3.6 Agro-Processing

Present agro-processing conditions in the Study Area are as follows:

(1) Crop Processing

Processing of staple crops such as maize, rice, cassava and millet in the Study Area is conducted by women's hands by means of simply using a mortar and a pounder at home for economic purposes.

As for maize milling, mechanization has been proceeded for last few years. There is one large scale maize mill plant of 6 MT/hour capacity owned by INDECO Milling Ltd. and 28 hammer mills of 0.5 MT/hour capacity in the Study Area and its vicinity. This large scale milling plant could cover 47.8% of Mongu District population and 28 units hammer mills could cover its 28.7%. (Annex-Table III. 6.1). The said mill produces two kinds of meal such as roller mealie meal and breakfast mealie meal for the Commercial purposes. This plant is too large to process the maize harvested in Mongu, so maize harvested in neighboring Kaoma District, in which the maize production is the highest in the Western Province, is imported to satisfy the plant capacity. The products are packed in the 25kg bags and are sold to the dealers and residents in this area as well as a considerable volume of produce is sold to other Districts and Provinces. The problem of these facilities and equipment is how to secure the raw material. There is no problem in the selling products. Small scale hammer mills have been distributed to townships as leading parts for the last few years. This equipment is sold through VIS(Village Industry Service) or SIDO(Small Industries Development Organization) supported by Ministry of Commerce, Trade and Industry (MCTI). VIS distributed 9 units to Mongu District and 5 units to Kaoma District as well as SIDO sold 17 units to Mongu District by March 1994.

For rice milling by machine, one large scale rubber-roll-type rice mill plant of 1.5 MT/hour owned by West coop Trading Ltd. affiliated to Western Province Co-operative Union and two units of small scale rubber-roll-type rice mill belonging to Nutrition Group NGO organization are used. These plants, however, could cover only 5.1% of Mongu District population.

Cassava and millet are rarely processed by machinery but usually manually processed in the farmers' houses. Maize hammer mill can be used for processing these crops, but the marketing volumes of these crops are little due to the large quantity for self consumption.

On the processing of crops, insufficient road maintenance system within the area, traditional characteristic of self-efficient economy in the area, unstable production based on the natural conditions with poor infrastructures on the fields and improper crop production system by farmers etc. have prevented the processing plant from receiving raw materials of good quality and in stable volumes as well as the related mechanization in the Study Area excluding the township. There are some problems such as the moisture content of maize from farmers is very

low under 10 percent, and the production volume is rather small within the area.

(2) Tree Crops and Fruits

There is a large scale cashewnut processing firm in the Study Area. Zambia Cashew Company Ltd. owns 1,300 ha of cashew fields and the said firm which has a roast-processing capacity of 1.5 MT/hour. In four years, 1,200 ha have been planted. These trees on the field are too young to supply enough harvest to the firm. Although raw materials are collected from neighboring farmers, the processing volume in 1993 was only 12,624 kg and it is equivalent to only 10 days of full operation (Table III.4.3).

Western Province Co-operative Union possesses a large mango juice firm in the Study Area. This firm was operated only for three months for few years just after its installation, and now is suspending its operations. It is difficult to continue the operation of the firm, for only three months during the harvesting season in a year. The present harvest of mango fruits is only enough for three months operation of the firm. Western Province Co-operative Union, therefore, is planning the whole year operation by means of rehabilitation and upgrading the equipment for suitable not only mango but also to orange, guava and tomato processing.

(3) Animal Husbandry

Zambia Cold Storage Corporation Ltd. has a large scale slaughter with cold storage facilities in the Study Area. The plant capacity is 60 heads/day. Approximately 70% of meat processed by this facilities are transported to other Provinces such as Copperbelt and Lusaka and the rest is sold to the private shops or consumers in Mongu township at the factory gate. This facility is too large to receive an enough quantity of cattle for processing. Furthermore, the notice on free market by the Government in 1993 caused to reduce the number of cattle to be processed by this firm to half. There are also small scale slaughter houses, three in Limulunga and one in Namushakende owned by District Council. The processed quantity is one head per day in each house. This capacity is suitable to the area demand due to the absence of cold storage system in order to keep the raw meat fresh.

Almost all farmers in the Study Area are rearing some chickens and ducks. In necessary cases, farmers dispose some of them for self-consumption or selling at farm gate or market for a cash income. There is no breeding facilities or processing facilities in large scale for poultries, because of difficulties to obtain enough feed.

(4) Inland Fishery

Fishes caught in the Zambezi River are sold in the forms of fresh or dried at riversides or markets in the townships. Drying is done in the way that : fishes caught in the river are opened up(body) and dried for few days at the catching places, then final drying is done by charcoal fire in the houses.

The small scale cold storage for fish owned by the Nutrition Group is useful for satisfying somewhat the area demand.

Local women catch the fingerings of tilapia with large baskets in the canals and consume fresh or dried as valuable protein nutrition in the Study Area.

(5) Handicraft and Cottage Industries

In farmer's houses, some farmers produce hand sweepers, tapestries, baskets etc. during the farming off season. Especially in Limulunga, women's groups work together to make baskets and matting. These produces are sold in the Limulunga museum. However, Limulunga market is rather small and has little demands. Producers are trying to sell their products to the larger markets such as in Mongu or other large townships, but poor transportation facilities are the causes of constrainting the marketing channel. PHC(Primary Health Care) funded by Netherlands has a shop in Mongu township to sell seeds of vegetables, maize etc. This shop sells handicrafts collected directly from farmers. In Mongu market, some dealers sell handicraft products gathered from neighboring farmers.

3.7 Rural Infrastructure

3.7.1 Rural Road

(1) Road System in Zambia

From the viewpoint of the function and the maintenance, the road system in Zambia can be classified into 7 categories, namely International Main roads(T), Main roads(M), District roads(D)(RD), Branch roads(B), Rural roads(R), and Estate roads(E). The functions of the roads system are as follows:

- (T), (M) roads : (T) roads are the international roads which together with (M) roads form the primary road network.
- (D), (RD) roads : (D) and (RD) roads form the secondary network linking principal municipalities.
- (B) roads : (B) roads are the roads of local importance.
- (R) roads : (R) roads are local roads connecting rural area with low traffic.
- (E) Roads : (E) roads are the ones in the areas of government residential or industrial plots.

(T), (M) and (D) roads, are wholly maintained at public expense, and standard structures of these roads are determined by the Road Department.

(2) Present road conditions in the Study Area

In the Study Area there are two (M) roads namely M9 (Lusaka road) and M10 (Senanga road), one (D) road namely D315 (Limulunga road), and two (RD) roads namely RD305 (running from Namushakende to Kataba) and RD819 (Lealui road). Out of these roads, Lusaka road, Senanga road, and Limulunga road have two wide carriageways and tarred pavement. These roads have relatively busy traffic volume and are well maintained and very important for the economic activities in the Study Area. The villages located in the plain edge are connected by gravel paved roads or footpaths which are connected to Senanga or Limulunga roads.

The structure of gravel paved roads is composed of subgrade course using solid silty clay loam and laterite gravel surface. Out of these gravel paved roads, some roads in sloping area have serious erosion problem caused by rainwater running on the surface. At first, rain and traffic carry away the surface laterite and solid silty clay loam appears on the surface. After that, the ditch is formed by traffic on the surface, and the ditch grows bigger owing to run off rainwater. Solid silty clay loam has the characteristics that it becomes weak remarkably in case of high

moisture content. Therefore it is destroyed by rainwater so that in some roads it is impossible for vehicles to run.

In the Study Area the existing roads are footpaths which are mostly cleared grasses and trees. The surface of these footpaths are covered by deep loose sand so that it is very hard to even walk on foot, and only 4 wheel drive vehicles are able to run during dry season. In some cases, soil erosion problem occurs due to the clearing of trees.

The main tarred roads running from north to south in the Study Area are well-equipped but secondary roads and village roads are defective. The defectiveness make it difficult to convey of agricultural products and materials, to access to public services and communicate between villages, resulting in the cause of development constraints.

Table 3.7.1 Present Condition of the Existing Roads in the Study Area (1/2)

Ward(Area)	Description	Length (km)	Density (m/km^2)	Ratio (%)
Limulunga	Tarred pavement	4.2	365	17.5
(1,150 ha.)	Gravel pavement	6.7	583	27.9
	Footpath	13.1	1,139	54.6
	Total	24.0	2,087	100.0
Mabumbu	Tarred pavement	5.9	339	16.4
(1,740 ha.)	Gravel pavement	4.5	259	12.5
	Footpath	25.6	1,471	71.1
	Total	36.0	2,069	100.0
Lealui	Tarred pavement	5.0	340	16.4
(Excluding	Gravel pavement	3.0	204	9.9
Township)	Footpath	22.4	1,523	73.7
(1,470 ha.)	Total	30.4	2,067	100.0
Katongo	Tarred pavement	5.6	265	14.2
(2,110 ha.)	Gravel pavement	7.7	365	19.5
	Footpath	26.2	1,242	66.3
	Total	39.5	1,872	100.0
Yeta	Tarred pavement	6.4	296	13.0
(2,160 ha.)	Gravel pavement	16.6	769	33.7
	Footpath	26.2	1,213	53.3
	Total	49.2	2,278	100.0

Source : Measuring from topographic map 1/50,000

Table 3.7.1 Present Condition of the Existing Roads in the Study Area (2/2)

Ward(Area)	Description	Length (km)	Density (m/km^2)	Ratio (%)
Namushakende	Tarred pavement	8.2	291	18.8
(2,820 ha)	Gravel pavement	13.6	482	31.1
	Footpath	21.9	777	50.1
	Total	43.7	1,550	100.0
Total	Tarred pavement	35.3	308	15.8
(11,450 ha.)	Gravel pavement	52.1	455	23.4
	Footpath	135.4	1,183	60.8
	Total	222.8	1,946	100.0

Source : Measuring on the topographic map 1/50,000

3.7.2 Irrigation and Drainage

In the Study Area, no irrigation is practised, except bucket irrigation which is carried out on the gardens in Wet-Litongo and Mazul. Only a few paddy fields along Sefula river are supplied with water from the river. However, no irrigation facility is used because the level of the river bed is relatively higher than the surrounding paddy fields. But, it is difficult to irrigate from Namitome canal with this method because of the higher level of the paddy fields.

Drainage condition in the Study Area is very poor especially along the plain edge with only a few drainage facilities set in Mushiamo and Muwayawamo canals using human power. Carefulness must be taken in carrying out an intensive drainage for it may create the sinking of the peat soil in the Shishanjo garden.

3.7.3 Rural Water Supply, Rural Electrification, and Posts Telecommunications

(1) Water supply

Mongu District has a total of 286 water points installed using public fund. These water points consist of windlass or boreholes and cover the demands of 69% of the total rural population in Mongu District. Water coverage is defined as having a water point for 300 people (WASHE). Distribution of a water point in the Study Area is as follows:

Table 3.7.2 Water Point and Coverage in the Study Area

Ward	Population	Water Point	Water Coverage(%)
Limulunga	9,447	12	38
Mabumbu	3,287	9	82
Lealui	9,714	9	28
Katongo	8,969	12	40
Yeta	4,643	19	100
Namushakende	3,438	8	70
Total	39,498	69	52

Source : Vulnerability Assessment Mongu District, Adaptive Research Planning Team Western Province, MAFF

Some of the water points are now useless due to the breakdown of the pumps, or due to clogging or silting. Therefore it seems that actual water coverage is lower than as mentioned above. Also, fetching water is a great burden for women as most of the water points are located far away.

According to the Department of Water Affairs which handles the well construction program, 14 wells were targeted for Mongu District in 1993, and 4 of these were planned in the Study Area. Well construction is in progress based on the needs of each village. The Department of Water Affairs sets the priority according to the following components, 1) water need, 2) development potential, 3) technical feasibility and 4) social feasibility. More than twenty households in a village are required as acceptable minimum condition of well installation. The wells are maintained by the Department of Water Affairs, but the maintenance costs are covered by the beneficiaries.

(2) Rural electrification

An electric main line with a capacity of 66 KV comes into the Study Area from Livingstone which runs along the tarred road. The secondary line is also widespread in the Study Area. The supply system is as follows :

Main line	66 KV
Secondary line	11 KV
Third line	400 V (3 phase)
Domestic line	240 V

The total number of households receiving transmitted electricity in Mongu district is around 2000, only 176 of them are in the Study Area. And the electricity coverage is less than 10%. The 176 households are distributed 60 in Malengwa, 90 in Limulunga, 11 in Sefula and 15 in Namushakende. Although existing electricity line is widespread, coverage is quite low.

A half of the construction cost of extending secondary power line with a capacity of 11 KV are paid by ZESCO with the beneficiaries bearing remaining half of the cost. In case of third line, the beneficiaries bear all the cost.

(3) Posts and Telecommunications

The Posts and Telecommunications Corporation (PTC) provides postal and telephone services while television and radio are provided by Zambia National Broadcasting Corporation (ZNBC). Postal services include conveyance of mails and parcels, money order, saving, pension, and sale of post stamps.

Postal services in rural areas are poor and rural residents must travel more than 10 km to reach a post office.

Mongu District Headquarters and its branch office are located in Mongu township. Rural residents who are living in the vicinity of Mongu township can utilize these post offices. In rural area, there is one post office each in Limulunga and Namushakende. In Sefula, a postal agent is allocated to deal with some of postal services.

Postal services in Namushakende are very limited due to poor facility of the Post-Office. Conveyance of mails and parcels and sale of postal stamps are the main activities. Out of 75 post-office boxes, only 36 boxes are in use.

Telephone services in local as well as international calls are always available in Mongu township through Mongu control exchange system with 1,000 lines. Telephone services in Limulunga and Namushakende are available through Rural Subscriber System (RSS) connecting radio system with Mongu control exchange system. Nineteen subscribers are registered under the RSS.

3.7.4 Health and Education

(1) Health

1) Health Service Infrastructures

In Western Province, there are one General Hospital (Lewanika Hospital in Mongu), five District hospitals, five mission hospitals, and 92 health centers with 326 CHEWs (Community Health Workers).

Health services in Mongu District are delivered by District Health office (DMO's office) through 3 urban clinics and 20 Rural Health Centers (RHCs). DMO's office is also responsible for the chest clinic and MCH (Maternal Child Health) services both located at Lewanika Hospital. The RHCs and urban clinics are staffed by clinical officers, environmental health technicians (or health assistants), nurses and daily employees.

In the Study Area, every ward except Katongo has a RHC. As Katongo ward can be served by Mulambwa urban clinic, all the six wards are covered by the District health services. Staff distribution of health institutions in the Study Area is presented in Table 3.7.3.

Table 3.7.3 Staff Distribution in Health Centers, Mongu District, 1993

Name of Facility	Type	CO	EHT	ZEN	CDE			RM
					Male	Female	Total	
UHC and RHCs in the Study Area								
Mulambwa (Katongo)	UHC	1	1	4	2	1	3	0
Lealui	RHC	1	0	1	1	1	2	0
Limulunga	RHC	1	1	6	1	3	4	1
Mabumbu	RHC	1	0	1	2	2	4	0
Sefula	RHC	2	1	5	1	2	3	0
Namushakende	RHC	2	1	5	1	2	3	0
Other Health Facilities								
Lewanika MCH	GH	0	1	3	0	1	1	1
Prisons	UHC	1	1	4	0	2	2	0
Ndanda	UHC	1	1	0	1	1	2	0
Liyoyelo	RHC	1	1	5	0	2	2	0
Mawawa	RHC	1	1	1	1	1	2	0
Namitome	RHC	0	1	1	1	0	1	0
Sitoya	RHC	0	1	1	1	0	1	0
Iloke	RHC	1	1	0	1	1	2	0
Mwanawina	RHC	1	1	1	1	1	2	0
Luandui	RHC	1	1	0	1	1	2	0
Nalikwanda	RHC	1	1	1	1	1	2	0
Lukweta	RHC	1	1	1	1	1	2	0
Kama	RHC	0	0	1	1	1	2	0
Ndau	RHC	0	0	1	4	1	5	0
Lukalanya	RHC	1	0	0	1	1	2	0
Nangula	RHC	1	1	0	1	1	2	0
Ushaa	RHC	1	1	0	1	1	2	0
Total		20	18	42	25	28	53	2

Source: Ministry of Health, Mongu District
Note: GH = Provincial General Hospital
UHC = Urban Health Center
RHC = Rural Health Center
CO = Clinical Officer
EHT = Environmental Health Technician
ZEN = Zambia Enrolled Nurse
CDE = Classified Daily Employees
RM = Registered Midwifery
MCH = Maternal Child Health

2) Primary Health Care Program

The Primary Health Care (PHC) Program covers a number of components which are briefly described below.

a. Nutrition

Malnutrition for children under 5 years of age is one of the most serious problems in Western Province. Overall trend in the Province is an increase of the malnutrition rate of about 0.5 to 1.0 % per year. The solutions for nutrition problems are pursued through the intersectoral cooperation with the Department of Agriculture, research groups, NGOs and intersectoral nutrition teams. Nutrition activities include to promote diversification of farming introducting various crops such as legumes and vegetables.

b. Water and Sanitation

Lack of adequate water supply and sanitation is the most common problem in the communities. Diarrhea and eye diseases are related to the lack of clean water and sanitation. Water supply system in rural areas are mainly taken care by the Department of Water Affairs with the assistance of NORAD. RHCs are promoting the improvement of unprotected dug wells scattered in the rural communities.

c. Malaria control

Malaria is the main cause of morbidity as well as mortality in Mongu District. Preventive measures such as spraying of chemicals and delivery of mosquito nets are conducted by RHCs. Spraying services are provided at the costs of K500 per room or K 1,000 per house. Mosquito nets are sold at the cost of K 6,500 per unit.

d. AIDS and Tuberculosis

AIDS is rapidly becoming the main health problem in Mongu District. The spreading of the AIDS epidemic is resulting in an enormous increase in the number of tuberculosis cases. AIDS counseling at health center level is underway of preparation introducing training of district trainers. Health education through the creation of AIDS clubs is also conducted through RHCs.

e. Immunization program

The Universal Child Immunization (UCI) program is extensively carried out in Mongu District under support of UNICEF. The program aims at reducing diseases such as measles, whooping cough, tetanus and polio. RHCs play an important role in this field.

f. Other activities

In addition to the above, PHC program activities include supply of essential drugs

and equipment, child spacing, health education, and others.

These activities are conducted by community health workers in each RHC with participation of local communities. Activities of these RHCs are regularly monitored by the District offices.

3) Morbidity and Mortality

Malaria is still in all health centers the leading cause of morbidity. Number of out-patients increased from 89,080 in 1992 to 98,897 in 1993 and number of deaths also increased from 29 in 1992 to 41 in 1993. The Case Fatality Rate for malaria has hardly changed (4 per 10,000). The reason for the increase in reported malaria morbidity is not clear, although it could be postulated that not diagnosed HIV infection might play a role.

Upper respiratory infections (URIs) is ranked the second in leading causes of morbidity, with a total out-patients of 30,580 in 1993. Skin infection is ranked the third (20,863), eye diseases are ranked the fourth (13,082) and diarrhea diseases are ranked the fifth (11,578). Leading causes of morbidity and mortality in Mongu District during 1993 are presented in Table 3.7.4 and 3.7.5.

Table 3.7.4 Leading Causes of Morbidity, Mongu District, 1993

Causes	Total	Out-patient	In-patient
Malaria	100,317	98,897	1,420
URI	30,960	30,580	380
Skin infections	21,085	20,863	222
Eye diseases	13,114	13,082	32
Diarrhoea	11,882	11,578	304

Source: District Health Office, Mongu Note: URI = Upper Recipiratory Infection

Table 3.7.5 Leading Causes of Mortality, Mongu District, 1993

	Deaths			Mortality Rate
	Under 5	5 Over	Total	per 100,000 Population
Malaria	21	20	41	27.15
URI	20	5	25	16.56
Other communi. diseases	9	13	22	14.57
Pneumonia	15	6	21	13.91
Diarrhea	12	8	20	13.25

Source: District Health Office, Mongu
Note: Population of Mongu District in 1993 is estimated at 151,213.
URI = Upper Respiratory Infection
communi. = communicable

4) Major Issues

District Health Office is faced with the problem of shortage of trained staffs. Four of the RHCs are running without clinical officers, seven RHCs without health assistants (HAs) and six RHCs without nurses.

RHCs in the Study Area is likewise faced with the problem of shortage of trained staffs. Two RHCs (Mabumbu and Lealui) are running without HAs, having only one nurse at each RHC. Lack of transport is also the problem in RHCs. Most of RHCs are extending their services with only one motorcycle and two bicycles. Access to the villages are one of the most serious problems in Mongu District.

(2) Education

1) Educational Institutions in Western Province

Formal education in Western Province is classified into primary, secondary and higher schools. In 1991, the Province had 424 primary schools including basic schools, 14 secondary schools and a primary teachers' training college. Thus, primary schools with grades 1 to 7 classes form 87.3% of the total number of institutions, while basic schools with grades 1 to 9 account for 9.1% of the same.

2) Educational Institutions in Mongu District

Educational institutions in Mongu District consist of 89 primary schools, 6 secondary schools and a primary teachers' training college.

3) Educational Institutions in the Study Area

There are 12 primary and basic schools, 3 secondary schools, and a primary teachers' training college in the Study Area.

The total number of classes, enrollment and teachers of primary and basic schools are 222, 7,458, and 288, respectively in 1993, with the classroom-pupil ratio of 1:65.

The total number of classes, enrollment and teachers of secondary schools are 38, 1,656 and 64, respectively in 1993.

Statistics on educational infrastructures in the Study Area are presented in Table 3.7.6.

4) Major Issues in Education Sector

Major issues in education sector identified in the Study Area are as follows :

a. Inadequate school buildings

Most of school structures are old and need renovation. A number of window glasses and doors are broken. Electricity wiring is not available in most schools.

b. Inadequate classroom accommodation

As presented in Table 3.7.6, almost all schools are exceeding the classroom-pupils ratio of 1 : 40 which is the standard capacity of a classroom. Two or three shift teachings (sessions) a day are common in most of the primary schools.

c. Shortage of school furniture and equipment

In many schools, desks are old and need to be replaced with new desks. Drawers for teachers are not adequately furnished.

d. Inadequate housing accommodations for teachers

Staff houses for teachers are not adequately provided in terms of number as well as quality.

e. Lack of general maintenance costs in schools

Maintenance costs are not adequately provided, resulting in uncompleted renovation works of school buildings.

Table 3.7.6 Educational Institutions in the Study Area (1993)

Ward	School Name	No. of Classes	No. of Pupils	No.of Teachers	No.of Classroom	Classroom Pupil Ratio	No.of Desks
A. Primary and Basic School							
Limulunga	Mupatu	14	575	26	10	1:58	140
	Limulunga Basic	33	1,195	44	15	1:80	348
	Sub-total	47	1,770	70	25	1:71	488
Mabumbu	Mabumbu Basic	16	565	22	11	1:51	200
	Kalangu	7	293	8	5	1:59	88
	Sub-total	23	858	30	16	1:54	288
Lealui	Malengwa Basic	39	1,357	44	20	1:68	450
Katongo	Katongo	23	894	30	7	1:128	119
Yeta	Mutwiwambwa	14	536	13	7	1:77	169
	Namachaha	7	262	8	5	1:52	72
	Sefula Basic	25	762	38	11	1:69	171
	Sefula Basic for the Blind	14	80	15	9	1:09	42
	Sub-total	60	1,640	74	32	1:51	454
	* Excluding Sefula Blind:	46	1,560	59	23	1:68	412
Namushakende	Liunga	7	251	8	5	1:50	83
	Namushakende Basic	23	688	32	10	1:69	203
	Sub-total	30	939	40	15	1:63	286
Primary and Basic School		222	7,458	288	115	1:65	2,085
B. Secondary School							
Limulunga	Limulunga Secondary	9	393	12	9	1:30	n.a.
Malengwa	Holy Cross Girls	13	503	28	13	1:39	n.a.
Yeta	Sefula Secondary	16	850	24	16	1:53	n.a.
C. College							
Malengwa	Primary Teacher Training	n.a.	320	27	n.a.	n.a.	n.a.

Source: (1) Department of Education, Namushakende
(2) Interview Survey at each Institution

3.8 Environment

3.8.1 Environmental Administration

Based on the Environmental Protection and Pollution Control Act enacted in 1990, the Environmental Council of Zambia, which is in charge of environmental problems and environmental administration, was established and incorporated later within the Ministry of Environment & Natural Resources established in November 1991. Therefore, the Ministry has been engaged in formulating and revising regulations based on the Environmental Protection and Pollution Control Act and is expected to implement a full scale environmental administrative system in the near future.

(1) Environmental Administrative Agency

1) Ministry of Environment & Natural Resources

The Ministry of Environment & Natural Resources supervises natural resource management and environmental protection activities. It mainly ensures the sustainable use of Zambia's restorable natural resources (forests, agricultural lands, wildlife etc.), endeavors to maintain Zambia's biological diversity (animals, plants, organisms etc.), the essential ecological processes and life-support systems (soil regeneration and protection, nutrient recycling, environmental protection, and purification of polluted water etc.). The Ministry is not only made up of a Headquarters, Department of Forest and Department of natural Resources, but also has the Environmental Council of Zambia (ECZ) and the Zambia Forestry and Forest Corporation Limited (ZAFFICO) under its jurisdiction (Annex Figure III.8.1).

The Environmental Council of Zambia advises Government on environmental matters and implements environmental policies in accordance with the Environmental Protection and Pollution Control Act. It is also authorized to identify and approve projects which necessitate studies on environmental impact assessment. The Council constitutes a Pollution Control Inspectorate, Natural Resources Inspectorate and Environmental Planning & Management Division, plans environmental restrictions, environmental impact assessment and educational programs on environment, and co-ordinates the activities of related agencies. The Pollution Control Inspectorate are in charge of the restrictions on water pollution, air pollution, waste disposal, pesticides & toxic substances, noise and ionizing radiation (Annex Figure III.8.2).

The Departments of Forest and Natural Resources supervise environmental protection policies in accordance with the Forestry Act and Natural Resources Conservation Act.

2) Other Central Government Agencies

The formulation and supervision of basic policies on environmental problems encountered in fields other than those above-mentioned are carried out by the related Agencies and Ministries shown below.

Field	Supervising Ministry
Water use	Ministry of Energy & Water Development (Water Board, Department of Water Affair)
Agriculture	Ministry of Agriculture, Food & Fisheries (Department of Agriculture)
Fisheries	Ministry of Agriculture, Food & Fisheries (Department of Fisheries)
Land	Ministry of lands
Wildlife	Ministry of Tourism

3) Agencies in charge of the planning and implementation of policies

The actual policy making, planning and implementation works are mainly carried out by departments of provincial governments concerned with environmental issues.

(2) The Environmental Administrative Organ of the Western Province

The provincial natural resources and environment protection plan is under the supervision of the Provincial Natural Resources Committee. The Committee reviews and evaluates these resources for conservation, wise use and improvement. The Minister of Environment & Natural Resources appoints the Chairman and members of the Committee which consists of directors of provincial departments, 2 representatives from every district and 4 men learned and experienced in these fields. The Permanent Secretary of Western Province is the appointed Chairman of the Committee and Provincial Natural Resources Officer is appointed as Secretary of the Committee.

In the Western Province, the Forest Department, Natural Resources Department, Animal Husbandry Department, Land Use Planning Department, Town&Country Planning Department, Fisheries Department, Water Engineer Department, Rangeland Department and the Wildlife Service make plans and implement projects in their field respectively.

(3) Environmental Impact Assessment Executing System

The Draft of the Environmental Impact Assessment Regulations, formulated based on the Environmental Protection and Pollution Control Act, is presently under consideration, and is expected to be enacted in the first half of 1995. The Draft stipulates that developers, any person who proposes to undertake a new project or to repair, to extend or to maintain an existing project, will not be granted permission unless an environmental impact assessment (EIA) is concluded in accordance with this regulation. The implementation procedure of EIA, as

stipulated in the Draft, is outlined in Annex III.8.1 for reference. The Draft, however, is subject to amendments.

3.8.2 Environmental Situation

(1) Social Environment

1) Inhabitants

The Census of 1990 gave the population of the six wards which include the Study Area as 39,498, and the population density is 27.6 persons/km^2. The majority of the population is made up of the Lozi tribe, while the rest is a mixture of small tribal groups that have assimilated the ways of the Lozi tribe. Accordingly, the lack of diversity in small tribal groups' way of living eliminates problems that frequently impede the implementation of development project.

2) Institutions and Customs

Basically, the Study Area has been under dominance of the Lozi, and the tribe's traditional ways are still largely practiced by the residents. Plans should be formulated, therefore, with considerable respect to the prevailing institutional practices.

The water right is applicable to all river surface water except for international rivers like Zambezi, Luapula and some parts of the Luangwa river. However, it is not applicable to the waters at the flood plain in the Study Area. The customs and traditions of the Lozi tribe do not restrict the water use rights from being implemented(Annex-III.8).

The fishery practices in Zambia are regulated by the Fisheries Act enacted in 1974. Although there is no such thing as fishing right, the Minister of Agriculture, Food & Fisheries, in accordance with relevant statutes, is capable of designating commercial fishing areas. Fishing in commercial fishing areas is prohibited unless one is registered with the Director of Fisheries in the manner prescribed by the Minister. The residents in the Study Area have the liberty to fish anywhere owing to the absence of areas specifically prohibited to activity. However, one of the practices of the Lozi Tribe handed down by the Litunga, namely, "Right to Produce of the Land", is still valid at present. The permission of tenants, either of breeding ponds or flooded plains, is required for fishing, and most of these places impose fishing or entrance fees. If the road construction plan runs across a private breeding pond and may violate the "Right to the Produce of the Land", the cooperation of the Provincial Land Department should be acquired to effectively settle things with the tenants before the plan is regulated.

3) Pollution by Agrochemicals

The agrochemicals available in shops in Mongu include the likes of pirimiphos-methyl, pirimicarb and malathion. These chemicals are not very poisonous to fish, having low crop residual toxicity and little biological concentration, and are used by the farmers in minimal doses. Conclusively, the use of agrochemicals has no fear of environmental pollution.

In 1993, 1.55 tons of hydrated sulfur and 100 liters of endosulfan were sprayed on the Zambia Cashewnut Company Farm in Mabumbu(1300 ha in 1993). Although endosulfan is a highly toxic chemical, especially to fish, it is estimated to cause little effect on the environment because only a small amount per unit area was applied and the absence of irrigation and drainage canals for discharging this chemical into the water are absent in the Area.

4) Endemic and Epidemic Diseases

Malaria is the most serious endemic disease in Mongu District. The number of malaria patients treated in the clinics of the 7 sanitary areas, in which the Study Area is included, averages 49,514 or 65 % of the total population(Annex-Table III.8.1). However, the actual number of patients will be much more for some infected people try to heal themselves without seeking professional help.

Major malaria in this area is faciparum malaria, vicious and accompanied by severe symptoms that can lead to death. The carrier of the plasmodium is Anopheles gambiae. Regardless of the fact that the average number of work leaves by malaria is 15~20 days annually, this matter should be taken seriously as it occurs in the busy season when workers are over fatigued and susceptible to disease. Malaria countermeasures are necessary to avoid labor shortage in the busy season.

5) Treatment of Excreta and Waste

The Mongu urban area is installed with flush toilets which are connected to septic tanks and oxidation ponds for treatment. These methods safeguard the area from water pollution.

The rural area uses pit latrines which are covered with soil when full and new ones are dug thereafter. This method prevents environmental pollution unless overflowing occurs.

The area has no problems concerning the disposal of wastes due to a low population density and availability of vast vacant lands.

6) Cultural Legacy

The village constructed by British settlers in Sefula a hundred years ago has become an important historic site. Development projects that may affect the scene of the site should be restricted in order to preserve its original landscape.

Other sites of cultural importance do not exist in the Study Area or within its circumference from the anthropological, archeological, artistic, cultural, historical and ethnologic points of view.

(2) Natural Environment

1) 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 Study Area or within its circumference. Although many wild birds fly over the flood plains, none of these species are endangered.

The implementation of the Master Plan will scarcely affect the existence of the birds as the Study Area only covers a small part of the flood plains. Therefore, the existence of these wild species will not in anyway restrict development (Annex-III.8)

2) Forest

The wooded area of Western Province totals 9,538,000 ha, covering about 76% of the province's whole land area. In Mongu District, woodlands are 690,000 ha or about 68%. Forests in the Study Area are managed by the Mongu District Office of the Provincial Forest Department.

The forest resources of the Western Province decreased between 1975 and 1985 at an annual rate of 0.2%, the smallest rate among all provinces, especially in comparison with Copperbelt Province (2%). The national average is 0.5%. The present rate is forecast by the Provincial Forest Department as slight increase.

The wooded areas near settlements are used for fuel wood, poles and shifting cultivation of mainly cassava and/or bulrush millet. Generally less than 2% of the forests areas are used for crops. After several year of harvest, the land is left idle and forest regeneration takes place. Land clearing for shifting cultivation is very wasteful as far as forest resources are concerned. The amount of felled trees for urban residents is increasing.

Felling activities are restricted to individuals with felling licenses by the work conditions stipulated in the Forest Act, 1974 (Annex-III.8). The records of the Mongu District Office indicate that 2,331 m^3 of trees to be used as firewood were felled between January

and December of 1993, about half of which was used to make charcoal. If this situation is true, worrying over the depletion of forest resources is futile. However, the actual amount is said to exceed by far the records. Between January and December of 1993, the registered volume of charcoal shipped from the Mongu District was 3,750 bags, and this means using 1,125 m^3 of logs. However, the Mongu District Office found the actual shipment to be 9,850 bags. This would mean using 3,000 m^3 of logs (The Survey on Shipment of Charcoal in Mongu District).

The Mongu District Office which has the Section of Forest Patrol, is responsible for management on production and conservation of the national forests, including control of illegal felling activities. Due to extreme shortage in budget, staff and vehicles, however, patrol services are scarcely carried out. Therefore illegal felling for firewood and forest destruction by slash-and-burn method are left almost free to lawless person.

3) Soil and Land

The greater part of the Study Area consists of a very thick mantle of sand known as Kalahari sands and some areas are covered with the sand to a depth of 60 meters. 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 consists of more than 90% sand measuring 0.01-2.00 mm and contains organic matter only 1% or less.

The gradient of the plain edge escarpment is generally less than 10 degrees, though there are escarpments rarely have a 20 degree gradient. The greater part of the escarpment is covered with high trees and/or shrubs and wild grasses. Maize, millet and cassava are partly cultivated on a gentle sloping area and gullies develop in the steeper sections of the escarpment. In addition, rain causes soil runoff at the escarpment section where vegetation cover is sparse. Although most of the paths connecting the tar road on the plateau and villages in the plain edge incline at angle of less than 5-6 degrees, the passage of man or animal causes land slide. Torrential rain usually causes incredible sand runoff in these paths, burying canals and crops grown on the edge. The distance between each path is 500-600 meters.

3.9 Construction Materials

(1) Situation of Acquisition/Source of Construction Material

Concerning construction works, the situation relating to the acquisition of the material is as follows:

- Cement : A steady supply is possible depending upon Chilanga and Ndla cement plants. Normally it is brought from Lusaka.

- Crushed stones : A steady supply is possible from crush plants. The source is normally from Lusaka or Kafue National Park for no plant exists in Mongu.

- Sand : Plentiful amount is available in the plain or high ridge, but the sand (Barotse sand) is poorly graded. Grain size concentrates around 0.1~0.6 mm, and cohesion is scanty. Therefore, it is necessary to improve it by mixing with cement when it is used as a road construction material.

- Form (plywood) : The form produced in Zambia is more expensive than the imported one, and the usage is quite unsatisfactory. The source is normally from the Republic of South Africa.

- Reinforced bar : All reinforced bars are imported normally from the Republic of South Africa or the Republic of Zimbabwe.

- Gravel : It is possible to obtain laterite gravel as a road pavement material around Mongu, but it is not useful as a course aggregate of concrete works. The source around Mongu is as follows;

  Mawawa Plain : Located 8 km east of Mabumbu
  Mbuta, Simulima : Located 30 km east of Mongu township.

- Solid soil : It is possible to obtain solid soil composed of silty clay loam for the use of road bed or subgrade course materials. The source around Mongu is as follows :

  Ngonga Plain : Located 5 km. east of Mabumbu
  Mwiulwe : Located 45 km. east of Mongu township

- Building materials, Pipe materials, Lime
  : Most of these materials are bought from Lusaka

(2) Material Cost

Construction materials are normally bought from Lusaka. Therefore, material costs in Mongu are more expensive than in Lusaka when the transportation costs are added.

(3) Labour Cost

There is an official labour cost based on ZAMBIA GAZETT. However, there is a great difference between actual labour cost and official one, as GAZETT labour cost merely provides the minimum wage. The principal labour costs obtained from some construction companies in Lusaka are 2 to 3 times of GAZETT labour cost.

(4) Production Rate / Machine Expenditure

There is no official production rate in Zambia. The principal production rates and rental costs for the principal machines (bulldozer, tipper, grader, front-end loader, etc.) used by private construction works have been investigated. The proper depreciation of machine for construction works can be calculated from purchase cost, the period of durability, and maintenance ratio. Rental cost obtained from quotation of some companies should be compared with the above depreciation. Construction machines in Zambia are normally not well-maintained and in case of break down it takes long time to repair because of shortage of spare parts.

4. MASTER PLAN OF THE STUDY AREA

4. MASTER PLAN OF THE STUDY AREA

4.1 Basic Principle of the Plan

4.1.1 Study Objectives

Mineral resources in the Western Province are the least among 9 provinces in Zambia, and agriculture is, therefore, the sole industry in the Province which is mostly carried on by small scale subsistence farmers. The amount of staple foods produced in the area cannot fulfill the demand in the province. The Study Area which includes Mongu township has the most dense population in the province and the potentiality of development is very high. Up to now farmers in the area, however, are relying on rain-fed agriculture without utilizing water and land resources effectively.

Under these circumstances the Study aims to improve the livelihood of small scale farmers in the area through means of consolidated implementation of rural facilities relating to agriculture in the area.

4.1.2 Development Potentials

(1) Land resources

The Study Area includes 3,480 ha of farmland, 1,102 ha of grass land and 2,882 ha of Flood Plain. These areas account for 60% of the Study Area and are the subject of development.

(2) Water resources

There are two natural streams in the Study Area, Namitome canal and Sefula river. Both have a discharge of 0.3 m^3/sec even during the dry season.

The potentials of ground water along the flood plain edge within the Study Area are estimated as follows.

Description	Namusha-kende	Yeta	Katongo	Lealui	Mabumbu	Limulunga	Total
River flow		0.30				0.30	0.60
Ground water	1.83	2.19	1.46	2.19	1.09	1.09	9.85

Re: 1) Dimension m^3/sec
2) Ground water discharge, if pumping up from borehole.

4.1.3 Constraints to Development

(1) Physical constraints

1) Unpredictable time and fluctuation of Zambezi flood water level.

2) Infertile Kalahari sand which covers all the area with thick layer.

3) Unstable rainfall patterns.

(2) Social constraints

1) Agriculture

a. Lack of animal draught power and farming equipments among farmers.
b. Difficult situation for small scale farmers to get loans or credits for their inputs.
c. High price and shortage of agricultural materials and equipments.
d. Insufficiency of cooperative activities among farmers.
e. Shortage of extension personnel and equipments.

2) Infrastructures

a. Lack of irrigation and drainage facilities.
b. Lack of accessibility and facilities relating to marketing distribution.
c. Unproper functions of above facilities

3) Livestock and Inland fishery

a. Lack of preventive measures against epidemics.
b. Lack of processing and marketing facilities.
c. Lack of equipments for fish cultural extension.

4) Rural society

a. Increase of female headed households in the rural area caused by male migration.
b. Defficiency of rural and farm roads.
c. Traditional land tenure system preventing the modernization of agriculture.

4.1.4 Programmes and Projects related to the Development

(1) Provincial Medium Term Development Plan of Western Province (1991~1996)

The Plan aims at achieving the provincial development with their own resources, and it describes an analysis of present situation, constraints of the development and so on.

An integrated study for master plan and feasibility study of the Province will be carried out from now on.

(2) Relating projects

There are several projects and research teams in various fields for assisting farmers in Western Province. Most of them seem to be taking their approach, in a way, mainly from aspects of administrative and technical extension of agriculture. At the same time, consolidation of fundamental facilities relating to agriculture in the rural society should be encouraged to make those technical extension activities more efficient. Major projects or programmes concerning to the study are the following.

FSRT	(Farming System Research Team)
LWMP	(Land and Water Management Project)
ADPP	(Animal Draught Power Programme)
RPP	(Rice Promotion Programme)
VPIT	(Veterinary Production Investigation Team)
PPP	(People's Participation Programme)

4.1.5 Principal Concept of the Development Plan

(1) Basic principle

Mongu district, where the Study Area locates in, has 142,000 (14.1 person/km^2) population and most densely inhabited in the province. Mongu township is a center of political and economical activities in Western Province, and has 40,000 population in it, that means a potential market for the farmers around the township to sell their products.

Farmers in the Study Area consist of about 6,600 households and have 1.36 ha farmland per farm in average. This is considered too small to support their family.

The survey, carried out by the Study Team, shows that an average farmer in the area can get only K140,000 of cash income, from agricultural products, equivalent to 30% of his home expense of K450,000 a year.

The principles of the Study for the consolidation of rural facilities relating to agriculture by exploring regional resources are as follows :

1) Achievement of the self sufficiency in food production for the area and the establishment of market oriented farm management with surplus products.

2) Improvement of livelihood level of the small scale farmers in the area.

3) Establishment of intensively managed cultivation through the consolidation of

fundamental facilities.

4) Promotion of the agricultural diversification.

5) Encouragement of farmers' groups for cooperative activities in agriculture.

6) Encouragement of women's activities for getting equal status to men.

7) Fundamental facilities :

   a. Rural facilities
      Rural roads, Domestic water supply.
   b. Agricultural facilities
      Farm roads, Irrigation & Drainage canals
   c. Management facilities
      Agro-processing, Fishpond, Meat processing, Crush pen, Integrated training, Marketing

8) Management, operation and improvement of the facilities by farmers own efforts and expenses.

9) Farmers' positive participation to the project as the prerequisite for implementation of the project.

10) Conformity with Agricultural Sector Investment Programme(ASIP) by Zambia Government.

(2) Execution of the Plan

1) This development plan is to be executed in two phases, a short term plan (5 years) and a long term plan (20 years).

2) The short term plan is to be executed in a defined area within the Study Area selected by priority, as a model to be applied to other areas in the Study Area.

3) The long term plan is to follow the short term plan with related improvements or modification based on the changes of circumstances after its execution and ASIP conception.

4.2 Land Use

4.2.1 Utilization Of Land Facets In The Project Area

To improve land use system and utilize the land resources efficiently a Sustainable Land Use Plan is proposed.

In formulating this Plan, soil, climate, topography, economy and socio-politic of Mongu district, and conservation of its natural environment have been considered. With this Plan the land facets are used under the following Management Regimes :

(1) Plateau will be used under the following regimes -

1) Crop Production :

Less nutrient and less moisture demanding crops(millet, cassava) suited to sandy soils are grown in this part. Some new crop varieties also will be grown in small scale to check the soil suitability for producing non-native crops.

2) Fruit Production :

Deep rooting fruit trees such as cashew are recommended. Beside their high commercial and nutritional value, these plants utilize the soil and water efficiently. The plant roots penetrate in deep layers and utilized the stored nutrients and moisture.

The initial cost of nursery and plantation may be high, but after establishment the plants will use the natural parameters for further development and fruit production. Fruit production would reduce the problem of cash shortage and malnutrition in rural communities. It also stimulates the fruit related industries in the area.

3) Wood Production and Grazing :

Natural vegetation will be improved through minimal management and used as wood source and grazing site. Removal of rotted and infected vegetation, destruction of termite mounds, cleaning surface between the trees, planting young trees and leguminous grasses in these spaces are part of the management. New trees are marked and the public is cautioned to avoid their removal.

(2) Escarpment: Cultivation on escarpment will be abandoned. It will be rehabilitated, its natural vegetation promoted(as mentioned for plateau) and used for wood production. Filling the gullies, fencing eroded areas, and making proper footpath, track and waterway are part of the rehabilitation works.

(3) Dry Litongo : This part is most suitable for crops that do not require too much nutrients and moisture in their growth period. Millet, cassava, and cashew trees will be grown.

(4) Wet Litongo : will be used for producing -

- Fruits such as mango, cashews, guava, citrus and banana
- Crops such as maize and sorghum
- Vegetables such as onion and profitable summer vegetables.

Some shallow wells are necessary to be dug in this part to facilitate the "Bucket Watering" practice.

(5) Sishanjo : Will be improved and used mainly for profitable rice production. Based on cropping pattern, maize, millet, sweet potatoes, pumpkin and some vegetables also can be grown.

Increasing the soil pH, removal of weeds, and controlling soil moisture regime are part of the improvement works.

(6) Sanna : The grazing value and carrying capacity of Saana will be improved through minimal management and used for supporting the livestock production. Introducing leguminous and nutritional grass varieties, controlling termites and pest are part of management.

(7) Sitapa : Fertility of Sitapa will be promoted through soil improvement practice and used mainly for rice production.

With suitable cropping system, maize and some vegetables are also produced. Application of farm manure, incorporation of crop residue into soil will increase Sitapa productivity.

(8) Mazulu: Will be used mainly for maize production. With suitable cropping system, sorghum and fast growing vegetables are also produced.

4.3 Water Use

4.3.1 Surface Water Use Plan

There are two natural streams in the Study Area, which are Sefula river and Namitome canal. Both are tributaries of Zambezi river and their source are Dambo which are located on upland area in the eastern part of the Study Area. Discharge of the two streams are about 0.3 to 1.0 cubic meter per sec. Depending on a water quality test carried out on February 1994, the water qualities of the samples were in conformity with the limit of the WHO Guidelines for drinking water, except for the pH values which range from 5.4 to 5.8 for all the samples(Annex-Table III.1.2). The test results for the river water indicate better quality values than the result for shallow wells at the seepage zone in the plain edge area. According to the results of the test, if each family boils up the water, it could be domestically used but it cannot be conclude perfectly as the test did not carried out bacteriological analysis. People liveing along the Sefula river carry drinking water from shallow wells at the seepage zone of the plane edge area because they think that the river water is more contaminated than the well water. Although the results of water quality analysis indicated reverse conclusion, one can observe that part of the pollution of the river water is related to the living conditions, especially near the village area. In the future, the pollution of the river water will be more sensible due to the expected demographic growth in the Study Area. In addition, the river water use for drinking has similar problems with the well water use in that lots of labour for its picking and its transport.

Considering a water supply system is provided by boreholes drilled in Mongu township area already, it should not be recommended to use the river water for domestic consumption.

No problem was found in the quality of the two natural rivers when used for irrigation and inland fisheries except for sensitive crop or fish of acidic water. With respect to discharge, the base flow amount corresponds to the maximum limit appropriate for the technology considered in the study. If much water discharge is applied over the base flow amount, the required water storage facilities such as dam and pond will necessitate high technology and experience for operation and management. Similarly, water use system with long canal to convey water from the small Zambezi (Malile river) or the Zambezi river, cannot be advised in this plan for the same reason, in that it would also require higher technological level for operation and management.

4.3.2 Underground Water Use Plan

Some findings of the water supply feasibility study for Mongu township indicate that the plain edge area retains enough amount and quality of underground water resource. If underground water is developed in the whole Study Area by means of boreholes, high lift pump, storage tank and pipe line system with huge initial and management cost, the development plan will not be feasible in the present circumstances considering the small number of beneficiaries and the level of technology involved.

4.4 Rural Infrastructure

The present state of rural infrastructure such as roads, rural water supply, electricity, post and telecommunication, education and health is extremely poor in the Study Area. However, it is actually difficult to solve each problem in a short term considering the present low productivity and income of the area, and the lack of maintenance fund.

Therefore a plan closely related to agricultural development and aiming to increase agricultural productivity and income should be emphasized because this study concerns a rural development project based on agricultural development. Accordingly, the development plan for roads, an integrated training facility, soil erosion control and water supply should be included in this master plan. The development plan for items such as health and education are excluded in this master plan but will be made reference to.

4.4.1 The development plan in this master plan

(1) Roads

It is very hard even walking on foot for most existing roads as they are covered by deep loose sand which seriously hinders the transport of agricultural products and materials and the access to public services such as education, health care and so on. The road development plan is the most important component from the viewpoint of conveyance of agricultural products and materials which will increase after implementation of the project, and the promotion of extension and community activity.

Taking into consideration the present state, the roads which have to be improved and/or constructed are categorized as follows :

1) The roads connecting the tarred road running from north to south along the Study Area and the villages (Feeder Roads)
2) The roads connecting villages (Village Roads)
3) The roads to be constructed in the Plain (Peripheral Roads and Field Roads)

1) Feeder roads

The roads connecting schools, health care center and market should be especially emphasized for improvement. This category of roads should be improved every 2~4 km interval from north to south. Almost all roads existing on escarpments are subject to serious erosion by runoff rainwater. This fact requires, therefore, to consider the horizontal alignment of proposed routes, specially when these are located on steep slopes, in order to decrease the vertical slopes and equip the roads with drainage canals. This type of road structure will allow not only four wheel drive vehicles to pass but any other vehicle to convey the agricultural products, materials and necessities.

2) Village roads

The roads connecting villages in dry or wet Litongo should also be improved and have to be connected to the planned feeder roads. As a result, the improvement of access to public services such as schools and health care centers, the development of community activities and improvement of technical extension are expected.

3) Peripheral roads and field roads

Peripheral roads will be installed around the farm land in the Plain and will have the function of conveyance of agricultural products and materials and access to the farm. In addition, it is desirable that such roads also have the function of embankment to protect the farm land from the influence of floods. Therefore, the elevation of peripheral roads surface is determined according to the water level in the Plain, and the proposed routes are planned depending on the topography in the Plain.

It is impossible to protect completely the farm land from the flood water because the Plain area is composed of sandy soil with a relatively high permeability coefficient, in the order of 10^{-3} cm/sec. However it is possible to generate a difference in water level between the outside and the inside of the embankment, and this will lead to increase the arable land during the flood season.

The material of the embankment is mainly composed of the sand obtained in the Plain, but some portions are composed of impervious material to protect against floods and slope destruction. Clay or sandy clay belonging to the Bulozi soil type is available at the lower part of the Plain and is suitable as impervious material.

Farm roads will also be provided in the Plain to allow access to the farm land from the peripheral or village roads and to move within the farms

Table 4.4.1 Outline of the proposed roads

Ward	Feeder roads	Village roads	Peripheral roads	Field roads	Total (km)
Limulunga	0.6	3.3	5.7	1.5	11.1
Mabumbu	1.5	5.7	5.4	1.8	14.4
Lealui	1.2	5.7	7.7	2.6	17.2
Katongo	1.7	7.9	7.7	1.6	18.9
Yeta	5.2	7.6	7.4	2.3	22.5
Namushakende	1.9	8.9	8.6	2.0	21.4
Total (km)	12.1	39.1	42.5	11.8	105.5

(2) Integrated training facilities

In order to promote community activities, extension, women's activities and farmers' organization, some integrated facilities will be installed. An integrated training facility is composed of a multipurpose conference room, a training room, a camp officer's room, a women's training room, a vaccination room and so on. In some cases, the combination of agro/fish/livestock processing facilities, storage and marketing facilities will be taken into consideration.

It is desirable that each ward owns at least one integrated training facility, which should be installed near the public facilities, school, health care center or market. The roads connecting community halls will be improved as feeder roads, or village roads.

(3) Soil erosion control and farm land conservation

Rainfall causes soil particles transfer from escarpments towards the dry and wet Litondo where fruit trees, crops, vegetable gardens, and residential areas are located. Natural streams also form gullies in escarpments causing much soil transfer.

Soil erosion control should be carried out in the aspect of not only farm land conservation but also cost reduction of the village road maintenance. Proposed countermeasures of soil erosion include the following items.

1) Abandonment of cultivation in escarpments and recovery of natural vegetation
2) Installation of catch drains or collection canals
3) Installation of gully control structures and sedimentation tanks in natural streams

(4) Rural Water Supply

To ensure a clean drinking water is indispensable for people in the Study Area. It is an urgent subject to allocate one water point per 300 people and to repair the existing water points especially in Limulunga, Lealui, Katongo, and Namushakende where the water coverage is low. In Yeta and Mabumbu, installation of new boreholes should be also considered for people living in the high ridge where the provision of water and public facilities is very difficult.

4.4.2 Health and Education

(1) Health

1) Provincial development policy

Importance of the Primary Health Care (PHC) programme, sponsored by UNICEF and the Government of Netherlands, is stressed in the Provincial Medium Term Development Plan 1991-1996. The PHC programme in Western Province started in 1988. The

programme is now in its second phase. The PHC phase II aims at community development, district autonomy in planning and execution of programme activities, building up the capacity of local staff with respect to PHC, and technical, logistical and financial support for the PHC activities. In the execution of the PHC programme, stimulation of community participation, intersectoral cooperation and strengthening of existing health services are considered to be extremely necessary.

In this regard, training of community health workers is emphasized in the Plan document. It is also stressed in the Plan document that measures will be taken and workshop facilities will be further developed to guarantee reliable transport which is the key to the success of the PHC Programme.

Emphasis is also given to the rehabilitation and maintenance of the existing infrastructure, most of which do not meet the acceptable minimum standards. Improvement of RHCs facilities will be carried out in the RHCs where necessary facilities are lacking. Necessary facilities include rooms (for consultations, environmental services, mother and child health services, and delivery services), hygienic latrines, a safe and adequate water supply and electricity.

2) Basic Concept for Development

Major issues which Provincial as well as Mongu District Health Offices are facing are inadequate facilities and equipment and the problem of shortage of trained staffs. The main problem in the rural areas is, among others, lack of transport facilities due to remoteness of the communities and difficult access due to bad road condition.

Considering the present situation and Government policy in health sector, priority areas will be renovation and maintenance of the existing health facilities, with special emphasis on the improvement of training facilities in Sefula RHC. The second priority will be recruitment of trained staffs in the RHCs which are lacking health assistants (environmental health engineers) and nurses. Provision of transport facility to each RHC is also considered necessary to improve the activities of community health workers.

(2) Education

Major problems in the Study Area are poor school buildings with broken doors and window glasses, inadequate classroom accommodation and shortage of furniture and equipment, particularly for primary schools. Therefore, the first priority should be given to the improvement of primary school facilities including school buildings, furniture and equipment. Schools with classroom-pupils ratio of more than 80 will be given priority. The second priority shall be given to expansion of classrooms of the existing secondary schools to accommodate more pupils. Construction of staff houses for teachers is also needed.

4.5 Irrigation and Drainage

4.5.1 Necessity of paddy field irrigation in the Study Area

The reasons why the Study Area, where annual rainfall is 900 mm and undeveloped lands are scattering around it, should be developed for paddy field irrigation are considered and mentioned below.

Average arable land area for each farmer in the Study Area is only 1.2 ha and almost all suitable land is used already. It is hard to increase the arable land in the future due to land tenure system and soil suitability. Forest and bush land are often found in the plateau near the Study Area, these areas should be kept and conserved in the present conditions for environmental conservation, namely wild animal conservation, ecological systems conservation and soil and water conservation. Therefore, it is important to improve productivity within the present arable land area but the Lozi tribe do not have fertilization system traditionally, except for the application of cattle manure. The transpiration pattern is quite unstable and the yield of rice is only about 1 ton/ha.

In order to improve the present condition and these systems, it is important to prepare irrigation system and stabilize the production. An irrigation system, which allows the farmers sustainable agriculture, therefore its expenditure for facilities and operation management is reasonable, is proposed and recommended.

4.5.2 Irrigation development policy in the plain edge area

The main object of the study is integrated rural development with irrigation being one of the main components. Appropriate technology level for the Study Area was already set up by the Agricultural Verification Study which was carried out as a former project of this study. According to the appropriate technology level, plan of gravity irrigation system using natural stream and/or seepage water is expected as one of the leading components of the development project.

It is important to establish a basic policy of irrigation, which stresses not only irrigation necessity but also the importance of operation and management of irrigation facilities in order to keep functions of facilities by farmers themselves.

4.5.3 Premises of Irrigation Plan

(1) Premises for the irrigation plan

There is no experience and practice in irrigation in the Study Area, therefore the irrigation plan has to take into consideration on water losses due to poor management and failure of the irrigation facilities.

(2) Basic year for irrigation plan

A drought year with three to five years return period which is given from consideration of applicating appropriate technology level and construction cost is targeted as basic year for irrigation plan. Using probabilities of non-exceedance computed from the annual rainfall records for 30 years at Mongu meteorological station, 1985/86 was selected as the basic year for irrigation plan.

(3) Proposed irrigation systems

As proposed irrigation systems in the basic irrigation plan for the Study Area, three types are considered as follows.

- Gravity irrigation system for rice cultivation by natural streams which are Sefula river and Namitome canal (for Sitapa, Mataba and Shisanjo garden types in Yeta and Limulunga/Mabumbu blocks only)
- Gravity irrigation system for rice cultivation by catch drain which will be constructed along the seepage zone
- Bucket irrigation system for upland crop cultivation by shallow wells in wet-Litongo and Mazulu area

4.5.4 Irrigation Water Requirement

(1) Evapotranspiration

Evapotranspiration can be found by multiplying the reference crop evaporation by the crop coefficient "FAO Irrigation and drainage paper no.24, Guidelines for predicting crop water requirement" (here in after FAO IDP no.24).

The crop coefficients FAO IDP No.24 were used for rice in northern Australia, where the latitude is almost the same with Zambia, because the coefficients for Zambia were not available. The proposed cropping pattern and crop coefficient (KC value) are shown in Annex-Figure IV.5.1

(2) Other irrigation water requirement

The water requirements of initial ponding for direct seeding and puddling and nursery for transplanting are estimated to be 150 mm per month.

(3) Effective rainfall.

The effective rainfall is considered 80% of monthly rainfall which is integrated daily rainfall in each month .

(4) Irrigation requirement

Net irrigation requirement and Gross irrigation requirement are calculated as follows:

Net irrigation requirement = (Seasonal water requirement) - (Effective rainfall)

Gross irrigation requirement = (Net irrigation requirement) / (1 - Conveyance loss percentage)

The gross irrigation requirement is 2,300 mm/year which is calculated by the method mentioned in (1) and (2). Monthly irrigation requirement is shown in Annex-Table IV.5.1.

4.5.5 Proposed irrigable area in each block

Proposed irrigation areas in relevant blocks, which are calculated from irrigation requirement and base flow discharges of the Sefula river and Namitome canal, are mentioned as follows. Irrigable areas for the bucket irrigation are calculated to whole area of Wet-Litongo garden type and 5% of Mazulu and Sitapa garden type areas.

(1) Limulunga / Mabumbu Block

- Gravity irrigation system by natural stream: 200 ha for late matured rice in rainy season and 100 ha for early matured rice in dry season.
- Bucket irrigation system: 50 ha in Wet Litongo and 50 ha in Mazulu and Sitapa.

(2) Lealui Block

- Bucket irrigation system: 50 ha in Wet Litongo and 25 ha in Mazulu and Sitapa.

(3) Katongo Block

- Bucket irrigation system: 25 ha in Wet Litongo and 25 ha in Mazulu and Sitapa.

(4) Yeta Block

- Gravity irrigation system by natural stream: 200 ha for late matured rice in rainy season and 100 ha for early matured rice in dry season.
- Bucket irrigation system: 50 ha in Wet Litongo and 30 ha in Mazulu and Sitapa.

(5) Namushakende Block

- Bucket irrigation system: 35 ha in Wet Litongo and 35 ha in Mazulu and Sitapa.

4.5.6 Drainage Plan

Considering the appropriate technology level for the Study Area, drainage facilities such as drainage pump, construction of drainage canal connected to the Zambezi river and improvement of the Musiamo canal cannot be recommended, because these drainage methods are able to secure only small benefits compared to quite high construction and management costs. Therefore, drainage plan for the Study Area aims to improve farmer's technologies, for example, to extend field management for gravity drainage.

4.6 Water Management

In the irrigation plan, plot-to-plot irrigation system which derives irrigation water from upstream plot to downstream plot is recommended. Therefore it is difficult to carry out independent water management for each plot which exceeds the function of facility and system. At the same time, detailed water management practice may be not required from farmers because it is not carried out intensively in the Study Area. However, in order to get better productivity from limited resources, adequate water management plan with some latitude which is managed by farmer themselves has to be prepared, for each farming and crop raising systems. It is recommended to set up a 3-5 years practice and training term, and to form detailed water management plan with farmer's participation in the training term.

4.6.1 Adequate Irrigation Water Supply

(1) Water management for direct seeding cultivation of paddy rice on well drained paddy field.

In the direct seeding on well drained paddy field, initial ponding shall be prepared at adequate growing period when rice has 3, 4 leaves about a month after seeding. At the initial ponding period, water is necessary not only for crop water requirement but also for additional water to fill up the pore spaces and keep the ponding water depth on the field. As the irrigation requirement reaches to maximum, seeding period shall be calculated back to initial ponding period. However if nursery growth is not good but enough water resource is available, it can be recommended to apply irrigation water until it is wet on the field surface.

(2) Water management for transplanting cultivation

Practice of paddling and nursery is needed in transplanting cultivation. Paddling water amount include the water to saturate dried up paddy soil and to keep the water depth for carrying out field surface leveling. Therefore, net water requirement for transplanting cultivation will be maximum in this period.

After transplanting, it is desirable to keep the ponding depth which is adjusted with rice but it is also important to drain the surplus water quickly when rainfall comes and inundates over the adequate ponding depth. Therefore, right after transplanting, it is recommended to keep shallow ponding water depth.

(3) Water management for rainfed cultivation

In rainfed paddy field, it is important to prepare levee for effective water use, carrying out levee coating after enough rainfall for the sake of reducing the loss of rain water.

(4) Water management in drought (to carry out dry field cultivation/to reduce Evapotranspiration)

It is important to keep ponding water for the purpose of sustaining multiple functions of paddy field effectively. However, when drought comes and irrigation water is short, water saving irrigation such as rotational irrigation and prolongation of irrigation interval should be carried out

4.6.2 Operation and Management

(1) Water users' organization

There are almost no self-support agricultural organizations not only in the Study Area but also in the whole country. If operation and management of irrigation facilities are entrusted to farmers, it can be supposed that the irrigation facility will not be used effectively due to the lack of enough knowledge on operation and management. Therefore, taking social and traditional condition in the Study Area into the consideration, practicing and training with 3 to 5 years period shall be established according to following basic concepts. Then it is desired that farmers' water use groups and organization operating rules have to be established concretely depending on the training activity.

- According to concept of people's participating development plan, practice and training system shall be established and subjects of operation and management should be practiced using the Namushakende Verification Farm and the Agricultural Training Institute where irrigation facilities are prepared. The farmers will also understand the importance of operation and management through the practical experience such as group work of dredging canal's sediment.

- Following the traditional land management system, not only beneficial farmers but also some Indunas, village head men and DAO have to be included in the constitute members of the management organization by which taking the function of the traditional mediation of the Royal Council into the organization.

(2) Concrete training plan

A concrete training plan is mentioned in connection with other fields in the paragraph of 4.15 entitled Operation and Management of Facilities Plan.

4.7 Agricultural Development

4.7.1 Farming and Crop Husbandry

(1) Plan of Crop Production

1) Cropping Plan

Allocation of crops to each garden type extended in the flood plain edge, which is locally classified by Lozi tribe based on natural topography, soil type and water regime, is examined with consideration of each garden's aspect as follows.

a. Matema garden

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

b. Dry Litongo garden

This garden type is dominantly sandy soil with poor water retention capacity and nutrients. Permanent crop like mango and cashew is suitable. Cassava and bulrush millet are better to be inter cropped with cowpea and pigeon pea. Improved variety of bulrush millet has higher yield than local variety.

c. Wet Litongo garden

This garden type keeps a favorable moist condition throughout the year with fair humus content. Permanent crops like mango, orange are suitable, while vegetable with a rotation of leguminous crop like ground nut is also preferable.

d. Sishanjo garden

Muck-peat soils are dominantly extended with regular water logging condition throughout the year, and the farming is directly subject to the function of the catch-drain existed. Rice cultivation requires heavy labour force in terms of weeding and plowing, thus this garden is not much cultivated. But the raising of rice or vegetables by high ridge cultivation has to be considered under the high land pressure.

e. Matapa-sitapa garden

This garden is a fertile sandy to loamy sand soils because of being exposed to annual flood which supplies minerals to the soil. Rice is a chief crop which can adapt to this garden including double cropping.

f. Mazulu garden

This garden is a mound shaped land with rich bases formed on ant-hill of old river bed levees, and seldom flooded. A rotation of maize, sorghum and vegetables is a sustainable cropping system combined with manuring practice once every three years, and a bucket irrigation method is employed for vegetable production.

2) Selection of Target Crops

Rice, maize, vegetable and fruits (mango, cashew and citrus) were selected as the major target crops to introduce in the Study Area. The reason for selecting the said crops is as follows :

Rice is a promising crop suited for the edge of the flood plain. Only one third of the national demand has been domestically self-supported. Thus improving a self sufficient rate of the rice is an important national policy in order to save foreign currencies. Rice is widely cultivated among the farmers in the plain edge area in the rainy season. Thus, an extension of the rice crop appears to be easy.

Maize is an important staple food in Zambia. Suitable area for maize cultivation is very limited in the Western Province, resulting in regular importation of maize from outside of the Province. Thus it is necessary to increase maize production to improve a self-sufficient rate.

Most of the exotic vegetables like bulb onion, cabbage, tomato and potato depends on importation from out of the Province except for the leafy vegetables. Ecologically cultivating them in the Area is possible but the cultivation practice is not spread over the small scale farmers coupled with poor distribution of farming inputs. However, the vegetable is regarded as the crop for livelihood improvement of the small scale farmers.

Concerning the fruit crops of mango, cashew and citrus, Mongu regional research station has already tackled for the collection of stock and agronomic research.

Mango is widely grown in the plain edge and high quality of mango fruit containing less fiber is well competitive in the domestic market. Meanwhile, the closed mango pulp factory in Mongu is expected to reopen through the rehabilitation and upgrading plan, thus marketing fruits is no problem.

Cashew is only one promising tree crop suited for the dried Kalahari sand, and the product is fully procured by the ZCCL which is implemented with the cashew estate farm and processing factory in the Study Area.

Citrus fruits are already cultivated in the plain edge(wet Litongo garden) among the small scale farmers who are highly motivated, and marketed within the Area. A future possibility of juice processing at the mango pulp factory is also remained if the production is increased.

Endemic crops like cassava, sorghum and bulrush millet are cultivated as usual, and also inter cropped with the cashew till it reaches the nut bearing stage after planting.

3) Cropping schedule

a. Rice

In the area where water is available during the dry season, a rice double cropping system is applied. Rice of irrigated system in the dry season is directly sown on August with early matured variety and harvested on December. Meanwhile, the wet season crop for late matured variety is transplanted on January and harvested on June. Supa, a marketable variety, is used for the wet season, and thermal sensitive variety for the dry season.

b. Maize

Completing a sowing operation from late October to late November, harvest operation is done from late April to early June. So far observed, early planting is recommended because of less risky and reasonable harvest.

c. Fruit

Planting seedling is suited to onset of the beginning of the rainy season.

d. Vegetables

Vegetable cultivation is suited from the late rainy season to the cool dry season because of less occurrence of disease and insect problems.

(2) Category of the Farming Systems

Formulating the farming system plan, the current farming system based on a combination of natural water regime, soil type and topography interacted with cattle farming is a chief point to be considered with available labour force, and farmers' intention in the Study Area, and two cropping patterns are formulated as shown in Figure 4.7.1.

1) Double cropping of rice in both of the dry and wet seasons with upland crop, vegetable and fruit

Yeta and Limulunga/Mabumbu blocks where the water resource is available during the dry season are corresponded.

2) Single rice cropping in the wet season with upland crop, vegetable and fruit

Three blocks of Namushakende, Katongo, and Lealui where the water stream is not available during the dry season are corresponded

The second type is divided into two sub types mentioned below in terms of accessibility to the urban area like Mongu township and kind of target crops involved.

a. Namushakende block
b. Katongo, Lealui blocks

(3) Formulated cultural practice

Implementing the formulated plan, a labour intensive cultural practice is required because it involves rice double cropping for both of the dry and the wet seasons and vegetables cropping by bucket irrigation method. The formulated cultural practice is briefly mentioned below.

1) Irrigated dry season rice

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

b. Sowing operation
The water-screened seeds should be sown in line at 30 cm apart with 60 kg of seeds per hectare.

c. Fertilizer dosage
Followed by emergence, 200 kg/ha of D'mix (10-20-10) are broadcasted with the first weeding practice. At tillering and meiosis stages, 50 kg/ha of urea for top dressing is applied.

d. Field management
Insect control should be timely managed, and of which biological/physical method is mainly applied. Severe weed infestation during the upland condition should be timely controlled by hand. Flooding the field should be practiced at 20 cm high growth stage and be kept thoroughly at tillering, panicle formation and flowering stages, because of its high water demand.

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 the ponding water 2 to 3 weeks prior to harvest so as to make a harvest operation easy.

f. Harvest operation
Cutting rice stalks at panicle base by sickle is employed with foot pedal thresher and manual winnower for processing.

2) Wet season rice

a. Plowing operation
Following the harvest operation in December, plowing the field by animal draught power should be immediately carried out. Sitapa-matapa garden has an enough bearing capacity, thus an oxen-plowing operation possible in the rainy season.

b. Nursery bed

Pregerminated seeds via screened by water is sown on a prepared flooded nursery bed on mid-December. A size of the nursery bed is approximately 5 % of the field size and 70 g seeds/m^2 density.

c. Transplanting operation

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

d. Fertilizer dosage

Same as the dry season rice.

e. Field management

Same as the dry season rice.

f. Draining of residual water

Same as the dry season rice.

g. Harvesting operation

Same as the dry season rice.

Note: Rice single cropping under rainfed condition is carried out by line owing method on dry bed.

3) Maize

a. Plowing operation

Plowing the field by ADP at onset of the rainy season is carried out to promote an expansion of the cropping area with labour saving.

b. Sowing operation

As cropping maize in Mazulu garden during the rainy season, a hybrid variety of the late maturity is used with a density of 40,000 plants/ha and 32-40 kg seed rate/ha.

c. Fertilizer dosage

Basal dressing of 200 kg D'mix (10-20-10)/ha is broadcasted within 3 weeks after sowing. Top dressing is applied in 5 to 6 weeks after sowing at a rate of 100 kg urea/ha.

d. Field management

Weeding practice should be done twice, 4 weeks after sawing and knee high stage respectively.

e. Harvest and storage

Drying cob under the sunlight followed by harvest is stored in a storage bin with husk to avoid insect attack.

4) Vegetables

A cropping pattern over the cool dry season is managed by employing a bucket irrigation method based on the soil moisture condition. Fertilizer is used with both kraal manure

and chemical fertilizers. A rotation cropping with maize, leguminous crops is introduced to avoid severe pest and disease problems in Mazulu garden. Similarly this rotation is applied to Litongo garden to sustain soil fertility and suppress pest and disease problems. Chemical spray is also done according to the crop need.

5) Fruit crops

Five kg of kraal manure is applied into a planting hole by mixing with soils thoroughly and an enough time is given for decomposition prior to planting a seedling. It needs to protect the soil desiccation around the seedling by mulching with organic matter like grasses. Watering juvenile seedlings in Matema garden is an important cultural practice. Annual manuring and regular chemical spray, especially for cashew tree during the flowering period gives a significant effect to yield.

(5) Mechanization

In order to expand the cultivable area with higher labor efficiency, an introduction of ADP plays a significant role to plow, harrow and transport on the farming. However, the number of ADP in the Study Area does not meet to a high local demand, thus it results in late plowing and planting. In this plan, promoting an introduction of ADP and its expansion, operation of various field management like weeding by ADP is also examined in collaboration with the Animal Draught Power Project. It is preferred to possess agricultural equipment as follows.

1) Paddy rice

a. ADP and its implements(plow and harrow) : Possessed by individual or group
b. Foot pedal type thresher and manual winnower : Possessed by individual or group

2) Upland crop and Tree crop

a. ADP, plow and harrow : Possessed by individual or group
b. Manual shoulder type sprayer : Possessed by individual or farmers group

(6) Yield Projection and Crop Production Plan

Crop yield is expected to increase by stabilizing a supply of irrigation water and improving the farming practice after implementing the formulated plan in the future. The projected yield is shown in Table 4.7.1.

Table 4.7.1 The Projected Yield Level

Crop	Present (t/ha)	Without Project (t/ha)	With Project(t/ha)
Paddy rice			
Wet season	1.2	1.32	4.0
rainfed	1.2	1.32	3.5
Dry season	-	-	4.5
Upland crop			
Maize	0.84	0.92	2.5
Cassava	0.78	0.86	1.5
B/millet	0.62	0.68	1.0
Sorghum	0.64	0.70	1.0
Sweet potato	1.0	1.1	1.5
Vegetable	- depends on crops -		
Tree crop			
Mango*	0.173	0.19	0.22
Cashew	0.15	0.16	0.50
Orange*	0.015	0.017	0.04

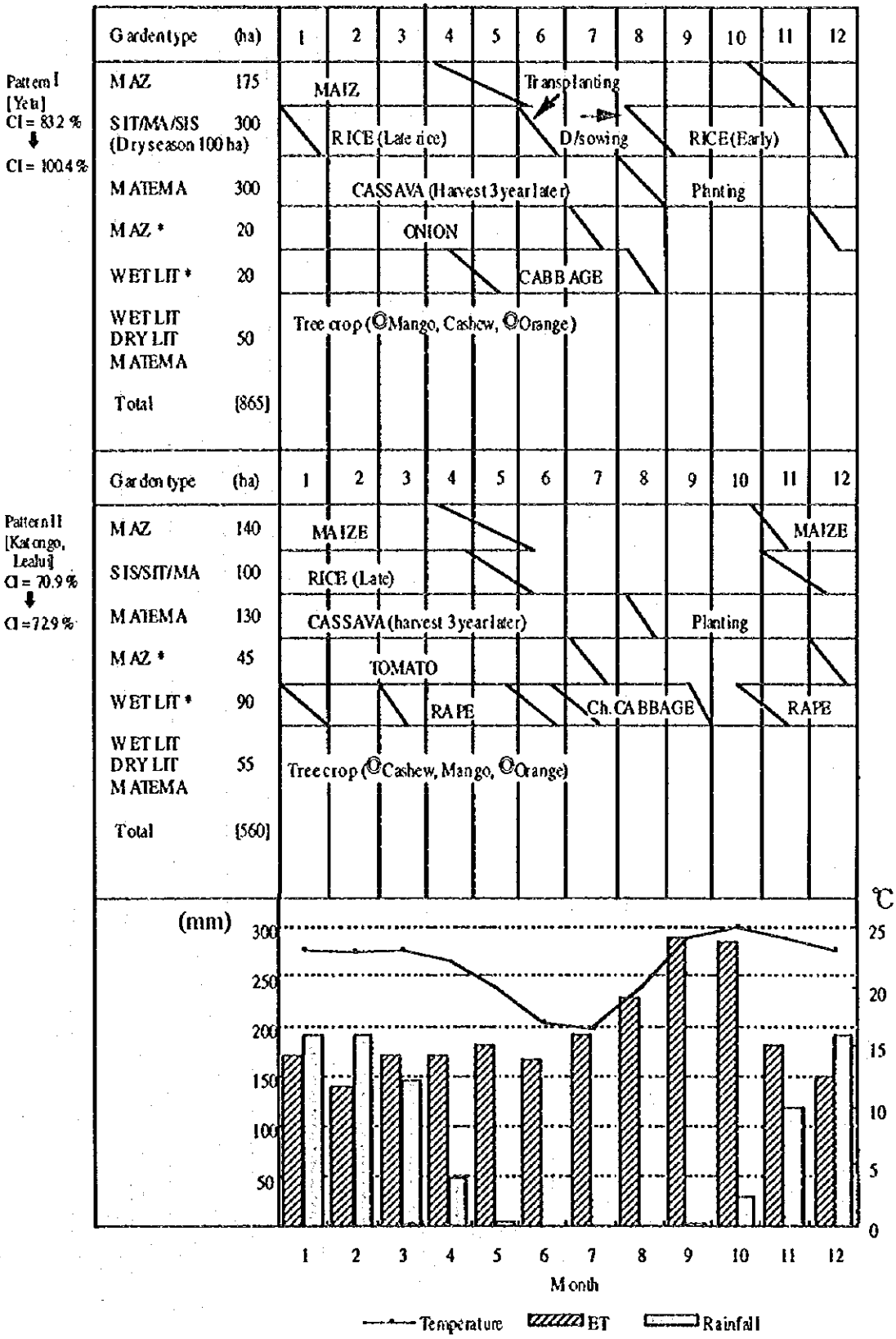
Note: Mango & orange refer to yields(kg) per tree, not per ha.

The plan of crop production after implementing an irrigation scheme is projected based on the above table as mentioned in Table 4.7.2.

Table 4.7.2 Crop Production Plan

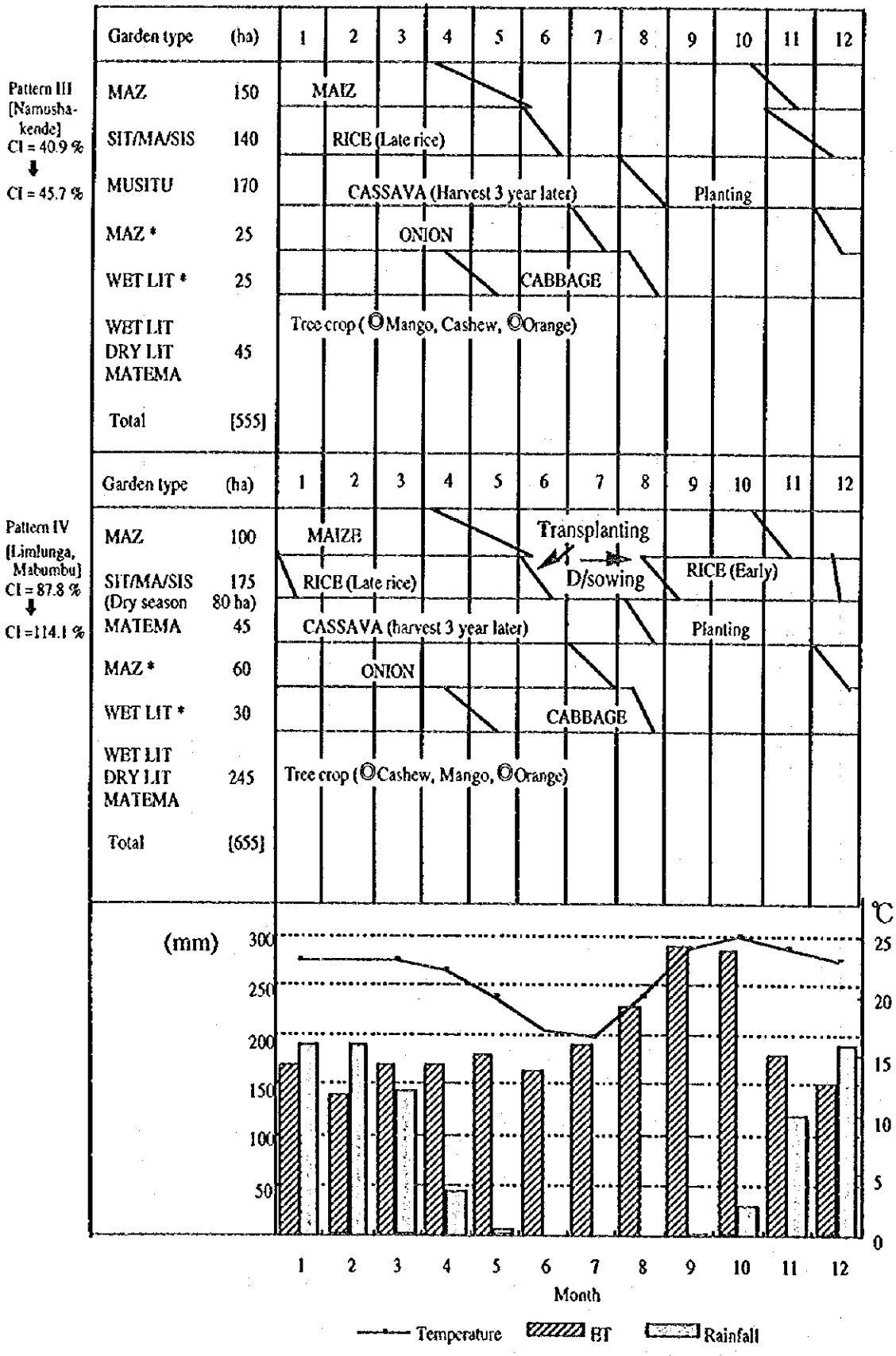
Crop		Area (ha)	Yield (t/ha)	Produce (ton)
Paddy rice	Dry season	180	4.5	810
	Rainy season (included Rainfed)	535	4.0	2,140
Upland crop	Maize	565	2.5	1,412.5
	Cassava	645	1.5	967.5
	B/millet & Sorghum	220	1.0	220
Vegetables	Onion	105	20.0	2,100
	Cabbage	75	25.0	1,875
	Chinese Cabbage	30	20.0	600
	Rape	60	4.0	240
	Tomato	45	20.0	900
Fruit tree	Mango*	12,100	0.22	2,662
	Cashew	270	0.5	135
	Orange*	460	0.04	18.4
Total		2,730		14,080.4

Note: Asterisked fruits refer to the numbers of trees and yield per tree, not per hectare.



Note: The Cropping patterns of asterisk employ the bucket irrigation method.

Figure 4.7.1 Formulated Cropping Pattern (1/2)



Note: The Cropping patterns of asterisk employ the bucket irrigation method.

Figure 4.7.1 Formulated Cropping Pattern (2/2)

4.7.2 Animal Husbandry

(1) Construction of Multipurpose Office

In 1993, the Government of Zambia formulated a guideline for the care and management of cattle in the Western Province for the development of animal husbandry. This guideline was then distributed to the extension and guidance division. But the distribution of guidelines alone was not effective enough to promote technological extension, due to the absence of educational facilities for the demonstration of technical activities specified in the guideline, and medical facilities for the vaccination of cattle.

Further, even with free vaccination (anthrax) during the 5 month campaign for the prevention of livestock epidemics, the inoculation ratio was still low. The two major factors why vaccination is not practised widely are ;

1) In the traditionally practiced communal grazing, the caretaker is usually difficult to contact with the cattle owner immediately because of long distance between them, thus delaying treatment or the discovery of the disease especially when the caretaker is ignorant about cattle diseases.

2) It takes long time to vaccinate cattle due to the absence of crush pens that facilitate vaccination.

Although epidemics can be effectively prevented by educating both cattle owners and caretakers about cattle diseases, this is blocked by the absence of educational facilities in the district, insufficient technology and the continuous practice of communal grazing.

The factors that mainly impede development in the area are ineffective extension of techniques and shortage in medical facilities.

The development plan includes the construction of a multipurpose office which shall be used as the headquarters for activities related to technological extension and the prevention of cattle epidemics. Technological extension activities will require audio visual tools such as a blackboard and video, which can also be used during the assembly of farmers. A crush pen will be constructed within the office grounds to shorten the time required to initiate vaccination and castration and also to reduce the work load of ranchers. A cattle loading rump will also be installed in the office grounds to facilitate loading of cattle for sale and to save time.

The officers assigned with technological extension should be able to carry out effective guidance, making things understandable to the farmers through the facilities provided by the office. Conclusively, the office will be open to the farmers in terms of facility utilization for their education and the prevention of cattle epidemics.

(2) Construction of Small Scale Meat (Sausages) Processing Facilities

The sausages presently sold in the market spoil easily as they do not undergo heating, and the their consumption of sausages is restricted in the urban area.

The development plan, therefore, will implement the heating of sausages as a preservation measure and consequently increase the consumption in the rural area where no refrigerators are avairable. Concerning the pertinent facilities, a marsh gas generating equipment and sales counter will also be installed to carry out heating in the rainy season when temperature is high. On the other hand, charcoal will be used in the dry season when temperature is low. The development plan also includes the purchase of meat for the sausages from local slaughterhouses.

The features of the plan are as follows.

1) As regards the management plan for the sausage processing factory, Provincial Agriculture office will form a new managing organization (namely, the steering committee of the sausage processing factory) that will manage the factory.

2) The sausage processing factory is scheduled to be constructed in the vicinity of the Mongu Green market.

4.7.3 Inland Fisheries

(1) Small Scale Fry Production farm Plan

In 1987, the Government of Zambia formulated the guideline for fish culture using weir water and planned to increase the production of cultured fish. It was, however, difficult to popularize the practice as the construction of a weir requires quite a lot of expenses.

Furthermore, fry production was interrupted in the facility in Kaoma, which is the only facility in the Western province, as the weir was destroyed in 1982 and the reconstruction program has not been realized since then due to financial constraints.

Ground water level averages 2 meters high in the flood plain even in the dry season. The area, if equipped with fry production facilities, is considered favorable for fresh water fry production.

The Inland Fisheries Development Plan aims to construct a small scale fry production farm, breed and sell fries, and promote fry breeding in paddy fields or ponds to farmers. This plan will also attach to the fry production farm a training facility for farmers inexperienced in fish culture management.

The practice of fish culture is expected to improve the diet of the farmers and provide them with secondary income. The lands in the flood plain area can be effectively used as they are mostly

suitable to fish breeding activities.

Manure and compost will be used as feed for the propagation of adult fries and fish breeding. Feed for fries will be the finely pulverized mixture of chicken feed and rice bran.

The outline of the plan is summarized below.

1) The fry production farm consists of breeding ponds and fry rear tanks.

2) Fries will be sold at the shop of the fry production farm. They shall be transported to the breeding pond of each farmer.

3) The fish size to be sold to farmers will be limited to fries and fingerlings.

4) The kind of fish to be bred will be selected based on water conditions, feed, growth conditions, market prices and preference. Tilapia is the most favourable kind.

4.8 Agro-Processing

Based on the aforementioned agricultural development framework, agro-processing will be planned to fundamentally pursue a self-sufficient livelihood as well as market-orient agricultural economy.

4.8.1 Crop Processing

Crop processing facilities, which has suitable capacity to increased production of main staple crops such as maize and rice, will be introduced aiming at the reduction of farmers' working hour of milling them at home, the increasing of field working hour and increasing the farmers' income.

At present, lack of the regional infrastructure and scarcity of transportation prevent obtaining the benefit from the existing processing facilities. In spite of the development of hammer mill distribution, this is limited to the Mongu township only.
Planned processing facilities are designed many small cooperative facilities aiming at providing close services to the farmers.

As the type of agricultural is similar in the Study Area and maize and rice are principal in the area, planned agro-processing facilities are expected to utilize jointly. The places to be installed and areas in charge have to be taken into consideration the range of administration and economic activities, and conditions of accepting raw materials transported by manual or animal power. As the range being able to be brought in the raw materials easily would be less than 4 km, following number of facilities will be allotted in the Study Area.

Table 4.8.1 Allocation of the Facilities

Place	Planned Area (ha)			Production (ton)			No.	Type of Facility
	Maize	Rice		Maize	Rice			
		R*	D*		R*	D*		
Limulunga	45	40	40	112.5	160	180	1	A
Mabumbu	55	40	40	137.5	160	-	1	A
Lealui	50	40	-	125	160	-	1	A
(Mongu township)		-		-			-	
Katongo	65	70	-	162.5	280	-	1	A
Yeta	200	200	100	500	800	450	2	B
Namushakende	330	300	-	825	1200		2	B
Total							8	

Note: Yield : Maize = 2.5 t/ha, Rice 4.0 t/ha, * : R = Rainy Season, D = Dry Season

Table 4.8.2 Outline of the Facilities

Facilities	Scale of Facilities	
	Type A 100 MT/year	Type B 250 MT/year
I. Buildings & Facilities		
1. Inspection Office	55 m^2	66 m^2
Post-harvest Machine Bldg.		
2. Milling Machine Bldg.	40 m^2	60 m^2
3. Warehouse	20 m^2	60 m^2
4. Drying Yard, Winnowing Yard	91 m^2	204 m^2
5. Market Bldg.	48 m^2	72 m^2
II. Equipment		
1. Harvesting Machine	1 set	1 set
2. Rice Mill	1 unit	2 unit
3. Hammer Mill	1 unit	1 units
4. Accessories and Maintenance Tools	1 set	1 set

(Refer to Annex-Figure IV.8.1 and IV.8.2)

- Proposed Organization of the Planned Facilities

  The facilities will be co-operative facilities for producers.

  Owners of facilities should be co-operatives or Government who will be able to play a leading role instructing the production know-how to the farmers.

  Production and transportation of the produce will be conducted by the farmers' group.

- Simple machine such as corn sheller, winnower etc. may be rent or hired and operated by the farmers' group.

Table 4.8.3 Required Personnel for Organization

Position	Facilities	
	A	B
Staff		
Manager	1	1
Operator and others		
Operator	2	3
Assistant	2	3
Keeper	1	1
Total	6	8

4.8.2 Tree Crop and Fruits

As cashewnut has almost as much protein as meat or fish, it may be valuable to supplement the malnutrition. At the same time, it is possible to sell to metropolitan area and other countries for it has large demands. At present, as there is a 1.5 MT/hour large scale cashew roast processing firm owned by Zambia Cashew Company Ltd. and it is not under full operation for lack of raw

materials. The factory can process much more raw materials, even if the production of cashewnuts is increased. In future, as the production system will be established and enough produce will be secured, it is expected that the business chance will be increased for the private sectors on entrepreneurs.

There is a mango juice firm as fruit processing plant at present. However it is difficult to operate throughout the year for harvesting period of mango is only three monthes. Owner is planning a rehabilitation and upgrading of the firm for being suitable to other fruits and vegetables such as guava, tomatoes and oranges. Although Mango fruits are produced enough volume for the firm 3 months of operation, other fruits and vegetable are not sufficient. It is expected to increase the production volume by ensure the production systems and stable receipt of raw materials.

Women's groups in the other District are getting a successful results of making dried mango. The processing of dried mango could be introduced and operated by the women's group in the Study Area, for enough volume of Mango fruits is produced in the Area.

4.8.3 Cattle Processing

The large scale slaughter cold storage firm in Mongu is not under full operation. As this firm is modern and hygienic, it is expected that the receipt of cattle will be ensured by the establishment of production system and cooperation of grazers. Small scale slaughter houses in the townships are necessarry rehabilitate the hygienic. Marketing system having a good connection between the slaughter house and shops and cold storage chain system are expected in the regional marketing.

4.8.4 Inland Fishery Processing

Dried fish made by sunshine is economical. The internal organs obtained by opening are thrown into the river, and utilized as feed of other fishes. In future, it is expected that the marketing system between the fisher men and shops is established and cold storage chain is equipped.

4.8.5 Handicraft and Cottage Industry

Bottle neck for marketing of handicraft and produce of cottage industry is non existence of the marketing channel. As great demands are not expected within the area, because of self-sufficy of the residents in the area, it is necessary to sell to other larger townships. At present, lack of infrastructure and scarcity of transportation measure are preventing the development. In future, it is expected that the marketing system is established by improving the infrastructure and the road channels.

4.9 Marketing Programme

Zambian economy had completely liberalized in 1989, and anyone can get into marketing of any commodities. Before the liberalization, as the Food Security Act had forced that agricultural products had to be dealt with through cooperatives, Zambia Cooperative Federation(ZCF) and its subsidiaries had been monopolized the handling of agricultural products. As the result of the policy change, many traders came into the agricultural markets and the dealing share by cooperatives has been declined a great deal. Moreover, respective unions and their affiliates are competing the declining remainder of market share each other. These undesirable situation should be improved quickly by the persons concerned.

Though the economic institution has been changed, the role of cooperative movement does not change. The importance is rather increasing in order to protect farmers' especially small farmers' benefits. From this point of view, respective level of cooperatives has to be strengthened toward the direction of mutual cooperation and coordination. As the necessity of upbringing of Primary Cooperative Society(PCS) will be mentioned in 4.10.2, items relating District Cooperative Union(DCU) and Provincial Cooperative Union(PCU) are discussed here.

4.9.1 Strengthening of District Cooperative Union

As DCUs are affiliated by PCSs in the competent area, they are the closest cooperative unions to the local farmers and they are, at the same time, very familiar with the local agricultural circumstances. In spite of these situation, the activities of DCUs are constrained to lower level because of various restrictions especially the shortage of floating capital.

The DCU in Mongu District (MDCU) is also facing serious deficit of operating fund, and stopped the business on crops (rice and maize) and cattle dealings since 1993. This type of businesses basically should be carried out by DCUs fully utilizing their characteristics mentioned above. In order to encourage DCUs' proper businesses, political and administrative assistances are necessary on financial and operational phases for the sake of stabilizing farmers' economic states.

4.9.2 Amplification and Readjustment of PCU

PCUs are affiliated by DCUs and PCSs in the Districts where DCUs are not organized. As DCU is not established in every District, PCU is executing the business of DCU in the district where DCU is not organized yet. In the Western Province, three Districts do not yet have their own DCUs.

PCUs are also facing lots of difficulties in various phases. In the case of the Western Province, WPCU (Western Province Cooperative Union) is wrestling with problems vigorously. WPCU manages a rice mill in Mongu and a maize mill in Kaoma, and is going to start the operation of a mango juice factory in the coming fall. Rice, maize and mango are most important crops in the

Province together with beef cattle. Marketing of these products with better prices is one of the principal duties of WPCU. An urgent problem in the marketing of agricultural products is the disposal of rice. Because of lower quality, the rice produced in the Western Province was refused the dealings in the Lusaka market except for the " Supa " variety. There are, however, other places where the Western rice will be sold with reasonable price apart from Lusaka. These types of business belong to PCUs and those should be solved through the cooperation with ZCF.

Another problem necessary to be solved is the adjustment of the business extents between DCU and PCU. Under the circumstances of liberalized economy, PCU and DCUs in the same Province are sometimes competing in assembling agricultural products in the same area. Financially fragile DCUs are occasionally driven out from the dealings by PCU as a result of competition. Such phenomena will oppose to the ideal of cooperative society. Reasonable and realistic segregation of business which enables prosperous coexistence all together should be devised between PCU and DCUs.

4.9.3 Cooperation and Coordination between Respective Level of Cooperatives

As mentioned previous paragraphs, the businesses of respective level of cooperatives should be carried out in cooperation and coordination as one body on the whole because they were organized based on the concept of cooperation, the upper organizations are affiliated by the lower organizations, for the purpose of protecting agriculture and supporting farmers. Because of these reasons, it will be necessary to set up certain reasonable segregation in order to promote the business more effectively and efficiently and, at the same time, to guarantee the sphere of activities to respective level of organization.

First of all, at least one PCS has to be organized and strengthened in each Ward. Dealings with PCSs should be basically restricted to DCUs except for the cases that DCUs are not yet established. PCU has to expand its business toward the direction of securing new customers who can consume more products harvested in the Province getting the assistance of the National Federations. The direct dealing with PCSs should be transferred to DCUs step by step in order to give more business opportunities to DCUs. PCU also should endeavor to establish new DCUs in the districts where DCU is not yet organized.

4.10 Farmers' Group Upbringing

The activities of farmers' organization can be divided into two categories. The one is that which is related to the production activities themselves and the other is that which is concerning to support the production activities such as procuring production materials, handling products and so on.

The former type is basically subject area of the extension activities. This type of group is sometimes organized by donor institutions such as NGO for the specific purpose with supporting finance. Groups supported by donor, however, quit their activities and disappear in many cases when the financing by donor is expired.

The latter type is usually organized as cooperatives. Although the cooperative system in Zambia is well organized on National and Provincial levels, those on District and Primary level cannot be said always in good order. Especially PCSs are not effective and facing various problems. In order to overcome the poor circumstances surrounding agriculture, cooperation among farmers in diverse ways is essential and inevitable.

4.10.1 Upbringing of Production Oriented Groups

Under the circumstances of poor agricultural condition with meager land and scanty implements, more effective utilization of production resources by cooperation and coordination among farmers is essential. A timely sowing is necessary in order to get better yield, and fields have to be prepared in time. This purpose will be achieved through cooperative work utilizing common draught power. This is especially important on rice growing under the improved irrigation system for the water supply will be regularized. Furthermore, water management by farmers' group is extremely important for the purpose of distributing the water impartially.

There are four types of farmers' groups in the Study Area. Those are PPP Groups, Women's Extension Groups, Younger Farmers' Clubs and Village Extension Groups(VEG). Many of them overlap each other for they are usually formed based on existing groups. Many of them, however, do not have to do with production activities except for some of PPP Groups. A VEG is organized in each Zone of respective Camp, occasionally more than one in a Zone. Although the member farmers of VEG meet CEO regularly during his scheduled visits and get information on new technologies and others, very few production oriented activities in cooperation were observed.

Cooperative works in production processes have been contributed a great deal to the development of agriculture in more developed countries and it is still performing important role even in the most developed countries. VEGs also should direct their positive eyes to the cooperation on production activities mentioned above.

4.10.2 Upbringing of Primary Cooperative Society (PCS)

The cardinal point of successful farm management is to practice economically rational transaction together with higher yield and lower cost production performances. Activities by cooperatives in purchasing production materials and selling agricultural products are the most basic and familiar ways to achieve this purpose. Unfortunately, the organization of PCSs in the Study Area is very weak. Although three PCSs are registered among six relevant Wards in the Study Area, one has stopped its activities after " eaten up " its share capital, one is inactive because of passive attitude of the Board of Directors and members, and only one PCS is operating its transaction actively. Such a situation should be improved as soon as possible.

At least one PCS will be necessary in each Ward in order to promote smoother transaction of products and materials. PCSs should be utilized as the basic stations of assembling agricultural products and distributing production materials preparing necessary warehouses and facilitating transport accessibility from the trunk road.

Moreover PCSs should be utilized by the members as the undertakers of responsibilities and guarantees of getting loans from financing organizations. The credits and loans of ZCFFS are disbursed only through PCSs. VEGs are occasionally used as acceptors of loans for some financing organization e.g. Lima Bank who requires to set up a group as the prerequisite of disbursement. Principal purpose of VEGs, however, has to be rather concentrated on production oriented technical activities and separated from financing transaction activities.

4.11 Women in Development

The aim of "Women's Participation Supporting Plan" is to make the position of female equal to that of the male in society. In promoting the plan, it is necessary a) to make both men and women be aware of the unequal position of women in their society, and b) to make both the male and female realize that they are equal partners in society.

In order to carry out a project in which both men and women could be able to participate impartially, it is necessary that the project would be an exchange of ideas and information or a cooperative work on agricultural productive activities between men and women.

Has the system to be established with the exchange of ideas between men and women, it would be possible to form a balanced society with a harmonious and equal working condition between men and women. With a balanced society, women will have more chance to improve their agricultural skills, which in turn will improve the productivity which will eventually make a sustainable self supporting agriculture.

4.11.1 The Consideration for WID

(1) Technical Training and Study

Trainings and procedure mentioned below have to be taken into consideration carefully.

- To concentrate on the cultivation training of cassava, millet, sorghum, groundnuts, legumes and sweet potatoes, which are also called "women's crop", as most women are involved in.
- To give a training of planting, weeding, harvesting and processing of crops because those are mainly carried out by women.
- To promote introduction of animal draught power to women's groups in cooperation with ADPP, WP(Animal Draught Power Programme, Western Province).
- To make it easier for women to participate in training. Thoughtful consideration should be taken into the decision of the place, time, season and other relating things in order to give opportunity to the women who want to participate in but impossible because of various interferences. Participation together with husband and wife(MHH's women) should be encouraged too.

(2) Extension

It is necessary to be established a communication network including FHH's by Extension officer. (Because women are usually excluded from the network in the rural society.)

(3) Education

It is necessary to establish middle and long range programmes that both men and women could realize and understand the situation of women in the society. Both sexes would voluntarily strive to make things better, and the above situation would be a basic part of education.

4.11.2 Organization for Women

In the Study Area, there are already many women's groups. The women's groups would be better organized and used to their full potential. The objectives of group activity would be a) renting or hiring of draught animals and farming implements, b) getting agricultural small scale loan, c) co-operative working during busy farming season, d) producing and selling of handicrafts and processed agricultural products, e) obtaining better communication and exchange of information in the rural society.

(1) Strengthening of the present groups and the supporting system

A supporting system for the groups already organized is necessary. The existing groups consisted of both FHH's women and MHH's women are of low social status with lack of farming techniques and materials, along with a lack of farming loan. The women of FHH are not only hampered by a shortage of labour, but also are bound by their household duties. The supporting system for the existing groups should consider all these aspects to step up women's participation to the project.

- The Department of Agriculture are carrying out a training and supporting system of PPP's groups and village extension groups. Therefore these DOA's supporting systems would be complemented and strengthened to make more powerful women's groups.
  In order to be treated equal and survive against every group of the area and reduce women's heavy labour, it is necessary for all existing groups a) to hold a periodical meeting for reporting of a group activities and exchanging of information and ideas, b) to establish a system for hiring of animals and farming implements, c) to make DOA's various supporting systems more reasonable.

- In order to carry out a guidance of intensive farming suitable for women, it is necessary to involve extension officers and group leaders. And as a medium term plan, a method of agricultural loan, investment and saving would be introduced into the texts of the training for them, and it is also necessary to establish a system which would be able to make the best use of these methods.

- A periodical meeting should be held in order to exchange ideas and information. And in the busy farming season when the support of men is needed, it is necessary to establish a system which is managed cooperatively and works for production activities effectively supporting women's groups.

(2) Organization and System for Agricultural Loans

The credits and loans of ZCFFS are disbursed only through PCSs. In order to use this by women's group, PCS should organize a women's section and establish a loan system (small scale) on PCS's responsibility.

4.11.3 Facilities for Women

For the purpose of promoting the project smoothly, it is important to establish following facilities.

(1) Facility for meeting and training

There is a need for facilities where women can gather at ease to use for a meeting or training. When women are going to participate in some training or being busy in the farming season, they mostly have no place to entrust the care of their babies. As the participation of women in economic or social activities proceeds and its importance increases, the communal day nursery facilities will be augmented in importance. And such facilities will be operated and managed democratically by women themselves.

(2) Facility for agro-processing

For rural women, selling of fruits is one of a means for cash earning; however they cannot make full use of surplus fruits because of lack of technique of processing or preservation. It is necessary for enhancing of value of fruits by teaching easy techniques and establishing a simple processing facility,

For example : Technical training and facility for Dry Mango processing

Although the Study Area is producing a great deal of good quality mango fruits, people have little processing technique and marketing route. Mango is possible to harvest with a small labour. Women's groups will be able to get cash income by undertaking the processes of dry mango production such as harvesting, processing , packing and selling.

4.12 Agricultural Extension

The frame work of the Extension System is well organized uniformly throughout the Nation and extension activities are carried out under the T&V system according to the basic concept of the National Extension Action Plan enforced in 1991. This Action Plan is now under the procedure of reconsideration through the discussion of Extension & Information Sub-Programme in the ASIP Appraisal by MAFF. Although there are no fundamental change in ASIP concerning to Extension Programme, the great difference is that the draft of concrete budgets are attached to the necessary requirements. This is extremely important in order to assure the programme, because the extension work will be promoted more intentionally based on definite finance.

At the present time, there are various barriers disturbing the promotion of extension work. Among those, the followings should be solved urgently in order to push forward the extension programme in accordance with the ideology of ASIP.

4.12.1 Replenishment of Extension Equipment

One CEO is in charge of from 300 to 700 farmers and from 400 to 1,000 ha of farm land. These figures themselves are moderate compared to other countries. However, the condition of transport is extremely bad because of poor natural roads consisted of Kalahari sand. CEOs have to spent quite a lot of time on visiting farms on foot. Provision of a mountain bicycle to each CEO is indispensable as the ordinary bicycle does not seem to fit to the road condition of the area.

An office to each CEO and BS is necessary to be prepared for the purpose of effective desk work and group study etc. At present, only two Camps among nine in the Mongu Central Block have an office in common in a government building. The others are using a small and dark room of official or private residences as the office respectively. Moreover, the BS is not given an official residence and he is living in a small mushroom house which has no space for the extension business. Proper training of CEOs by BS won't be possible under such condition. These circumstances should be solved as soon as possible in order to promote normal extension activities.

4.12.2 Filling Up of the Vacant Posts of Extension Workers

The extension authorities are intending grade up of extension workers' qualification. Actually the number of applicants to the extension worker is, however, decreasing. Replacement and replenishment of CEOs are, therefore, getting more difficult by degrees. Three of CEO's seats among 41 are unfilled in Mongu District of which two are those of the Mongu Central District where the Study Area is included.

The duties of two CEO absent Camps are covered by the BS. The responsibilities of two Camps by one BS are excess burden and the duty of the BS will be considerably restricted. The vacant

posts of CEO should be filled up with all possible haste together with the provision of the BS's official residence in order to normalize the extension activities and training of CEOs by the BS.

4.12.3 Establishment of Guidance Farm for the Small Farmers

Activating the facilities of former JICA Agricultural Verification Farm currently under the control of PAO in the Western Province should proceed through discussion with concerned authorities. It is necessary to expand its facilities and manpower to endow a function of guidance farm for extension purpose of the small farmers. Further a key expert coupled with some assistant technicians of indispensable fields should be stationed for implementing this farm.

1) Paddy seed multiplication and supply

Multiplication of the paddy seeds for the both of dry and wet season rice, and supply to the local farmers

2) Distribution of vegetable seeds

Procuring and stocking vegetable seeds (rape, cabbage, Chinese cabbage, tomatoes, bulb onion etc.) and distributing them to the farmers with reasonable prices

3)Training of the Camp Extension Officer

Training item is desirable to focus on the post harvest techniques including a judgment of optimal time to harvest rice, and further farming practice of the rice double cropping coupled with water management is also included.

4) Display of Demonstration Field

It is desirable to establish the demonstration field to disseminate the formulated farming system for rice and vegetables over the local farmers.

4.13 Human Resource Development

Higher quality of human resource is the fundamental and one of the most important elements in order to promote any kind of contemplation. Education and training of those who participate in the programme are, therefore, essential in achieving successful results. The direct beneficiaries are the farmers residing in the Feasibility Study Area when facilities are implemented according to the project schedule. For this reason, the training of related farmers should be considered first of all in order that they have to be acquainted with the carrying out the newly introduced farming system. The principal trainer must be CEO concerned. Therefore, he has to be prepared in educating and training of relevant farmers beforehand. On the other hand, training on the activities of cooperative society is also indispensable. As stated in the Marketing Chapter, to activate PCS movement is also essential in order to promote better farming, and this is another point which should be discussed at the same time.

4.13.1 Training of Relevant Staff Officials

One of the most important components is technology transfer which will raise up the level of productivity in various ways when a development project is going to be implemented, and success or failure of the project will be influenced a great deal by the consciousness of beneficiaries and occasionally the adaptability of social tradition because the implementation intends in a sense to destroy the old technical and social equilibrium and build up a new one. In the case of implementation of irrigation facilities which is one of the main components of this project, for example, the organization of water management group by beneficial farmers is indispensable in order to utilize the restricted irrigation water, and enforcement of exchange and consolidation and authorization of lending and borrowing of farm land will be necessary in order to promote appropriate land utilization. A revolutionary changes of consciousness by not only beneficial farmers but also relevant officials of administration, extension and related organizations have to be achieved in order to realize those situations under the circumstance in which the experiences of cooperative activities are rare and land tenure system is inflexible.

Principal Agricultural Officer in Western Province, District Agricultural Officer in Mongu District and other Staff Officers who are in charge of project promotion in the Study Area, have had opportunities to get training abroad with relation to the Agricultural Verification Study sponsored by JICA and the Adaptive Research Planning Project sponsored by the Netherlands Government, and they are endowed with enough knowledge and leadership. To the staff officials who do not have opportunities to be trained on the affairs mentioned above, necessary training should be prepared.

Although new technologies intended to introduce are extended to farmers mainly through the hands of CEO, those have to be acquainted by respective technical officers at first and then CEO has to be educated and supported by them in actual extension activities. Opportunities to be trained on essential technologies including study abroad should be prepared to relevant technical

officers in the District.

4.13.2 Intensified Training of Extension Workers

In the T&V system, it is supposed that all CEOs gather together at BS' office fortnightly or monthly in order to report the results of their activities and get training. In the Study Area they meet monthly, but they don't have enough opportunities to receive sufficient training for the reasons mentioned in the previous two paragraphs.

Most of small farmers in Zambia are situated under the conditions that they are not able to get sufficient impact from extenuation because of lack of farming materials and facilities in spite of extension workers' endeavour. However, there will be possibilities to effectuate the extension activities through enduing the extension workers with higher qualification, for relatively abundant natural resources such as labour and land owned by farmers can be utilized more effectively if extension workers guide them with precise knowledge. More intensive training of extension workers are, therefore, exceedingly important and minimum room and facilities should be prepared for this purpose. At the same time, implements for chemical analyses to test such as water qualities, soil components and so on had better to be prepared in the CEOs' offices for the purpose of training themselves in order to get more effective extension knowledge.

4.13.3 Training and Bringing Up of Qualified Farmers

It is most important to be acquainted with the newly introduced facilities and farming technologies in order to utilize them in proper ways. This aim will be attained only through education and training of relevant farmers. Those who belong to Village Extension Group and supposed or acting demonstration farmers nominated by CEO will be eligible for this purpose, and this must basically be carried out by the CEO getting assistance of District Technology Officers concerned through on the job training (OJT).

Together with OJT, enforcement of intensive training course gathering participants in a place is also necessary in order to let the farmers get higher level of knowledge and technologies. In these cases, however, it should be noticed that the materials should be chosen based upon the real status on which the target area is situated. It has been often happened that the training has carried out using sophisticated materials apart from the status quo so that the fruits of the training were almost useless. Materials based on the newest science or highly developed technology should not be used in these cases. Education and training have to be promoted gradually contemplating farmers' present situation and real state of farming in the target area.

4.13.4 Training of Farmers on Cooperative Business

As already mentioned in the chapter of Marketing, the activities by cooperative transaction of produces and production materials are vital to support farming operation for the purpose of achieving better production and getting ameliorated rural life. The education and training on

cooperative have been continuously carrying out by the hand of the Department of Marketing and Cooperatives in Mongu District and Western Province respectively. They prepare several courses such as mobile courses, residential courses and provincial course, but participants to the training are restricted to the members of existing cooperatives.

Unfortunately, the number of PCSs in the Study Area are very few and that which is performing prosperous transaction is only one. There is an urgent necessity to establish PCS in the areas where the one is not yet and, at the same time, to rehabilitate almost dying or already died PCUs. Rearing of well qualified persons endurable for this purpose is earnestly expected.

4.14 Facility Planning

On the basis of the development plan mentioned above, outline of the facility planning in the Study Area is as follows:

Table 4.14.1 Outline of the Facility Planning in the Study Area (1/2)

Development Plan	Purpose	Component
Rural Roads	a) Conveyance of agricultural production, materials and necessities b) Promotion of extension and community activities c) Improvement of access to public services d) Maintenance of irrigation facility and access to farm land	1) Improvement of the Feeder Roads connecting villages and the main road 2) Improvement of the Village Road connecting villages located on the plain edge line 3) Construction of a Peripheral Road in the plain
Irrigation	a) Improvement of agricultural productivity and stability b) Promotion of sustainable agriculture	1) Installation of irrigation facilities such as canal, division works, sand trop and so on in order to utilize the water of Namitome Canal, Sefla River and catch drain etc. for rice growing by gravity irrigation 2) Installation of levee and implementation of land leveling owing to proper distributing water in the proposed gravity irrigation area 3) Bucket irrigation system for upland crop cultivation by shallow well in wet-Litongo and Mazuluu area
Soil erosion control	a) Farm land and environment conservation	1) Carrying out of surface water control such as catch drain or collection canal 2) Installation of gully control and/or sedimentation tank in natural stream

Table 4.14.1 Outline of the Facility Planning in the Study Area (2/2)

Development Plan	Purpose	Component
Animal Husbandry	a) Nutrition improvement in rural area b) Saving labour c) Extension for vaccination	1) Installation of meat-processing facility in the proposed integrated training facility 2) Installation of loading ramp near the tarred road 3) Installation of crash pen
Inland Fisheries	a) Promotion of diversified agricultural management b) Nutrition improvement, increase of cash income, and extension	1) Installation of fry production farm and fish pond by using water source from natural stream or grand water
Agro-processing	a) Improvement of marketability of rice production b) Saving labour for milling	1) Installation of rice mill, hammer mill, inspection office, warehouse, drying yard, market facilities, and so on
Integrated training facility	a) Extension/training of skill and technical know-how for agriculture, animal husbandry, and inland fisheries b) Promotion of farmer's group/organization and women's activities	1) Installation of multipurpose conference room, training room, camp officer's room, women's training room, vaccination room, and so on 2) Combination of agro/fish/livestock processing facility, storage facility, and marketing facility
Guidance Farm	a) Supporting of farming and extension work for smallholder farmers	1) Multiplication and supply of paddy seeds, and distribution of vegetable seeds 2) Training of camp extension officer, and display of demonstration field

(2) Cost Estimation

The total construction cost in the Study Area at current price (at December of 1994) amounts to 14,632 million Zambia Kwacha composing 9,186 million Zambia Kwacha for local currency portion and 5,446 million Zambia Kwacha for foreign currency portion. (Table 4.14.2)

Table 4.14.2 Construction Cost in the Study Area

Ward	Construction Cost (K 1000)		
	Local Currency	Foreign Currency	Total
Limulunga	1,540,000	951,000	2,491,000
Mabumbu	1,116,000	597,000	1,713,000
Lealui	1,237,000	727,000	1,964,000
Katongo	1,281,000	766,000	2,047,000
Yeta	2,296,000	1,425,000	3,721,000
Namushakende	1,716,000	980,000	2,696,000
Total	9,186,000	5,446,000	14,632,000

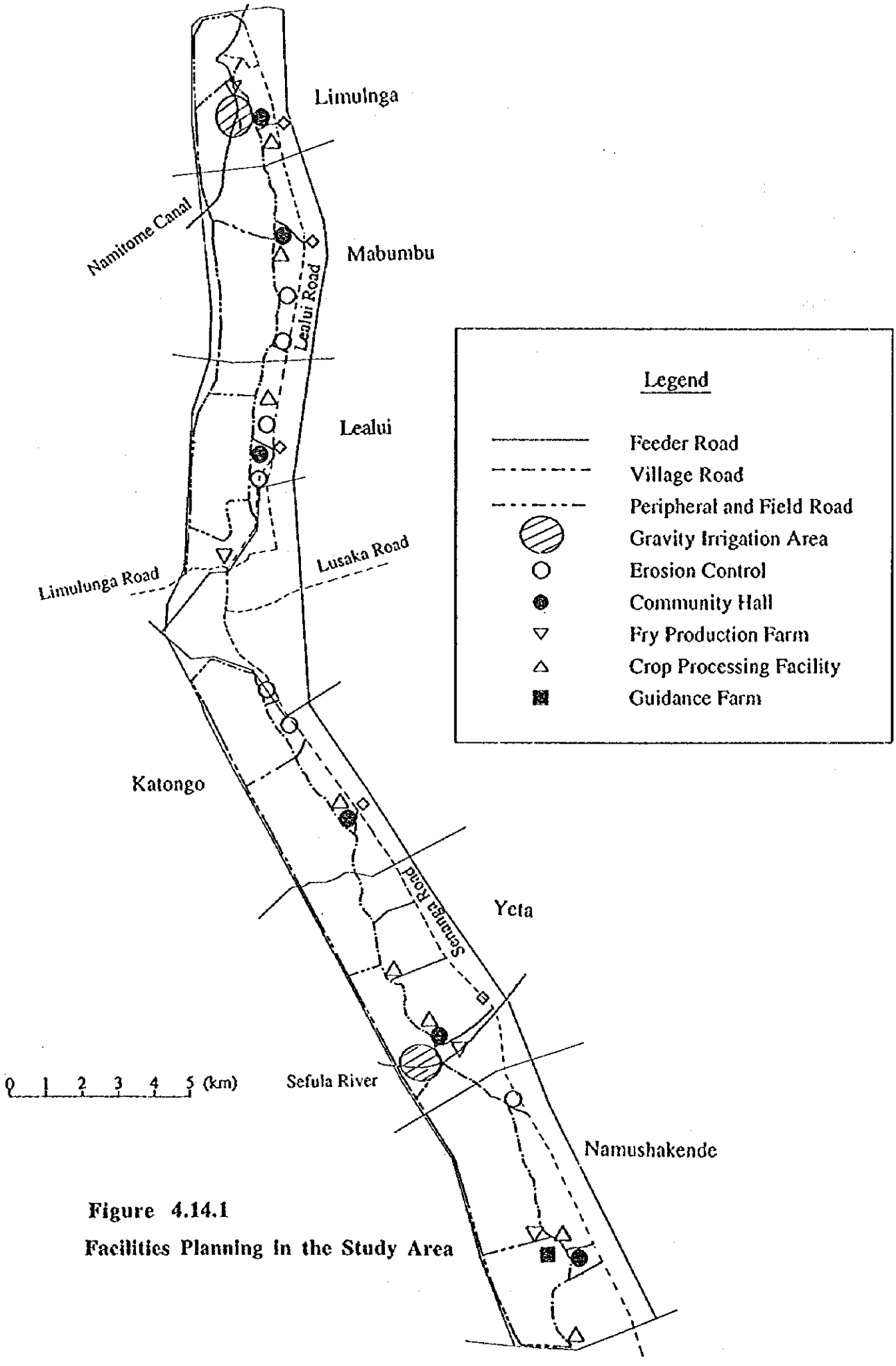


Figure 4.14.1
Facilities Planning in the Study Area

4.15 Operation and Management of Facilities Plan

4.15.1 Necessity of Facility Operation and Management

The operation and management are so important that all facilities cannot display their functions effectively without adequate operation and management. It is, however, difficult to continue the operation and management by beneficial farmers who are supposed to be main constituents of management without concrete plan which defines "by whom", "when" and "How" the operation and management of respective facilities are carried out.

4.15.2 Placement of Facilities

Placement of each objective facility has to be clarified in order to make a concrete operation and management plan. Proposed facilities in this study can be divided into groups depending on the view of the object and subject for operation and management as follows.

Table 4.15.1 Grouped Facilities

Facility	Beneficial Object	O & M Subject	Character of Property
Rural road	unspecified people	governmental organization	official property
Irrigation facility	specified farmer	rural community	common property
Agro-processing equipment	specified farmer	rural community	common property
Training/assembly hall	unspecified people	governmental organization	official property
other rural facility	specified farmer	rural community	common property
other urban facility	unspecified people	governmental organization	official property
Land resources	specified farmer	rural community	common property
House/household goods	specified personal	specified personal	private property

Where the urban facility is indicated such as school, hospital, market, water supply, electric survey , official facilities and etc. The character of property is the grouping of facilities by management subjects. Facilities can be grouped into official, community and private property. The official property is a property for unspecified people, the private property is a property for only a specified personal. The common property has medium characteristics between official and private property and is the one managed by community or organization which can own a common judgment of some specified people.

It is recommended that the facilities grouped in official property will be carried out the operation and management by governmental organization, private property is managed by personal and common property shall be management by rural community which is organized with some

flexibility.

4.15.3 Necessity of Farmers' Organization in Operation and Management

It is mentioned in the preceding article that rural facilities have specified beneficial object and hold the characteristic of likely common property . Operation and management of rural facility hold a duty which shall be carried out jointly by beneficial people. Achieving the duty, specified people can continuously get the beneficial right the of facility. There are few facilities and farmers' organization with experience of operation and management except for some women's groups which are carrying out joint work. Therefore, it is important subject of operation and management how to establish farmers' organization in the Study Area. Training and extension activities to support joint work and organization have to be promoted in parallel with preparation of facilities.

4.15.4 Farmers Participating Operation and Management Plan

It is difficult to extend joint operation and management work in the area where few farmers' organization are existing, therefore a farmers' group which operates and manages the facility has to be organized as the basis in this plan. Then it is recommended that operation rules of the farmers' organization should be established depending on the findings, which will be obtained to solve the problems and trouble among the farmers operation and management through trial carried out basing on the farmers group, and shall be fed back to concrete operation and management plan.

4.16 Environmental Conservation

4.16.1 The Environmental Impact caused by Implementation of the Master Plan (Initial environmental Examination)

(1) Social Environment

1) Socio-economic Issues

This Master Plan aims to increase agricultural production and raise the standard of living of small scale farmers. Further, it intends to construct small scale facilities that can be independently maintained and managed by the farmers, thereby adverse impacts are not forecast.

Residents' way of living: This Master Plan does not bring about problems such as resettlement, conflict among communities and the people, and significant changes in the way of life, because it does not include dam construction work, land development, and construction of new large scale irrigation systems.

Demographic problems: Sudden increase in population and drastic changes in population composition are not forecast because the Master Plan does not include land reclamation which results in immigration. However, a slow or gradual increase in population can be anticipated as economic development improves family financial conditions.

Economic activities of residents: The Master Plan does not relocate zones of economic activities, effect occupational changes and closure of businesses, because it does not expropriate large scales of land.

Customs and traditions: The "Right to the Produce of the Land", a right handed down by Litunga, is a Lozi Tribe practice that still exists to this very day. Accordingly, if the road construction plan of the Master Plan violates the "Right to the Produce of the Land" by running across a private breeding pond or any other agricultural land, the plan should be regulated after things are effectively settled with the tenants.

2) Health and Sanitation

Pollution by agrochemical use: The Master Plan works 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 Master Plan teaches also the farmers how to distinguish between agrochemical with high and low residual toxicity, and in the process eliminate the fear of environmental pollution.

Malaria: Malaria is the major health destructive factor in the Study Area. The construction

of the irrigation facilities is generally considered to increase the number of carriers.

3.8.2(1) 4) apparently states concern about the adverse effect of malaria on farming activities. Countermeasures, therefore, should be formulated as labour shortage influences the effective implementation of the development plan.

Excreta and waste : Significant problems in the disposal of excreta and wastes are not forecast, since development is not expected to result in drastic population increase.

3) Cultural Legacy

Church Land Area of Sefula is an area of historical importance. Problems that could arise from the destruction of the area can be avoided by prohibiting construction works that may mar the beauty of the memorial buildings in Sefula.

(2) Natural Environment

1) Biological and Ecological Issues

There are no legal constraints imposed on the Master Plan as the works involved do not affect restricted development areas and areas affected by international treaties for the protection of the environment and wildlife.

The Master Plan shall strip off vegetation cover only for the construction of farm and rural roads. This is undertaken with due care to avoid environmental damages such as the destruction of the ecosystem of the area's diversified species and the acceleration of the intrusion and proliferation of harmful organisms. The planned re utilization of the flood plain area, where is geologically made up of peat and muck soil layers as paddy fields, is also considered environmentally harmless because peat land development, which is carried out by drying, will not be implemented.

2) Soil and Land Resources

Soil erosion: Soil erosion at the plain edge escarpment usually results in very severe conditions. The implementation of the Master Plan will not exacerbate this condition, because the vegetation cover of the area will not be stripped off.

Other soil problems: With sufficient guidance in soil management, leaching, depletion of soil nutrients and salinification, which could damage soil fertility, do not result from the implementation of the Master Plan. There is no worry of soil contamination as well, because the Master Plan intends to minimize agrochemical use and avoid using those which are highly residual-prone.

Devastation of land and ground subsidence: These conditions do not occur because the

Master Plan excludes desiccation of swamp and peat lands, and the excessive exploitation of groundwater.

Devastation of forests and grasslands: Illegal felling for firewood and the slash-and-burn farming practices could deforest Mongu District. But these activities are not related whatsoever to the Master Plan which is assessed to have no adverse impact on the environmental conditions of the Study Area and circumference.

However, since the devastation of the forest at the plain edge escarpment is bound to accelerate soil erosion and make firewood collection difficult for the resident, anti-deforestation measures should be taken and afforestation should be aggressively promoted in view of one of the Master Plans objective to improve the production of small scale farmers and to raise their standard of living".

3) Hydrology, Water Quality and Air

Hydrology: The Master Plan constructs irrigation facilities to stabilize agricultural production. These facilities are small in scale so the farmers can financially manage and maintain them, and simple in structure so the farmers can independently reproduce them. Accordingly, the implementation of the Master Plan does not affect surface water hydrology, water level, fluctuation of groundwater level and depletion of groundwater reserves. Nevertheless, the study of adequate measures to counteract sedimentation in canals caused by the runoff of soils from the plain edge escarpment remains crucial.

Water quality: The use of agrochemical and fertilizers in minimum doses is taught during the implementation of the Master Plan. Therefore, water pollution does not result from the use of agrochemical and fertilizers. Neither results it from the installation of facilities such as processing facilities, hatcheries etc., because these facilities are not for swage drainage.

Air pollution: The implementation of the Master Plan does not pollute the air, as it does not entail 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.

4) Landscape and Mining Resources

The implementation of the Master Plan does not damage the landscape because it excludes works such as large scale agricultural land development, sea/swamp reclamation, large scale felling and building construction. Mining activities are nonexistent in the Study Area and circumference.

The above discussions are summarized in Annex-Tables 4.16.1, 4.16.2 and 4.16.3.

4.16.2 Environmental Protection Plan

(1) Escarpment Soil Conservation Plan

1) Increase of vegetation cover

To prevent soil loss in the plain edge escarpment, the Master Plan will promote revegetation and ask farmers to abandon cultivation of annual crops for afforestation for the production of firewood and dense vegetation cover.

2) Soil Loss Control in small paths

Most of paths connecting the tar road of the plateau and the villages in the plain edge incline at an angle of less than 5-6 degrees. Nevertheless, torrential rains result in incredible sand runoff. Prevention measures such as installation of cross drains and mini-percolation tanks should be considered. This is applied to the small paths which are not covered by the Road Construction Plan.

(2) Forest Conservation Plan

The Master 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 firewood collection difficult for the resident, anti-deforestation measures should be adopted and afforestation should be aggressively promoted.

The Study Team also expresses the desire to the Provincial Forest Department aggressively implement the following forest conservation activities.

1) Reinforcement of Monitoring System

The factors largely influential in the decrease of forest resources in the Study Area and circumference are illegal felling for firewood and slash-and-burn farming practices.

The Mongu District Office of the Provincial Forest Department consists of not only Afforestation, Extension and Licensing Divisions, but also has a Forest Patrol Division responsible for illegal felling activities. The duties of the Divisions, however, are not effectively implemented owing to considerable budget, personnel and facility shortage problems. Because patrol works are scarcely carried out, violators are free to perpetuate their illegal activities.

The acquisition of budget and staff is therefore a matter of extreme importance in order to strengthen the monitoring system.

2) Afforestation

Afforestation is a necessity in the Study Area, particularly at the plain edge escarpment, for the provision of firewood and vegetation cover. The propagation and distribution of nursery stocks are considered important to achieve this aim.

3) Extension Works

It is necessary to heighten the residents' awareness on forest resources conservation through public extension and education works.

(3) Malaria Control Plan

The following methods are applicable to the Study Area in consideration of social environment and characteristics of vector mosquito :

- Use of insecticide impregnated mosquito nets: to sever contact between mosquito and man
- Use of mosquito larvicide: to control the breeding of mosquitoes
- Management of fish ponds and small reservoirs

5. SELECTION OF THE FEASIBILITY STUDY AREA

5. SELECTION OF THE FEASIBILITY STUDY AREA

5.1 Outline of the F/S Area Selection

The selection of the F/S area was carried out based on the findings of Phases I and II field surveys, the works in Japan and the prepared topographic maps. The selection work process is shown in the following flow chart.

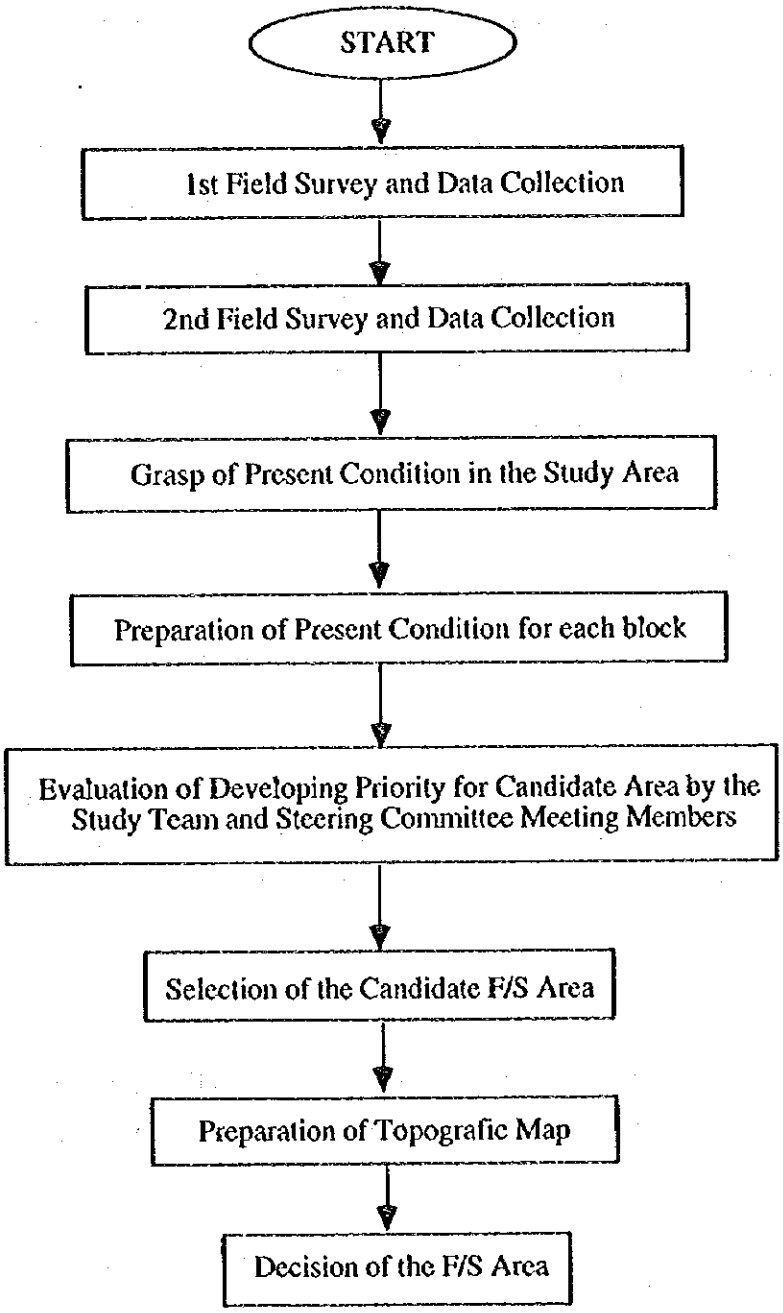


Figure 5.1.1 Flowchart of the F/S area selection

5.2 Selection Criteria for the F/S Area

The main objective of the Feasibility Study is to improve small scale farmers' living condition in the Zambezi flood plain edge area. In executing the implementation of the Mongu Rural Development Project, the objective of the project has to be well understood by the beneficiary farmers. In selecting the priority area, it is necessary to choose an area where has a high demonstration effect to surrounding areas and the highest possibility of immediate project benefit to be a model of future rural development projects not only for the M/P Study Area but also for any area similar to the Study Area.

Based on the considerations mentioned above, the selection criteria for the F/S area are as follows :

- availability of adequate water resources
- presence of topographic conditions making gravity irrigation possible
- number of beneficiary farmers with an easy access to arable land
- number of existing agricultural organizations and farmer's groups
- possibility of crop diversification
- potentiality of rural infrastructure improvement
- application of appropriate technology level
- potentiality as model for water management practice

5.3 Selection of the F/S Area

(1) Division of the Study Area

The Study Area is divided into 6 blocks based on administrative wards, namely Namushakende, Yeta, Katongo, Lealui, Mabumbu and Limulunga, of which the last two blocks are combined in one candidate of F/S area because of their relatively smaller size. This, therefore, leaves us with 5 blocks as candidate F/S areas.

(2) Characteristics and evaluation of each block

In order to choose properly the block to be included in the F/S , their present conditions have to be evaluated and each block are ranked according to the following descriptions and category criteria.

1) Agricultural Condition
   a. Farming/Crop-Raising
   b. Livestock & Fisheries

The blocks with large number of the components in a) and b) and larger yields are given higher priority.

2) Physical Condition

a. Soil and Land use

The Sishanjo and Wet-Litongo are given the first priority. Therefore, areas with large ratio of these garden types will score the highest points. Also areas with large ratio of farmland in an area as presented in the Land Use description is also given high priority.

b. Water resources / Irrigation

The presence of a natural stream to deliver the irrigation water is given first priority. The topographic condition for gravity irrigation system is considered.

3) Social Condition

a. Land tenure

The stable land ownership is quite important for the development. Areas with small number of temporary tenants have the first priority.

b. Agricultural Organizations / Farmers' Groups

Large number of the groups and their activeness are given high priority.

c. Women in Development

In the light of Development anthropology, Female Headed Households are classified as the disadvantaged sub-group in the Study Area which may not able to get the benefits from the development project. Therefore, large number or ratio of the FHHs were given high priority.

d. Rural Infrastructure

Large population density, water points, public institutions and areas with large ratio of renovated training facilities and pupils score higher points.

With regard to the selection criteria, the Study Team and the Steering Committee Members have fully cooperated and have ranked block by block. The result is shown in Table 5.1.1.

As the result, the Yeta block was selected as the candidate area for the F/S.

(3) Determination of the F/S area

The most precise topographic maps covering the Study Area were of scale 1/50,000. Therefore, new 1/5,000 scale maps covering an area of 3,000 ha and including the candidate F/S area were elaborated by the topographic mapping team based on existing aerial photographs. According to these maps and the existing basic development plans, the Study Team has selected the F/S area through the work in Japan with the collaboration of Mr. M.M.Chinda, the Western Province PAO, who was then in Japan as a JICA counterpart personal training course mission.

Table 5.1.1 Priolitization of Block for the F/S Area (1/3)

Description	Namushakende	Yeta	Katongo	Lealui	Mabumbu	Limulunga
1.General						
1) Area (km2)	28.2	21.6	21.1	14.7	17.4	11.5
2) Agricultural Population	3,231	3,270	1,883	4,203	924	2,086
2 Agricultural Condition						
1) Farm HHS (Men)	256	244	126	320	87	202
Farm HHS (Female)	153	170	106	212	30	62
Farm HHS (total)	409	414	232	532	117	264
Priority Point	4	4	2	5	1	3
2) Farmland (ha)	1,230	881	410	250	150	205
Priority Point	5	5	3	2	1	2
3) Area(ha)/crop						
Maizu	126.0	54.0	65.0	50.0	53.0	34.2
Rice	135.0	230.0	64.0	39.0	40.0	55.5
Cassava	166.0	300.0	93.0	40.0	12.0	36.0
Millet & Sorghum	52.5	51.5	27.3	38.0	21.0	31.5
Total : ha	479.5	635.5	249.3	167.0	126.0	157.2
Priority Point	2	5	2	1	1	1
4) Production (t) / crop						
Maizu	142.1	36.5	46.1	36.3	74.3	29.4
Rice	184.3	249.6	78.1	40.8	60.0	65.2
Cassava	124.8	108.0	62.6	38.9	10.8	32.4
Millet & Sorghum	53.7	29.1	14.9	24.5	14.3	15.3
Total : ha	504.9	423.2	201.7	140.5	159.4	142.3
Priority Point	5	4	2	1	1	1
5) No of Fruit trees						
Mango	4,147	2,219	926	3,086	819	903
Cashew	450	828	1,670	958	702	697
Total	4,597	3,047	2,596	4,044	1,521	1,600
Priority Point	5	4	3	5	2	2
6) Produce /fruit						
Mango (t)	953.8	508.2	138.9	543.1	189.2	51.6
Cashew (kg)	1,654.4	2,431.6	866.2	1,367.3	11,123.3	7,698.7
Priority Point	1	1	1	1	5	4
Total Priority Points	22	23	13	15	11	13
Order of Priority	2	1	4	3	5	
7) Livestock						
No of Kraal	22	16	13	9	12	16
Heads/kraal	78	79	79	82	46	97
No of castles	1,716	1,264	1,027	738	552	1,552
Chicken / HH	12.6	3.8	2.9	6.7	7.0	7.3
No of Chicken	5,153	1,573	673	3,564	819	1,927
Priority Point	5	3	3	2	1	4
8) Fisheries						
Fresh fish (t)	13.2	23.1	0.0	0.0	0.0	55.0
Dry fish (t)	7.6	10.4	0.0	0.0	0.0	79.7
Total : (t)	20.8	33.5	0.0	0.0	0.0	134.7
Priority Point	3	3	2	2	2	4
Total Priority Points	8	6	5	4	3	8
Order of Priority	1	2	4	5	3	

Table 5.1.1 Priolitization of Block for the F/S Area (2/3)

Description	Namushakende	Yeta	Katongo	Leatui	Mabumbu	Limulunga
3. Physical condition						
1) Topography	5%	6%	9%	8%	7%	7%
(Ave.Slope of Escapement)						
Priority Point	3	3	4	4	3	3
2) Soil (Garden type) (ha)						
- Grazing Saana	1.7%	6.1%	3.9%	13.9%	4.9%	3.3%
- Cultivable Sitapa	14.0%	8.9%	28.1%	9.6%	18.6%	33.6%
- Cultivable Mazulu	14.0%	10.1%	11.6%	7.0%	14.6%	5.3%
- Shishanjo	11.1%	11.1%	10.1%	6.8%	11.4%	8.5%
- Wet Litongo	1.6%	1.6%	1.9%	1.5%	1.9%	1.9%
- Dry Litongo	1.9%	2.0%	2.4%	1.9%	2.1%	2.6%
Priority Point	5	5	4	2	5	3
3) Land Use						
- Wood land	12.2%	11.7%	1.2%	3.4%	3.4%	3.5%
- Shrubland	13.3%	5.4%	13.8%	0.9%	22.4%	2.4%
- Grassland	2.8%	0.7%	5.2%	17.5%	11.4%	4.2%
- Deepflood area	21.2%	13.6%	38.2%	12.8%	23.8%	49.4%
- Farmland	32.3%	37.7%	26.5%	15.7%	29.7%	18.0%
4) Upland Condition						
- Plateau	18.0%	19.1%	22.2%	35.2%	20.4%	25.1%
- Escarpment	29.7%	22.5%	47.3%	29.2%	15.4%	13.3%
Priority Point	4	5	3	1	3	2
Total Priority Points	12	13	11	7	11	8
Order of Priority	2	1	3	5	4	
4) Water Resources						
- Natural Stream Discharge	NIL	0.185m3/s	NIL	NIL	0.255m3/s	0.255m3/s
- Topographic Condition	Fair/Best	Best	Fair	Fair	Fair	Fair/Best
Priority Point	3	5	2	2	3	4
Order of Priority	3	1	4	4	2	

Table 5.1.1 Priolitization of Block for the F/S Area (3/3)

Description	Namushakende	Yeta	Katongo	Lealui	Mabumbu	Limulunga
4. Social Condition						
Land Tenure						
Proportion of Tenant						
Number of Farms (%)	12.1	9.9	0	0	0	22.7
Priority Point	3	4	5	5	1	1
Area of Cultiv.. Land (%)	16.9	5.0	0	0	0	5.9
Priority Point	2	5	5	5	5	4
Ave.Size of Cultiv. Area(ha)	1.25	2.28	1.41	0.45	1.20	0.78
Priority Point	3	5	3	1	3	2
Farm Income						
Ave. Ag. Net Income (K '000)	748	405	162	165	264	432
Priority Point	5	4	1	1	2	4
Farmers' Group						
No. of Groups in Total	16	16	12	15	14	17
Priority Point	5	5	4	5	4	5
Women's Group						
Systematized Rate(%)	24	65	15	21	53	32
Priority Point	2	5	1	2	4	3
Rate of Active Groups(%)	64	100	33	56	60	67
Priority Point	3	5	1	2	3	3
Total Priority point	23	32	20	21	27	22
Order of Priority	3	1	5	4	2	
5.Rural Infrastructure						
1) Rural Roads						
Agricultural Population	3,231	3,270	1,883	4,203	924	2,086
Area (km2)	28.2	21.6	21.1	14.7	17.4	11.5
Population density	115	151	89	286	53	181
Priority Point	1	3	1	5	1	3
2) Water Supply						
Water Points	8	19	12	9	9	12
Priority Point	2	4	4	2	2	4
3) Electrification						
No. of pubic institution	3	5	2	3	2	3
Priority Point	3	5	1	3	1	3
4) Health						
Renovation of training Facility		1				
a. Clinical Officer	2	2	1	1	1	1
b. Envi. Health Tech.	1	1	0	1	0	1
c. Nurse	5	4	1	5	1	6
Priority Point	1	5	4	4	4	4
5) Education						
Classroom-pupils ratio	63	68	128	68	54	71
Priority Point	4	4	5	4	4	4
Total Priority Points	11	21	15	18	12	18
Order of Priority	5	1	3	2	3	

Order of Priority

Description	Namushakende	Yeta	Katongo	Lealui	Mabumbu	Limulunga
1. Agricultural Condition	2	1	4	3	5	
2. Livstock/Inland fisheries	1	2	4	5	3	
3. Physical Condition	2	1	3	5	4	
4. Water Resources	3	1	4	4	2	
5. Sosial Condition	3	1	5	4	2	
6. Rural Infurastructure	5	1	3	2	3	
Total Priority Points	16	7	23	23	19	
Final Order of Priority	2	1	4	4	3	

6. DEVELOPMENT PLAN OF THE FEASIBILITY STUDY AREA

6. DEVELOPMENT PLAN OF THE FEASIBILITY STUDY AREA

6.1 General Description of the Feasibility Study Area

6.1.1 Natural Conditions

(1) Location and Topography

The Feasibility Study Area (F/S Area) belongs to Yeta Ward which is located 10 km south of Mongu township, and covers an area of 1,900 ha from Mutuwambwa as the northern border and Sefula River with its environs as the southern boundary. The status quo of land classification is as follows:

Table 6.1.1 Land Facets

	Facet	Area (ha)
Upland	Plateau	876
	Escarpment	147
Seepage	Dry litongo	39
	Wet litongo	41
	Sishanjo	205
Flood Plain	Matapa/Sitapa	592
Total		1,900

(2) Meteorology, Hydrology and Water quality

1) Meteorology

Despite the Study Area is located in the tropics, the heat is not so severe because of its high altitude(1,000m), and monthly average temperatures are 25.3 °C in October and 16.7 °C in June. According to the temperature-records at the Namushakende Agricultural Verification Farm of JICA, the highest is 38 2 °C (November 1990) and the lowest is 2 °C (June 1991). Frost falls once in an interval of three years. For the last 30 years, the average annual rainfall is 916 mm. Wet season starts in October and lasts until April, and monthly average rainfall throughout the year is 190 mm.

2) Hydrology

Discharge values by two-year return period of Sefula River are 0.29 m^3/s in dry season and 1.80 m^3/s in wet season, and those of 10 years are 0.25 m^3/s and 2.70 m^3/s, respectively.

3) Water Quality

Although the running water of Sefula River shows an acidity of pH 5.8, it does not have any specific problems for utilizing as irrigation water for rice. The electro-conductivity is 17.7 μ S/cm and Dissolved Oxygen is 5.5 ppm.

(3) Soils

The soils in the F/S Area consist of five following types .

1) Podzol

Soils derived from unconsolidated materials, having a sporadic B horizon and lacking hydromorphic properties. Its low fertility, low water holding capacity, and high acidity are considered as their major constraints for cultivation.

2) Acrisols

Poor soils with a low base saturation and high acidity. Sensitive to erosion because of unfavorable structure.

3) Arenosols

Soils derived from coarse textured unconsolidated materials, showing a weak horizon differentiation and lacking hydromorphic properties.

4) Histsols

Commonly called Peat Muck, Organic, Bog or Marsh Soils. These soils occur on poorly drained sites (Sishanjo), where the production of organic matters exceeds. Their properties of mineralization, water logging, high acidity, and nutrient deficiency are main constraints for cultivation.

5) Gleysols

Soils formed from unconsolidated materials under condition of poor drainage. They have coarse texture and show hydromorphic properties.

Podzols and Acrisols are the dominant soils on Plateau and Escarpment, while Arenosols, Histsols, and Gleysols occur on Seepage Zone and Flood plain.

6.1.2 Social Situation

(1) Population and Farm Households

The F/S Area is roughly divided into rural area and church land area. The church land area was given to the Paris Evangelic Missionary Society by the Litunga Lewanika when the missionary visited Barotseland in 1885. The society constructed a church and schools in the area and has carried out education and propagation activities for the village people.

The population and the number of households in the F/S Area are as follows:

Table 6.1.2 Population and Household Structure in F/S Area

A. Population

		No. of HHs	Population
Rural Area	Farmer	333	2,010
	Farmer with fishing	123	738
	Others	113	666
	sub-total	569	3,414
Church Area	Teacher	98	588
	RHC *	11	66
	Church	20	120
	Dormitory **		432
	sub total		1,206
	Total		4,620

* Rural Health Center,
** Secondary School and Blind School

B. Rural Area

	Zone 1	Zone 2	Zone 3	Zone 4	Total
No. of Villages	19	11	10	21	61
No. of HHs	196	119	98	156	569
MHHs	86	63	34	62	245 (43%)
FHHs	110	56	64	94	324 (57%)
Farmland (ha)	170	178	188	211	747

(2) Social Infrastructures

1) Roads :

National Highway	6.0 km	Asphalt
Feeder Road	3.8 km	Gravel
Village Road	4.1 km	Sand
Foot Path	20.0 km	Sand

2) Electrification :

Electric power line of 11 KV has been installed along Sefula road up to Sefula Hospital, and a 400 V transformer is equipped in the church land area.

3) Domestic Water Supply :

Shallow well	Windlass	4 (2)
	Others	14
Borehole	Hand pump	10 (1)
	Electricity	2 (1)
	Diesel	1 (1)
	Total	31 (5)

* The figures in the bracket indicate the number of broken units.

4) Health : One rural health center is in operation at Sefula with 3 clinic officers, 4 nurses and 3 classified employees.

5) Post Office : One

6) School :

Primary school	3	Teachers 59	Pupils 1,560
Basic blind school	1	15	80
Secondary school	1	24	850

7) Market and others : Sefula Market (deals with crops, vegetables, fishes, meat and sundries)

(3) Land tenure

The land in the F/S Area is governed by the traditional tenure system under the control of Area Chief Namutwi. Besides, the public land (e.g. the land for government institutions) and church land which was given by the king to the Paris Evangelic Missionary Society (presently UCZ) are excluded from the traditional customary low.

According to the Lozi tradition, the land tenure can be classified into (i) Ngwesi or King's own land, (ii) Mubu wa Luu or land of title, (iii) Mubu wa Lusika or family land and (iv) Mulala Mubuwa or unused land under the control of the King. Locations of these classified land areas, except for family land, are difficult to be identified on the map as these lands are scattered in many places and are recorded only in the memories of the persons concerned.

The greater part of the F/S Area can be classified as family land. Although definite data on land holding per household is not available, the average cultivable land is estimated to be approximately 1.3 ha per household. Out of 590 households in the F/S Area, 35 households have no farm land and 99 households borrow the farm land from others.

6.2 Basic Principles of the Development Plan

6.2.1 Development Objectives

This Project aims at establishing a model for the purposes of promoting a highly effective implementation based upon the Master Plan of the Study Area. At the same time, its results are extended not only for the Study Area but also for other areas with similar conditions through the dissemination of the necessity and profitability of the Project.

6.2.2 Basic Planning Directives

The Feasibility Study Area was chosen on the basis that the area has an adequate potentiality after the execution of implementation. The proper response to the social disadvantages such as female headed households and landless farmers was also taken into consideration. The Development Plan was formulated based on the following basic directives, taking care of the reasons for selecting the Area.

An effective development plan has to have the sustainability of he validities of the exploitation. In order to maintain the sustainability of effectiveness by the development, the economical, technological, environmental and social aspects were carefully studied in the development plan.

(1) Economical Sustainability

Components of which the initial investment and operation & management costs are low but the result can be obtained promptly.

(2) Technological Sustainability

Technologies pertinent to the Area and maintainable by the local people, based on the locality of technological level and human resource.

(3) Environmental Sustainability

Components which will not deteriorate the regional environment.

(4) Social Sustainability

Cautious consideration for the social disadvantages to be shared the benefits of the development.

6.2.3 The Components of the Development

(1) Social Infrastructures

1) Rural Roads

Improvement of feeder roads connecting the tarred road and villages, construction of village roads connecting villages located on the plain edge and others.

2) Water Supplying Facilities

Installation of wells with hand pumps at the places of the Integrated Training Facility, Mutuwanbwa Primary School and the Agro-Processing Facilities.

3) Upbringing of Farmers' Organization

Upbringing of production oriented farmers' groups including water users' group and primary cooperative societies in order to improve the productivity of crop raising and efficiency of marketing.

4) Consideration on WID Scheme

Arrangement for women participating in the Development

Programs for Female Headed Households and the socially disadvantaged people.

5) Construction of Integrated Training Facility

Construction of a Training Facility utilized for multipurpose training and meeting such as the rural life improvement, various kinds of group activities, farming and cropping technologies, management of irrigation and drainage and so on.

(2) Agricultural Infrastructure

1) Construction of Irrigation and Drainage Facilities
Implementation of irrigation and drainage facilities utilizing the water of Sefula River for a stable rice production in the wet season and partial double cropping in the dry season.

2) Construction of Agro-Processing Facilities
Construction of a rice mill and hammer mills

3) Construction of a Facility for Inland Fisheries
Construction of Facility for Fry Production and Fish Ponds.

6.3 Land Use

(1) Present Consideration of Land Use

- Woodland (776.0 ha)
  Degraded Woodland dominated by Brachystegia bakerana (Lozi-Mundu) and Guibourtia coleosperma (Muzauli).

- Shrubland (129.0 ha)
  The Shrubland is dominated by Baphia massaiensis (Isunde) which is highly adopted to adverse environmental conditions.
  The Woodland and Shrubland are distributed on Plateau and Escarpment, and used as wood source and grazing site.

- Grassland (476.0 ha)
  Flat parts (Saana) in flood plain are the principal grazing land. Some grass species are used for making house roof and local mat.

- Farmland (404.0 ha)
  The most important land for crops and fruit production, scattered all over the Study Area.

- Residential (93.0 ha)
  Land for villages, schools, churches, and other public buildings. Most of villages are concentrated on Litongo, where water is more available.

- River/canal (3.3 ha)
  Natural stream and man made canals conveying water for irrigation and domestic use.

- Tarred road (6.7 ha)
  Part of the main national road connecting the major townships, passing through the Study Area.

- Track (9.6 ha)
  Motorable sandy tracks branching from main road to villages.

- Footpath (2.4 ha)
  Paths running to fields, and connecting houses within the villages.
  The tarred road, track and footpath are used for communication and transportation.

(2) Current Land Suitability Classes

Land suitability classification is important to know the natural suitability of lands for agriculture under normal climatic conditions and current economy of the area.

Agricultural lands in the Study Area are divided into three classes:

- Poorly suitable

  Lands with severe limitations that restrict their utilization for general agricultural crops. Only very specified crops, with risk of low yield or crop failure can be grown in these lands. Steep slope, erosion hazard and low fertility are some of their limitations.

- Marginally suitable

  Lands having limitation which reduce their productivity, limit the choice of crops, and regume a great deal of inputs. Suitable for crops with low nutrient/water requirement and deep rooting fruit trees.

  Major limitations are excessive drainage and mole hazard.

- Moderately suitable

  These lands are productive and suited to most of general agricultural crops and fruit trees. Because of moderate limitations their response to management is high. Rat, Termite and Flood hazards are the main limitations.

(3) Land Use Plan

To improve the land use system and utilize the land resources efficiently, a Sustainable Land Use Plan is proposed. In formulating this plan, the soil, climate, topography, economy, social and political conditions of the area have been considered. Key points of the plan are mentioned below:

1) Natural resources are used wisely for economical purposes. Woodland on Plateau will be improved and used for commercial wood production.

2) Grassland will be improved to promote livestock production.

3) Suitable parts of the grassland will be converted to paddy fields through provision of irrigation.

4) Escarpment is used for Nature Conservation and production of wood for local use.

5) Crops of less nutrient and less moisture requirement, and deep rooting fruit trees are grown on Plateau to minimize the risk of crop failure.

6) Plantation of fruit trees will be concentrated on Litongo, and high demanding vegetables are grown between the trees. Some shallow wells will be dug in Wet Litongo to facilitate the Bucket Irrigation.

7) Sishanjo, Sitapa and suitable lands in the Saana will be used efficiently for commercial rice production.

Details of the Land Use Plan is given in Table 6.3.1.

Table 6.3.1 Plan for Agricultural Use of Land Facets in the Study Area

Land Facet	Area (ha)	Utilization	Remarks
I. UPLAND			
(1) Plateau	876.0	Crop production	: Mainly millet and cassava
		Fruit production	: Mainly cashew
		Wood production	: Brachystegia speciformis (Mutuya)
			Guibourtia coleosperma (Muzauli)
			Erythrophleum africanum (Mubako)
			Burkea africana (Musheshe)
			Parinari curatellifolia (Mubula)
		Grazing	: Particularly in flood season
(2) Escarpment	147.0	Wood production	: Baphia massaiensis (Isunde)
			Bauhinia petersiana (Mupondopondo)
		Nature conservation	: Natural grasses such as Digitaria ciliaris (Busambo) and Aristida (Nangenya) grown on escarpment help in erosion control
II. SEEPAGE ZONE			
(1) Dry Litongo (upper part)	39.0	Crop production	: Mainly millet and cassava
		Fruit production	: Cashew, mango
		Nature conservation	: Natural grass and shrub grown in this part prevent transport of sand by runoff water
(2) Wet Litongo (mid part)	41.0	Fruit production	: mango, guava, citrus, banana
		Kitchen-garden	: Onion, cabbage (inter-tree)
		Crop production	: Maize, sorghum
(3) Sishanjo (lower part)	205.0	Crop production	: Rice, sweet potatoes
III. FLOOD PLAIN			
(1) Saana (flat parts)	567.0	Crop production	: Maize, rice
		Grazing	: Nutritional grasses are eaten by cattles.
		Inferior grass species such as Loudetia simplex (Mwange) are used for making house roof and local mat.	
(2) Sitapa (depressions)	9.0	Crop production	: Mainly rice
(3) Mazulu (mounds)	16.0	Crop production	: Maize, sorghum
		Vegetable production	: Onion, tomato, okura, pumpkin
Total	1,900.0		

* ( ) Local names in Lozi.

6.4 Soil Conservation

(1) Present Status of Soil Erosion and Land Degradation

Rill erosion was observed on the plateau on sides of the old gravel road, particularly in places where it joins the tarred road. Gully erosion was found on the plateau on sides of the old gravel road, and on the slope facing sefula river. Dimensions of the rills and gullies are given in table 6.4.1. Localized sheet erosion was observed in a few areas. Accumulation of water transported sand occur on escarpment foot. Many mole heaps were observed on plateau and dry litongo. Numerous rat holes were found in saana and mazulu. Numerous termite hills were observed in the flood plain, particularly in the southern part of the Study Area. Wind erosion is not a problem in the Study Area.

Table 6.4.1 Dimension of Rill and Gully Occurring in the Study Area

	Gully 1	Gully 2	Rill 1	Rill 2
Location :	Near Namaenya local court	Near Namaenya local court	Near Namaenya local court	Near Namaenya local court
Position :	Right side of old road facing Sefula river	Left side of old road facing Sefula river	Right side of old road joining tarmac road	Left side of old road joining tarmac road
Length (m) :	460.00	470.00	305.00	302.00
Width (m) :	3.40	4.80	1.70	1.40
Depth (m) :	0.70	0.90	0.30	0.25
Area (ha) :	0.17	0.22	0.05	0.04

(2) Causes of Soil Erosion and Land Degradation

Cattle : overgrazing and trampling by cattle cause destruction of vegetation, leaving the soil bare and susceptible to erosion.

Man : removal of vegetation by man leave the soil unprotected. Improper farming activities accelerate the erosion rate.

Wild Animals: Moles damage the vegetation, loosen the sands and subject them to runoff water. Rats reduce the land productivity by attacking the crops. Termites damage the vegetation, and their hills hinder the agricultural operation and damage the farming tools.

Rain water : surface runoff on bare land deepen and widen the rills, gullies and footpaths.

(3) Plan For Soil Conservation and Land Improvement

In Land Facets of the Study Area, the soil conservation and land improvement could be achieved through following management proceeding :

- Plateau

  Filling the rills and gullies and planting vegetation on these places; controlling the moles.

- Escarpment

  No cultivation but promotion of natural vegetation

- Dry litongo

  Promotion of natural vegetation; mole control ; introduction of proper crops and fruit production system

- Wet litongo

  Weed control ; proper crops and fruit production system

- Sishanjo

  Adjusting the soil pH through application of liming materials ; weed control

- Saana

  Termite and rat control

- Sitapa

  Weed control and soil - improvement using crop residues

- Mazulu

  Rat control and soil - improvement using crop residues

6.5 Water Use

6.5.1 Present Conditions of Water Use

(1) Surface Water

Sefula river flows in the southern part of the F/S Area issued from a Dambo which is located at about 5 km east of the culvert structure on the Mongu - Senanga road. Assuming the average runoff discharge to be 0.5 m^3/s, the annual total runoff discharge is estimated to be 1,580 million m^3.

Any water right concerned with the river water use has not been established so far, but some farmers practice bucket irrigation for upland crop and paddy rice along both banks of the river. However, there is no intensive water use which diverts lump amount of water from the river. Fishery is not approved in the river and any fishery license has not been established as well.

Musiamo canal flows from north to south west in the north western part of the F/S Area. This canal was dug in monarchic time by human power under the king's instructions. Nowadays, the lack of maintenance and management have seriously hindered the drainage function of the canal, its main original object, due to much weed growth and decreased cross section. In the F/S Area, the canal is used mainly for bathing by residents.

(2) Underground Water

Existing underground water for domestic use is discussed in the paragraph 6.6.2 entitled Rural Water Supply.

Some farmers in the flood plain edge area (Wet-Litongo Garden Type) are carrying out bucket irrigation for vegetables from hand dug shallow wells (with diameter and depth nearly equal to 1m). Underground water in the F/S Area is used only for the rural water supply and the bucket irrigation mentioned above.

6.5.2 Water Use Plan

(1) Surface Water Use Plan

Water use plan for Sefula river water consists of irrigation plan and inland fishery plan. In the irrigation plan, water discharge of 0.3 m^3/s as maximum gross water requirement is scheduled to be taken out at the point near the Sefula Market (refer to Irrigation and Drainage Plan of paragraph 6.7.2). Water right relative to this water amount has to be obtained and confirmed with the Department of Water Affair and Induna before implementation of the project. Water requirement for the inland fishery plan is insignificant at present, however, water right should be obtained and confirmed in the same way as the irrigation plan provided the expected increase in water demand in the future.

Surface water use except for Sefula river is planned for bucket irrigation for maize and the initial growing stage of rainfed paddy rice (about a month) in the flood plain edge area with abundant seepage water (zone 1 & 2).

(2) Underground Water Use Plan

Drilling of three boreholes with manual pumps is planned in the paragraph 6.6.2 entitled Rural Water Supply. In the near future, underground water demand will undoubtedly increase, but underground water is so plentiful that the supply will not be affected by it.