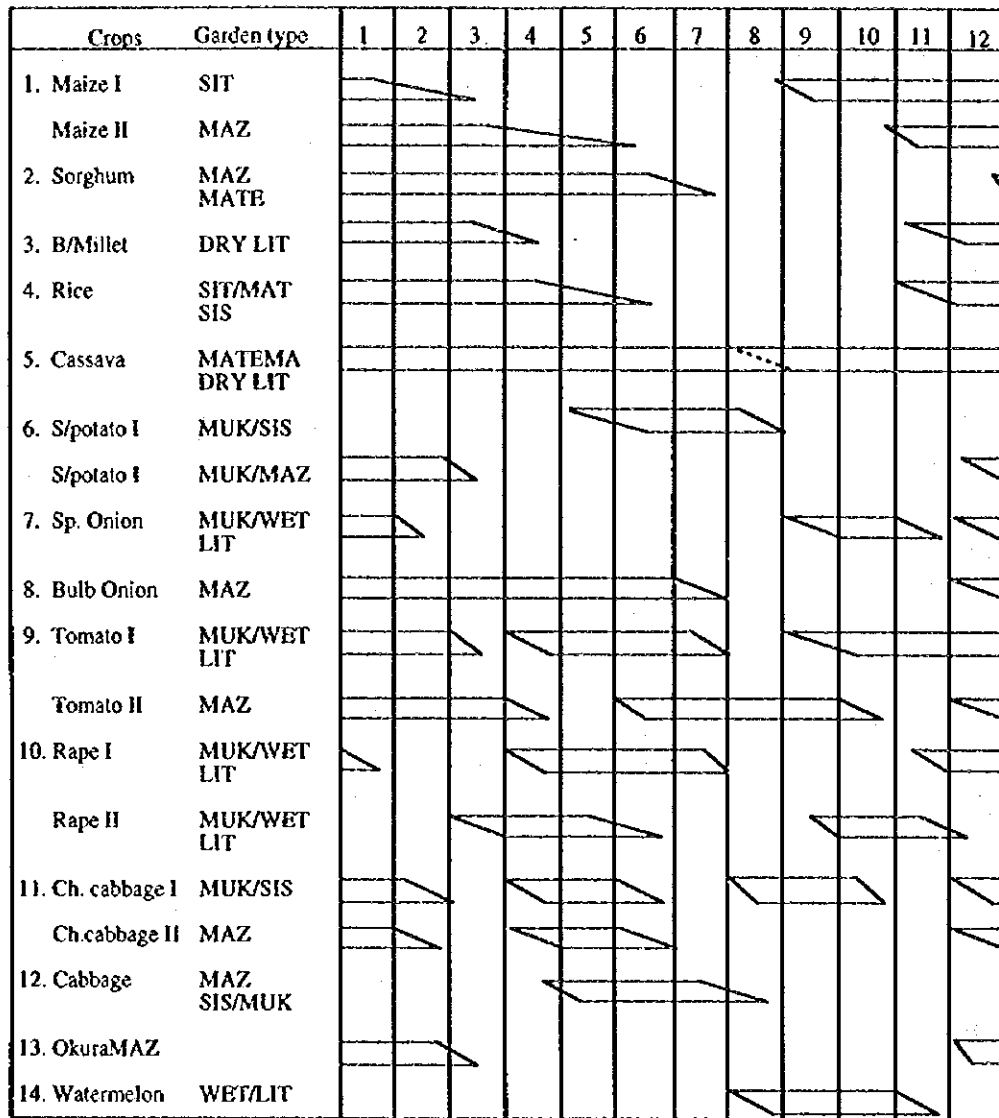
Crops		Area (ha)	Yield (t/ha)	Produce (ton)
Paddy rice	Dry season(Irrigated)	100	4.5	450
	Rainy season(Irrigated)	200	4.0	800
	Rainy season(Rainfed)	90	3.5	315
Upland crop	Maize (Mazulu)	16	2.5	40
	(Sitapa)	75	2.0	150
	(Sitapa w/bucket)	25	2.5	62.5
	Cassava	240	1.5	360
	B/millet & Sorghum	40	1.0	40
Vegetables	Onion(Bucket irrigation)	10	20.0	200
	Cabbage(bucket irrigation)	10	25.0	250
Fruit tree	Mango(t/tree) 2479 trees	29.0	0.29	719
	Guava(t/tree) 2000 trees	7.2	0.025	50
	Orange(t/tree) 1250 trees	2.0	0.04	50
<b>Total</b>		<b>844.2</b>		

Note: Fruit refers to a yield per tree. Total yield refers to the food crop only. Cassava is harvested on every three years.

**Table 6.9.2 Farmhouse, Farmland, Area devoted to each crop, and Crop Production in the F/S Area**

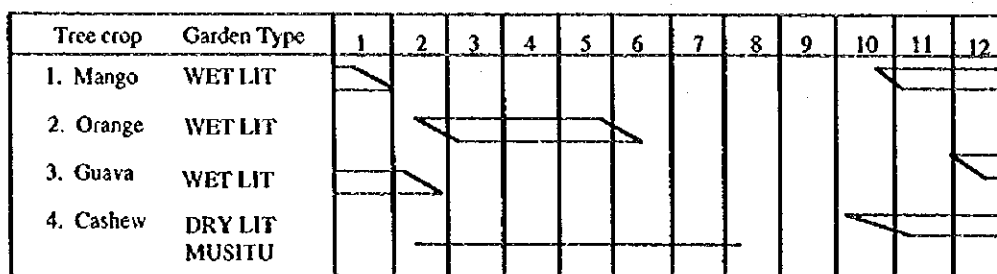
Parameter	Yeta Ward				Total	
	Zone 1	Zone 2	Zone 3	Zone 4		
Farm HHS	M	30	32	33	38	133
	F	42	51	55	52	200
<b>Total</b>		<b>72</b>	<b>83</b>	<b>88</b>	<b>90</b>	<b>333</b>
<b>No. of Villages</b>		<b>19</b>	<b>11</b>	<b>10</b>	<b>21</b>	<b>61</b>
<b>Farmland (ha)</b>		<b>170.0</b>	<b>178.0</b>	<b>188.0</b>	<b>211.0</b>	<b>747.0</b>
<b>Area (ha) / crop</b>						
Maize		25.0	22.0	32.0	36.0	115.0
Rice		38.0	50.0	55.0	45.0	188.0
Cassava		55.0	54.0	72.0	61.0	242.0
Millet		6.0	7.5	6.5	7.0	27.0
Sorghum		3.0	3.0	4.5	3.0	13.5
<b>Total (ha)</b>		<b>127.0</b>	<b>136.5</b>	<b>170.0</b>	<b>152.0</b>	<b>585.5</b>
<b>Production (t) / crop</b>						
Maize		45.0	39.6	57.6	64.8	207.0
Rice		60.8	80.0	88.0	72.0	300.8
Cassava (Dry chip)		9.9	16.0	21.6	18.3	65.8
Millet		6.5	8.1	7.0	7.6	29.2
Sorghum		5.4	5.4	4.9	5.4	21.1
<b>Total (t)</b>		<b>127.6</b>	<b>149.1</b>	<b>179.1</b>	<b>168.1</b>	<b>623.9</b>
<b>Production / Fruit</b>						
Mango (t)		122.0	140.0	166.0	139.0	567.0
Cashew (kg)		691.0	796.0	940.0	787.0	3214.0
Guava (kg)		313.0	361.0	426.0	356.0	1456.0
Citrus (kg)		615.0	720.0	840.0	705.0	2880.0
<b>Total (t)</b>		<b>1741.0</b>	<b>2017</b>	<b>2372</b>	<b>1987.0</b>	<b>8117.0</b>

Note: This table is compiled based on the 93-94 crop forecasting survey data.



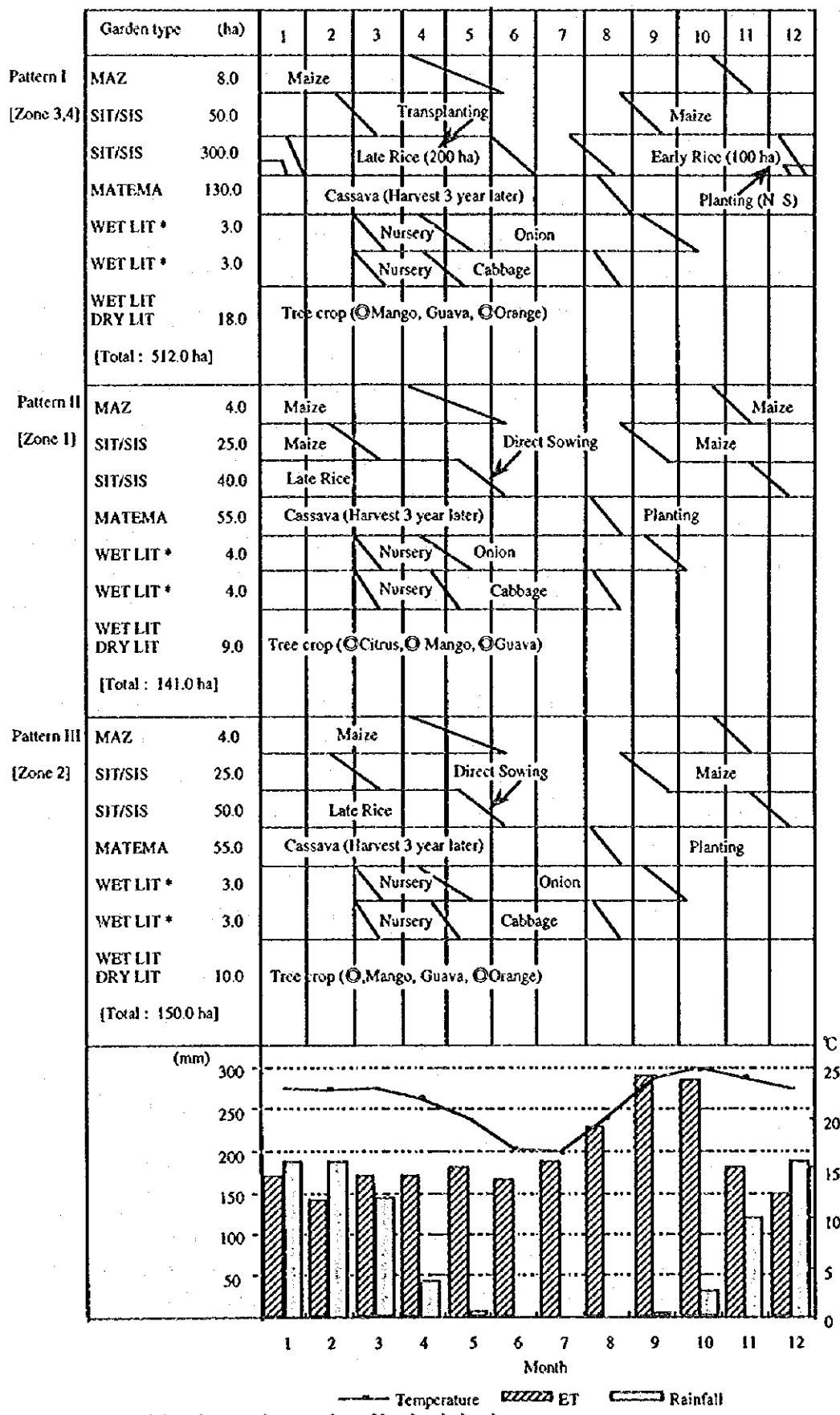
Notes: SIT/MAT: Sitapa-malapa                      MUK/SANA: Mukomena in Saana  
 MAZ: Mazulu    MUK/WET LIT: Mukomena in Wet Litongo  
 DRY LIT: Dry Litongo                              SIS: Sishanjo  
 MUK/SIS: Mukomena in Sishanjo              MATE: Matema

Figure 6.9.1 Traditional Cropping Pattern of Food Crops and Vegetables



Notes: 1) Abbreviation of "Garden" is same as the figure .6.9.1.  
 2) [—] : This period produces small amounts of nuts.

Figure 6.9.2 Fruit Bearing Season of Major Tree Crops



Note : The asterisks of mean the practice of bucket irrigation

Figure 6.9.3 Projected Cropping Pattern

## 6.10 Animal Husbandry

### 6.10.1 General Condition of Livestock In the F/S Area

#### (1) Type of Animal Raising

The dominant livestock in the F/S Area is the cattle amounting to around 1,600 in 1994. Most of them are dairy and beef cattle and draught animal occupies only 5 % of the total heads. The traditional cattle raising system is a transhumant system combined with communal grazing system, cared by a caretaker, who is called "kraal owner" or "herd owners". Thus cattle owners do not always care their cattle by themselves. A kraal size is generally not more than 100 heads. Other livestock is chicken coming to around 1,300 and no other conspicuous livestock in the F/S Area. Seasonal movement of the cattle herds is directly related to a flood cycle of Zambezi river. Namely, cattle herds are grazed in the flood plain from onset of the dry season and move up to the upland at the beginning of flooding in the plain. The change of cattle liveweight is also strongly related to the said grazing cycle and decreased considerably in the late rainy season when feeding material is dried up in the upland. Concerning cattle breeding in the Area, only natural breeding is dominant without no artificial insemination. A rate of head increment is around 2.8 % per year.

The main purpose of keeping cattle in the Area is mainly for 1) Acquisition of the benefits related to the farming such as securing animal draught power, manure and milk, 2) Security function in care of urgent needs, 3) Prestige of a social status. The composition of the cattle herds in the F/S Area consists of 40.5 % of cow, 15.6 % of oxen, 13.2 % of heifers and so on as presented in Table 6.10.1.

**Table 6.10.1. Composition of Cattle Herds in the F/S Area**

Composition	No. of Heads	Percentage(%)
Cow	672	40.5
Oxen	258	15.6
Heifers	219	13.2
Heifer calves	202	12.1
Bull calve	184	11.1
Young bulls	83	5.0
Bull	41	2.5
Total	1,659	100.0

Source: The heads of cattle are estimated based on the number of Kraals and the composition ratio of cattle herds in Western Province.

## (2) Animal Products

### 1) Meat

Local slaughtering number is quite small with three to four heads per month at the Sefula abattoir. Therefore, the local consumption of meat is estimated to be really small amount. Two thirds of the meat demand come from Mongu township and some other urban areas. One of the health officers at Sefula RHC (Rural Health Center) is conducting meat inspection on behalf of the veterinary assistant officer stationed at Namushakende.

### 2) Milk

Statistically quantified milk production in the F/S Area is not available. However, judging from the cow rate and milking days per cow per year, around 220 kilo liter per year is assumed, and actual marketing bulk in the Area is presumed to be 22 kilo liter per year in a form of the sour milk.

## (3) Sanitary Condition of Livestock

Livestock in the F/S Area is controlled by the Namushakende veterinary camp office, around 10 km south of the Area, where one veterinary officer is stationed, and to cover a vast area of his jurisdiction. Under his veterinary camp area, there are five vaccination points and one of them is regularly set up in the F/S Area during July and August for the campaign period of epidemic disease like anthrax with free of charge. Other important diseases like Black Quarter (BQ) and Hemorrhagic Septicaemia (HS) in the Camp Area is also vaccinated during this period with charge. However, an outbreak of disease in the Area is relatively small and only BQ was reported to break out on 36 heads in 1994.

## (4) General Constraints of Livestock Development

### 1) Grazing area

With the onset of flooding in the flood plain for the grazing area, the cattle herds move up to upland to seek for grass. However, suitable grazing lands in the upland is quite limited coupled with limited water points for the herds. Thus, liveweight is markedly decreased in the late rainy season.

### 2) Poor Supporting Services for the Livestock Farmers

Currently, one veterinary assistant stationed at Namushakende covering his vast camp area has no optimal transportation mean to visit his overall territory. Thus, visiting range is confined only to the surrounding area of his office. Meanwhile, due to lack of permanent crush pen in the Area, emergent diagnosis for the livestock is facing difficulties to carry out.

### 3) Lack of Cattle Loading Ramp Facility

The number of cattle taken out from the F/S Area is estimated annually around 750 heads including the surrounding area. However, lack of cattle loading ramp, the cattle herds have to be moved up to Mongu township where the said facility is equipped.

## 6.10.2 Outlines of Livestock Development Plan

The feasible development plan is formulated to overcome the present problems in the F/S Area as follows.

### (1) Components

- 1) Construction of a cattle crush-pen
- 2) Construction of a loading ramp
- 3) Construction of a small sausage-processing factory

Outlines of the projected components are as follows.

### (2) Construction Plan of a Cattle Crush Pen

There is no permanent crush-pen for cattle in the F/S Area. Presently, a temporary crush-pen is made with wood and wires during the vaccination campaign of cattle against Anthrax. Under the proposed project, a permanent crush-pen will be constructed to enable continuous vaccination and veterinary care of cattle.

#### 1) Outlines of the facilities

Cattle will be enclosed in a crush-pen made of iron railings, similar to narrow corridors, in order to carry out vaccination and veterinary treatment.

#### 2) Operation and maintenance system

The crush-pen will be attached to the Integrated Training Center, and a service fee will be collected from the users. The Department of Agriculture (DOA) of the Western Province will be in charge of the operation and maintenance of the crush-pen.

#### 3) Annual number of cattle using the facilities

A total of 1,700 heads in the F/S Area will directly use the crush-pen together with 4,600 heads of cattle from the surrounding areas.

#### 4) Crush-pen Service Fees and maintenance cost

The crush-pen service fees will be the same as the current fee in the existing facilities of the Study Area which amounts to K 5,000/kraal in case of Anthrax vaccination, and K 200/head in case of Black Quarter vaccination and castration. The collected service fees will be used to operate, manage and renew the facilities.

### (3) Construction Plan of cattle loading facilities

There is no livestock market in the F/S Area, and most of the cattle are transported by the cattle traders to the Lusaka cattle market or markets along the railway line. Since there is no loading facilities for the transport of animals in this area, the cattle herd has to walk until Mongu town, and then carried by truck to the Lusaka market. Accordingly, the said facility is constructed in order to make the loading operation of cattle easier.

#### 1) Outline of the loading facilities

The loading facilities will serve to expedite the loading of cattle into the trucks, comprised of an inclined footboard and a ramp, with simple structure made of iron pipes and concrete.

#### 2) Operation and maintenance system

The cattle loading ramp will be attached to the Integrated Training Facility, and a service fee will be collected from the users. The DOA of the Western Province will be in charge of the operation and maintenance.

#### 3) Annual number of cattle heads using the loading ramp

Total cattle heads that will use the facilities, including those of the F/S Area are estimated to be about 750 heads annually .

#### 4) Annual Service Fees

Service fees collected from the users will be a uniform rate of K 200/head which is followed to the other existing facilities in the Study Area. The collected service fees will be used to operate, manage and renew the facilities.

### (4) Construction plan of a small sausage processing facility

The sausages produced in Mongu are made of minced meat mixed with spices and processed into sausages with a manual stuffer. However, the meat cutting is large and rough and the mixing of spices is not good. This is why the hotels in Mongu township purchase better quality of sausages from Lusaka.



Thus this facility aims at supplying cheap and good quality of the sausage to Mongu township by using cheap materials like viscera from the local slaughterhouses and heat-sterilized processing and improving the diet of rural residents.

1) Outlines of the sausage processing facility

The sausage processing facility will be attached to the Integrated Training Facility and occupies a 50 m<sup>2</sup> area. The main processing equipment will be an electric high-speed cutter and an electric sausage stuffing machine, for the production of sausages of high quality.

2) Operation and maintenance system

The DOA of the Western Province will be in charge of the management and maintenance of the sausage processing facility. Control of the sausage quality will be carried out by a food processing expert appointed by the DOA.

3) Production quantity

Two different types of sausage will be processed. One is an ordinary sausage for the hotels, and the other is sausage for improvement of the diet of rural residents. Total production of both sausages will be 2,000 kg/year each during the first year and 4,000 kg/year from the second year. As regards the method of preservation, ordinary sausage will be frozen while the nutritious sausage will be sterilized by steam heat for a better conservation. Moreover, the earnings from the sale of sausage is allotted for the cost of operation and maintenance of the facility.

## 6.11 Inland Fishery

### 6.11.1 General Condition of Inland Fishery in the F/S Area

#### (1) Type of Inland Fishery

Fishery in the F/S Area is playing an important role in the sense that it is the mean of obtaining cash income for fishermen and farmers, and the fish is one of the important protein sources for the villagers in general. The households related to the fishery in the Area are 123 and includes the fishermen who have no license. The numbers of the households by zone are presented in Table 6.11.1.

Table 6.11.1 Number of Fishermen in the F/S Area

Zone No	1	2	3	4	Total
No of Fishermen	52	34	10	27	123

Source: The data is compiled by the hearing survey.

Main fishing ground is Malile river (little Zambezi river), around 6 km west from the plain edge. The fishing activities are in general conducted on a small scale by using canoes with fishing net, or hook or spear. According to the results of hearing survey, income scale for fishermen including fish trader ranges from K 1,000 to K 10,000 per day.

The fishing season is mainly confined to the dry season starting from May up to December. Some of them has just settled down temporarily beside the river banks at the Malile or Zambezi rivers during the season. In the off-season of January to April, majority of the fishermen do farming activity and some are engaging in manufacturing handicraft for sale.

#### (2) Fish Marketing

In the F/S Area, there is a public market place at Sefula sub-urban area which is managed by Mongu District Council, and dry and fresh fishes are sold there. Although the definite data are not available, quantity of locally sold fishes appears to be relatively small. Most of haul of fishes are transported to urban areas such as Mongu, Kaoma or Lusaka through the fish traders. According to the record of the 1993 hauled fish bulk checked by the fish guard stationed at Sefula, the hauled quantities of fresh fish and dry fish were 23,128 kg and 10,353 kg respectively.

#### (3) Fish Control

Most of the fishermen in the Area conduct fishing on a small scale without any fishing license and their activities are usually acquiesced by the authority due to lack of staff in the Fishery

Department. Sefula market is attended every day by one fish guard officer from Namushakende fish guard office in order to check the haul of fishes and those species.

#### **(4) Constraints of Fishery**

The majority of fishermen are conducting fishing on a small scale with poor fishing gears by going to and from the far place, thus their production and income are unstable. Meanwhile, in spite of being found that there is much resources of land and water in the area, no fish raising facilities like paddy field or swamp in the plain edge are available for extension purpose.

### **6.11.2 Inland Fishery Development Plan**

#### **(1) Outlines of the Project Facilities**

The objectives of the inland fishery development plan are to provide the fishermen with the opportunities for supplementary revenue through fish farming during the fishing off-season, and to ensure a stable source of supply in proteins to the local residents.

##### **1) Construction plan of the model facilities for fish farming**

The facilities will serve as the model facilities for fry production and extension of fish farming which consists of the following components:

- a. Fry production facilities  
(annual production: 67,200 fries)
- b. Feedstuff production facilities for adult fish  
(annual production of feed: 24 tons)
- c. Parent fish breeding pond for reproduction  
(area: 100 m<sup>2</sup>)
- d. Pond for extension of fish farming  
(total area: 1,500 m<sup>2</sup>; items: 500 m<sup>2</sup> x 3)
- e. Staff lodging house attached to the fry production facilities

##### **2) Extension of fish farming to the villagers of the surroundings**

The technical staff appointed by the Fishery Department and Department of Agriculture in the Western Province will carry out the extension service of fish culture for the local residents through the said model facilities.

**(2) Operation and Maintenance Plan of the Facilities**

Operation and maintenance of the facilities will be carried out by the DOA of the Western Province. Feedstuff required for the breeding of fries and fishes will be made of the cheap materials locally available. Earnings from the sales of fries and adult fishes bred in the facilities will be allotted for the operation and maintenance costs.

**(3) Benefits from Fish Farming**

Estimating the profitability of fish culture with 100 m<sup>2</sup> fish pond by a farmer, an annual profit will be K 26,000. The required working hours for this scale are around 37 hours per year.

**(4) Management of the fish pond for extension purpose**

The earnings obtained from the 1,500 m<sup>2</sup> fish pond will be allocated for the costs of operation, maintenance and extension works.

## **6.12 Agro-Processing**

### **6.12.1 Present conditions of agro-processing in the F/S Area**

Major agricultural products in the F/S Area are rice, maize and cassava. These products are sold through private dealers or cooperatives except for their own consumption. Farmers carry out the processing of the agricultural products by themselves for home consumption due to lack of infrastructures and scarcity of the agro-processing facilities in the F/S Area.

Large scale processing facilities or processing plants for agricultural product are not found in the F/S Area.

There are two small-size maize hammer mills which are installed in the Sefula area which aim at extending services for the people in the area. However, people in the area have not yet been benefited for lack of access method and cash to pay for the processing etc.

There are no processing facilities for rice in the F/S Area. Although there are large rice mill processing plants in Mongu township. These are not being fully utilized by people in the F/S Area, because Mongu township is too far from the area, about 10km, and those processing plants are not suitable for a small volume processing particularly for home consumption and, at the same time, users have to prepare cash, hence farmers are processing their grains by themselves.

The population in the Sefula church area is some 1,200 and the total in the F/S Area, is supposed to be about 4,600. Daily consumption of food stuffs are considered to be fairly great deal. However, agro-processing facilities especially for staple foods, rice and maize, are not sufficient in the Area.

For marketing the agricultural products, in Sefula, there is a market house constructed by the District Council. People sell goods displaying them on the tables in this market house. Foods and other daily commodities are also being sold in the area is considered as an economically developed area compared with the other areas.

However, people in the F/S Area do not produce enough staple foods because of insufficiency of facilities such as hammer mills and rice processing machines and lack of infrastructures especially roads.

It is, therefore, essential to install the agro-processing facilities according to the production increase through the development of crop husbandry. Taking into consideration that rice-production would be increased from 1.2 ton/ha to 4.0 - 4.5 ton/ha in yield under the proposed developing plan of this study and since the proposed field is located in the flood plain along the Zambezi river, it may be appropriate that the small-scale facilities to be installed.

### **6.12.2 Development Plan**

#### **(1) Basic concept of agro-processing plan**

- 1) Since the staple foods in the F/S Area are rice and maize and plan of production increase is intended for these crops, the agro-processing plan as well as the plan for production increase aims at these crops.
- 2) Farmers' daily works for processing grains are reduced; and the field works to be increased.
- 3) As maize is sold in the shape of grain or flour and private maize millers are becoming popular, a small-size maize mill shall be introduced only for a farmer's self-sufficiency under this plan. Surplus maize grain should be sold through cooperatives.
- 4) Since there is no rice processing facilities in the F/S Area, the size of facilities should be suitable for the production aiming at the farmer's consumption as well as selling to the markets.
- 5) At present, as the rice production system is not formulated, the difference of harvesting season and the long drying period on the field are causing extremely low moisture content of rice and cracking of grains, and thus leading to the low quality of rice. Therefore, the plan should take into consideration various problem related to harvesting and processing.
- 6) Processing facilities for maize and rice should be installed in the same area.
- 7) Installation place shall be selected near the production field, and at the place where transportation and trade would have good access. The place will be economically activated by installing concrete tables for selling daily commodities in the market house .
- 8) Technical and performance level of the processing facilities shall be suitable for the Area and its vicinity.

#### **(2) Preconditions of agro-processing plan**

- 1) A flow chart of the processing system from harvesting to processing is shown in Table 6.12.1 below:
- 2) The facilities are designed based on the proposed raising areas and expected yields per unit area. But, the capacity of the maize processing facility is decided based on the amount of farmers' home consumption according to the basic concept of the programme (Table 6.12.2).

**Table 6.12.1 Proposed Agricultural Processing Flow Chart (1/2)**

---

**A. Rice**

---

**1. Harvesting**

It is necessary to reap at optimum period. Rice will be harvested by manual with sickles.

**2. Sun Drying**

Sun drying is done on the field for approximately one week up to 18 % of moisture content.

Dry season rice is harvested in the wet season, so sun drying on the field is not available, drying of which is carried out on the drying yard.

**3. Transporting of paddy and rice with straw**

Rice plant is collected to the plain dry place or the side of road. Half of it is transported by using the rear carts to the facility place. The remaining half is threshed and winnowed on the field using manual thresher and winnower before transporting.

**4. Threshing**

Transported rice plant is threshed immediately in the threshing shed. Straw is carried back to the field after threshing.

**5. Winowing**

Rough paddy is winnowed by motor winnower on the winnowing shed, if necessary.

**6. Finishing Drying**

Paddy is dried up to optimum moisture content (14%) for approx. 2 to 3 days on the drying yard made of concrete, if necessary.

**7. \*Stocking**

Dried paddy is stored in farmers bins for spare or stocked temporarily in the warehouse of processing facility for processing to sell soon.

**8. \*Rice Milling**

Paddy is processed by rice mill operated by the authority responsible.

**9. \*Stocking or Consuming**

Polished rice is stocked for approximately one week to sell, or some of rice will be carried back to the farmers' homes for their consumption

**10. \*Selling**

Rice is sold to the dealers or cooperatives who come to the processing place to buy, or some of which will be sold at the market.

---

Note: \* mark means necessity of quality inspection.

**Table 6.12.1 Proposed Agricultural Processing Flow Chart (2/2)**

<b>B Maize</b>	
<b>1. Harvesting</b>	It is necessary to reap at optimum period. Harvesting is done by manual.
<b>2. Transporting and Storing</b>	Harvested ears are transported to the farmer's house and are stored their shed. Storing should be careful against damages by the rodent.
<b>3. De-hulling</b>	The ears are hulled by manual at farmer's house.
<b>4. Transporting</b>	The hulled ears are transported to the processing facility for shelling.
<b>5. Shelling</b>	The ears are shelled using motor corn sheller. Some of maize are carried back to the farmer's house.
<b>6. *Stocking or Consuming</b>	The shelled maize is stored in farmers' bins for spare consumption or will be stocked in the warehouse to sell soon. Some of maize to be consumed are milled by motor hammer mill operated by the authority responsible, DOA.
<b>7. *Selling</b>	Maize is sold to the dealers or cooperatives who come to buy the produce at the processing place. Some of maize produce will be sold at the market.

Note: \* mark means necessity of quality inspection.

**Table 6.12.2 Target Area, Yield and Production**

<b>Crops</b>	<b>Harvesting Area</b>	<b>Yield</b>	<b>Production</b>
<b>Rice</b>			
Dry season	100	4.5	450
Wet season	200	4.0	800
Rainfed	90	3.5	315
<b>Maize</b>			
Dry season	16	2.5	40
Dry I	75	2.0	150
Dry II	100	4.5	450

- 3) Facilities will be selected from the places where are advantageous to farmers and accessible for transporting grains.



- 4) Since the present polished rice has a high ratio of broken rice and cracks, its quality is so low and, thus, difficult to be sold at a reasonable price. The harvesting at optimum time and drying up to suitable moisture content will, therefore, contribute to improved the quality of marketing rice.

(3) Selection procedure of processing facilities and equipment

Selection carried out according to the aforementioned basic concept and preconditions will be as follows,

- 1) Since facilities and equipment in the Area are not well provided and the experiences of utilizing the facilities are also little, facilities and equipment which are mechanically simple and can be operated easily should be selected.
- 2) The facilities and equipment are subjects to maintainability, and durability, so that those can be operated smoothly.
- 3) Since engine needs spare parts and fuel and is not economical for long operation, and public electricity is supplied in Sefula area, motor is selected for prime mover of facilities and equipment in this plan. Equipment used on the field will be small and manual type.
- 4) Facilities and equipment are supplied with accessories, maintenance tools and inspection and measuring tools.
- 5) Storing buildings for facilities and equipment, drying yards, warehouses, etc. are selected according to the processing flow. Buildings should be suitable to the natural conditions in the Area.

(4) Outlines of the proposed facilities and equipment

Outlines of the two sites of proposed facilities and equipment selected based on the aforementioned selection method are shown in Table 6.12.3.

Sefula site

- 1) Maize processing facility is not chosen for two private millers are allocated in this Area.
- 2) Market house are not selected, as this site has a market house owned by the District Council.

## Namaenya site

A market house is introduced, as there are no market facilities in this site.

Layout plan is shown in Figure 6.12.1.

Required number, proposed number of equipment and proposed equipment and are shown in Annex Tables VI.12.1, VI.12.2 and VI.12.4, respectively.

Size and outlines of the buildings are shown in the Annex Table VI.12.3, Drawings Annex, Drawings No.21~No.25 .

- (5) Proposed administration plan of facilities and equipment
- 1) Department of Agriculture (DOA), Western Province will administer the facilities directly.
  - 2) Users of the facilities and equipment are composed of farmers. This means each personnel who is in the cooperatives or societies organized or reorganized according to this proposed plan. However, people in the F/S Area and vicinity will be able to obtain the services from these facilities also.
  - 3) Farmers will operate the harvesting equipment basically after being trained by the DOA. Operation and maintenance will be done by the DOA and users will carry out the daily maintenance after using.
  - 4) DOA will operate the processing machine and equipment directly. However, an agent, who has the experience of operation and appointed by the DOA and cooperatives or societies, may operate them.
  - 5) Farmers' cooperatives or societies are responsible in loading and unloading of the grains or equipment as well as transportation of them from the site to the field and vice-versa.
  - 6) To obtain a high quality produce and to operate the facilities efficiently, farmers' cooperatives or societies shall systematically conduct the works such as optimum harvesting, suitable drying and optimum transportation of product to the site.
  - 7) Farmers are basically responsible to store the grain by themselves. Warehouse in the site will be used for temporary storing for approximately one week aiming at avoiding stagnation of the processing flow.
  - 8) Proposed organization and required personnel are as follows:

**Table 6.12.3 Proposed Facilities and Equipment**

Name	Description	No. of facilities & equipment	
		Sefula	Namaenya
<b>A. Equipment</b>			
1) Harvesting equipment			
a. for rice			
- Sickle	Blade length 20cm	75	75
- Thresher	Capacity 600kg/hr	3	3
- Winnowing	Capacity 300kg/hr	7	7
b. for maize			
- Corn sheller	Capacity 1.0 ton/hr	1	1
2) Processing facilities and equipment			
a. Rice mill	Capacity 0.5 ton/hr	2	2
b. Hammer mill	Capacity 0.3 ton/hr	-	1
3) Maintenance tools and accessories			
a. Maintenance tools		1 lot	1 lot
- Wrench, Hammer, Scissors, Grinder, welder, drilling machine, etc.			
b. Electric tools		1 lot	1 lot
- Nipper, Driver, Soldering iron, etc.			
c. Gauge & measuring tools		1 lot	1 lot
- Measuring tape, Balance, Tester, etc.			
d. Inspection tools		1 lot	1 lot
- Sampler, Moisture meter, Crack inspector, etc.			
<b>B. Buildings</b>			
1) Inspection, office building		1	1
2) Milling machine building		1	1
3) Warehouse		1	1
4) Drying yard, Winnowing yard		1	1
5) Market house			1
6) Guard house		1	1

**Table 6.12.4 Proposed organization and personnel**

Position	Sefula facilities	Namaenya facilities
Manager	1	1
Operator	2 (2 for rice mills)	3 (2 for rice mills) (1 for hammer mill)
Assistant	2	3
Guard	1	1
<b>Total:</b>	<b>6</b>	<b>8</b>

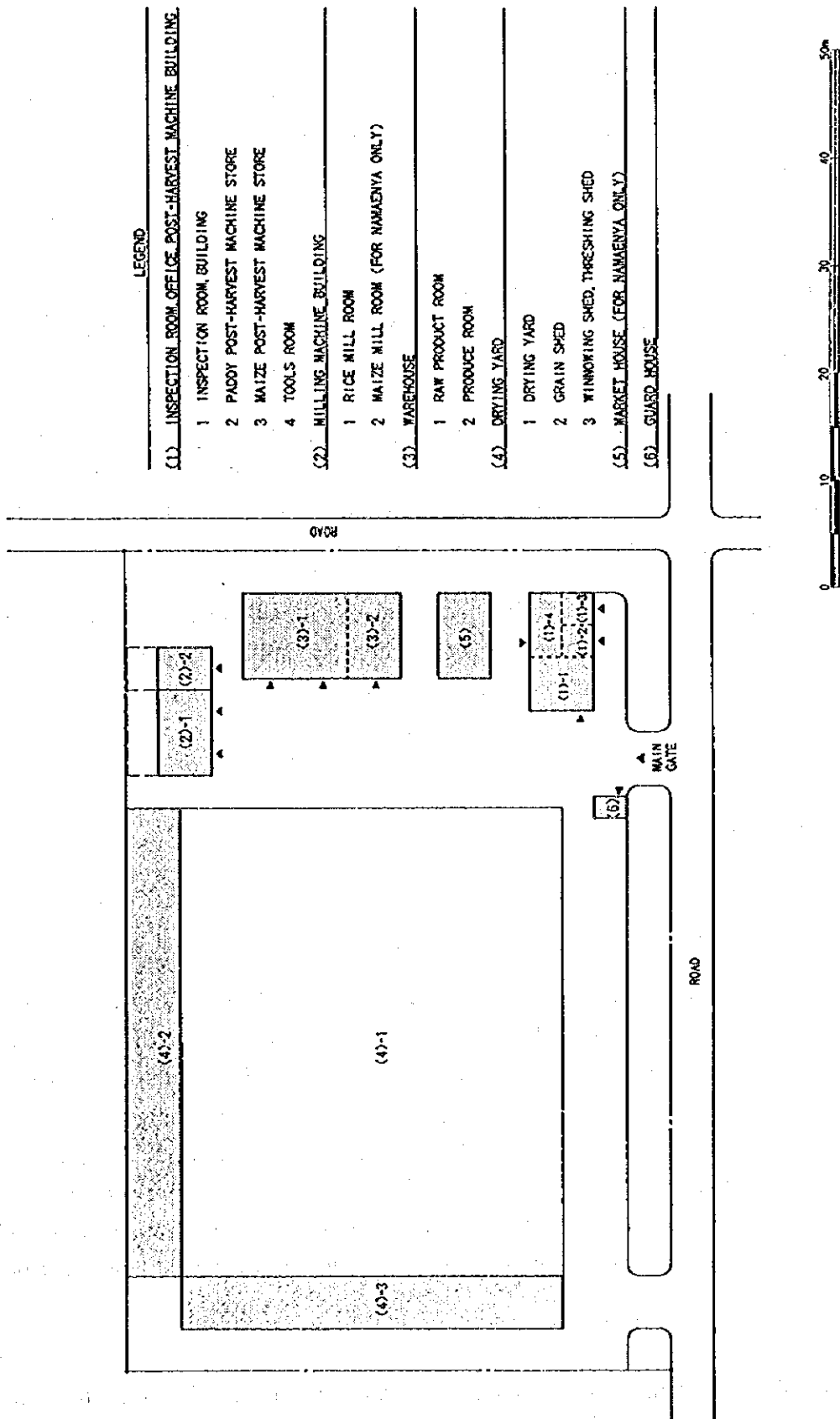


Figure 6.12.1 Layout Plan of Agro-processing Facility

## **6.13 Marketing**

### **6.13.1 Present Conditions**

In general, the disposal of agricultural products and acquisition of production materials are carried out by farmers themselves individually for there are no organizations to execute those activities in cooperation in the F/S Area. As already mentioned in the preceding chapter and paragraph, the Primary Cooperative Society (PCS) in Sefula has been in bankruptcy and District Cooperative Union (DCU) in Mongu District (MDCU) also has stopped the activities to collect crops and cattle because of financial deficit. Only Western Province Cooperative Union (WPCU) is dealing with rice, maize and cattle competing against commercial traders.

As the condition of feeder roads and village roads is so poor covered by heavy Kalahali sand that ordinary trucks cannot get into the villages except for four wheel driving ones. Farmers have to carry loads on their shoulder or, if possible, on sledge asking favour of neighbour who owns draft cattle and sledge when they want to sell staple foods in bags.

According to the result of the Farm Economic Survey, almost 60% of rice, around 80% of maize and cassava and more than 90% of sorghum and millet are consumed by farmers themselves. The other produces harvested in small amount are sold in the local market by the hands of women. Abundant mango fruits are perishing on the farm in spite of their best quality because of the poorest condition of transport.

### **6.13.2 Development Plan**

#### **(1) Establishment of Organizations which will manage, operate and maintain the Implemented Facilities**

In order to improve the worst marketing condition, there will be several ways in terms of physical and social & economical solutions. Physical aspects such as construction and rehabilitation of roads and building up of processing facilities of agricultural products will be easily achieved comparatively if only financing is well prepared. Concerning social & economic phases, however, constructed facilities will not be maintained and operated without relevant farmers' cooperation otherwise those will be useless and will disappear sooner or later. In accepting those physical improvements, establishment of farmers' organization manageable and maintainable those investments is essential beforehand with the execution of implementation.

#### **(2) Reestablishment of PCS**

To begin with, the PCS in the area has to be reestablished and strengthened for the purpose of purchasing production materials with cheaper prices and selling produces in better prices in cooperation. If those activities which deal with commodities and produces are achieved successfully under the unanimous solidarity of relevant farmers, the PCS will be able to proceed

to introduce higher level of various enterprises such as agro-processing. Up to then, management and maintenance have to be executed under the supervision of authorities concerned and/or higher organization of cooperatives.

## 6.14 Farmers' Group Upbringing

### 6.14.1 Present Conditions

There are 13 Village Extension Groups (VEGs), two Community Groups, one Nutrition Group and one PCS in the F/S Area. Among those groups and Organization, VEGs and PCS are most important in order to encourage farmers and promote agricultural production systematically. As stated in Chapter 2, Some of the VEGs have already started cooperative production as one of group activities and are getting fairly good results. The outlines of VEGs are shown in the following table.

**Table 6.14.1 Outlines of Village Extension Groups in the F/S Area**

Zone	Group No.	No.of Member	MHH	FHH	Paddy field	Upland Field	Villages Included
1	1	13	7	6	7.0	3.5	Sitongo,Nalusheshe,Nanala, Kandiana
	2	17	3	14	9.0	5.0	Sitongo,Namangu,Nalushiga
	3	16	8	8	8.0	3.5	Nambanda
	Sub Total	46	18	28	24.0	12.0	
2	1	15	7	8	8.0	3.0	Liyoo,Nakonga, Namusa, Natuyanga
	2	20	8	12	9.0	4.0	Nauyanga, Liyoo, Lifelo
	3	11	3	8	4.0	2.5	Nawinda,Nakasheke
	4	5	0	5	4.0	2.5	Sitoto,Namusa,Nakonga
Sub Total	51	18	33	25.0	12.0		
3	1	23	8	15	10.0	7.0	Kazulu,Shibata,Nalikolo, Nasikena
	2	17	3	14	7.0	4.0	Mulumbo,Lyanda,Sipai
	3	9	0	9	5.0	3.0	Setula,Mule
Sub Total	49	11	38	22.0	14.0		
4	1	25	7	18	20.0	9.5	Mule,Lifelo, Kahonono, Sitongo
	2	16	6	10	8.0	5.5	Kahonono,Lifeya,Naliele Sitongo
	3	16	4	12	5.0	0.0	Lumbae,Lifeya,Siliya
Sub Total	57	17	40	33.0	15.0		
Grand Total		203	64	139	104.0	53.0	

On the other hand, cooperative movement is inactive and Sefula PCS, only one registered PCS in the F/S Area, is not carrying out any activities. Reestablishment of the Cooperative is one of the most important keys for the purpose of supporting agricultural production.

## 6.14.2 Development Plan

### (1) Upbringing of VEGs

In bringing up farmers' groups, the formation of VEGs and encouragement of cooperative movement are principal components in order to promote agricultural production activities and support them from the marketing point of view as emphasized in previous chapters.

Three or four VEGs are already organized in each zone of the F/S Area, and some of them have started their production oriented activities. Most prominent example is the one which is an women's group headed by a female chairperson. They are raising tomatoes on a small plot and getting quite good size and high quality of fruits. They opened saving account in Zambian National Commercial Bank and are accumulating a part of proceeds for the sake of getting loans when the production is expanded in the near future. They are, however, facing various problems at the same time. Because of lack of insecticide, plants are gradually shrinking in the harvesting season affected by a kind of tiny spiders. They are also not getting appropriate price for the products in spite of supplying an excellent quality. If they can sell them in Mongu market, they will be able to get much more proceeds than selling in Sefula market. These matters should be solved as soon as possible with endeavor. More progressive cooperative trials in procuring suitable production materials and ways of selling produces with better price should be pursuit getting assistance of CEO and other relevant personnel.

Each VEG should proceed to establish better organization of cooperative production, studying the advanced example mentioned above and taking its merits into their group activities.

### (2) Strengthening of PCS's Function

The promotion of upbringing and strengthening of VEG has closely related to PCS's activities. As already mentioned in the previous paragraph, the transaction activities of purchasing production materials and selling agricultural products by PCS is indispensable in order to support VEG's production activities. The businesses of both organization, therefore, have to be carried out in so called organic relationship, and those will be achieved by participation of active leaders of VEGs into the board of directors of the PCS.

Another extremely important function of PCS is credit activities. Farmers especially small farmers are facing difficulty in getting loan from financial agencies. Small farmers who do not own pertinent tangible mortgage are not able to get loan from commercial financing agencies. There is, however, a way prepared to get credit from Zambian Cooperative Federation Financing Service (ZCFFS) by organizing PCS, because ZCFFS disburses only through PCS. As the interest rate of ZCFFS is a little lower than the other agencies, farmers are obtainable more favorable loans under the guarantee of PCS.



**Lima Bank prepare the way to offer short term loans up to K 500,000 without mortgages to the farmers' group eligible. VEGs were occasionally used for this purpose, but the results were mostly unsuccessful because of poor recovery. The primary objective of VEG should be placed on the promotion of production activities, and the businesses to support them such as purchasing, selling and financing are the duties of PCS. After clarifying the function of each organization, the cooperation of the both has to be strengthened.**

## 6.15 Women in Development

### 6.15.1 Present conditions of the F/S Area

#### (1) Female Headed Household in the F/S Area

The ratio of the Female Headed Households (FHHs) in the F/S Area is high by standing and represents about 60% of the entire number of households. These FHH families are ranked as the poorest small scale farmers in the rural society. The table below shows the number of Male Headed Households (MHHs) and Female Headed Households (FHHs).

**Table 6.15.1 Number of MHHs and FHHs in the F/S Area**

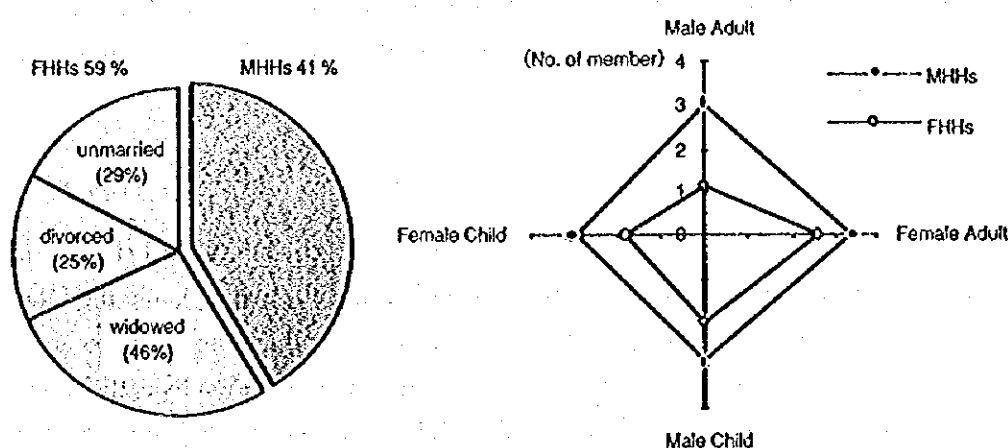
Head of household	F/S Area*	Study Area*	Mongu District**	Western Province**
Male	245 (43%)	1,235 (63%)	19,083 (72%)	86,089 (76%)
Female	324 (57%)	733 (37%)	7,304 (28%)	26,793 (24%)
Total	569	1,968	26,387	112,882

Source : \* Village Survey

\*\* The census of 1990 in Western Province by CSO

Notes : The ratio of population by gender in the F/S Area and Yeta ward (Table 3.3.7) varies according to season.

The comparisons between the MHHs and the FHHs based on the results of the interviews with the rural women in the F/S Area are shown in Figures 6.15.1 to 6.15.3 and in Table 6.15.2. Both types of households are restricted by many factors related to agricultural production. However, the circumstances surrounding of FHHs are much more severe.



**Figure 6.15.1 Household Characteristics, Marital status of FHHs and Family size of Interviewed women**

### 1) Labor

The number of family members in FHHs is about 60% of MHHs, and the average number of adult male is only one, leading to various restriction such as the lack of labor at the time of cultivation and farm preparation by cattle, the lack of access to animal draught power, the lack of measures to obtain cash income and so on. Because of these reasons, most of the FHHs employ laborers during the busy farming seasons. Nevertheless the labor is not sufficient. In addition, due to insufficient cash income, the FHHs are securing the labor in exchange with beers or crops. (Figure 6.15.1).

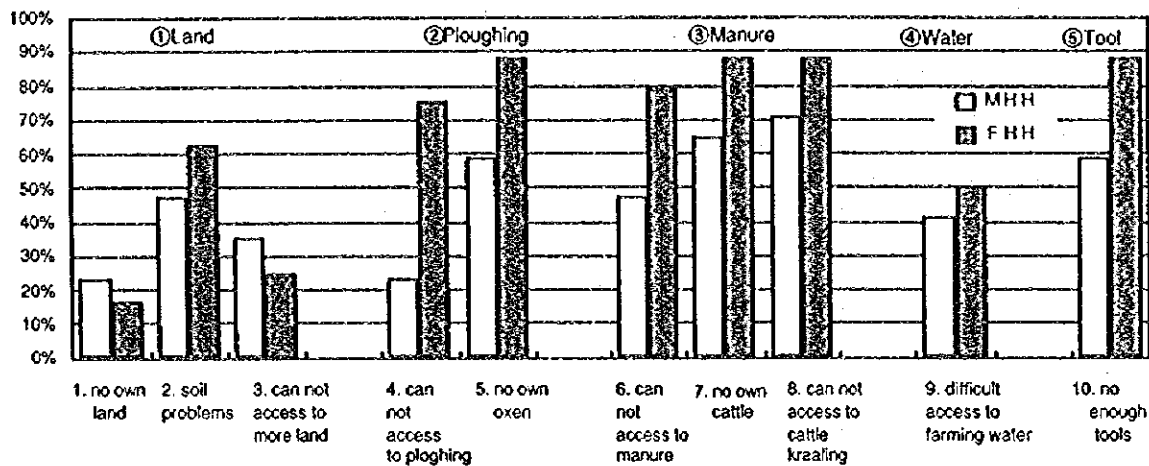


Figure 6.15.2 Access to Production Resources

### 2) Land

The Lozi society is controlled by the male members because it is a paternal society, and the land cultivation right is given to each family member. Thus the land cultivation right is given to women just like to men. However, many of the lands in which women are allowed to cultivate are low productive lands having less availability of water and less fertility. In other words, there is an unequal situation related accessibility to lands between man and women.

### 3) Cattle

Cattle is one of the most important properties in the Lozi society. In Lozi custom, a family head inherits most of the cattle from his father(ex-family head), and the inherited cattle is allocated to each family member, therefore, women are supposed to access to cattle. For the utilization of animal draught power and the fertilization by cattle, however, there is a significant difference between the MHHs and the FHHs(Figure 6.15.2). In other words, the hire or sharing of cattle among members of family/relative is being carried out unequally in the rural society.

There has traditionally been a taboo in this area saying "women should not touch the cattle". This taboo is, however, gradually diminishing and young women are actively

participating into the project to use cattle. On the other hand, there still remains a thought that the management of cattle is only allowed to men. In the interviews, this kind of tendency is found especially in the villages located at the inner part of the flood plain.

As mentioned above, there is no remarkable difference in the accessibility of productive resources between men and women. However, the quality and the quantity of resources are controlled by the male members and, therefore, women are found in a disadvantaged position. This social view on men and women based on the traditional system is leading to a productive inferiority for women. Especially, this will be a very serious problem for FHHs which have no male members in the family. Significant lack of productive resources prohibits the motivation of production.

#### 4) Agricultural techniques

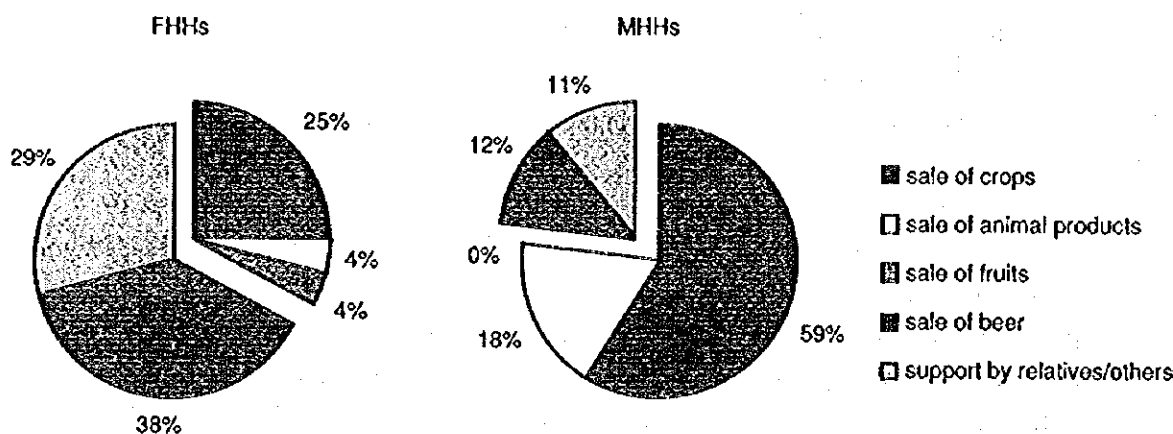
Although, as indicated in the Table 6.15.2, the main crops of the MHHs and FHHs are paddy and maize, the FHHs have a tendency to produce only these two crops. For the reasons of this fact, women listed the lack of labor as well as the lack of agricultural techniques and agricultural knowledge. There also were positive opinions that they would like to learn the new planting methods of paddy and vegetables.

**Table 6.15.2 Percentage of HHs Growing the Various Crops**

Head of Household	Rice	Maize	Cassava	Millet	Sorghum	Vegetables
Male	94 %	94 %	41 %	41 %	24 %	47 %
Female	100 %	92 %	21 %	29 %	4 %	17 %

#### 5) Income sources

There is a great difference of the income sources between MHHs and FHHs (Figure 6.15.3). While the income from agricultural products and cattle stands 77% for the MHHs, the same for the FHHs is only 40%. These figures indicate that the greater part of agricultural products are consumed to support the families that produce them. Thirty-eight percent of FHHs obtain the income from manufacturing and sales of beer. About 70% of the interviewed women (70% of FHHs and 59% of MHHs) said they brewed beer. Local beer is brewed in the drums of 200 liter size from the materials such as sorghum, millet, maize, sugar, and yeast. These materials cost about K10,000. The beer is sold at K20 for a glass. The net profit from a drum is about K2,000 to K5,000, which means that the beer brewing is not profitable considering the labor and the material cost. Beer brewing is, however, one of the important measures of getting cash income for women and the profit is used for food, education and buying clothes.



**Figure 6.15.3 Percentage of Income Sources in Farmer's Households**

**(2) Group activities**

In the F/S Area, there are 13 Village Extension Groups, two groups by the Department of Community Development and one Nutrition Group by NGO. Their main activities are farming, renting the cattle, and manufacturing handicrafts. These cooperative works play important roles in exchanging the information and opinions, improving the agricultural production and reducing heavy labors.

The existing groups shown in Annex Table VI.15.1 are not consisted of women only, but 74% of the group members are women and 53% of whom belong to FHHs. Most of the group leaders are women.

The extension officers of this area are very active for promoting the group activities and increasing the cash income for women. Most of these extension groups were newly being formed in 1994, which fact has caused them to be strongly motivated. However, it is apprehended that the conspicuous lack of financial resources, farming tools, seeds, fertilizers, and cattle may reduce the future motivation for activities.

**6.15.2 Development Program for WID**

**(1) Program preconditions**

Although the rural women in the Study Area are working longer than men and contribute a great deal to household economy, their works are rarely recognized as economic activities because the works conducted by women are not converted to currency. Even if the economy in the entire F/S Area is improved under such circumstances, it will be difficult to reduce the difference of income distribution or accessibility to resources between men and women. In other words, unless a development incorporating a clear correction plan towards inequality is implemented, it is difficult for women to receive the convenience brought by the development in the same manner as men.

Considering the above mentioned points, the plan must make a circumstance in which the women in the F/S Area can participate to related development programs easily, improve the economic and social status of women, and make better the rural livings. In addition, taking the extension of this plan to the entire Study Area into consideration, the F/S Area must be developed as the model area.

## (2) Program components

It is necessary to make a circumstance in which both the women and men can participate in the project and receive advantages with equal chance. The components of the project are as follows:

- 1) In order to eliminate the traditional taboos and unequal social relationships which are restricting women's behavior, it is necessary to enlighten not only women but men. To reduce the farming and household burden of women, the training programs subjected to men and women must instruct them to allot the labor equally among family members and villagers.

Training Items : Women's social status and role  
Utilization of Animal draught power and farming technique  
Improvement of rural life(cooking, child care, health etc.)  
Manufacturing and sales of dry mangoes

## 2) Facility for WID Training

In order to support the group activities and participation of women to the training programs, Farmer Training Rooms must be prepared including the working room, the cooking space, and the nursery. And a community space where women can gather easily is important for their talk about troubles of life and child care.

Working room : The processing of dry mangoes is instructed and manufactured, and the processing of preserved foods is instructed.

Cooking space : Cooking stoves or cooking stand must be placed for the purpose of demonstration, and the methods of farmer training including the cooking method and hygiene are instructed.

Nursery : A nursery must be incorporated to support the activities of women having infants, especially their participation to group activities and training sessions. Operation of the nursery must be determined by women themselves.

### (3) Training

#### 1) Improvement of agricultural techniques for women

Increasing the technical knowledge for women to whom the entire agriculture is entrusted is related to the improvement of productivity of each individual farm, which is also especially effective to FHHs.

#### 2) Instruction on the production of paddy, maize, and vegetables:

This training is related to the agricultural plan and technical training of women and must be implemented as a part of the WID plan. The time and the period of training must be fully taken into consideration. In addition, the practical training that is appropriate for the seasonal works and the training at the nearby farms so that women can participate easily must be planned regularly.

#### 3) Utilization of animal draught power

Extension of the use of cattle to women modernizes the traditionally unequal assignment of roles to agricultural works among men and women. With the active use of cattle by women, they can perform the agricultural works with the same level of efficiency performed by men, and this is particularly effective to FHHs. In cooperation with the ADPP classes for women, an introduction of the use of animal draught power by women must be extended.

#### 4) Transmission to children

Instruction and extension of the agricultural technique to women can result in easier transmission of the knowledge and the techniques of agriculture to their children than by men. In addition, instruction to women is more effective because it can directly transmit the equality of the sexes and the importance of women in productive activities to children through their lives.

### (4) Improvement of rural life

Rural women in the F/S Area have been playing a very significant role in agricultural production and they are also responsible for all household tasks. The mother's heavy works are the causes of undernourishment (30 % of pupils in the F/S Area) because of reduction for their childcare-time. And women's low cash income is also making the situation of children's nourishment worse. Decrease and reduction of working time and increase of cash income are necessary in order to improve children's health conditions.

### 1) Utilization of the training facilities

Among the household works that take about two to three hours of women's everyday works, pounding and fetching water need quite a heavy labor. However, these heavy works are not considered important because they are nonproductive from the economical point of view. The agricultural product processing project installs hammer mills and hand mills in relation to the WID plan. In addition to this project, the WID plan promotes the active use of these facilities and extends the use of hand mills to farmers.

### 2) Installation of wells

The WID plan also installs wells in the areas where they are having difficulty in fetching water as a part of the projects. These measures will make the women easy to have time to improve their livings, conduct group activities, and participate in agricultural training programs.

### (5) Support of women's group

Women are playing the largest portion of the basic human needs for the families such as clothing, cooking foods, and education. In other words, the increase of cash income by women will result in the improvement of the well-being of entire family and to the effective implementation of the improvement of farmer living. In addition, improvement of the economical status of women will lead to strengthen the influential voices from women in the community.

#### 1) Cooperative agricultural activities

"Women's Department" must be organized in each Primary Cooperative Society (PCS) to support the female farmers' groups. The financial aids offered by the ZCF-FS to the PCS can be used to provide loans as the agricultural fund to female groups under the responsibility of each PCS. These loans are particularly helpful for the group purchase of oxen, plow, and harrows.

#### 2) Processing and sales of dry mangoes

Processing and sale of dry mangoes are carried out by women's group under the guidance of extension officer of Department of Agriculture. The materials and spaces for making dry mangoes are prepared in the Integrated Training Facility (4.11.3-(2))



## **6.16 Agricultural Extension**

### **6.16.1 Present Conditions**

Present rural society in the F/S Area is supported officially by extension service and social service through VEGs and community groups, and unofficially by NGO through the Nutrition Group. As the social support is rather directed to non-agricultural activities, the argument here will be focused on the support by extension service.

An extension camp is allocated in the F/S Area. The camp area is divided into six zones and four of them are relevant to the F/S Area. The CEO is enthusiastic on his job and is promoting extension services earnestly. He already organized 13 VEGs in the Study Area and some of them have started their production oriented activities since last season. Because of worse condition of transport, visiting farmers by CEO seems to be quite difficult in order to promote more intensive extension services.

### **6.16.2 Development Plan**

The extension activities of the CEO in charge of the F/S Area is pretty good and those will be sufficient enough to illustrate as one of good examples of extension services. There are, however, various restrictions which disturb the normal performance. Poor facilities and short implementation make the range of activities very narrow. Especially, lack of transport facilities cause the CEO very difficult to visit villages.

#### **(1) Accommodation of an Extension Office**

Accommodation of an office with adequate space is quite necessary because the CEO is not given the office at present and is using a dark narrow room in the official residence. This will be achieved allocating it in the Integrated Training Facilities when the implementation of the Project would be completed.

#### **(2) Furnishing of Transporting Implement for Visiting Farms**

Supply of a motor vehicle is also indispensable in order to make visiting farmers more conveniently and effectively. Fortunately, this is taken into consideration in the ASIP programme. Accommodation of one into the competent Camp with the highest priority is sincerely expected. This will display a great power to expand the extension business especially when the road in the area is improved.

#### **(3) Allocation of at least a Staff to Support and Cooperate with CEO**

An extension worker has to cover almost all areas relating rural life not only technical fields of agricultural production but also various phases of economical and social affairs. This will occasionally leads CEO to overburden of duties quantitatively and qualitatively. When the

**Project is realized, this will be more overweighed without fail. In order to avoid such situation, at least one suitable personnel who can assist the CEO should be prepared and allocated before the commencement of the Project in advance.**

## **6.17 Human Resource Development**

### **6.17.1 Present Condition**

Human Resource Development is one of the basic components in any case to execute an exploitation design for certain area. Systematic and prominent ways of human development are not found in the Study Area, and those are carried out mainly through the " On the Job Training (OJT) " mostly by the hand of CEO and partly by other official and unofficial personnel in charge of social and agricultural development. Those are, however, disturbed by various restrictions such as geographical, physical, economical, social and so on. Endeavour should be directed toward the means and devices how to remove those obstacles and to establish normalized state as soon as possible.

### **6.17.2 Development Plan**

#### **(1) The Education and Training of Staff Officers**

First of all, the training of the trainers who are engaging in the training services should be taken into consideration. Among those, the most urgent one will be that of CEO in order to respond to the proceeding of exploitation. He has to be acquainted with the new knowledge and technologies which will be introduced in the process of exploitation in advance. Intensive training of the extension worker according to the line of the target in development schedule should be, therefore, prepared besides the ordinary fortnight training for the sake of acquiring necessary knowledge and technologies.

#### **(2) Self Training of CEO**

Together with the training by the hands of authorities, self-exploitation by CEO himself is also very important. He should be obligated that he has to screen various problems existing in the Camp area and choose one of them which has to be solved urgently and then study himself how to get rid of that subject. In order to practice this task, a set of minimum implements such as chemical analysis equipment and a microscope etc. are necessary to be implemented in the supposed new office.

#### **(3) Education and Training of Farmers and Farmers' Group**

Farmers and/or farmers' group in the F/S Area are usually trained and educated on the job by the hand of the CEO throughout the year. At the same time, they have to be intensively trained for some specific fields such as crop husbandry, animal husbandry, insect and pest protection and so on getting the cooperation of senior agricultural officers. For this purpose, the scheduled Integrated Training Facility should be used positively, in the combination with former JICA Agricultural Verification Farm especially in case of crop husbandry training. Crop husbandry

training utilizing the JICA farm should be organized in group and carried out for necessary period continuously in order to comprehend the new and advanced methods of farming.

The contents of the training on farmers utilizing the Integrated Training Facility have to cover a broad range from relatively simple technologies concerning individual crop production to compound and/or integrated ones relating to farming system, farm management, formation of farmers' groups, organization of cooperative and so on. Although the relevant matters are stated in the respective items, those are summarized as follows:

**Table 6.17.1 Outline of the Farmers' Training**

Field	Item	Contents	Subject
Water Use & Management	Irrigation & Drainage	<ul style="list-style-type: none"> <li>• Importance of Irrigation and Drainage</li> <li>• Function of Paddy Fields</li> <li>• Substance and Utilization of Irrigation Facilities</li> </ul>	Beneficiary Farmers in the F/S Area
	Water Management	<ul style="list-style-type: none"> <li>• Meaning of Water Management and Method of Enforcement Practice</li> <li>• Growing Rice and Seasonal Water Requirement</li> <li>• Countermeasure against Drought</li> </ul>	
Farming	<ul style="list-style-type: none"> <li>• Cultivating Method</li> <li>• Working Method</li> <li>• Animal Husbandry</li> <li>• Inland Fisheries</li> </ul>	<ul style="list-style-type: none"> <li>• Improved Technologies and profitability for Rice, Maize, Vegetables and Orchard Crops Cultivation</li> <li>• Improved Technologies and profitability of Animal and Machinery Use</li> <li>• Extension of Vaccination</li> </ul>	Farmers in the F/S Area
		<ul style="list-style-type: none"> <li>• Technical Extension of Fish Culture</li> </ul>	
Agro-Processing	Post Harvesting Machinery Use	<ul style="list-style-type: none"> <li>• Machinery Use for Threshing and Winnowing</li> </ul>	Farmers Concerned to the Machinery Use
	Social Life	<ul style="list-style-type: none"> <li>• Women's Social Status and Role</li> </ul>	<ul style="list-style-type: none"> <li>• Leaders of men and women in the F/S Area</li> </ul>
WID/GAD	Farming Method	<ul style="list-style-type: none"> <li>• Utilization of Animal Power on Farming</li> </ul>	<ul style="list-style-type: none"> <li>• Members of Women's Production group</li> </ul>
	<ul style="list-style-type: none"> <li>• Improvement of Living Standard</li> <li>• Agro-processing</li> </ul>	<ul style="list-style-type: none"> <li>• Nutritional Improvement and Cooking</li> <li>• Manufacturing and Sale of Dry Mango</li> </ul>	<ul style="list-style-type: none"> <li>• Women in the F/S Area in general</li> <li>• Members of Women's Group</li> </ul>
Farmers' Organization	Water Use	<ul style="list-style-type: none"> <li>• Necessity, Role and Function of Organization</li> <li>• Management of Organization</li> <li>• Adjustment of Water Use</li> </ul>	Beneficiary Farmers in the F/S Area
	Cooperative Production	<ul style="list-style-type: none"> <li>• Significance of Cooperative Activities and way of Organizing group</li> <li>• Way of Promoting Activities</li> </ul>	Members of VEGs and the Expectant
	PCS	<ul style="list-style-type: none"> <li>• Meaning of PCS and Way of Reactivating</li> <li>• Methods of Management and Operation especially Economic Crisis Management</li> </ul>	<ul style="list-style-type: none"> <li>• Leaders of VEG</li> <li>• Candidates for the Leading Members</li> </ul>

## 6.18 Design of Facilities

### 6.18.1 Outlines of the Facilities

Outlines of the proposed facilities in the F/S Area are as follows:

**Table 6.18.1 Outlines of the Facilities in the F/S Area**

Development Plan	Item	Contents, Place
Road	Feeder road	2 Lines, L = 3.9 km, Gravel pavement
	Village road	1 Line, L=4.1 km, Gravel pavement
	Peripheral road	1 Line, L=6.0 km, Gravel pavement
	Maintenance road	3 Line, L=2.9 km, Gravel pavement
	Field road	15 Lines, L=10.7 km, Sand pavement
	Others	Cross culvert N=27
Irrigation	Main canal	1 Line, L = 2.3 km, Cement block lining
	Secondary canal	15 Lines, L=10.4 km, Cement block lining
	Sand trap	Embankment, Intake works, Spillway N=2, Connection canal
	Bypass canal	L = 0.4 km, Earth canal, Cross culvert N=1
	Others	Division works N=8
Drainage	Main canal	2 Lines, L=12.0 km, Earth canal
	Lateral canal	15 lines, L=9.9 km, Earth canal
Agro-processing	Type A (Sefula)	Rice mill, Harvesting / Transportation Equipment, Others
	Type B (Namaenya)	Hammer mill, Rice mill, Harvesting / Transportation Equipment, Borehole, others
Inland fisheries	Fish culture facility	Fry production farm, Fish pond, Others
Animal Husbandry	Loading ramp	Near the starting point of Feeder B
	Crush pen	In the Integrated training facility
Extension	Integrated training facility	Multipurpose conference room, Training room Camp officer's room, Women's training room Vaccination room, Meat- processing facility, Staff Room, Borehole, Others
Marketing	Marketing facility	Market house, Warehouse

### **6.18.2 Roads**

Taking into consideration the maintenance after implementation and economic efficiency, laterite gravel is suitable as material of pavement which is easily obtained from Mawawa plain. The material used for sub-grade course, road bed or road body is the Barotse sand which can be obtained in the flood plain or high ridge. However, Barotse sand is of poor grade and scanty cohesion. In case of using this sand as the sub-grade course, it is desirable that the sand includes some fine grain size, clay portion. Therefore the sand should be mixed with cement to ensure a sufficient strength and to increase cohesion. California Bearing Ratio test has been done in Lusaka to investigate the proper cement mix proportion. On the basis of the result, a sufficient strength will be obtained in case of 2% ~4% cement ratio. The method of mixing sand with cement is popular in Zambia.

To prevent the breaking down of the cross sectional slope caused by runoff water, the surface of the slope and the bottom of the drainage canal should be lined with cement block to protect the road shoulder and bed.

The cross sections of the roads are shown in Figure. 6.18.1.

### **6.18.3 Irrigation and Drainage Facilities**

#### **(1) Basic Concept**

Taking into consideration the maintenance after implementation and appropriate technology, material and instrument which can be obtained and easily maintained in Zambia should be used. Therefore, instruments such as gate, pump and valve are not installed in this project.

Facility design should be done on the basis of the hydrometeorology corresponding to 3~5 years return period from the view point of construction cost.

#### **(2) Arrangement of the facility**

The following two cases are proposed in the arrangement of the irrigation drainage facility, and Case (1) is adopted as mentioned in Table 6.18.2. (Figure 6.18.2)

**Table 6.18.2 Arrangement of the Irrigation/Drainage Facilities**

Case	Case (1)	Case (2)
Characteristics	<ol style="list-style-type: none"> <li>1) Sefula river is improved as Main irrigation canal</li> <li>2) Existing canals surrounding the proposed irrigable area are improved as Main drainage canal</li> <li>3) Method of water use is as same as existing approach</li> </ol>	<ol style="list-style-type: none"> <li>1) Sefula river is improved as Main drainage canal</li> <li>2) Existing canals surrounding the proposed irrigable area are improved as Main irrigation canal</li> <li>3) Method of water use is different from existing approach</li> </ol>
Arrangement	<ol style="list-style-type: none"> <li>1) Spillway is installed at the sand trap in order to let extra water flow</li> <li>2) Flood discharge of Sefula river is divided into Main irrigation canal and two Main drainage canals through the spillway</li> <li>3) Secondary irrigation canals are installed 250 meter interval in the proposed irrigable area</li> </ol>	<ol style="list-style-type: none"> <li>1) Main drainage has a big cross section which flows flood discharge wholly</li> <li>2) Cross section of Main drainage canal is bigger than Case (1), but total improvement length is shorter</li> <li>3) Spill way is not necessary</li> <li>4) Cross section of Main irrigation canal is smaller than Case (1), but total improvement length is longer</li> <li>5) Number of division works is more than in Case (1)</li> <li>6) Arrangement of secondary irrigation canal is as same as Case (1)</li> </ol>
Construction Cost	K 879,440, 000	K 996,485,000
Evaluation	<ol style="list-style-type: none"> <li>1) Case (1) is adopted</li> <li>2) Case (2) is more expensive because total improvement length of main irrigation canal is longer than Case (1).</li> <li>3) To follow method of the water use is important, because farmer has a scanty experience.</li> <li>4) The characteristics of the topographic advantage, river bed is higher than field elevation, should be fully utilized.</li> <li>5) Less number of the division works is desirable in order to alleviate the water management.</li> </ol>	

(Annex - Table VI.18.1)

### (3) Design Discharge

#### 1) Main Irrigation canal (Sefula river) and Secondary Irrigation Canal

As mentioned in the (2) Arrangement of the facility, Sefula river is improved as main irrigation canal. Flood discharge of Sefula river corresponding to 3 and 5 years return period are estimated as 1.80 and 2.30 cubic meters per second respectively at the point of Water Affairs staff gauge, which is located at the crossing of the tarred road on the basis of observed water level. (Table 6.7.1) However, these discharges are not suitable as the design discharge of main irrigation canal from the viewpoint of the construction cost and water management owing to large cross section and division works. Accordingly, Design discharge of main irrigation canal is preferably to be determined by base flow. Base flow fluctuates every month, every year, depending on rainfall amount. Design discharge is determined on the basis of maximum base flow occurring each year. Maximum base flow corresponding to 3 and 5 years return period (exceedance probability) are 0.85 and 1.10 cubic meters per second respectively, therefore the adapted design discharge is 1.00 cubic meter per second. (Annex Table VI.7.7)

The peak discharge of irrigation water requirement is 0.30 cubic meter per second, and this discharge is equally distributed to the two secondary canals through the division works. Therefore the design discharge of the secondary irrigation canal is determined as 0.15 cubic meter per second.

#### 2) Main Drainage Canal

Flood discharge corresponding to 3 and 5 years return period of Sefula river are estimated as 1.80 and 2.30 cubic meters per second respectively. (Table 6.7.1) Therefore flood discharge corresponding to 3 to 5 years return period is around 2.00 cubic meters per second. This discharge is estimated based on the observed water level, but the data is observed only two times per day using staff gauge. Accordingly, peak water level is rarely observed, and the design discharge should consider a freeboard of around 50 percent, value decided after analysis of the flood water level. Therefore flood discharge corresponding to 3 to 5 years return period is determined as 3.00 cubic meters per second. This flood discharge will be distributed to two main drainage canals and one main irrigation canal at the point of the sand trap facility.

#### 3) Lateral canal

On-farm drainage requirement is determined according to the concept that daily rainfall is drained daily. The Rational Formula is used to calculate the on-farm drainage requirement. From the result of the calculation, on-farm drainage requirement is



determined as  $2.78 \times 10^{-3}$  cubic meter per second per hectare. (Figure 6.18.3 and Annex VI.18.1)

(4) Facility Planning

1) Main Irrigation Canal, Secondary Irrigation Canal

The design bed is set the same elevation as the existing river bed, because the existing bed is higher than the field elevation. Therefore, the canal bed slope of the main irrigation canal is 1/500, which corresponds to natural river bed slope. The canal bed and cross sectional slope are lined with cement block in order to prevent weed growth, save maintenance cost and decrease water loss. The cross section of the main irrigation canal shown in Figure 6.18.4 is determined from the Manning Formula.

2) Division Works

Eight division works will be installed in order to distribute water to the secondary irrigation canals. A water level controller made of log or timber to ease water distribution from the main canal to the secondary canals will be installed in each division work. The division works also have a structure to allow men, cattle and vehicles to pass.

3) Sand Trap

Sand trap is installed to prevent sand transportation caused by heavy rain into the irrigable area at the junction of the escarpments and the plain edge. Sand trap is composed of embankment, intake works, spillway and connection canal. The crest elevation of embankment is determined by the flood water level of Sefula river, freeboard and existing ground level of the left bank. The embankment of the sand trap is designed to allow vehicles to pass on the top and is connected to the Maintenance Road. The foundation of the embankment should be set on the sand around one meter below the existing river bed to prevent depression and base failure, because the existing river bed includes humus soil.

Two spillways connected to the main drainage canal and intake works connected to the main irrigation canal are also installed in this sand trap. Another spillway at the intake works is installed in order to allow a flow no more than the design discharge of 1.00 cubic meter per second into the main irrigation canal, and direct excess water to the main drainage canal through the connection canal.

Cleaning up of weeds and removal of the settling sand for the maintenance of sand trap should be done by the water user's group at least once a year.

#### 4) Bypass Canal

Sefula river is being used for human bathing or washing. However, its use is expected to be difficult, because the canal is lined with cement block. Accordingly, a bypass canal is installed for the purpose of bathing or washing.

#### 5) Main Drainage Canal, Lateral Canal

Drainage canal is installed for the purpose of removing the flood water and surplus soil moisture. Namaranga and Sefula tributary canals are improved as main drainage canals. The main drainage canals are extended into the plain for gravitational drainage and are connected to Sefula river. Lateral canals are constructed along Field roads and Secondary irrigation canals, and connected to main drainage canals. Both canals are scheduled as a earth canal.

#### 6.18.4 Integrated Training Facility

For the purpose of the promoting of community activities, extension, women's activities and farmers' organization, an Integrated Facility is installed at the plain edge near the proposed irrigable area. Outline of the Integrated Training Facility is shown in Table VI.18.3.

**Table 6.18.3 Outlines of Integrated Training Facility (1/2)**

Category	Facility	Objectives & Contents
Extension /Training	1) Multipurpose conference room	a) General meeting of PCS b) Meeting of village head c) General meeting of all farmer's groups d) Training for improvement of unequal social relationship between men and women
	2) Training room	a) Technical extension for farmer's group b) Technical extension of animal husbandry for farmers c) Training for water user's group d) Technical extension for fish culture

**Table 6.18.3 Outlines of Integrated Training Facility (2/2)**

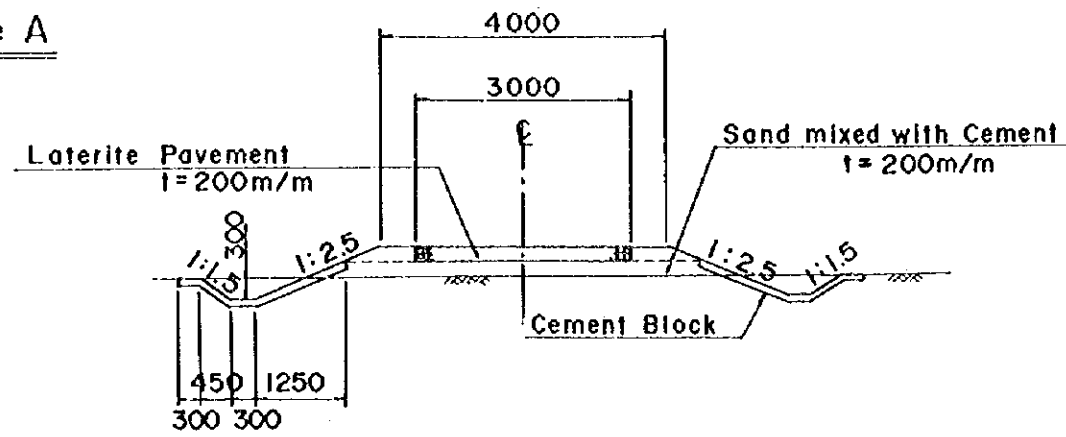
Category	Facility	Objectives & Contents
Improvement of living standard	3) Women's training room	a) Installation of work shop for women's group activities, technical training for dry mango processing b) Installation of cooking facility for nutritive improvement, sanitary improvement c) Installation of nursery d) Installation of borehole
	4) Meat-processing Facility	a) For the purpose of nutritive improvement b) Supply to Mongu township
Administration / Supporting for farmers	5) Staff office	a) Camp extension officer's office b) Manager's office c) Office of water management staff d) Office of meat-processing staff e) Office of vaccination staff
	6) Staff room	a) Accommodation for instructor
	7) Guard house	

#### **6.18.5 Marketing Facility**

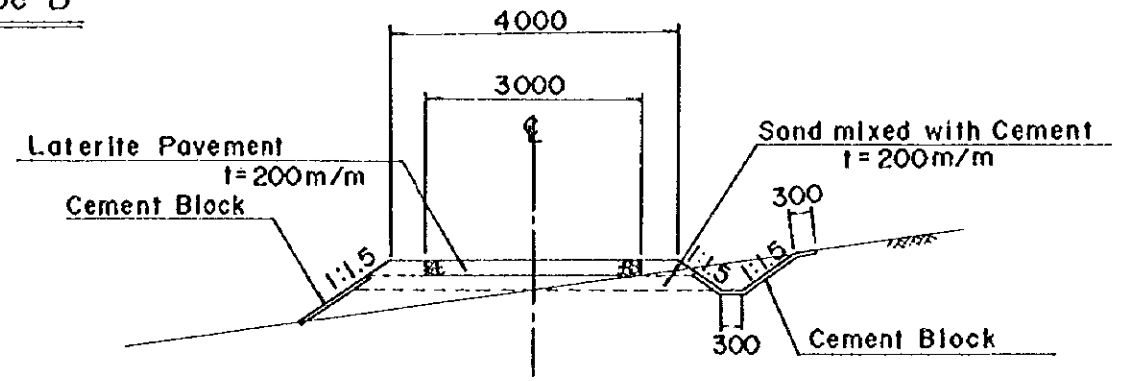
A marketing facility is installed in the site of the Integrated Training Facility for the purpose of selling seeds, fertilizer, agricultural and fishery products, processed products and necessities. The marketing facility is composed of marketing house and warehouse.



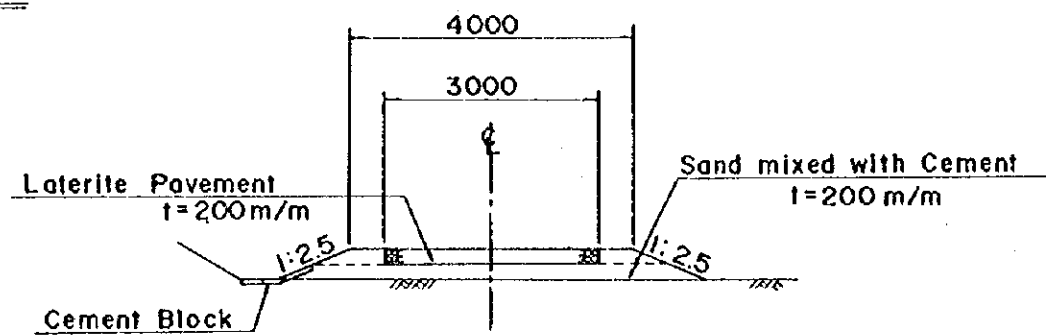
Type A



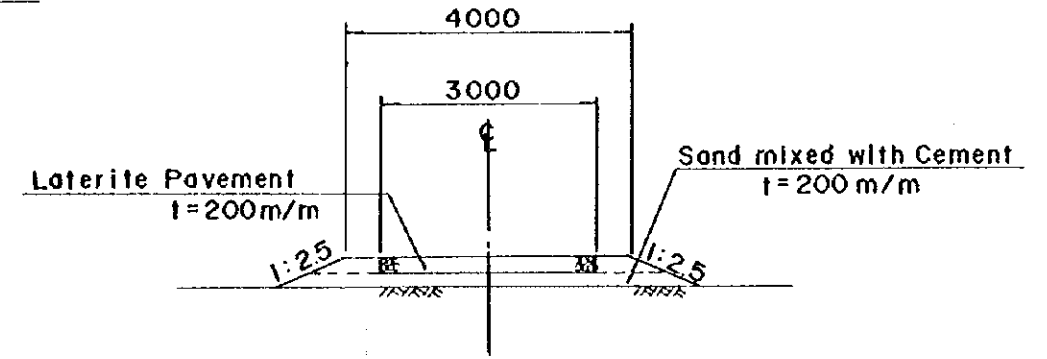
Type B



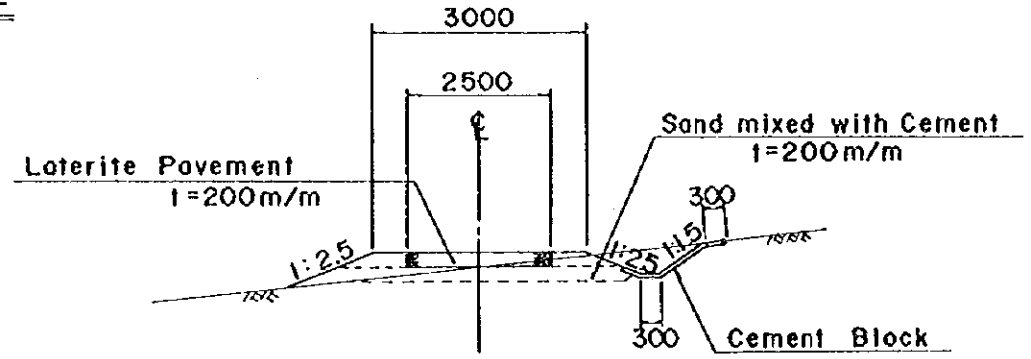
Type C



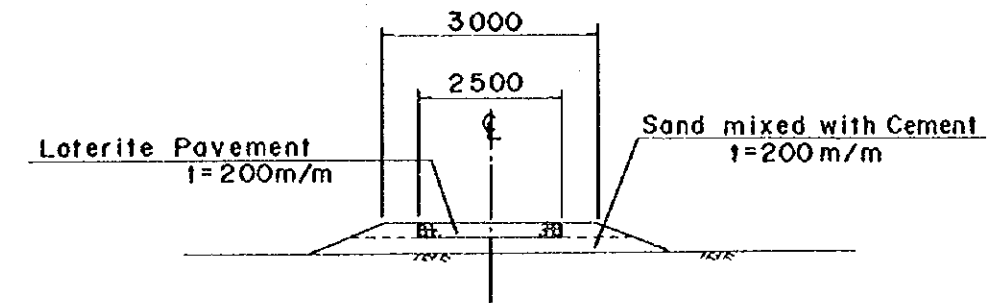
Type D



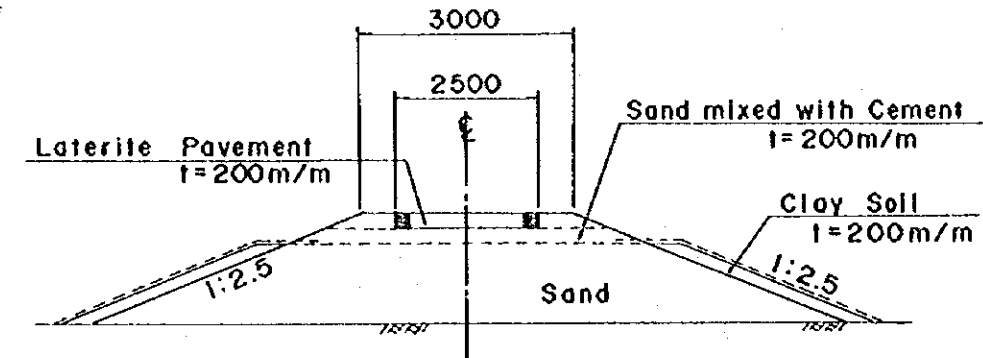
Type E



Type F

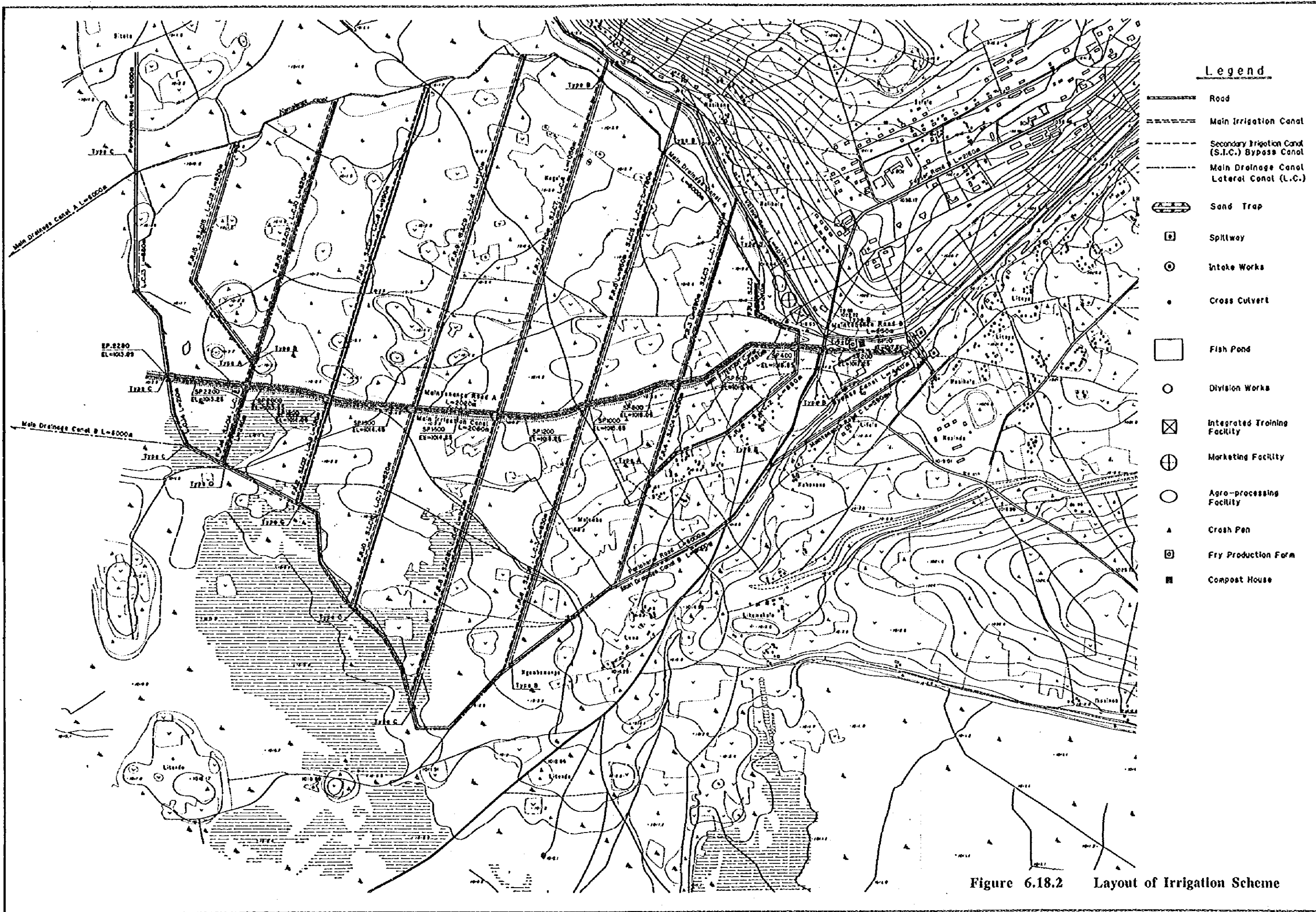


Type G



Feeder Road	Type A	L=1,360
	Type B	L= 825
	Type C	L=1,100
	Type D	L= 600
Village Road	Type E	L=4,070
	Type F	L= 1,800
Peripheral Road	Type F	L= 1,800
	Type G	L=4,200
Maintenance Road A	Type F	L=2,020
Maintenance Road B	Type F	L= 250
Maintenance Road C	Type F	L= 590

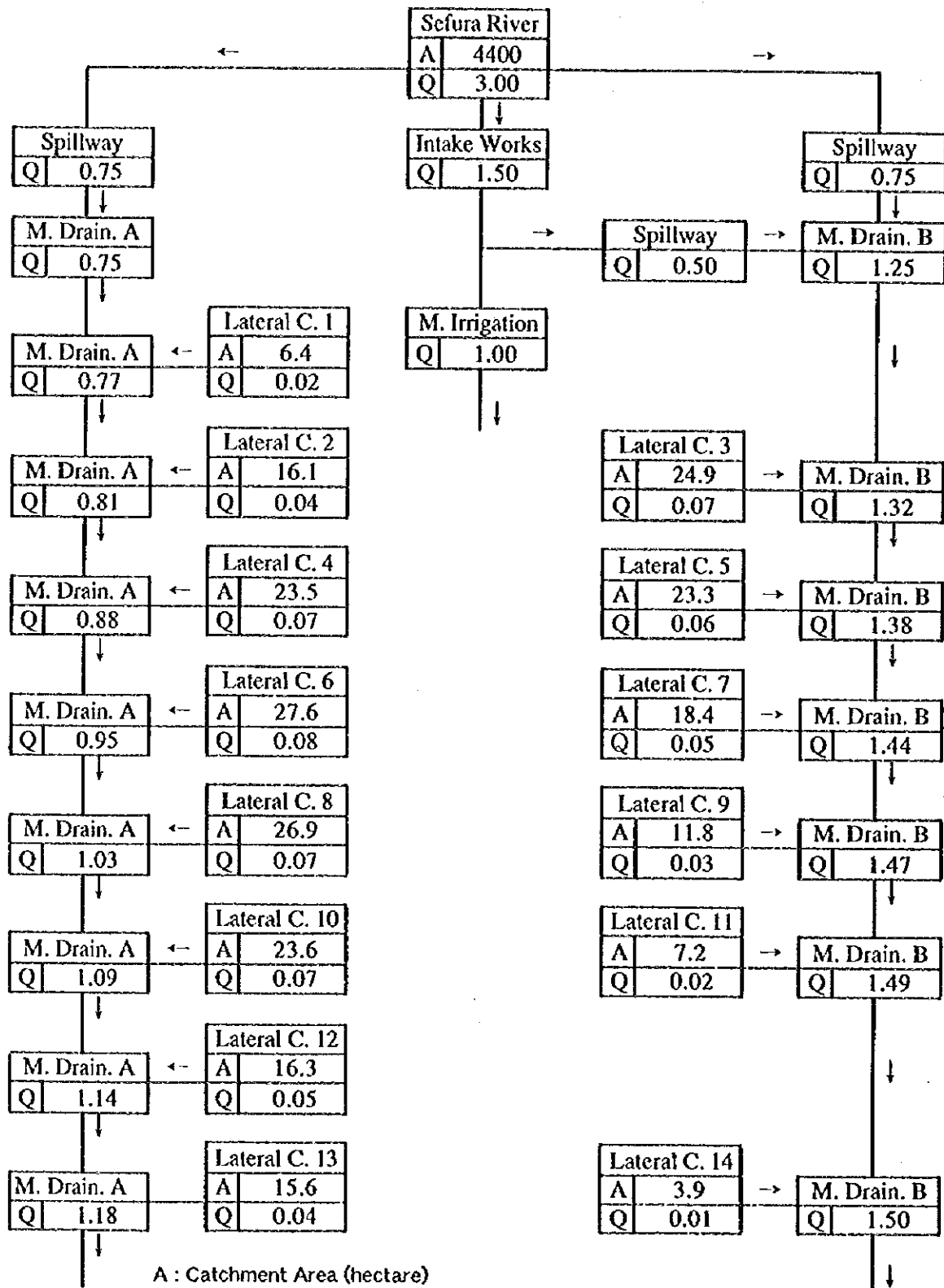
Figure 6.18.1 Cross Section of Roads



**Legend**

- Road
- Main Irrigation Canal
- - - Secondary Irrigation Canal (S.I.C.) Bypass Canal
- - - Main Drainage Canal Lateral Canal (L.C.)
- ⊞ Sand Trap
- ⊞ Spillway
- ⊙ Intake Works
- Cross Culvert
- Fish Pond
- Division Works
- ⊗ Integrated Training Facility
- ⊕ Marketing Facility
- Agro-processing Facility
- ▲ Crash Pen
- ⊞ Fry Production Farm
- Compost House

Figure 6.18.2 Layout of Irrigation Scheme



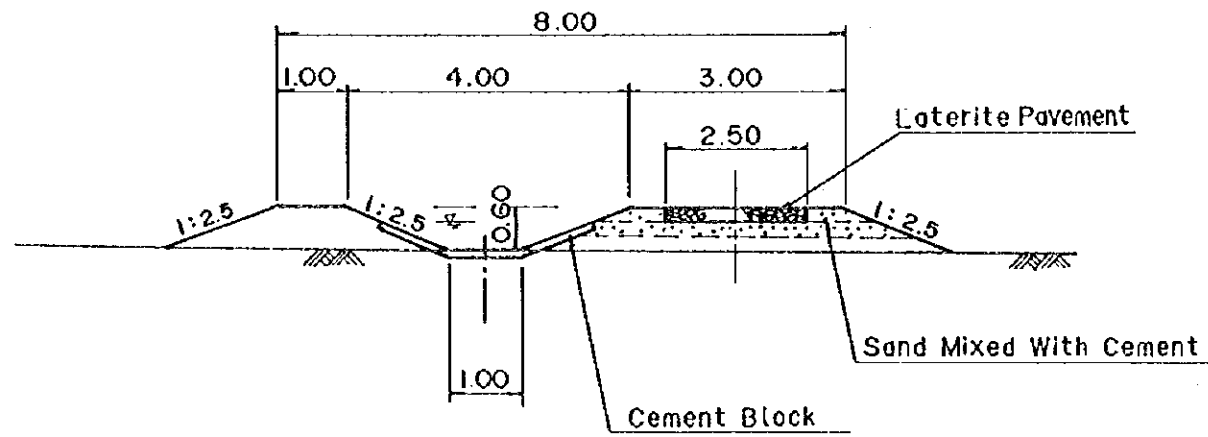
A : Catchment Area (hectare)  
 Q : Discharge (m<sup>3</sup>/s)  
 M. Drain. A : Main Drainage Canal A  
 M. Irrigation : Main Irrigation Canal  
 Lateral C : Lateral Canal

Figure 6.18.3 Drainage Scheme

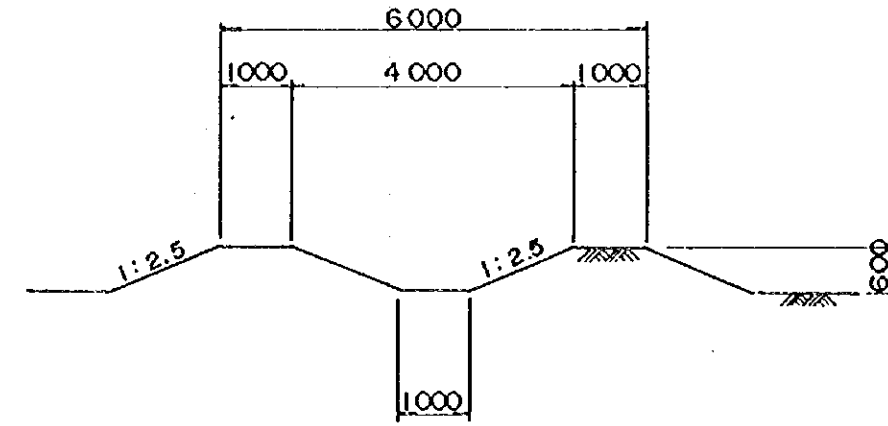




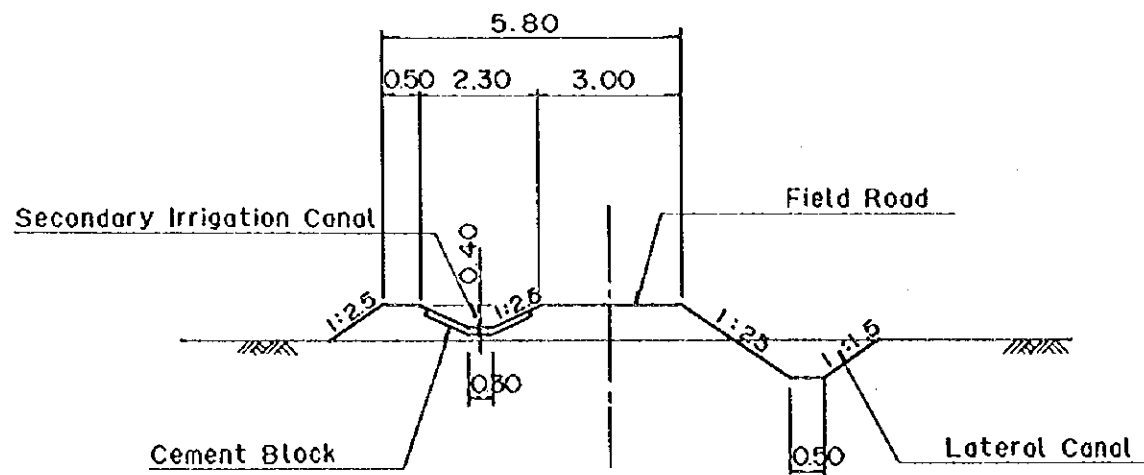
Main Irrigation Canal, Maintenance Road



Bypass Canal



Secondary Irrigation Canal, Field Road, Lateral Canal



Main Drainage Canal

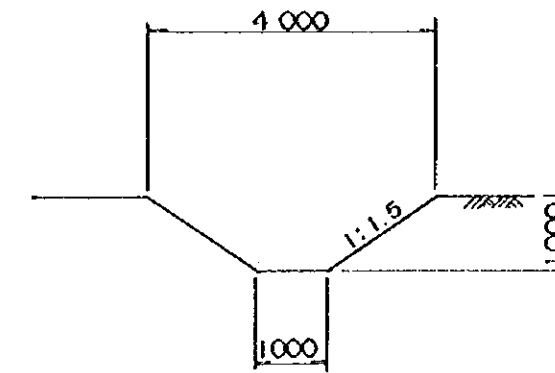


Figure 6.18.4 Cross Section of the Irrigation/Drainage Canal



## **6.19 Operation and Maintenance of the Facilities**

### **6.19.1 Necessity of proper operation and maintenance**

All the facilities in the rural area have to be operated and maintained properly to ensure a most effective function. In order to keep a maximized function of facilities, beneficiary farmers' self effort and authority's support should be combined. Therefore, concrete organization is quite necessary to operate and maintain the proposed facilities in the F/S Area.

According to the above mentioned reasons, participants analyses for the proposed facilities except for irrigation, namely rural road, fish pond, agro-processing facility, marketing facility and integrated training facility, were carried out with the steering committee members of the study. Nominated target groups were set up as a result of the participants analyses and are shown in the Annex Table VI.19.1 ~ VI.19.4.

### **6.19.2 Operation and maintenance plan of major facilities**

Operation and maintenance plans of major facilities are mentioned below and related items of operation and maintenance for major facilities are sorted out on Table 6.19.1.

#### **(1) Road operation and maintenance plan**

Beneficiaries of proposed rural roads include not only farmers living around the area but also people with several objects who pass through or come into the F/S Area. Therefore, operation and maintenance of rural roads should be carried out under governmental budget by public organizations which form the operation and maintenance body in the respective Department of Road and Agriculture(Land Use Division). However, operation and maintenance for the planned field roads have to be carried out by the water user's groups who would be the direct beneficiaries of those facilities.

The annual budget for road maintenance in the Western Province Road Department is K40,000,000. This department has also prepared an additional budget amounting to K3,300,000 for the proposed roads, which corresponds to 8% increment of the present budget.

#### **(2) Irrigation and drainage facilities**

Irrigation and drainage facilities are limited to specified beneficiary farmers in the proposed irrigable area. However, enough effect is not expected if each farmer has to perform operation and maintenance individually. A water user's group has to be established and would act as an operation and maintenance body. Required expenses for the actual maintenance, namely material cost of repairing, setting up of concrete block for irrigation canal and personal expense of water user's group have to be prepared.

(3) Agro-processing facilities

Operation and maintenance costs for the proposed agro-processing facilities are required for the repair and inspection fee for machinery, electricity cost for power source and personal expenses for operator and watchman. Those costs have to be provided by the beneficiaries, and the renewed primary cooperative society has to carry out operation and maintenance under the supervision of the Department of Agriculture.

(4) Integrated training facilities

Operation and maintenance of the integrated training facilities is carried out by the Department of Agriculture under ASIP.

Table 6.19.1 Proposed Operation and Maintenance Object

Facilities	Asset	Authority Responsible	Beneficiary	Advisory Services	Maintenance Funds	Reference
1. Road						
1) Rural / Peripheral / Village / Maintenance	GRZ	Road Dept. / Dept. of Agric. (land Use)	General	Road Dept. / Dept. of Agric. (land Use)	GRZ / PS's Office	PPU
2) Field Road	GRZ	Dept. of Agric. (land Use)	Farmer	Advisory Committee	Farmer	
2. Irrigation / Drainage Canal						
	GRZ	Dept. of Agriculture	Farmer	Water Users' Group / Advisory Committee	Water Users' Group / Advisory Committee	
3. Fish Pond						
	GRZ	Dept. of Agriculture	Farmer	Dept. of Agriculture	Farmer	
4. Agro-processing Facility						
	GRZ	Dept. of Agriculture	Farmer	Dept. of Agriculture	Farmer	
5. Meat-processing Facility						
	GRZ	Dept. of Agriculture	Farmer	Dept. of Agriculture	Farmer	
6. Marketing Facility						
	GRZ	Dept. of Agric / Dept. of Marketing & Crop.	Farmer	Farmer / Dept. of Agriculture	Farmer	
7. Integrated Training Facility						
	GRZ	Dept. of Agriculture	General	Dept. of Agriculture	Dept. of Agriculture / ASIP	

## 6.20 Execution of the Project

### 6.20.1 Project Implementation

#### (I) Executing Agency

Department of Agriculture in Western Province is in charge of undertaking the implementation of the project under the supervision of MAFF. The Project Executive Committee with PAO chairman must be organized for smooth implementation. The Project Executive Committee is responsible for the administration of the project before and after implementation substantially and Permanent Secretary and Director of Agriculture should advise the Committee periodically.

**Table 6.20.1 Composition of the Project Executive Committee**

Component	Component Leader	Responsibility
Committee leader	PAO	a) Management of the Committee
Extension	Extension & Training Section	a) Manager of the integrated training facility b) Management of training programme c) Technical extension activities for farmer
Irrigation/Drainage	Provincial Engineering Section	a) Organization of advisory committee of water users' group b) Establishment and guidance of Water users' group
Animal Husbandry	Animal Husbandry Section	a) Technical extension activities for farmer b) O/M of crash pen, loading ramp, and meat-processing facility
Inland Fisheries	Fishery Department / Extension & Training Section	a) Technical extension activities for farmer b) O/M of fry production farm and fish pond
Agro-processing	Provincial Engineering Section	a) O/M of agro-processing facilities
WID/GAD	Women Youth Development Section	a) Upbringing and training activities for women's group b) O/M of women's training room
Supporting for Farmer's group	Extension & Training Section	a) Upbringing of PCS b) Upbringing of production oriented group c) O/M of the marketing facility

## **(2) Financing**

The project finance would be provided by the government of Zambia, foreign government fund or international financial agency. However, it seems difficult to ensure the budget for the project implementation when the financial circumstance of the government of Zambia is taking into consideration.

Therefore, it is desirable that project cost, not only foreign currency portion but also local currency portion composed of construction cost and consulting services, would be provided by foreign government fund or international financial agency. The government of Zambia should make every endeavor to procure such foreign funds.

## **(3) Consulting Services**

As the Executing Agency, Department of Agriculture in Western Province, has not experienced such a large size of project to need foreign funds, it is essentially necessary to use well-experienced consulting firms, taking into consideration the procurement of finance and the measures for foreign agency. Consulting firms are required to undertake detailed design works, tendering procedure and construction supervision under overall management of the executing agency in order to contribute smooth implementation and completion

### **6.20.2 Implementation Schedule**

Considering the project size, the funds and the construction works, it is necessary to formulate the economical and efficient implementation schedule.

#### **(1) Construction Period**

Construction period are desired as short as possible in the aspect of benefit occurrence and overhead of the contractor. In case of this project, construction works will complete within one year from the aspect of the project size.

Irrigation/drainage facilities, peripheral road and field roads which are going to be installed in the plain are possible to be constructed in the period of eight months except for the period from February to May. Other facilities are possible to be constructed throughout the year.

Item	Project Year			
	1994	1995	1996	1997
1 Feasibility Study		██████████		
2 Select of the Consultant Firm		██████████		
3 Detailed Design		██████████	██████████	
4 Procurement of Finance			██████████	
5 Tendering Procedure		██████████		
6 Establishment of the PEC				
7 Upbringing of the Farmers' Group				
1) Advisory Committee of WUG		██████████		
2) WUG		██████████		
3) PCS		██████████	██████████	
4) Production Oriented Groups		██████████	██████████	
8 Construction Works				
1) Roads				
a) Feeder Road			██████████	██████████
b) Village Road			██████████	██████████
c) Peripheral Road			██████████	██████████
2) Irrigation/Drainage Facilities				
a) Dewatering, Diversion Canal			██████████	
b) Main Irrigation Canal			██████████	██████████
c) Sand Trap			██████████	
d) Secondary Irr. Canal, Others			██████████	██████████
e) Lateral Canal			██████████	██████████
f) Field Road, Maintenance Road			██████████	██████████
3) Agro-processing Facilities			██████████	██████████
4) Fish Culture Facilities			██████████	██████████
5) Integrated Training Facility			██████████	██████████
6) Marketing Facility				
7) Animal Husbandry Facilities			██████████	██████████
9 O/M of PEC			██████████	██████████

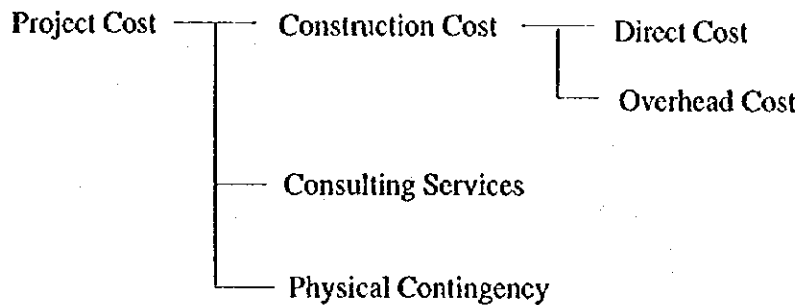
WUG : Water User's Group    PCS : Primary Cooperative Society    PEC : Project Executive Committee

Figure 6.20.1 Execution of the Project

## 6.21 Cost Estimation of the Project

### 6.21.1 Project Cost Components

The project cost is composed of the following items.



The construction works shall be carried out on a contract basis, considering the construction components, the characteristics and the scale of the project. There are no contractors in Mongu, but some contractors are available in Lusaka.

#### (1) Construction Cost

Construction cost is composed of direct cost, such as construction material, fuel, labour cost, construction machinery cost and overhead cost. Direct cost is composed of construction components as mentioned in Table 6.18.1, and the overhead cost represents 40 percent of material and labour cost, and is composed of the following items.

- Material stockyard, Equipment pool, Dewatering works, Diversion canal and Improvement of the access road to the gravel pit
- Material testing and measuring for construction works
- Transportation of machines and equipment
- Site office and Worker's camp
- Insurance and Tax
- Administrative expenses including staff salary at the site and head office, and Profit

#### (2) Consulting Services

This cost includes consulting fees for detailed design of the proposed facilities, tendering procedure, construction supervision, survey and investigation. The cost is estimated at about 10 percent of the construction cost.



### **(3) Physical contingency**

The allocation of contingency is made to cover minor differences between the actual and estimated quantities, unexpected difficulties in construction works. The cost shall be estimated at 10 percent of the construction cost and the cost for consulting services.

## **6.21.2 Estimate Conditions**

### **(1) Unit Construction Rate**

There is no governmental production rate and construction unit cost in Zambia. There is also no experience of the construction similar to this project in Mongu. Therefore the material cost for construction works has to be carried out through market investigation. Labour cost and unit construction cost used by private construction works has also been investigated from some companies in Lusaka. The costs of construction machines are calculated based on the depreciation of the purchase prices in Lusaka, the period of durability and maintenance ratio.

### **(2) Price Year and Exchange Rate**

Current price of December 1994 is applied to cost estimates. The exchange rate between US Dollar and Zambian Kwacha is 1 US\$ = K 670.

### **(3) Demarcation of Foreign Currency and Local Currency**

The project cost is divided into foreign currency portion and local currency portion. Local currency portion is composed of labour cost, material cost which can be obtained in Zambia, and domestic transportation cost. Foreign currency portion is composed of material cost which is imported normally such as reinforced bar, plywood, fuel, pipe materials, construction machines and so on.

### **(4) Project Cost**

Based on the estimated conditions as mentioned above, the total project cost (initial investment cost) at current price(at December of 1994) amounts to 4,300 million Zambian Kwacha composing 2,420 million Zambian Kwacha for local currency portion and 1,880 million Zambian Kwacha for foreign currency portion. (Table 6.21.1 and Annex Table VI.21.1~VI.21.6)

Table 6.21.1 Breakdown of Project Cost

Item	1st Year		2nd Year		Total	
	Amount (kwacha)		Amount (kwacha)		Amount (kwacha)	
	L.C	F.C	L.C	F.C	L.C	F.C
1) Construction Cost						
1)-1 Road			648,606,000	674,434,000	648,606,000	674,434,000
1)-2 Irrigation			401,398,000	201,008,000	401,398,000	201,008,000
1)-3 Drainage			90,022,000	206,742,000	90,022,000	206,742,000
1)-4 Agro-processing			635,970,000	228,198,000	635,970,000	228,198,000
1)-5 Animal Husbandry			9,199,000	5,533,000	9,199,000	5,533,000
1)-6 Inland Fisheries			52,738,000	20,353,000	52,738,000	20,353,000
1)-7 Extension			307,920,000	20,152,000	307,920,000	20,152,000
1)-8 Marketing			44,100,000	0	44,100,000	0
1)-9 Water Supply			11,400,000	1,350,000	11,400,000	1,350,000
Sub-Total			2,201,353,000	1,557,770,000	2,201,353,000	1,557,770,000
2) Consulting Service						
2)-1 Detailed Design		213,547,000				213,547,000
2)-2 Supervision		213,547,000		142,364,000		142,364,000
Sub-Total				142,364,000		355,911,000
3) Physical Contingency						
		21,354,000		150,013,000		171,367,000
4) Grand Total		234,901,000	2,421,488,000	1,650,147,000	2,421,488,000	1,885,048,000
						4,306,536,000

#### 6.21.4 Operation and Maintenance Cost

##### (1) Annual Operation and Maintenance Cost

Annual operation and maintenance cost is composed of the following items.

**Table 6.21.2 Components of O.M.**

Item	Component	
Roads	a) Supplement of laterite gravel	0.5% of total volume
	b) Mending of the drainage canal	0.5% of the cement block
	c) Leveling works	Operated by motor grader
Irrigation/Drainage facilities	a) Salary and wage for the water user's group	Head officer, Officer, Water master, Casual worker
	b) Mending of the canal	0.5% of the cement block
	c) Weed control, and Removal of the settling sand	Casual worker
Agro-processing	a) Rice mill, Hammer mill	10% of the purchase cost
	b) Harvesting/Transportation equipment	10% of the purchase cost
	c) Salary and wage	Manager, Operator, Assistant, Watch man
	d) Electric fee	
	e) Mending of the buildings	0.1% of construction cost
Integrated training facility	a) Salary and wage	Cook, Watch man, Housekeeper
	b) Mending of the buildings	0.1% of construction cost
	c) Electric fee	
Marketing facility	a) Mending of the buildings	0.1% of construction cost
Water supply	a) Maintenance of the pumps	10% of the purchase cost

Based on each item mentioned in Table 6.21.2, the annual operation and maintenance cost at current price (at December of 1994) amounts to 26 million Zambian Kwacha.

**Table 6.21.3 Annual O.M. Cost**

Facilities	Annual O.M. Cost (K 1,000)	Reference
Roads	3,297	
Irrigation	2,635	
Drainage	180	
Agro-processing	18,715	
Integrated training facility	1,477	
Market facility	44	
Rural water supply	135	
<b>Total</b>	<b>26,483</b>	

**(2) Replacement Cost**

All equipments procured by the project will be replaced at the end of the economic durable years. Economic life span for each equipment is listed below.

Agro-processing

Rice mill, Hammer mill	10 years
Thresher	5 years
Transportation equipment	10 years

Rural water supply

Hand pump	10 years
-----------	----------

## **6.22 Environmental Consideration**

### **6.22.1 Current Environmental Conditions in the Feasibility Study Area and Environmental Impact by Implementation of the Development Plan**

#### **(1) Social Environment**

##### **1) Inhabitants**

The population in the F/S Area totals about 4,500 with the Lozi Tribe dominating the populace. The remaining part of the population consists of a mixture of small tribal groups that have assimilated way the Lozi tribe. Accordingly, the lack of diversity in small tribal groups' way of living eliminates problems which frequently impede the implementation of the Project.

##### **2) Institutions and Customs**

Basically, the F/S Area has been under dominance of the Lozi, and their traditional ways are still largely practiced by the residents. One of the practices of the Lozi Tribe, for example, "the Right to Produce of the Land" handed down by the Litunga, has actually prevails at present in Mongu District. Fishing activities usually require the permission of tenants, either of breeding ponds or flooded plains. Fortunately, cases which impose fees on fishing do not exist in the Area. However, if the road construction of the Development Plan is to cover cropping fields, or the dam construction results in a submergence of cropping fields, the matter should be discussed with tenants before any modification to be carried out..

##### **3) Pollution by Agrochemical**

The agrochemical available in the shops of Mongu District are not very poisonous to fish. They have low crop residual toxicity and biological concentration. And since farmers in the area only apply a minimum dosage for vegetable cultivation, their use is not environmentally harmful.

The Development Plan will work toward minimizing agrochemical use, with emphasis on "integrated pest and disease control" through the use of varieties highly tolerant to diseases and insects, the application of crop rotation and adequate farm management practices. In addition, the Development Plan will also teach the farmers how to distinguish between agrochemical with high and low residual toxicity, and in the process eliminate the fear of environmental pollution.

#### 4) Endemic and Epidemic Diseases

Malaria is the most serious endemic disease in the F/S Area. The annual number of malaria patients treated in the Sefula Rural Health Center averages 6,696 or 70 % of the population, from 1990 to 1993 (Annex Table VI.22.1). However, the actual number could be much more considering that some infected people try to heal themselves without seeking professional helps.

The major malaria in the F/S Area is faciparum malaria, vicious and accompanied by severe symptoms that often leads to death. The carrier of the plasmodium is *Anopheles gambiae*.

Regardless of the fact that the average number of work leave due to malaria takes annually 15-20 days, this matter should be taken into consideration seriously because it occurs in the busy farming season when workers are overfatigued and susceptible to the disease. Malaria preventive countermeasures are necessary to be elaborated to avoid labour shortage in the busy season.

Larvae *Anopheles gambiae* inhabit small pools, puddles between furrows, puddles formed from footprints of cattle and sometimes at the base of grown rice plants. There is also fear that the construction of the new fish breeding ponds and dam may increase the number of malarial mosquitoes.

#### 5) Cultural Legacy

The village constructed by British settlers in Church Land Area a hundred years ago has become an important historic site. Alterations should not be carried out in this area in order to preserve its original landscape.

### (2) Natural Environment

#### 1) Precious Wild Life and Ecosystem

There are no national parks, wetlands designated by the Ramsar Convention, fauna and flora habitat referred in CITES, and other areas protected or restricted due to the existence of wild species in the F/S Area and within its circumference. Although many wild birds fly over the flood plains, none of these species are endangered (Annex III.8.4).

The implementation of the Development Plan will scarcely affect the existence of the birds as the Study Area only covers a small part of the flood plain. Therefore, the existence of these wild species will not in anyway restrict the development.

## 2) Forest

The plateau and the escarpment of the plain edge are sparsely wooded and are covered with some shrubs. The vegetation category of the F/S Area is *Brachystegia spiciformis* - *Burkea* - *Guibourtia* bushy woodland. Illegal felling activities have also rendered small places being bare.

Forests in the F/S Area are under the supervision of the Mongu District Office of the Provincial Forest Department. Felling activities are restricted to individuals with felling licenses by the work conditions stipulated in the Forest Act, 1974. Nevertheless, a huge amount of trees are illegally felled. Between January and December of 1993, the registered volume of charcoal shipped from the Mongu District was 3,750 bags which meant using 1,125 m<sup>3</sup> of logs. The survey carried out by the Mongu District Office, however, discovered the actual shipment to be 9,850 bags, which corresponds to 3,000m<sup>3</sup> of logs (The Survey of Charcoal Shipment in Mongu District). The F/S Area is one of the major target area for illegal felling.

## 3) Soil

The greater part of the F/S Area consists of a very thick mantle of sand known as Kalahari sands. Soils developed in Kalahari sands have poor physical and chemical properties; low water holding capacity and low nutrient content etc. The soil of the plain edge escarpment contains more than 90% of sand which is 0.01-2.00 mm of particle size and contains only less than 1% of organic matters.

The gradient of the plain edge escarpment of the F/S Area is rather gentle in comparison with other area in the Study Area. From the application of shifting cultivation on the escarpment, cassavas are raised everywhere but at great intervals that the surface of the escarpment seems bare. Accordingly, soil runoff is easily triggered off during rainy days. The same condition was observed in small paths. Although most of the paths connecting to the tarred road on the plateau and villages in the plain edge incline at an angle of less than 5~6 degrees, torrential rains could cause an incredible sand runoff.

With a sufficient guidance in soil management, the Development Plan is not expected to cause leaching and depletion of the soil nutrients and solidification etc., which could deteriorate soil fertility. In addition, there is no needs to worry about soil contamination because the Development Plan intends to minimize the use of agrochemical and avoid items of highly toxic residuals, as mentioned in 6.22.1 (1) 3).

## 4) Hydrology, Water Quality and Air

**Hydrology :** The Development Plan is envisaged with irrigation facilities to stabilize the agricultural production. These facilities should be small in scale so that the farmers can

financially manage and maintain them, and simple in structure so that the farmers can independently reproduce them. Accordingly, the implementation of the Development Plan will not affect the surface water hydrology and water level, fluctuate groundwater level and deplete groundwater reserves. Nevertheless, the study on adequate measures for preventing sedimentation caused by the runoff of soil from the plain edge escarpment remains a crucial matter.

**Water quality :** If the use of agrochemical and fertilizers in minimum doses will be taught during the implementation of the Development Plan, water pollution will not happen from the use of agrochemical and fertilizers. The installation of facilities such as processing facilities, hatcheries etc. will be subjected to proper regulation on sewage drainage.

**Air pollution :** The implementation of the Development Plan will not pollute the air as it does not entail the spraying of large quantities of agrochemical and the rapid increase in vehicular use which results in the emission of a large volume of exhaust gas.

#### 5) Landscape and Mining Resources

The implementation of the Development Plan will not damage the landscape because it excludes works such as large scale agricultural land development, sea/swamp reclamation, large scale felling and large scale building construction. There are no mining activities in the F/S Area and its circumference.

### 6.22.2 Consideration for the Environmental Conservation

The Development Plan is assessed to have no adverse impacts on the environmental conditions in the F/S Area as mentioned above. However, the following consideration are necessary in order to heighten the effect of the Development Plan to improve the production of small scale farmers and to raise up their living standard.

#### (1) Soil Conservation on Escarpment

##### 1) Increase of Covering Vegetation

To prevent soil loss by promoting the revegetation of the escarpment, the Study Team recommends farmers to abandon cultivation of crops such as cassava & millet on the escarpment and encourages to let there in natural vegetation.

##### 2) Prevention of Soil Loss from Small Paths

Soil runoff occurs in most paths connecting the villages in the plain edge with the tarred road of the plateau during torrential rain. Prevention measures such as installation of



cross drains and mini-percolation tanks should be constructed. This is applied to the small paths which are not covered by road construction plan.

## (2) Forest Conservation

The Development Plan is not responsible for deforestation activities prior to its commencement. However, since the devastation of the forest is bound to accelerate soil erosion and make difficult collection of fire wood by the residents, anti-deforestation measures should be adopted and afforestation should be aggressively promoted.

The Study Team proposes that the plateau of the F/S Area is given a role as the firewood production center and afforestation should be actively carried out to provide firewood there. *Eucalyptus* spp., *Acacia* spp. and *Pinus* spp. etc. which have characteristics of drought tolerance and fast growing are recommendable.

The Study Team also would like to recommend the Provincial Forest Department for implementing the following forest conservation activities:

### 1) Reinforcement of Monitoring System: Augmentation of Budget and Staff

The factors largely influential in the decrease of forest resources in the F/S Area and its circumference are illegal felling for firewood and shifting farming practices.

Mongu District Office of the Provincial Forest Department is responsible not only in charge of afforestation, extension and licensing, but also that of forest patrol in order to keep watch over illegal felling activities. The duties of the divisions, however, are not effectively executed owing to limited budget and shortage of personnel and facility. Because of scarce patrol, violators are free to perpetuate their illegal activities.

The acquisition of proper budget and staff is, therefore, a matter of extreme importance in order to strengthen the supervising patrol.

### 2) Enhancement of Nursery Activities

Afforestation necessitates the propagation and distribution of nursery stocks. The production of nursery stocks of suitable species should be actively promoted.

### 3) Extension Works

It is necessary to educate the local residents the indispensability of conserving forest resources through public extension activities.

**(3) Malaria Control**

The following methods are considered applicable to the F/S Area in consideration of the social environment and characteristics of vector mosquito;

- use of insecticide impregnated mosquito nets in order to sever the contact between mosquitoes and man
- use of mosquito larvicide for the purpose of controlling the breeding of mosquitoes
- management of fish ponds and small reservoirs

Malaria control activities should be carried out in close cooperation with the Ministry of Health.