1.0 BACKGROUND

1.1 Introduction

Malawi's economy depends very largely on agriculture. Over the past decade rainfall distribution and pattern has been changing frequently to the disadvantage of the agricultural sector whose agricultural production is mostly rain fed despite concerted efforts of promoting irrigation.

About 180,000ha of irrigation schemes have been developed so far against a potential of 800,000ha of irrigable land. Over 42,000ha of this potential is in the Shire Valley. The major crops that are being grown under irrigation are sugarcane and rice, maize in low lying areas which is mostly sold green on-the-cob, and supplementary irrigation of tea, coffee, and macadamia. Maize is the major staple food followed by rice, cassava, sorghum and millet.

The Shire Valley has the potential of growing crops under irrigation and thus contributes to the food security and poverty alleviation initiatives. This potential has remained virtually unexploited because of lack of readily available water for irrigation. The most reliable source is the Shire River and development of irrigation in the Shire Valley would mean harnessing these waters. However, the Shire River is also the source of electrical energy for the whole country. Only recently a hydropower generation plant was commissioned at Kapichira Falls on the Shire River. Thus, there is competition of water use among the various stakeholders that rely upon the Shire River for the provision of their services. The notable stakeholders are Blantyre Water Board and Electricity Supply Commission (ESCOM).

The Shire Valley Irrigation Project is being planned for development to cover an area of 42,320ha. Development has been split into two phase. The first phase lies between Chikwawa township and Mwanza River and covers an area of 17,320ha comprising 9,200ha already developed by ILLOVO, 180ha of Kasinthula Irrigation Shceme and 7,940ha of new development by SVIP. The second phase lies between Mwanza River and Thangadzi River near Bangula and covers an area of 25,000ha.

For these new developments, irrigation water will be abstracted from Shire River at Hamilton Rapids which is about 3.0 km upstream of Kapichira Falls. The project water requirements are 23m^3/s for the first phase and 55m^3/s at full development. Water will be conveyed to the fields through open canals. The canal will pass through Majete Game Reserve during the first phase construction and Lengwe National Park during the second phase construction. Thus, the key stakeholders that will be impacted by this project are the Department of National Parks and Wildlife and ESCOM, in addition to the local community and the commercial and community service establishments within the project area.

According to Environmental Management Act of 1996, Part V, Section 25, an environmental impact assessment (EIA) is required for the Shire Valley Irrigation Project (SVIP) as it is a prescribed project and Category A project according to the World Bank standards. The Government of Malawi commissioned Coda And Partners in association with Ninham Shand (Pty) Ltd to carry out the Shire Valley Irrigation Project which entailed design of irrigation system networks including all associated structures and related infrastructure for social support services such as domestic water supply and sanitation, access roads and marketing services. Other aspects of the assignment include mitigation of environmental impacts. The Consultant commenced work on 13th July 2005.

1.2 Development Strategy

1.2.1 Background

In the past, several technologies have been employed to increase the land under irrigation and these have been targeting mostly the smallholder farmers. However, the Government is now changing its approach to irrigation development and has committed itself to have an integrated approach through the Irrigation and Integrated Infrastructure Development Programme. This entails implementation of three major irrigation development projects, one in each region, which will complement the current irrigation efforts which are mostly small scale. This will start with the implementation of the Shire Valley Irrigation Project, which is located in the Southern Region of Malawi.

1.2.2 The Project Development Objective

The major objective of the Shire Valley Irrigation Project is to exploit the high irrigation potential of the Valley through the development of gravity-fed irrigation system from the Shire River, expanding coverage and providing complementary infrastructure and services in order to increase agriculture production and farm-based incomes, hence ensuring food security and poverty reduction. Apart from improvement of standards of living and household food security of the community, the project offers opportunities for development of agro-based industries and generation of foreign exchange earnings.

1.2.3 Ecological Environment

Deforestation, overgrazing, soil degradation, flooding and water pollution are current environmental problems in the area with wider ramifications on land and general productivity. Protection of the environment is one of the Government of Malawi's (GoM) priority activities. The introduction of the SVIP will alter the situation particularly if environmentally sound activities as included in the design of this project are adhered to. The management of the project together with the introduction of environmentally-friendly activities such as agro-forestry, woodlot establishment, proper water and land utilization, monitoring and controlling of vector borne diseases, environmental rehabilitation, will enhance the quality of the environment, minimize the effects of flooding and soil loss, and create a sustainable environment for irrigation and hydropower development.

1.2.4 Project Target

The SVIP targets the development of a large gravity-fed irrigation project for the ocal community and especially smallholder farmers for the production of main food crops, such as maize, rice, sorghum and cash crops including cotton and sugarcane. There will be vegetables and other crops that will be grown in rotation with the main crops. Other activities will include livestock rearing, fish farming and agro-forestry. The project will also promote agro-processing and related industry for adding value to the crops to improve farmers' income and generate essential foreign exchange.

The development of the Shire/Zambezi Waterway will open up access routes for export marketing opportunities for the agricultural produce and products from this project area.

The project will promote a high degree of beneficiary farmer participation and women involvement in agricultural activities and project management through their Water Users Associations. The project will also provide a gravel road network to serve the irrigation project and the communities living in the project area, as well as promote sustainable management of the environment through improved conservation farming system.

The project will also incorporate rural and urban water supply services in order to reduce the community's dependence on boreholes which dry up during the dry seasons or shallow wells with very poor quality water. This process will mitigate health hazards and improve the health and sanitation of the farming communities.

1.2.5 Expected Results

The expected results of this project are as follows:

- Diversified crop production in the project area with maize, rice, sugarcane, cotton, sorghum, high value vegetable crops, among other crops, grown under irrigation.
- Cropping pattern that will be adopted will intensify land use, especially where double cropping will be practiced;
- Increase production per unit area of crops that can be marketed locally and internationally;
- Increase food availability at household, as well as national level from the current 70 per cent of household requirement to a surplus production; and
- Increase foreign exchange earnings from cash crops and processed agricultural products;
- Promote livestock rearing, fish farming, agro-forestry;
- Improvement of access to production supporting services (credit, extension and research, marketing, transport, storage, processing) and social facilities and services (education, health, domestic water supply, and telecommunications); and

- Raise standards of living and improved nutritional status due to diversification of diet;
- Increase employment in the project area by 47 per cent; improve access to production supporting services (credit, extension and research, marketing, transport, storage, processing);
- Improve access to social facilities and services in accordance with the standards set by the GOM with regard to education, health, domestic water supply, and telecommunications; and
- Raise standards of living and improved nutritional status due to diversification of diet with vegetables and fruits;
- Improve marketing systems;
- Improve crop and livestock husbandry practices; and
- Minimize environmental degradation through rationale and controlled use of available resources by the beneficiaries, through community development and capacity building.

The project will contribute to meeting the Millennium Development Goals on food security and poverty alleviation, and gender balance.

1.2.6 Multi-sectoral Approach

One of the main objectives of Malawi Economic Growth Strategy (MEGS) and Malawi Poverty Reduction Strategy Paper (MPRS) is to institute programmes for poverty reduction and improve the Malawian population welfare economically. This broad objective can only be achieved by concerted efforts of all stakeholders. This project design is based on this principle. The strategy also aims at institutionalizing a multi-sectoral collaboration effort and cost effective implementation through utilization of appropriate technology. An integrated approach in the implementation of this project will ensure its success.

2.0 PUBLIC CONSULTATION AND DISCLOSURE PROCEDURES (PCDP)

The objective of public consultation was to review the implementation of the project as well as the resettlement plan and assess its impact on the project affected people (PAPs). The tasks conducted included assessment of institutional arrangements (implementing agency, organization, operational capacity); assessment of implementation of the resettlement plan (number of PAPs resettled, compensation, restitution of livelihood); assessment of social impacts of the resettlement; review of the resettlement plan (number of PAPs, land tenure, vulnerable groups and compensation procedures); and suggestions of recommendations based on donor agency's safeguard policies on resettlement. The relationship between project development and communities should ideally be managed to achieve public acceptance of the project both on the social as well as physico-chemical context. This will therefore require attention to the linked issues of stakeholder identification, communication, consultation, participation, negotiation, prior consent and dispute/grievance resolution.

The SVIP PCDP was prepared taking into account the requirements of the EIA legislation in Malawi and consultations already undertaken during preparation of the original EIA report. The PCDP specifies that consultations will be required throughout the project implementation process and this is a requirement under national EIA legislation. These consultations will be done by the Ministry of Irrigation and Water Development under the guidance of Department of Environment Affairs of the Ministry of Natural Resources and Environmental Affairs.

The Terms of Reference (ToR) for the 2005 EIA studies required that public consultation and disclosure should be in accordance with the guidelines and regulations of the Government of Malawi. Considering that in future there shall be need to seek financial resources elsewhere the consultant decided to include herein the World Bank policies, specifically (OP) 4.01 to be in line with requirements followed by financial lending institutions.

2.1 Public Consultations

The objective of public consultations was to enlist views and opinions, reflections and aspirations, expectations and community involvement and participation of the affected community and other stakeholders in the development process for sustainable implementation of the project. Included in these consultations were screening of environmental issues and impacts for detailed analysis and some updating of approach, organisation and inputs for the EA (Environmental Assessment) in order to achieve a Comprehensive Mitigation Plan (CMP). Consultation of the affected community started with training of the Community Development Assistants (CDAs) in the methodologies of information and data collection. After training, the CDAs consulted the local community and traditional authorities, and held focus group discussion with a selected number of PAPs. They also consulted beneficiaries of existing irrigation schemes within the Shire Valley. The Consultant visited other stakeholders within the Shire Valley, Blantyre, Zomba, Liwonde and Lilongwe, including field visit of project sites and existing irrigation schemes.

2.1.1 Consultation with the District Executive Committee and other Stakeholders

Local (primary) and national (secondary) stakeholders were identified and meetings held to obtain their views and concerns with respect to the likely impacts of the project. An awareness meeting for District Executive Committee was held in July 2005. A stakeholders' meeting was held in Chikwawa in September 2005 that comprised of the Paramount Chief, Traditional Chiefs, representatives of government ministries and departments, NGOs and African Parks Conservation (Majete Game Reserve Management) chaired by the Principal Secretary of the Ministry of Irrigation and Water Development. Five key members of the Consultant's team attended the meeting. This meeting was prompted by an objection to the project presented by African Parks (Majete) Ltd who are in a 25-year management contract of Majete Game Reserve with the Department of Parks and Wildlife.

The second stakeholders' meeting was held at Chikwawa for two days in October 2005. The first day was held in Chichewa and was aimed particularly at local people residing in, or near the proposed Project Area. The second day was held in

English and aimed particularly at Ministry staff, policy makers, potential investors and other interested groups.

Tables 2.1 and 2.2 show the target groups for the two sets of local and national stakeholders. Table 2.3 lists the individual consultation meetings with details of date, location and attendance.

The results of the scoping consultations are described in detail in the Scoping Report presented as Appendix A. That appendix also includes the consequent additions that were made to the ToRs for the update studies, presented as a series of additional questions. Each of those questions has been addressed within the present report.

Table 2.1: Primary Stakeholder Target Groups

1.	Representatives of Chikwawa District Assembly:	- Agriculture - Health - Education - Labour - Works - Police
2.	The Farm Manager of Nkhate Irrigation Cooperative Society.	
3.	Non-governmental organisations: Aqua-Farms and CADECOM.	
4.	Traditional Chiefs and Elders	- Lundu - Kasisi - Maseya - Katunga
5.	Young people (16 -19 years of age) - male and female.	
6.	Co-operative associations and/or special interest groups (farmers groups; fishermen).	
7.	Religious leaders	- Muslim Imams - Roman Catholic Priest in Chikwawa
8.	Head Master and Teacher of secondary school -. Chikwawa.	
9.	General Manager and Operations Manager of the Kasinthula Cane Growers Ltd.	
10.	Agriculture Manager-Illovo, Sugar Corporation of Malawi, Nchalo.	
11.	Site Manager, Kapichira Hydro-Electric power, ESCOM.	

Table 2.2: Secondary Stakeholder Target Groups

1.	Central Government Ministries	- Ministry of Agriculture - Ministry of Economic Planning and Development - Ministry of Finance - Ministry of Gender, Child Welfare and Community Services - Ministry of Water Development and Irrigation - Ministry of Local Government - Ministry of Tourism, Parks and Wildlife - Department of Geological Surveys - Department of Meteorological
2.	Parastatals	- Electricity Supply Commission of Malawi - Southern Region Water Body - University of Malawi (Polytechnic and Bunda College of Agriculture)
3.	Others	- Sugar Corporation on Malawi - Kasinthula Cane Growers Limited

Table 2.3: Individual Consultation Meetings

Stakeholder	Location	Date	Type of meeting	No. of women	No. of attendees
T/A Katunga Salumeje GVH Salumeje II Migano Lauji Community members	Namalindi F.P. School T/A Katunga	2-10-05	Focus group discussions, public interviews, key informant interviews	81	241*
Aqua-Farm	Kasinthula	3-10-05	Key Infomant	0	2
Fombe GVH Fombe II Chekiteni Kannthema Santana Community members	Fombe Village	3-10-05	Focus group discussions, group interviews,	70	112
District Commissioner. Agriculture, Healthy, Police, Education, Labour, Works	District Assembly	4-10-05	Focus group discussions	0	7
CADECOM	Matechanga	4-10-05	Focus group discussions	1	4
Chambuluka GVH Chambuluka II Bereu Community members	Chambuluka near Bereu Trading Centre T/A Maseya	4-10-05	Focus group discussions, group interviews,	99	193*
Nkhate Irrigation Cooperative Society Committee members The Farm Manager	Nkhate	5-10-05 5-10-05	Focus group discussions Key Informant interviews	1 0	5 1
Group Village Headman Representative Mbande II Rep. Community members	Mbande Village	6-10-05	Focus group discussions	6	17
Mbenderana GVH Mbenderana II Mlingama Community members	Mbenderana Village	6-10-05	Focus group discussions, group interviews,	120	270*

Notes: * Numbers participating fluctuated during the meeting. Numbers provided are either an estimated average or range.

2.1.2 Consultations during the EIA Update Studies

Two specialist study teams worked in the project area to conduct the additional field studies during September and October 2005. During this period, team members actively consulted local people to increase the team's knowledge and understanding of the local environment, key changes since 1997 and current trends. Such discussions provided a forum in which stakeholders expressed any new concerns, as well as reinforced issues and concerns already raised in the earlier consultations.

3.0 EXISTING ENVIRONMENT

3.1 Introduction

3.1.1 Study Area Boundaries

The following system is adopted in this report to refer to the various parts of the study area:

Shire Basin: The drainage area along the Shire River from Mangochi. *(The elevation on each side of the river is below 500m, decreasing to 100m downstream of Kapichira Falls. The area of influence for the SVIP from Hamilton Falls to the conference of Ruo River covers a surface area of 4,950 km^2)*;

Upper Hamilton Falls: The drainage area of the Shire River upstream of the weir, which covers 13,820 km^2;

Immediate Catchment: The area upstream of the weir, within the highlands immediately east and west of the Shire River, extends approximately 7 km on each side of the river, covering an area of around 448 km^2, including the new reservoir;

Project area: The area covered by the project structures (weir, canals, roads and associated facilities);

Downstream area: The Shire River downstream of the weir to as far as Mwanza River in the Phase I;

Resettlement area: Area potentially suitable for resettlement of Project Affected Persons (PAPs).

3.1.2 Data Sources

The following description of existing environmental conditions in the area that could be affected by the project is based on data from a variety of sources. These include:

- Existing data (from Government agencies and NGOs, published reports, books, papers, etc) contained in the 1997 EIA report (Coda and Partners, 1997) and additional existing data collected by Coda and Partners in 2005;
- New data from surveys (terrestrial flora and fauna, archaeology, public health, socio-economics, etc) carried out by Coda and Partners in 1997and in 2004;
- Data from other studies related to the Kapichira Hydro-Electric Power, including the Feasibility Study (Kapichira Hydro-Electricity Environmental and Resettlement Supervision Mission, 1999).

A comprehensive reference of sources of data and information is shown in Appendix A. Raw data collected during the present study has been analysed and is presented in appropriate sections.

3.2 Physical Environment

3.2.1 Climate

Malawi has a tropical savannah climate, with distinct wet and dry seasons resulting from migration of the Inter-tropical Convergence Zone (ITCZ), Zaire Air and occasionally by cyclonic influence that separates the warm dry continental air from moist air blowing northwards across the Indian Ocean through the Mozambique Channel.

In the Shire Valley the wet season begins in November and ends in April and is characterised by heavy rain (reaching a maximum of around 425 mm in January), high humidity (75-95%) and air temperatures that are generally above the annual average of 22°C. Thunderstorms occur in the transition periods between the two seasons, accompanied by short periods of strong winds and heavy rain.

3.2.2 Rainfall and Evaporation

Rainfall decreases as the dry season progresses, until in May there is virtually no rain at all. Humidity is lower and temperatures are a little above average, at generally around 25-30°C in the day and 20-25°C at night. October is the hottest month when temperatures reach the annual maximum of 40°C. Between September and November, Conditions are a bit modified by, dry dust-laden winds

that blow from southwest intermittently for periods of up to a few days. At such times the sun can be obscured by airborne dust and temperatures can fall to 20°C and humidity to 40-70%.

Total annual evapotranspiration averages around 2,000mm with high monthly rates in the dry season from September to December, and lower rates from June to July. Evapotranspiration far exceeds rainfall even during the rainy season, except in January and February. The combination of high evapotranspiration and low rainfall leads to severe soil moisture stress during critical crop development stages.

Table 3.1: Rainfall, Evaporation, Evapoiration and Average Radiation for Nchalo

Month	Total Rain (mm)	Av. pan (mm/d)	Total pan (mm)	Av. Et (mm/d)	Total Et (mm)	Average Radiation	Min. Temp °C	Max Temp °C
January	250.9	5.5	170.9	5.7	176.9	6.9	23.5	35.6
February	218.7	4.9	139.5	5.2	147.8	7.1	24.0	34.4
March	96.9	5.2	159.8	5.1	158.7	7.7	23.8	33.6
April	29.5	5.1	154.2	4.9	145.6	8.4	23.4	33.2
May	9.9	4.3	132.4	4.0	124.5	8.3	23.2	33.2
June	7.7	3.7	111.2	3.5	105.6	7.3	21.1	32.0
July	24.5	4.0	122.6	3.5	108.9	7.7	17.8	29.9
August	9.6	5.2	162.3	5.0	154.2	8.9	16.5	28.5
September	12.9	6.8	204.0	6.6	198.2	9.1	15.6	28.2
October	10.5	8.2	254.9	8.2	252.7	9.6	16.9	30.9
November	56.3	7.9	236.6	7.7	232.2	8.9	19.2	33.8
December	116.7	6.2	192.9	6.1	190.6	7.4	21.9	35.3
Annual	**844.1**	**5.6**	**2,041.3**	**5.46**	**1,995.9**	**8.1**	**20.6**	**32.4**

3.2.3 Hydrology

The Majete Game Reserve is drained by Mkurumadzi River and the Mwambezi and Masakala streams which flow into the Shire River and by the Phwadzi, Chipudzi and Manjombe streams which flow into the Mwanza River. Most of the Shire River tributaries within the project area are seasonal, some flow continuously through the rainy season until May, June or July, while others are intermittent even during the rainy season. All tributaries experience flash floods lasting from several hours to

several days. Flooding in general is endemic in the Shire Valley, and is likely to become worse as catchment areas continue being deprived of soil and vegetation. On the west bank, the Thangadzi, Labanje, Nyakamba and Namikalango often make drifts impassable for short periods.

Mwanza River: Mwanza River which forms the southern boundary of Phase I of the project originates in the Kirk Range and is perennial only in its upper course. It has an average annual flow of 2 cumecs, although monthly average flows can be less than 0.03 cumec in October. In the dry season all surface flow ceases downstream of the Mwanza marshes near Tombodera. At Tomali, the river is often dry for three to four months of the year. It appears that the flow from the Mwanza disappears into the highly permeable sands of the Mwanza Valley.

Other important rivers on the west bank are M'thumba, Nkombedzi wa Fodya, Mafuna, Pwadza and Dandi which are also dry for most of the year.

Marshes: The Shire Valley has two major marshes, the Elephant Marsh, covering approximately 43,300 hectares and the Dindi Marsh covering about 16,190 hectares. Both marshes depend on Shire River water for their productivity and any changes in the Shire River regime affect them. The marshes are also affected by the flow of the Ruo River. However, about 50 percent of the Dindi Marsh flooding is due to the spill-over of flood waters of the Zambezi River into the Shire River.

The Shire River: The Shire River is the only outlet of Lake Malawi and passes through the Shire Valley on its way to the Zambezi River. It has a total length of 410km and drains a catchment area of 19,248 km^2. It falls over 350m in elevation over a distance of 90km between Liwonde and Maganga, passing through a series of falls and rapids including Kholombidzo, Nkula, Tedzani, Hamilton and Kapichira. Within this distance, it is joined by the Lisungwe River and the Mkurumadzi River, whose source is in the Kirk mountain range and follow a north-south fault, and the Lirangwe River. It is within this reach that hydropower stations and the proposed offtake for the Shire Valley Project at Hamilton Rapids are situated. Below the Hamilton Rapids, the Shire River widens and is joined by two other tributaries the Mvusa and Mwambezi, near Maganga village. From Maganga, Shire River flows for

140km through a broad, fairly flat valley with a gradient of 0.5m/sq.km up to the Mozambique border at Bangula/Chiromo where it is joined by Ruo River.

The Thyolo Escarpment Tributaries: All the principal east bank tributaries rising in the Thyolo Escarpment from the Likabula in the north to the Thangazi in the south are perennial. These rivers are subject to high flash flood flows and low dry season flows due to the deterioration of vegetation cover in the catchment area.. The dry season flow probabilities increase from north to south, with the Likabula and Mwampanzi having very low dry season flows per unit catchment area during this period.

The Ruo River: The southernmost tributary on the east bank rises in the foothills of Mulanje and Chiradzulu mountains. The Ruo River has a 20 year annual meanflow of 56 cumecs but the average monthly flows vary from 151 cumecs in February to a low of 10 cumecs in October. When flood flows of the Ruo coincide with high flows in the Shire, they cause a back-up of the Shire River at Chiromo, with the consequent flooding of Chiromo Township and its environs.

Makande Plain: There are a few small streams flowing from the Matundwe Hills but these run dry for three to four months of the year. The Makande clay soil, which covers most of the area, is a heavy cracking clay which swells and seals up with the first rains, resulting in an area of low infiltration, high run-off and consequent low water retention. The streams or gullies within this area may flow for several days after heavy rains but then dry up completely.

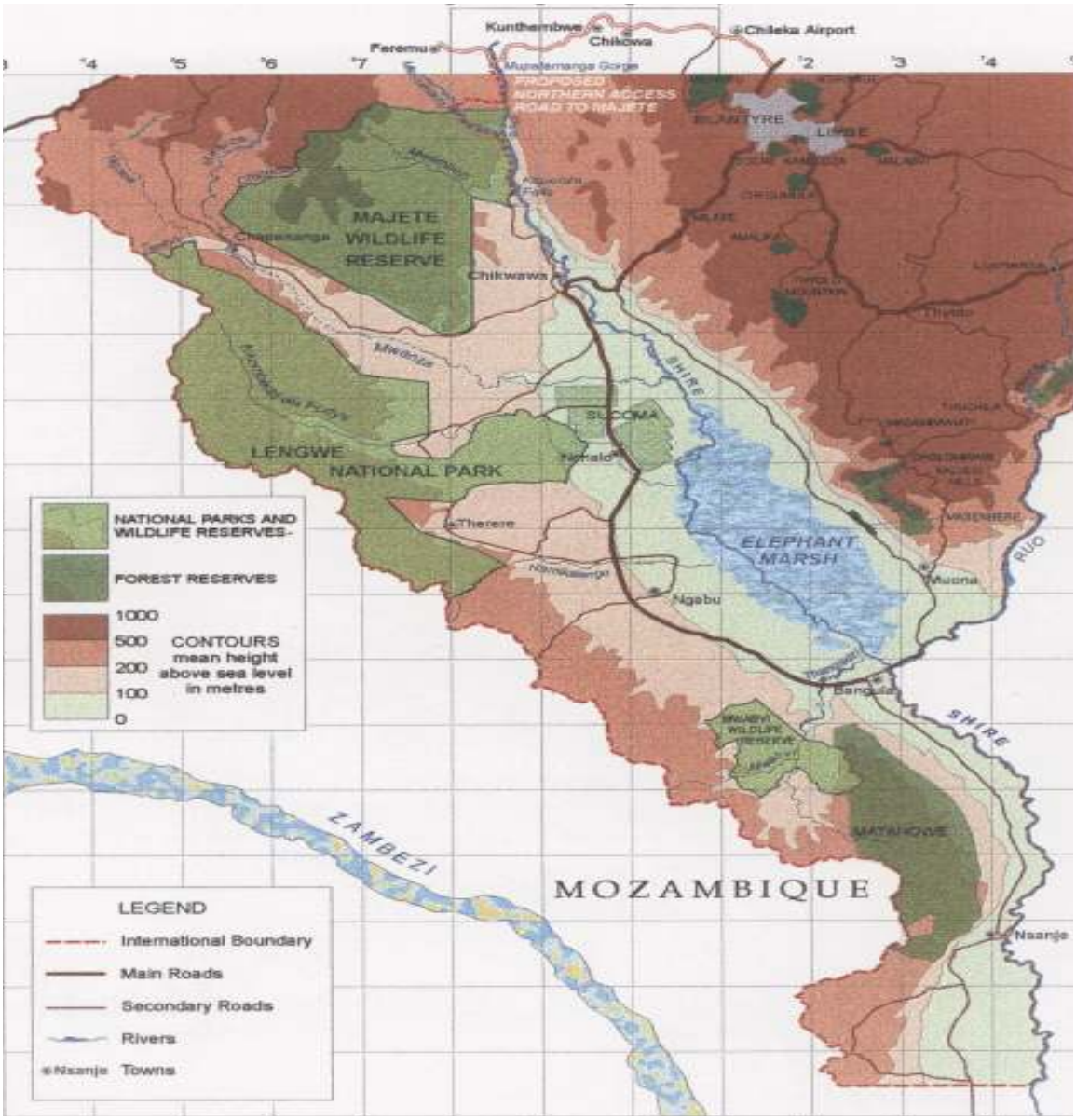
Nsanje Highlands: This area includes the Mulaka and Natundu Hills. The Thangadzi River in the north of the area, near Bangula, has a catchment area of 360 km² giving rise to high spate floods in the wet season but becoming dry by mid April, at the end of the rains. There are also few springs within the Mulaka Hills which flow for approximately nine months of the year. The probability of the dry season flows improves moving southwards to the Matundu Hills around Chididi which have a higher rainfall. The Nyamadzere stream has the highest dry season flow with the Nyachipere and Nyachirenda also being perennial in the foot hills, but dry by the time the streams reach the plain. The soils of the plain between the hills

and the Shire River are sandy and very permeable and even during the rains when the streams flow out onto the plain, the water quickly disappears within the first few kilometres.

Groundwater: Over 800 boreholes have been either drilled or hand dug in the Shire Valley. These have normally been located in villages or towns where the demand for water is at its maximum. All domestic supply boreholes have been fitted with mechanically operated hand pumps which are capable of pumping at a rate of 1000 - 1500 L/hr. There is no current study indicating the quantity of water pumped from these boreholes.

Water Supply: Despite a rich water resource mainly in the form of rivers with Shire River at the forefront, and a potentially extensive borehole and wells network resulting from a high water table within the Shire Valley, accessibility to clean water is still a problem. Current estimates are that 172,000 people have no access to clean water. The majority of the boreholes which have been developed since pre-independence are not in use and many of them are saline. Those being rehabilitated are breaking down at a rapid rate as there are shortages of spare parts as well as artisans to repair them.

Figure 3.1: Relief of the Shire Valley



3.2.4 Geology and Geomorphology

The geological formations of Malawi may be considered in three main divisions: The pre-Cambrian or Basement Complex, the Karroo System and the post-Karroo formations. Tectonic movements that led to the formation of the Great Africa Rift Valley, of which the Shire Valley forms part, largely determine geology of the project area. Escarpments associated with major fault lines running in an SE-NW direction flank this part of the Rift Valley floor. The Lower Shire River Valley area has an altitude of between 50 to 200m amsl; the western uplands have an altitude of around 300m amsl, whereas the hills in the northwest and southwest rise to an altitude of nearly 1,000m amsl.

The alluvium deposits of the Shire Valley are usually between 50 and 150 meters thick. The ground water levels in the area are between 3 to 15 meters below the ground surface. The water depth varies with topographic relief. Little reliable information is available on the hydraulic properties of the alluvial soils. However, Bradford in the *Lower Shire Irrigation Feasibility Study (1973)* reported an average aquifer transmissivity of about $30m^3$ per day, but could go as high as $400m^3$ per day.

4.0 IRRIGATION DEVELOPMENT IN MALAWI

Development of irrigation activities is being promoted through the Department of Irrigation. The main focus is on how to facilitate the increase of agricultural production through mobilisation of small- and large-scale irrigation projects within the smallholder and estate sub-sectors. Human and financial resources are contributed by the beneficiaries, the private sector, non governmental organisations (NGOs), and the public sector. Strategies for irrigation development emphasise full participation of the beneficiaries, ample observance of environmental aspects and equitable involvement across gender lines in order to ensure sustained productivity and growth, food security, effective poverty alleviation and national economic development. The total irrigation development potential is estimated at 800,000 hectares of which 118,000 ha are already under *dimba* cultivation (FAO 2002). Currently the area under formal irrigation is estimated at over 27,000 ha (DoI 2000).

Planned irrigation development started in Malawi in 1949 at Limphasa in Nkhata Bay District. In the mid 1950s two more schemes were developed on the Chilwa/Phalombe plain and an irrigated crop research station was established at Makhanga near Bangula. The research station was later shifted to Kasinthula near Chikwawa because of flooding problems. Since then, irrigation development has continued in four categories.

(i) The first and largest category is private sector estates developed on public land largely with private capital and expertise (growing sugar).

(ii) The second category is private estates on freehold or leasehold land, producing mainly tea, coffee, macadamia and tobacco.

(iii) The third category is government-owned settlement schemes on public land in which rice is the principal crop grown. These schemes are in the process of being handed over to the beneficiaries through the formation and establishment of water user associations. The new policy advocates irrigation development on customary land with full participation of the beneficiaries in planning, development and management.

(iv) The fourth category is “self help” schemes on customary land, generally producing rice and vegetables. Use of treadle and small motorised pumps is being promoted for the production of green maize and vegetables in this category.

The largest irrigation scheme, Nchalo Sugar Estate, was established at Nchalo in 1965, and reached its full development of 9,200 ha in 1977. An extension of this project was later developed at Alumenda near Ngabu. The second largest irrigated estate was developed at Dwangwa on the central lakeshore plain in 1979, and covers 6,000 ha. These schemes are growing sugar cane for the processing into sugar for the domestic and the export markets.

5.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

5.1 National Water Policy

The GoM through the then Ministry of Works, Supplies and Water Development, launched and adopted a Water Resources Management Policy and Strategies document in 1994 that has been guiding water resources development and management. However, this policy focused on the water service delivery whose major outcome was, among othr things, the creation pf the Ministry responsible for Water and thre regional water boards, and the reconstitution of the Water Resources Board, Lilongwe and Blantyre Water Boards. This policy therefore revised and approved by Government in 2000, to strengthen the management aspects of water resources.

Despite revision of the policy in 2000, it still did not articulate the issues which it was trying to advocate. There was need to develop a new policy that would be compatible with the current global and regional trends of collective and participatory approach to developmet and utilisation of water resources in order to achieve the UN Millennium Development Goals and the World Summit on Sustainable Development targets of 2015. The new policy, the National Water Policy 2005, addresses all aspects of water including resource management, development, and service delivery conforming to the current global and regional trends and the requirements as reflected under the Millennium Development Goals. The overall policy goal is sustainable management and utilisation of water resources in order to0 provide water of acceptable quality and of sufficient quantities, and ensure availability of efficient and effective water and sanitation services that satisfy the basic requirements of every Malawian and for the enhancement of the country's natural ecosystems.

5.2 Agricultural Development Policies

The Malawi Agricultural Sector Policy (DEVPOL 1987-1996) emphasizes enhancing social welfare, income distribution among the agricultural community, and prosperity and stability of the nation as a whole. Specific policy guidelines include attaining self-sufficiency in food production and the diversification of export receipts. The

Malawi agricultural policy aims at curbing deterioration of natural resources, maldistribution of agricultural incomes, and over-dependence on volatile external trade flows.

5.2.1 Crop Development Policy

Crop development policy aims at increasing maize yields through the provision of support services and introducing new varieties of crops such as rice, sorghum, sunflower, burley tobacco, improving tobacco yields and introducing more smallholders to burley tobacco production; and assessing the viability of out-grower schemes for certain crops. Issues of policy of particular significance to environment are the improvement of yield through encouraging use of high analysis fertilizer and encouraging use of agrochemicals in pest and disease management.

5.2.2 Livestock Development Policy

The main objectives of the current Livestock Policy are:

- To respond effectively to the challenges of poverty reduction and improving rural livelihoods in Malawi.
- To articulate the specific strategies and activities that shall boost livestock production, and
- To encourage and involve the various stakeholders in the livestock sub-sector, and in particular, the private sector (commercial producers), Non-Government Organisations (NGOs), Farmer Associations and Cooperatives and the public sector.
- Continuing government programs in disease control through vaccinations, dipping, controlled grazing.

The policy relates to animal production, animal health, regulatory services, public health and inspectorate service, research and technology development and dissemination, and cross-cutting issues such as gender, HIV/AIDS, environment, and globalization and involvement of other relevant stakeholders (DAHLD, 2005).

5.2.3 Irrigation Development Policy

The GoM Irrigation Development Policy and Strategies adopted in 2000 aim to rehabilitate a number of small existing irrigation schemes and offer technical advice to

a number of self-help schemes; encourage gravity-fed irrigation; undertake a full study of phased execution of a new 42,000 hectares project in LSV; promote viable irrigation for estate tobacco, wheat and tea production and avoid any situation requiring recurrent subsidy; exploring and implementing small irrigation schemes that can be managed using minimal capital expenditure, and clarifying the institutional arrangements for future small and large schemes.

5.3 National Forestry Policy

This policy aims at promoting sustainable contribution of national forests, woodlands and trees towards the improvement of the quality of life in the country by conserving the resources for the benefit of the nation and to the satisfaction of diverse and changing needs of Malawi population, particularly rural smallholders. The main goal of the forest policy is therefore to reduce the degenerative impact of development on the environment that is associated with poverty. It also aims at creating an enabling environment or framework for promoting participation of the private sector in forest conservation and management, eliminating restrictions on sustainable harvesting of essential forest products by local communities and promotion of planned harvesting and regeneration of the forest resources by village forest authorities.

5.4 Parks And Wildlife Policy

The National Parks and Wildlife Act No. 11 of 1992 stresses the need to preserve selected examples of Malawi's biotic communities and their physical environments; protect areas of aesthetic beauty and of special interest; preserve populations of rare, endangered, and endemic species of wild plants and animals; assist in maintaining water supplies through catchment conservation, and promote fish conservation and fisheries management downstream. The policy also advocates use of national parks and wildlife reserves for studies for the advancement of science and understanding; providing facilities for public use and enjoyment; and protecting upper catchments of major rivers and their tributaries.

5. 5 National Environmental Policy

The Government reviewed past laws regarding the environment and developed the National Environmental Action Plan (NEAP) whose aim is to provide a framework for integrating the environment in the socio-economic development of the

country through greater public participation. Major environmental problems are rooted in population growth, pressure on land, land tenure, poverty, deforestation, soil erosion and decreasing soil fertility.

The National Environmental Action Plan (NEAP, 1994) calls upon the State "to manage the environment responsibly in order to prevent its degradation; provide a healthy living and working environment for the people of Malawi; accord full recognition to the rights of future generations by means of environment protection and sustainable development of natural resources, and conserve and enhance biological diversity of Malawi". Malawi is also among the first African countries to develop and ratify a National Environmental Action Plan (NEAP).

A review of the NEAP identified deficiencies and omissions especially relating to population growth, poverty, illiteracy and lack of environmental information and awareness. Another deficiency was that many cross-sectoral matters were not covered such as: overall environmental policy; environmental quality criteria and standards; environmental impact assessment; pollution of environmental media; institutional co-ordination and conflict resolution, and monitoring of environmental policies by sectoral agencies. The review culminated in the drawing up of the current "Draft Environmental Management Bill, 1995".

5.5.1 Environment Management Act

An Environment Management Act (EMA) to make provision for the protection and management of the environment and the conservation and sustainable utilization of the natural resources and for matters connected therewith and incidental thereto was passed by parliament in August 1996. It has, therefore, a positive impact on the environment of the country as well as creating a more attractive climate for investors, NGOs and other development assistance agencies.

5.5.2 Administrative Structure

Until 1988, environmental issues were dealt with by the Ministry of Forestry and Natural Resources. Thereafter the unit was transferred to the Office of the President and Cabinet to become part of the National Research Council of Malawi. In April 1991, the current Department of Environmental Affairs (EAD) was created in the Office of the President and Cabinet (OPC). This move

signalled the growing importance of environmental issues with inter-sectoral policy implications. EAD now has the obligation of ensuring that Government policies, programmes and activities that are environmentally sensitive are conducted and carried out or implemented in an environmentally responsive manner.

5.6 National Eia Requirements

It is particularly important that any EIA process should be fully compliant with applicable national EIA requirements and procedures. The original 1997 EIA was conducted soon after the NEP was approved by the cabinet and EMA was passed and enacted by parliament both in 1996 and before the publication of the EIA guidelines in December 1997. Under the procedures laid in the guidelines, the SVIP is classified as a prescribed project in category Class A Project, requiring Full Environmental Impact Assessment.

It is noted that while environmental impact assessment was incorporated at the time of the feasibility studies, it was not incorporated at the time of detailed engineering design. The consultant proposed that an environmental impact assessment be part of the assignment with all due consideration in terms of public consultations. The original EIA complies with that requirement retrospectively, in terms of the overall content of its EIA study and report. The current studies have also been conducted in compliance with the EIA Procedures, to the extent possible within a largely post hoc up-dating process.

The Consultant also reviewed the EIA process as advanced by the World Bank. The idea was to compare whether there are similarities or differences. The national EIA requirements do not conflict with those of the World Bank and are similar in many respects, including project categorisation and EIA study and report content. The World Bank recommends more public consultation at the scoping stage while the national EA requires more public consultation at the EA review stage. These have both been incorporated in this report.

5.7 Other Policies

5.7.1 World Bank Safeguard Policies

The World Bank has developed environmental impact guidelines which are conditional to their financial support of projects. These guidelines, known as "Safeguard Policies", have been introduced into the project preparation process after the national EIA guidelines had been developed. These guidelines are reviewed in order to identify the adequacy of the existing EIA for compliance in the development of the SVIP.

(a) Environmental Assessment (OP 4.01)

Operational Policy (OP) and Bank Procedure (BP) 4.01 on Environmental Assessment (EA) published in January 1999, combine and replace several previous policies, including the Environmental Policy for Dam and Reservoir Projects. The OP 4.01 describes the environmental assessment screening categories and their requirements as follows:

(i) Projects are classified into categories that reflect the degree of risk, contention, or multidisciplinary nature of environmental impacts. Category "A" is highly risky reqiring a comprehensive EIA;

(ii) Defines the required structure of the EIA report and the Environmental Management Plan (EMP);

(iii) Describes the procedures and processes for public consultation in order to ensure active involvement and participation of the stakeholders in the EA process;

(iv) Promotes mainstreaming of environment assessment requirements at an early stage into the project planning process that would have an influence on decision making;

(v) Describes the appropriate procedures for environmental assessments for each category to ensure acceptance of the report by all stakeholders. These procedures include use of independent environmental specialists to verify and advise on all aspects of the environmental impact assessments.

(vi) Provides guidelines on procedures that need to be followed during resettlement or relocation of people. For example, a resettlement plan is required where more than 200 persons are to be resettled or relocated;

(vii) Sets out reporting requirements on environmental assessment issues during implementation of the project to vrify compliance with the agreed mitigation measures, the environmental management plan, and environmental monitoring procedures.

SVIP is classified as falling within Category 'A' projects.

(b) Cultural Property (OPN 11.03)

The United Nations term "cultural property" includes sites having archaeological (prehistoric), palaeological, historical, religious, and unique natural values. Cultural property, therefore, encompasses both remains left by previous human inhabitants (including shrines, graveyards and battlegrounds) and unique natural environmental features such as canyons and waterfalls.

The World Bank requires that, before proceeding with a project that may risk damaging cultural property, a reconnaissance survey should be undertaken in the field to determine the cultural property aspects and isolate critical natural habitats of the project site. The World Bank defines a critical natural habitat as:

- Existing protected areas, areas officially proposed by governments as protected areas, areas initially recognised as protected by traditional local communities, and sites that maintain conditions vital for the viability of these protected areas (e.g., reserves that meet the criteria of IUCN classifications, sacred groves, etc.); or

- Sites identified on supplementary lists prepared by the Bank or an authoritative source determined by a regional environment sector unit (RESU). Listing is based on systematic evaluation of such factors as species richness; the degree of endemism, rarity, and vulnerability of component species; representativeness; and integrity of ecosystem processes. Such sites may include areas recognised by traditional local communities (e.g. sacred groves); areas with known high suitability for biodiversity conservation; and sites that are critical for rare, vulnerable, migratory, or endangered species.

Given that the intake works and part of the feeder canal are located within a protected area, the sites fall within the World Bank definition of critical natural habitat. If an EIA indicates that a project would significantly convert or degrade natural habitats, the project must include mitigation measures acceptable to the Bank and technically justified.

(c) Forests (OP 4.36)

Whilst this OP is principally related to World Bank activities in the forestry sector, it includes policies on the conservation of forest biodiversity, the sustainable management of forest areas, and the participation of local people. It stipulates that management, conservation, and sustainable development of forest ecosystems and their associated resources are essential for lasting poverty reduction and sustainable development. The impact of the SVIP on forest resources will be limited to the routes and surrounding areas of the canals and related structures. Activities in the catchment areas may not be under the control of SVIP but rather will have an impact on the project.

(d) Involuntary Resettlement (OP 4.12)

Involuntary resettlement is considered to be one of the most important impacts of a proposed project. The World Bank has developed the following guidelines on resettlement and identification, participation and support of project affected persons (PAPs):

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs;
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs;
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to

pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

The SVIP advocates voluntary resettlement and people within the project area have welcomed this idea, realising that the project is theirs and they will be the frontline beneficiaries. In the circumstances as identified in this study, the Client is requested to commission a Resettlement Action Plans (RAPs) for the irrigable areas and for the canal line routes respectively.

The Shire Valley Irrigation Project EA has complied with some of these requirements, and will meet any other obligations that are associated with this type of project.

5.8 Multilateral Environmental Agreements To Which Malawi Is Committed

The Government of Malawi has signed or ratified the following multilateral environmental conventions, treaties and agreements:

- The Convention on International Plant Protection;
- The Convention on Wetland of Significant Importance;
- The Convention Concerning the Protection of the World Cultural and Natural Heritage;
- The Convention on the Conservation of Migratory Species of Wild Animals;
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- The African Convention of Conservation of Nature and Natural Resources;
- The FAO International Undertaking on Plant and Genetic Resources;
- The United Nations Convention on the Law of the Sea;
- The Montreal Protocol for Protection of the Ozone Layer; and
- The Convention on Biological Diversity.

In addition, Malawi is subject to the United Nations General Assembly Resolution 34/186 of 18 December 1979 which requires all member states to adopt the United Nations Environment Program (UNEP)'s Environmental Law Principles as guidelines and recommendations "in the formulation of bilateral or multilateral

conventions regarding natural resources shared by two or more states". These cover the following:

- Stockholm Declaration (1992); Shared Natural Resource (1978);
- Weather Modification (1980); Offshore Mining and Drilling (1982);
- World Charter for Nature (1982);
- Banned and Severely Restricted Chemicals (1984);
- Marine Pollution from Land-based Sources (1985) and
- Cairo Guidelines and Principles for the Environmentally Sound Management of Hazardous Wastes (1987), and others.

6.0 PRESENT PROJECT

The Shire Valley Irrigation Project is located in the southern tip of Malawi on the west bank of the Shire River in Chikwawa and Nsanje districts. The project is envisaged to cover an area of 42,320 hectares stretching 150 km from north of Chikwawa District headquarters to around Bangula in Nsanje District and spans between 20 to 30 km in width.

The major objective of the Shire Valley Irrigation Project is to exploit the high irrigation potential of the Valley through the development of gravity-fed irrigation from the Shire River, expanding coverage and providing complementary infrastructure and services in order to increase agriculture production and farm-based incomes hence ensuring food security and poverty reduction.

The project has two major components as follows:

6.1 Irrigation Development

The high irrigation potential of the Lower Shire Valley provides a great opportunity to boost agriculture potential in particular and the economy. The project will source water from Shire River in a sustainable manner to irrigate vast areas in the districts of Chikwawa and Nsanje. Irrigation development will promote agricultural diversification.

6.1.1 Irrigation Water Requirement

The diversion intake weir at Hamilton Rapids is within the Majete Game Reserve and has a catchment area of 133,700km^2. The design flood discharge is approximately 3150m^3/s with a 100 year return period. This intake is designed to divert 55m^3/s from the Shire River by gravity, at an elevation of 156m amsl.

6.1.2 Drainage Requirement

The unit drainage water requirement for the surrounding and fallow land is estimated on average at 3.04 litres per second per ha, or in a worse case scenario 5.11 litres per second per hectare, which corresponds to discharge from cyclonic type rains. The drainage systems will comprise cutoff drains taking care of surface runoff from the land area outside the irrigation land and the the field

drainage system. Existing natural drainage systems consisting of Nthumba and Mwanza rivers and their tributaries will form part of the drainage network. All external runoff flows will be concentrated into the natural streams and cross the main canal by means of culverts and siphons. In this way flooding from these rivers will be controlled.

6.1.3 Agricultural Development

(a) Farm Size and Cropping Patterns

Each farmer will be allocated one hectare under irrigation and 0.5 hectare under rain fed, commensurate to the availability of sustained hosehold labour for irrigation farming. The selected crops for SVIP are cotton, maize, sorghum and rice. However, other crops such as tomatoes, beans, sweet potatoes, and spices will be grown in rotation. The project will also promote growing of fruit trees. Maize is estimated to occupy a net area of 4,037 ha while rice will occupy 1,594 ha. Cotton is estimated to occupy a net area of 2,000 ha while sorghum is estimated to occupy 309 ha with 50 ha allocated for demonstration and research sites.

(b) Crop Selection Criteria

The crop selection is based on requirements for national and household food security and value adding to high value crops for income generation. In compliance with the above objectives, more land will be allocated to food crops which will be grown under double cropping and in rotation with high value crops. Land allocated to sugarcane will initially comprise that which has already been developed by the Kasinthula Cane Growers Ltd. Tobacco crop has suffered major setback in the world market as a result of the no smoking lobby, and therefore has not been considered. Table 6.1 shows parameters of the selected crops.

(c) Maize and Sorghum Farms

For the reason of food security, the land initially allocated for tobacco will now be used for hybrid maize and sorghum production. The double cropped maize under irrigation will be followed with a vegetable crop, such as tomato or carrot. The choice will be guided by the demand from private industrial groups or marketing

groups. The sorghum crop will be followed by vegetable or spices crop that may require extended time on the ground, e.g. garlic, onion or ginger.

Table 6.1: Selected Crops Parameters

Project Crops	Acronym	Variety (Short Duration Varieties Preferred)	Expected Yield (mt/ha)	Expected Maturity (Days)
A) Main Crop				
Maize	M	SC 403, 407 & 515, MH 18 (Highly Resistant to Blight and MSV)	5	110 to 130
Cotton	C		4	120 to 150
Rice	R	Faya and Kilombero	4	160
Sorghum	S	Pilira (SPV 351)	3	120
B) Rotated Crops (Produced to Demand)				
1) Tomato	To	Money Maker, Heinz, Marglobe, Rodade, Roma VF	25	120
2) Beans/Green Beans	Gb	Kansana, Nasaka, Nagaga, Kalima, Bunda 93	2.5	70 to 90
3) Strawberry	Sb		20	150
4) Onion	On	Early Texas Grano, De Wildt, Pyramid, Red Creole	20	180
5) Ginger	Gg		1.8	210 to 270
6) Garlic	Gc		8	120 to 180
7) Carrot	Ca		30	90
8) Soybean	Soy	Santa Rosa, Impala, Ocepara 4	4	
9) Groundnut	Gn	Malimba and Chalimbana	1.5	120 to 150
10) Turmeric	Tc		20	210 to 270
11) Sweet Potato	Sp	Kenya, Babache	10	120 to 150

(d) Rice Farm

The land initially allocated for rice production will remain for double cropping of rice, followed in rotation by sweet potatoes or beans for food security compliance. The Kasinthula Cane Growers Trust project is presently occupying the 100ha old Kasinthula Rice Project, and this has been extended to 750 ha of smallholder sugarcane land in the project area.

Thus, the major crop in the new project will be maize, cotton, rice and sorghum. While maize and rice will be double cropped under irrigation, cotton and sorghum will be grown under irrigation for one season, followed by soybean or groundnut crop or vegetable crop. Table 6.2 shows a suggested cropping model for the project.

Table 6.2: Cropping Model

Old Project		**New Project**		**Rotations**		
Old Crops	Total Land (ha)	New Crops	Total and (ha) (Proportionate)	Year 1		
Sugarcane	5,037	Sugarcane	750			
		Maize	2,287	M	M	VT
		Cotton	2,000	C	--	Soy+Gn
Rice	1,594	Rice	1,594	R	R	Sp + Bn
Tobacco	1,309	Maize	1,000	M	M	VT
		Sorghum	309	S	--	VT
Demonstration	50	Variety and Seed Trials	50	Agronomist will use these plots for farmers training, varietals or seed selection at different locations on the project.		
Total:	7,940		7,940			

Notes:

- Such Vegetable and Spices Crops as Onion (6 months), Garlic (4-6 months), Turmeric (7 -9 months), and Ginger (7-9 months) will be due for harvesting 6 to 9 months after planting. They could therefore be rotated with the Cotton and Sorghum crops.

- These Vegetable and Spices crops will be better grown as demand driven crops or when the LSV Authority or Farmers Association are able to set up processing facilities in Lower Shire, otherwise its production will create glut in the local market.
- Such Vegetable crop as Tomato could be grown sparingly for domestic consumption in the project area, but extra care should be taken not to flood the local market as they are highly perishable and will reduce the returns drastically.
- The cropping period of the year for the Vegetable crops will be determined by demand from buyers. It can be before the first crop of Maize or after the first crop or after the second crop.
- The oil seed industrial crops, Groundnut and Soybean also take about 5 months to reach harvesting, and will therefore only allow for two cropping. They can be rotated with Cotton and Sorghum.
- In cases where the third crop is grown, usually to follow the double crop of maize, this crop should not require too much irrigation but rely more on the residual moisture in the soil. At this time as well, there may not be too much water in the Shire River.
- Sugarcane is already being grown on 750ha by the Kasinthula Cane Growers Ltd. on land that was previously earmarked for rice. It is proposed that this area for sugarcane be maintained.

It should be noted for consideration that within the sub-region and in Europe, there is a high demand for crops grown under organic farming processes. Such crops generally attract a better selling price, usually in the range of 30 to 50 % above the normal market price. This option should be carefully explored by the project management.

(e) Agricultural Services

The farm operations will be expected to be mechanized with the aid of tractors for land preparation and planting programs. The post-harvest operations will also require low cost technology harvesters, threshers and dryers to speed up the processes as expected in an irrigated farming operation. The mechanization processes will free the farmers from manual farm operation activities and enable them to have much more time than usual for other non-cropping farm industries such as rearing livestock and other non-farm income generation activities.

Table 6.3: Input Requirements per Crop for Optimal Yield in Kg/ha

Crop	Seed	N	P	K	CAN	S	Man-days
Summer Rice	70	160	50	-	-	-	355
Winter Rice	75	80	30	-	-	-	379
Summer Maize	30	150	50	50	-	-	106
Winter Maize	30	150	50	50	-	-	126
Tobacco	89	48	108	90	200	9	307
Groundnuts	70	20	35	-	-	-	115
Sugar-cane	-	180	35	200			238
Beans	90	100	20	-	-	-	127
Soya Beans	90	20	35	-	-	-	111
Tomatoes	0.5	180	80	180	-	-	941
Onions	0.5	100	100	100	-	-	826
Chillies	0.5	120	50	25	-	-	376
Bananas	-	150	40	-	-	-	444
Cassava	-	-	-	-	-	-	128
Sorghum	4	-	-	-	-	-	26

(f) Crop Protection

Pest and disease will be controlled through the use of chemicals, cultural practices and integrated pest management. Use of resistant varieties, cultural practices and chemicals is recommended as a means of managing certain diseases although no one practice can be relied upon to manage pests and

diseases. Early harvesting is recommended for all annual crops to reduce field losses and to facilitate land preparation for the next crop.

Table 6.4: Disease Control of Selected Crops

Crop	Diseases	Control
Maize	- Northern leaf blight	- Resistant varieties
	- Streak virus	- Chemicals on the vector - Management practices
	- Cobb rot	- Management practices - Resistant varieties
Rice	- Leaf blight	- Husbandry practices - Control of fertilizer use - Management practices
	- Leaf blast	- Husbandry practices - Certified seed
Beans	- Fungi	- Chemicals
	- Angular leaf spot	- Chemicals
	- Webb blight	- Chemicals
Groundnuts	- Leaf spot	- Management
	- Rosette	- Early planting
Cassava	- Mosaic	- Chemicals on vector - Cultural practices
	- Bacterial blight	- Management practices - Resistant varieties - Clean planting material
	- Brown streak	- Clean planting materials
Onions	- Blights (early or late)	- Chemicals
	- Bacterial wilt	- Crop rotation
Tomatoes	- Fungal	- Chemicals

Source: Ministry of Agriculture and Food Security

Table 6.5: Pest Control of Selected Crops

Crop	Pests	Control
Maize	- Army worms	- Chemicals
	- Stalk borers	- Chemicals - Biological control
	- Leaf roller	- Certified seed - Chemicals - Crop hygiene
	- Ear worm	- Chemicals
	- Greenhoppers	- Chemicals
Cotton	- Bollworms	- Chemicals
	- Red spider mute	- Chemicals
Rice	- Stem borer	- Chemicals
	- Stalk eyed shoot flies	- Chemicals
Onions	- Trips	- Chemicals
Tomatoes	- Caterpillars	- Chemicals
	- Nematodes	- Chemicals
Beans	- White flies	- Chemicals

Source: Ministry of Agriculture and Food Security

(f) Livestock Development

Almost every household keeps livestock. The introduction of the irrigation project will create a potential conflict of interest because grazing land will be limited. To minimize these conflicts, and to integrate livestock successfully in irrigation scheme, it is recommended that some areas within the irrigation project which can not be irrigated because of command problems should be fenced and

designated for livestock. Farmers who will be allocated land in the irrigated portion of the project and also in areas under rain fed condition will be urged to utilize the rain fed portion for their livestock rearing. Pigs, goats and poultry will not be raised on free-range. Pens and piggery units will have to be constructed by the producers raising these animals.

(g) The Development of Fish Farming

The Kasinthula fish farm was established initially with an area of 22 ha to demonstrate the commercial viability of warm water fish farming in Malawi. A total of 13 ponds were constructed. In 1976, three 0.1 ha ponds and nine 0.05 ha units were constructed for breeding and nursery purposes.

The project will promote commercial fish farming under smallholder and commercial farmer operation and management. As much as possible, fish farming will be integrated with livestock development and rice faming of the farm has been transferred to private management for breeding and production of fish.

(i) Commercial Fish Farms: There is potential for establishing 25 commercial ponds. Two of these ponds will have an area of 5 ha, one will be a 3 ha unit, ten of them will be one hectare unit each, three will be of 0.3 ha each and nine of them with 0.1 ha each. This will take up a total of 24.8 ha of land. These commercial ponds will be run by entrepreneurs with skills in aquaculture.

(ii) Smallholder Fish Farming: There is potential for individual producers to establish their own fish ponds. Currently there are no farmers practising fish farming in Shire Valley, although Evangelical Alliance for Relief and Development (EVARD) has been pushing for the adoption of this enterprise in Chikwawa since 1988. Possible ways of integrating fish farming in the existing farming practices under irrigation are described below.

(iii) Integrated Fish/Livestock Farming: Under this system, chicken, duck, or pig houses could be constructed over the ponds. The livestock are fed, while the fish ponds do not get any external input except livestock manure dropping into the water as a fertilizer. This system will attract those producers keeping either chicken or pigs.

(iv) Fish-Rice Farming: This system has been introduced in Malawi. About three weeks after transplanting rice, fish are introduced into a specially constructed rice paddy. Since the period through which fish are raised is determined by the vegetative period of rice, which is normally not more than three months, fish from this system can be used as fingerlings.

(v) Species Suitable for Fish Farming: Currently, two tilapia species have been found to perform well in fish ponds. They are *Tilapia rendalli* (locally known as chilunguni) and *Oreochromis shiranus* (locally known as makumba). However, another species of fish, the catfish, *Clarius gariepinus* (locally known as mlamba) has also proved to do well in many parts of Malawi, including the Shire Valley. Local communities appreciate the taste of these fish.

6.2 Water Supply And Sanitation

This will be an integrated project with broad impact on beneficiaries and socio-economic development. Access to potable water supplies and sanitation activities has direct impact on the health status of the people and their productivity. Availability of abundant clean water will facilitate establishment and growth of manufacturing/ processing industries, where water is a major input in the production process. The estimated demand for water supply up to year 2015 is 0.13m^3/s (125.83l/s).

Apart from providing clean water to the rural communities, the project will also promote use of sanitary facilities in order to control spread of water borne diseases. Most of the people in the project area are known not to use sanitary facilities for disposal of wastes, and the District Assembly does not have specifically designated sites for waste disposal from septic tanks. This has contributed to the spread of cholera and other water borne diseases when combined with uncontrolled flooding during the wet season.

6.3 Infrastructure Development

6.3.1 Road Network

The strength and life of roads especially in rural areas, depends largely on proper construction, accompanied by adequate drainage services. The roads within the villages are not all-weather roads and are virtually inaccessible at stages, especially during the rainy season. Some of these roads required for construction purposes are expected to remain as permanent roads on completion of the works. The roads (commonly shown as tracks in the drawings) are constructed to a gravel standard. For convenience of service and maintenance, the feeder canal and branch canals are tracked on both sides. The other canals and drains are tracked on one side, and all the tracks are either 5 or 6 meters wide. A summary of their pavement characteristics is given in Table 3.6 below. The tracks will be constructed concurrently with the canals.

Table 6.6: Pavement Characteristics

Type of Road/Track Section	Carriageway/Pavement Width
1. Feeder canal	6 M (on each side of the canal)
2. Main canal	6 M (on one side only)
3. Branch canals	5 M (on each side of the canal)
4. Tertiary canals	5 M (on one side only)

Figure 6.1: Consequences of inadequate storm water drainage

6.3.2 Residential and Auxiliary Facilities

Facilities will be constructed to accommodate the contractor and the resident engineer. These facilities will include offices, laboratories, workshops and stores, and residential houses, and would revert to the Government of Malawi after construction works are completed. They will eventually be used by the agency which will run the project.

6.3.3 Buildings

Buildings will be needed for the implementation and management of the project. All of these buildings can readily be constructed using locally available materials. They should all be constructed in areas away from the flood plains. For the purpose of implementation, it is recommended that all the buildings be constructed during the first year.

6.3.4 Telecommunication

The project area has already benefited from a modernization telecommunication network improvement programme that covered the five districts of Thyolo, Mulanje, Phalombe, Chikwawa and Nsanje through the installation of digital telephone exchanges in particular rural areas in the Southern Region. The project was financed by the Kuwait Fund for Arab Economic Development and the Government of Malawi to the tune of US$ 10.70 million. A total of 7,000 telephone lines were installed in the five districts during the project life.

6.3.5 Schools

Chikwawa Boma has a nursery, primary and secondary schools. ESCOM has also proposed to construct an additional primary school at Chikwawa essentially for its employees and this would likely be near the power station at Kapichira Falls. This would not be available for the majority of the children in the project area. Whereas the population in areas where irrigated fields are designated have at present no schools, relocation will not bring them any closer to these facilities and therefore there will be need to construct new schools. Presently the school enrolment in is only about 43 per cent of the intended capacity and therefore there will be no need for school expansion in the next eight years during the implementation of Phase I of the project.

6.3.6 Health Facilities

Health facilities follow the same distribution as schools with most dispensaries being located along the major roads where the highest concentrations of people live. The villages in the remote areas are served by mobile health services. This again implies that investment in the construction of health centres will not be necessary in this project, since current levels of health care are sufficient. At any rate, the people to be relocated from the interior will be brought closer to the existing centres.

6.3.7 Sanitation

With provision of irrigation water closer to the villages, an increase in water-borne diseases is likely to occur. Public health awareness and emphasis on personal hygiene is one of the methods proposed to tackle the health problems. The community will be required to observe basic hygienic procedures, especially waste disposal through appropriate pit latrines. Continuous usage of septic tanks and pits is recommended.

Figure 6.2: People using water in canals for domestic purposes

6.3.8 Domestic Water Supply to Chikwawa

There are three boreholes for Chikwawa *Boma* which provide water to 165 consumers and 12 communal distribution points. The average consumption currently is 55 litres per person per day and is estimated to increase to 70 litres per

capita per day by the year 2025. The project has allowed for development of treared water supply facilities to cater for Chikwawa *Boma* with a projected population of 23,183 by the year 2025, and the rural community. The water treatment works will be located at the start of North Junction Canal.

6.3.9 Agro-processing Facilities

There is potential for the establishment of agro-processing industries to process various commodities based on the planned agricultural production. Possible industries include rice processing; processing of horticultural products; cottage leather industries; fish processing facility; and processing of cotton products.

6.4 Engineering Component

6.4.1 Intake Works

The project will draw water from the Shire River just above the Hamilton Rapids. Intake works include a 210m long and 4m high concrete weir across the Shire River, and headworks with gate controlled intake channels for abstraction of water and discharge of sediments into the Shire River. To the headworks will be connected the feeder canal conveying water to the irrigation lands. The intake works have been designed to draw 55m^3/s from the Shire River with a water elevation of 156m amsl. The weir has been designed to pass a flood discharge of about 3150 cumecs with a 100-year return period, emanating from a catchment area of 133,700 km^2.

6.4.2 Feeder Canal

The project will have a feeder canal to convey irrigation water to the cropping area. The feeder canal route traverses rugged terrain on irregular ground in the hills through the Majete Game Reserve, which makes it very sinuous. It will cross by means of inverted siphons under many rivers which drain the catchment on the right bank of Shire River. Other structures on the feeder canal will be culverts, light weight vehicle bridges, foot bridges and watering points for wildlife and livestock. The end of the feeder canal, at KP 33.242m, will mark the beginning of two main canals.

6.4.3 Main Canals

The main canals start near district road D134 at the off-take for Branch 2. The first main canal, 12 km long, will supply water to the Phase I irrigation area through four branches, crossing the Mwanza River by means of an inverted siphon to the west of Tomali Bridge, where it continues to serve Nchalo Sugarcane Estate owned by ILLOVO. The first branch canal takes off from the feeder canal at KP 28.446m. Each of the five branch canals will be regulated by an automatic gate with a constant upstream level control. The discharge in the main canal will decrease downstream as follows: 1st reach: 19.8 cumecs; 2nd reach: 16.8 cumecs; 3rd reach: 16.2 cumecs; 4th reach: 12 cumecs for Nchalo Sugarcane Estate. The main canal will be protected from surface run-off coming from piedmont areas by a spoil embankment on the right bank. Its main structures are regulators, drop structures and drain culverts. The main canal will have its sections traversing the Nthumba and Mwanza alluvia lined as a measure against seepage loss.

6.4.4 Branch Canals and Night Storage Ponds

There will be five storage ponds or reservoirs on each branch canal from which water will be conveyed to field canal systems. The reservoirs will be constructed by slight excavation below the ground level, bordered by earth embankments. Bank slopes are designed on 1:2.5 and 1:3 to ensure their stability and safety. Pond dimensions are given in Table 3.7 below.

Table 6.7: Dimensions of Night Storage Ponds

Branch	Length (m)	Av. width (m)	Depth (m)	Area(m^2)	Volume (m^3)
1	12.0	4.26	2.25	51.12	115.02
2	12.0	4.26	2.27	51.12	115.02
3	15.0	7.84	2.84	117.60	120.44
4	10.0	2.8	2.19	28.00	61.32
5	15.0	9.22	3.42	91.12	174.83

Each pond has been equipped with a spillway to discharge surplus flow into the main drain when the pond is full. An intake which diverts the required flow into the branch is also incorporated in the design. Branch canal dimensions are given in Table 3.8.

Table 6.8: Branch Canal Dimensions

Branch Canal	Dimensions		
	Bed Width (m)	**Water Depth (m)**	**Discharge (l/s)**
1	2.4	1.22	3,433
2	2.4	1.22	2,800
3	3.30	1.64	6,000
4	1.9	0.92	1,200
5	3.5	1.75	8,400

The second main canal, also termed the South Junction Canal will convey water to the potential irragable lands between Mwanza River and Tangadzi River near Bangula. Details of this canal will be given in the Phase II report.

6.4.5 Tertiary Canal Network and Structures

The design of this system, and that of the quaternary, is determined by the type of farm being served. The farm layout designs for sugar-cane, cotton, maize, and rice are different and have varying cultural practices.

6.4.6 Drainage System

The area to be drained covers the irrigation fields and land surrounding the project area. The drainage system includes the watershed of Nthumba and Mwanza rivers which are tributaries of Shire River.

The drainage system comprises collector drains, branch drains, and a main drain. Collector drains catch the drainage water from the irrigated fields, and lead the drained water to the branch drains or the main drain. Branch drains carry the drained water to the main drain or directly release to the natural streams or rivers.

Main drains lead the drained water collected by the branch drain to the natural stream and rivers. A branch drain commands an area of 500 ha while the collector drain commands 100 ha. When the drain area commanded by the branch canal is more than 500 ha, the secondary drain is provided under the main drain.

The flows from the west towards the plain are intercepted and collected by a drain running along and parallel to the right bank of the main canal. All external run-off flows will be concentrated into the natural streams and cross the main canal by means of culverts. They will join the scheme drainage system and be conveyed into Shire River. The southern run-off streams will be diverted directly into Mwanza River through the wasteway. The main drains within the irrigated area are planned between the proposed five branch canals. They will be positioned within the existing natural stream beds and widened to accommodate the increased discharge.

6.5 Phasing And Implementation Schedule Of Engineering Project Component

The implementation of the project works entails preparatory works, construction of the project works, and procurement of required equipment and machinery. The implementation schedule is shown in Figures 3.3 and 3.4. The preparatory works have been split into three components. The first component includes obtaining an official approval and an administration permit on project implementation as well as arranging financial resources. The second component includes the establishment of the agency to oversee the construction works and manage the project when it is completed. The third component includes the selection of the contractor for the project works. Establishing of a farmers' organizations for operation and maintenance of the irrigation and drainage facilities which will commence with training activities soo after the physical construction works have started and will continue up to full scheme operations.

This phasing can be adjusted to suit the availed resources and funds be administered for individual manageable contracts.

Figure 6.3: Proposed Implementation Schedule

TASKS	WEEKS														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tender Advertising															
Issue of Tender Documents															
Site Visits															
Tender Submission															
Tender Evaluation															
Tender Award															
Issue of Performance Bond															
Contract Negotiation and Signing															
Commencement of Works															

Figure 6.4: Proposed Construction Schedule

CONTRACT NO.	TASK	YEARS		
		1	2	3
1.	Intake Works			
2.	Feeder Canal			
3.	Main Canal Branch Canals Tertiary, Quaternary Canals and Drains Ponds and On-Farm Works			
4.	Infrastructure Development			
	Land Acquisition			

6.6 Phasing And Implementation Schedule f Farm Development Component

Field development will go hand in hand with completion of major irrigation works, land levelling and development of scheme infrastructure particularly roads. This will be done after the resettlement process is complete.

6.7 People Affected By Project

The local people to be affected by the project can be broadly categorized into the following three types namely: households who live and possess pieces of land and houses within the area where the feeder and main canals will pass through; households who do not live but possess pieces of land within the area where

levelling and other irrigation development will take place; and households who live in the area but do not possess any land in the project area. These are mainly workers and business people.

Based on the survey of the area and discussions with the local leaders and Government officials together with the study of topographical maps on a scale of 1:50,000, the approximate number of households of first category is estimated at 380 (Table 3.9). The second category is estimated at 7500. The third category could not be ascertained due to lack of data.

Table 6.9: Estimated Number of Households to be Displaced by Major Canal Works in LSVIP

Irrigation Structure	No. Villages	No. Households	Population	Resettlement Site
Main canal	5	78	546	Section C and D
Branch 1	1	50	350	Section A
Branch 2	4	75	525	Section D
Branch 3	None	None		
Branch 4	4	88	616	Section C
Branch 5	4	89	623	Section B and C
Total	**17**	**380**	**2660**	

Note: 1. Feeder canal and North junction pipe pass through uninhabited areas

The first category will require relocation while the second and the third categories will not be relocated. Most of the people live between Branch 3 and Branch 5.

Dwellings are scattered in the Kasinthula plain between Matekenya and Nyamphota. The other area of scattered dwellings is to the east of road D140 and along D138. Another group lives within the Mulima-Kanthema-Chikhambe triangle. With this latter group however, the majority may not be relocated because they are on a raised area along the main road D134.

There are two areas of concentrated dwellings. One group is concentrated along the M8 highway and around Kasinthula Research Station. The second area of concentration is on Roads D138 between Mwasiya and Sande and on road D140 between Tomali and Mikango. A few of the villages, however, may be relocated, particularly those that are in the farm lands.

Considering the current socio-economic situation of the displaced people, the principal objectives of the resettlement plan of the project are to set up resettlement sites in the vicinity of the irrigated area; To give displaced people options to select a resettlement site preferred by them; To pay compensation amount with proper counselling for promotion of smooth resettlement of the displaced people; and to consider the impact on their second generation.

6.8 Local Consultations Conducted In The Project Area

The Consultant consulted with local leaders, members of the local communities NGOs and other stakeholders. The consultations were conducted on nine sites which included Namalindi FP School in TA Katunga's area, Fombe Village, Chamuluka Village near Bereu Trading Centre, Mbande Village, Mbenderana Village, Nkhate Irrigation Scheme, District Assembly, CADECOM and at Kasinthula Aqua Farms. The main object of the local consultations was to get the views of the local people and various stakeholders about the project. The views included local acceptance of the project and anticipated problems and suggested solutions. The local consultations were organized in such a way that traditional leaders including chiefs, group village headmen and village headmen were consulted separately from other members of the community. The local communities were also separated by sex during focus group discussions. Each focus group discussion composed of 7 to 10 people. Table 4.1 gives more details about the sites and people consulted in the project area.

Table 6.10: Activity Schedule for Local Consultations

Date	Time	Location	Stakeholders Consulted	Type Of Meeting	Women	Men	Total
2-10-05	1400-1800	Namalindi F.P. School T/A Katunga	T/A Katunga Salumeje GVH SalumejeII VH Migano VH Lauji VH Community members	Focus group Discussions, Group interviews, Key Informant interviews	81	160	241
3-10-05	0800-1300	Kasinthula	Aqua-Farm	Key Infomant	0	2	2
3-10-05	1430-1730	Fombe Village	Fombe GVH Fombe II VH Chekiteni VH Kannthema VH Santana VH Community members	Focus group Discussions, Group interviews,	70	42	112
4-10-05	0800-1000	District Assembly	Govt. District. Commissioner Agriculture, Healthy, Police, Education, Labour,Works	Focus group Discussions	0	7	7
4-10-05	0900-1100	Matechanga	CADECOM	Focus group Discussions	1	3	4
4-10-05	1500-1700	Chambuluka Near Bereu	Chambuluka GVH Chambuluka II VH	Focus group Discussions, Group interviews,	99	94	193

		Trading Centre T/A Maseya	Bereu Community members				
5-10-05 5-10-05	0800-1330 1000-1100	Nkhate	Nkhate Irrigation Cooperative Society Committee members The Farm Manager	Focus group Discussions Key Informant interviews	1 0	4 1	5 1
6-10-05	0800-1200	Mbande Village	Group Village Headman Representative Mbande II Rep. Community members	Focus group Discussions	6	11	17
6-10-05	1400-1715	Mbenderana Village	Mbenderana GVH Mbenderana II VH Mlingama VH Community members	Focus group Discussions, Group interviews,	120	150	270

All the traditional leaders and members of the local communities consulted indicated that they welcome the project. They think it will improve their food security and economic status. They indicated that they would like to see the project implemented as soon as possible and they warned that they did not want to see delays as a result of politics.

6.8.1 Problems Identified Through Consultations with Local Communities

The consultations revealed a number of anticipated problems and the local communities came up with a number of suggested solutions.

1. The design of the project may require that some people shift from their houses, gardens or grazing lands etc in order to allow for irrigation canals and cultivation of prime agricultural lands. Their suggested solutions were compensation and full involvement of local leaders in discussions of this nature. This problem will inevitably require that people be resettled and they will need adequate support and time for the resettlement process.

2. Coming in of people from outside the area to participate in irrigation farming. The communities suggested that traditional leaders should be fully involved in order to protect locals from losing their land. The traditional leaders will need to control the coming in of other people from outside the project area.

3. Land issues such as fear that land may be taken away by government, some people may not be allocated land or land conflicts, as well as people selling land without consulting local leaders. They suggested that a local management committee be set up to assist in land issues.

4. Increased incidences of water borne diseases such as dysentery, malaria, bilharzias, cholera, etc as well as water related accidents. Training and sensitization of local communities about general hygiene will be required. Hospitals and dispensaries will need to be well stocked with drugs.

5. Usage of untreated water for drinking was another problem cited and the suggested solution was provision of good water supply systems.

6. Community organization will be a major requirement for the success of the project. It is suggested that communities be organized in water users associations according to the canals. These water users associations will play a major role in controlling water use rights managing disputes and conflicts and promoting enterprises in the irrigation areas.

7. Livestock will be a source of conflicts due to problems associated with grazing in that their grazing areas will be converted to crop land and they will likely be damaging crops. The suggested solution is to identify special grazing areas and establish paddocks. This activity will need to be properly negotiated between government, project management and local leaders.

8. NGOs and other civil society organizations were concerned that the poor segments of society will be left out of all this development effort and they suggested that government should play a major role of sensitization and training to encourage them to take an active role in the project.

7.0 BASELINE DATA

7.1 Physical Features And Climate

7.1.1 Location and Size of the Project

The project area is in the southern part of Malawi within the administrative districts of Chikwawa and Nsanje. It is located on the west (right) bank of the Shire River in the Lower Shire River Valley which is 150 km long and 15-30 km wide. Phase One of the project covers 17,320 ha in Chikwawa District. This includes 7,940 ha of new development, 9,200 ha under ILLOVO, and 180 ha under Kasinthula Scheme. (It should be noted that the 90 ha under rice cultivation at Kasinthula was transformed into a sugar cane growing scheme which has now expanded to 750 ha under the Kasinthula Cane Growers Trust). The project area is bounded in south by Mwanza River while in the north by Manjalende Stream close to Majete Game Reserve. The western border is marked by the hills and ridges extending from Chapananga Road to Mwanza River west of Tomali. The Shire River forms the eastern boundary. Phase Two of the project comprises the southern part of Lower Shire River Valley with a total area of 25,000 ha. This portion of the project runs up to Bangula. The project location map is shown on Maps 1 and 2.

7.1.2 Physical Features

The project area forms part of the alluvial plains consisting of complex succession of river deposits and terraces on the bed-rock of the rift valley. The terrain of the project area is gently undulating with an average slope of less than 1 percent. This may require levelling to generate plots compatible with gravity irrigation. Areas with a gradient higher than 1 percent are not extensive. Termite mounds are also common features in the area.

7.1.3 Climate, Rainfall and Evapotranspiration

(a) Temperatures

The Shire Valley is characterized by a generally low elevation where the relief profile ranges from 60 m to 150 above sea level. Temperatures in summer months range from 28°C to 35°C. The mean temperatures in winter months vary from 20°C to 35°C with an annual temperature range from 12°C to 15°C. The hottest period is

from October - November when temperatures can reach 40°C. Table 4.2.1 shows the monthly temperatures at Kasinthula within the project area.

Table 7.1: Monthly Temperatures at Kasinthula

Monthly Temperatures (°C)												
Month	June	Jul.	Aug	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Max	29.1	31.4	34.6	39.5	40.4	41.5	36.1	35.4	34.5	36.5	33.6	29.6
Min	14.2	14.6	17.1	20.4	23.8	23.1	22.0	21.3	21.3	20.8	19.0	16.1
Mean	22.2	22.7	25.3	28.6	30.2	29.8	27.0	26.6	26.6	27.2	25.6	23.4

(b) Rainfall

The Lower Shire River Valley experiences a rainy season from November to March with an annual rainfall ranging between 700 and 900mm. The average rainfall is 652mm. The dry season stretches for seven months from April to October, a period in which mean monthly rainfall is below 60mm. During the winter season, the area is under the influence of low equatorial pressures giving big clouds heavy with humidity and the north-east monsoon, which are the principal sources of rain. Rain normally stops in April with the arrival of the southeasterly wind. Analysis of monthly climate regimes indicates that the climate of the area is humid to semi-humid between December and March thereafter oscillating between semi-arid to hyper arid in the period April to November. For a country where agriculture is the mainstay of the national economy, scarcity of soil moisture limits crop production to only four months and thus poses a major constraint to attainment of the local and national agricultural potential. This consideration is by far, the single most important justification of the proposed irrigation initiative in the Shire Valley Area.

Table 7.2: Analysis of Monthly Climatic Regimes in the SVIP area (Based on data for the Kasinthula Research Station)

Month	Mean rainfall-P (mm)	Mean Eo (mm)	Aridity Index (P/Eo)	Climate regime
October	18.7	279	0.07	hyper-arid
November	57.8	237	0.24	arid
December	158	183	0.86	Humid
January	155.6	155	1.00	Humid
February	136	129	1.05	Humid
March	95	152	0.63	semi-humid
April	39.3	138	0.29	semi-arid
May	9	109	0.08	hyper-arid
June	10.1	114	0.09	hyper-arid
July	22.9	109	0.21	Arid
August	3.3	161	0.02	hyper-arid
September	1.6	204	0.01	hyper-arid

(c) Evaporation

The average annual potential evaporation based on Pan Evaporation data for Kasinthula station averages 1969mm. Annual evaporation thus far exceeds the annual rainfall regime of 796mm implying that the SVIP area generally suffers a moisture deficit. With an aridity index (ratio of rainfall to Eo) of 0.4, the climate of the SVIP can generally be classified as semi-arid. The inadequacy of soil moisture imposes severe constraints to ecological productivity in the SVIP area.

Table 7.3: Classification of Climate Based on Soil Moisture Availability Zones

Zone	r/Eo ratio	Climatic designation
I	>0.8	humid
II	0.65-0.8	sub-humid
III	0.50-0.65	semi-humid
IV	0.40-0.50	semi-humid to semi-arid
V	0.25-0.40	semi-arid
VI	0.15-0.25	arid
VII	<0.15	very arid

*Source: Sombroek et al., 1982

Figure 7.1: Location and site Plan

7.2 Soils

7.2.1 Soils

In the north of the valley, the soils are of complex, stratified alluvia with a high proportion of sand. In the wet season they are usually inundated. In the Makande plains, the soils are medium to fine textured alluvia which contain a high proportion of weathered minerals. They weather rapidly to form the vertisols which are dominant in the plain. Successive cycles of erosion and deposition have resulted in the present landscape of gently slopping ridges of lithomorphic vertisols and flood plains and outwash fans with stratified alluvia and topomorphic vertisols. The clay fraction is dominated by montmorillonites. In the Drift Plain are sandy solids, but in low lying areas, heavy, poorly drained soils are found.

The Makande clay soil, which covers most of the area, is a heavy cracking clay which swells and seals up with the first rains, resulting in low infiltration, high runoff and consequent low water retention. The streams or gullies within this area flow for several days after heavy rains, but then dry up completely. The soils within the Nsanje highlands between the hills and the Shire River are sandy and very permeable. During the rainy season when the streams flow onto the plain, the water quickly disappears within the first few kilometres. This area is more suited to groundwater abstraction, but has limited agricultural potential because of the high permeability of the soils.

In the Lower Shire River Valley soils are deep, medium to fine textured, brown to very dark grey in colour and have a drainage that varies from good to very poor. Soils in the uplands and hills are predominantly moderately deep, medium textured, well-drained and yellowish brown. Alkaline and slightly saline soils occur at the edge of the swamps, otherwise soils have a slightly acid to neutral reaction. The nutrient status of most cultivable soils is low with widespread deficiencies of phosphorus and nitrogen.

Most of the upland soils are classified as Cambisols or Luvisols according to the FAO classification under undisturbed woodlands and grasslands while the soils in the lowlands are more variable and are predominantly classified as Luvisols, Fluvisols, Vertisols and Gleysols. These soils are predominantly moderately deep,

medium textured and well-drained and yellowish brown. Alkaline and slightly saline soils occur at the edge of swamps and marshes otherwise soils have a slightly acid to neutral reaction.

7.2.2 Soil Formation Processes

The main soil forming factors are parent material, climate, topo-location, vegetation and human activities amongst others. Dominant soil parent material in the uplands is gneiss, which weathers into a coarse loamy and often gravely soil. The soils in the LSV are developed under varying intensities of one or more of the processes including erosion/cumulization, calcification, pedoturbation, littering/humification/melanization, mineralization, gleization and, salinization/alkalinization. This last process is particularly common in hot and dry climates and in soils with a high groundwater. Such soils occur along the edge of Elephant and Dindi Marshes. Alluvium is found in the extensive lowlands (Lower Shire River Valley), associated with very deep soils of variable texture. Part of the Lower Shire River Valley (Makande Plain) has alluvia derived from basalt and calcareous medium-grained sedimentary rocks.

7.2.3 Soil Fertility

Soil fertility refers to the ability to produce high yield in a consistent fashion, provided factors of production such as light, moisture temperature, nutrients and crop management are efficient. A fertile soil must avoid nutrient losses through leaching or volatilization, avoid waterlogging. Frequent flooding, poor drainage, and the types and quantities of fertilizers used will influence fertility. Therefore the project should put great emphasis in maintaining or improving the soil fertility status for sustainable production.

The nutrient status of most cultivable soils is low with widespread deficiencies of phosphorus and nitrogen. Nutrient levels in the topsoil have decreased through the removal of the natural vegetation, continuous cultivation and man-induced soil erosion. The soil fertility status of the project area can be expected to change depending on intensity of cropping. However, the area is generally a recipient of low rainfall which cannot cause much leaching, and normally receives rich silt from upland areas. Even then, intensive cropping under irrigation will demand use

of fertilizers. Fertilizers are used at Kasinthula Research Station and Nchalo Sugar Estate. The important feature of the soil is the type and texture which influence water infiltration rates, hence the type of irrigation method, design, canal discharge rates, and sizes of basins, strips, etc.

7.2.4 Soil Salinity

Saline soils are soils that have accumulated high concentrations of soluble salts in the surface horizon, enough to seriously interfere with the growth of most plats. The electrical conductivity of a saturated extract is (ECe) is 4 mmhos/cm. Less than 15 % of the cation exchange capacity of such soils is occupied by sodium ions and the ph usually is below 8.5.

The soils in the area have a potential for building up a salinity problem. Salt mining takes place at Nchalo and Bereu, within the project area. Soil salt levels are high, and the high temperatures of the area may favour capillary pull of the salts to the soil surface, rather than drainage of salts. However, soils a suitable for agricultural purposes. In order to safeguard against soil salinity build up, research recommends applying 50 to 100% more water than is needed for plant growth at several points during the irrigation season. It is important, however, to apply the water gradually so that it has time to seep into the soil without evaporating on the surface.

7.2.5 The Flood Plain and Swamps of the Shire River

In the north of the valley, these soils are one to two kilometres wide around the Shire River, and in the south they spread out of the Mwanza confluence to form the Elephant Marsh. The Marsh gets constricted at Chiromo by the alluvial fans of the Ruo and Thangadzi rivers, but spread out again to the south to form the Dindi Marsh. The floodplain is composed of complex, stratified alluvium with a high proportion of sandy soils. Some salinity and alkalinity occur at the edge of the marshes as mentioned earlier. These soils form the major part of the *dimba* cultivation during the dry season. In the wet season they are usually inundated.

7.2.6 The Flood Plains Alluvial Terraces and Drift Deposit Flanking the Shire Floodplain

The Makande plains lie on the broad, gently sloping western side between Namikalango and Lalanje rivers. The soils are medium to fine textured alluvia along the stream lines which contain a high proportion of weathered minerals. They weather rapidly to form the vertisols which are dominant in the plain. Successive cycles of erosion and deposition have resulted in the present landscape of gently sloping ridges of lithomorphic vertisols and flood plains and outwash fans with stratified alluvia and topomorphic vertisols. The clay fraction dominated by montmorillonite is very fertile and hence the Makande plains are intensively cultivated. This inherent fertility which allows some areas to be cultivated continuously for long periods without any apparent decline in yields, is responsible for the low fertilizer use in the study area.

7.2.7 The Drift Plain

The Drift Plain forms narrow strips along the eastern flank of the Valley and consists of small outwash fans with complex, often sandy soils, and low lying areas with heavy, poorly drained soils between the fans, and the flanking Shire floodplains and swamps

7.2.8 The Upland Soils of the Valley and the Middle Shire

These are from the rocky escarpments with shallow soils to the east, and to the west, south of Bangula. Some basalt and sand stone hills to the west are rocky with little or no soil cover due to continuous denudation.

7.3 Drainage And Water Resources

7.3.1 The Thyolo Escarpment

Thyolo Escarpment in the eastern area of the Shire Valley is the source of fast-flowing tributaries to the Shire River. All the principal east bank tributaries rising in the Thyolo Escarpment from the Likhubula (north) to the Thangazi (south) are perennial. These rivers are subject to high flash flood flows and low dry season flows. The dry season flow probabilities increase from north to south, with the Likhubula and Mwamphanzi having very low dry season flows per unit catchment area during this period. On the west bank, the Thangadzi, Labanje, Nyakamba and Namikalango often make drifts impassable for short periods.

7.3.2 Majete Game Reserve

The Majete Area is drained by Mkurumadzi River and the Mwambezi and Masakala streams which flow into the Shire River and by the Phwadzi, Chipudzi and Manjombe streams which flow into the Mwanza River. Most of the Shire River tributaries within the project area are seasonal, some flow continuously through the rainy season until May, June or July, while others are intermittent even during the rainy season. All tributaries experience flash floods lasting from several hours to several days. Flooding in general is endemic in the Shire Valley, and is likely to become worse as catchment areas continue being deprived of soil and vegetation.

7.3.3 The Shire River

The Shire River is the major surface water in the Shire Valley and will be the source for irrigation water. The lake levels and river flows are partially controlled by the Liwonde Barrage. During the dry season, there is virtually no contribution to river flows below the Barrage from the catchment area between Liwonde and Chikwawa. Hence the rive-flows at Chikwawa and Liwonde are very similar throughout this period. Flow records at Maganga over the past twenty years show that the annual average flow has varied from a minimum of 196 cumecs to a maximum of 500 cumecs with an average of 308 cumecs.

The Shire River traverses a distance of 70 km from Matope to Maganga and drops over 350m in elevation passing through a series of falls and rapids including Kholombidzo, Nkula, Tedzani, Hamilton and Kapichira. Within this distance, it is joined by the Lisungwe River and the Mkurumadzi River, both of which originate in the Kirk mountain range and follow a north-south fault, and the Lirangure River. The proposed irrigation intake and hydro-electric power (HEP) plants at Hamilton Rapids and Kapichira Falls are situated south of the confluence of Mkurumadzi and Shire rivers. Below the rapids, the Shire River widens and is joined by two other tributaries the Mvusa and Mwambezi, near Maganga village. From Maganga, Shire River flows for 140km through a broad, fairly flat valley with a gradient of 0.5m/sq.km up to the Mozambique border at Bangula/Chiromo where it is joined by Ruo River.

7.3.4 The Mwanza River

The Mwanza River is a major tributary to the Shire River. It has an average annual flow of 2 cumecs, although monthly average flows can be less than 0.03 cumec in October. At Tomali, the river is often dry for three to four months in the year. The Mwanza River disappears into the highly permeable sands of the Mwanza Valley. Any irrigation development within the Mwanza Valley would require an offtake above Chapananga, or pumping from wells in the Mwanza sands.

Other important rivers are M'thumba, Nkombedzi wa Fodya, Mafuna, Pwadza and Dandi which are also dry for most of the year.

7.3.5 Makande Plain

The low lying Makande Plain, to the south of Mwanza River, is bounded to the west by the low Matundwe Hill range and the Makala Hills to the south, and adds little to the water sources of the Project Area. There are a few small streams flowing from the Matundwe Hills but these run dry for three to four months of the year. The Makande clay soil, which covers most of the area, is a heavy cracking clay which swells and seals up with the first rains, resulting in an area of low infiltration, high run-off and consequent low water retention. The streams or gullies within this area may flow for several days after heavy rains but then dry up completely.

7.3.6 Shire River Marshes

The Lower Shire Valley has two major marshes, the Elephant Marsh, covering approximately 43,300 hectares and the Dindi Marsh covering about 16,190 hectares. Both marshes depend on Shire River water for their productivity and any changes in the Shire River regime affect the marshes. The marshes are also affected by the flow of the Ruo river. However, the greatest cause of flooding of the Ndindi Marsh is the spill-over of flood water of the Zambezi into the Lower Shire. About 50 percent of the Ndindi flooding is due to the Zambezi.

7.3.7 The Ruo River

The Ruo River, the southernmost tributary on the east bank, rises in the foothills of Mulanje and Chiradzulo. The Ruo River has a 20 year average annual mean flow of 56 cumecs, but the average monthly flows vary from 151 cumecs in February to a low of 10 cumecs in October. When flood flows of the Ruo coincide with high flows in the Shire, the Shire River backs up at Chiromo, with the consequent flooding of Chiromo Township and its surroundings.

7.3.7.1 Nsanje Highlands

This area includes the Mulaka and Natundu Hills. The Thangadzi stream in the north of the area has a catchment area of 360 km² giving rise to high spate floods in wet season but becoming dry by mid April, at the end of the rains. There are also few springs within the Mulaka Hills which flow for approximately nine months of the year. The probability of the dry season flows improves moving southwards to the Matundu Hills around Chididi which have a higher rainfall. The Nyamadzere stream has the highest dry season flow with the Nyachipere and Nyachirenda also being perennial in the foot hills, but dry by the time the streams reach the plain. The soils of the plain between the hills and the Shire River are sandy and very permeable and even during the rains when the streams flow out onto the plain, the water quickly disappears within the first few kilometres. This area is more suited to groundwater abstraction, but has limited agricultural potential because of the high permeability of the soils.

7.3.8 Groundwater Sources

The Lower Shire Valley has alluvial aquifers with higher yields of up to 15 litres per second. Over 800 boreholes have been either drilled or hand dug in the Shire Valley. Usually, these have been located in villages or towns where the demand for water is at its maximum. All domestic water supply boreholes have been fitted with mechanically operated hand pumps which are capable of pumping at a rate of 1,000 – 1,500 litres per hour. It is estimated that about four million (4,000,000) litres are pumped out of the ground every day.

7.3.10 Water Supply

Despite a rich water resource mainly in the form of rivers with Shire River at the forefront, and a potentially extensive borehole and wells network resulting from a high water table within the LSV, accessibility to clean water is still a problem. Current estimates are that 172,000 people have no access to clean water.

Groundwater resources have been exploited to provide the majority of the water needs of the population. The water taste is not good as it is salty. The majority of the boreholes which have been developed since pre-independence are not in use and many of them are saline. Those being rehabilitated are breaking down at a rapid rate as there are shortages of spare parts as well as artisans to repair them. All domestic supply boreholes have been fitted with mechanically operated hand pumps which are capable of pumping at a rate of 800 – 1,200 l/hr. Where springs or perennial streams exist, people have tended to exploit these water resources in preference to the groundwater. The Shire River and irrigation canals are being used as sources for domestic water and other domestic uses. However, these water sources are not treated and have potential for contamination as well as danger of animal attack compared to the groundwater sources.

Figure 7.1: Borehole abandoned and in disrepair

Groundwater resources have also been exploited to supply water to townships of Chikwawa, Nchalo, Ngabu, and Bangula. The Southern Region Water Board is

responsible for the water supply network. Villages in the vicinity of the townships benefit from this water source through stand pipes and water points.

Figure 7.2: Community water supply near Chikwawa

The project has incorporated a water supply and sanitation component to provide treated sweet water to all the communities within the project area. Water will be drawn from the feeder canal at a convenient point and passed through a treatment process before conveying it to the communities. This facility will also reduce the number of people using the Shire River and irrigation canals as sources of domestic water. The Southern Region Water Board will also access this water to supply the townships.

7.4 Fisheries

7.4.1 The Shire River Fisheries System

The Shire River is the only outlet for Lake Malawi and it is very important for the obligatory river breeding fish from the lake in its upper reaches and of the marshes in its lower reaches. The Shire River is usually divided into four sections: the Upper Shire (between the outlet from Lake Malawi to Lake Malombe), the Middle Shire (from Lake Malombe to the Liwonde Barrage), the Rapids (from Matope to Kapichira Falls) and the Lower Shire from the Kapichira Falls to the confluence with the Zambezi River.

7.4.2 The Lower Shire River Fishery

The fishery in the Lower Shire River falls into three categories: the floodplain and swamp fishery, the lagoon fishery and the riverine fishery. The floodplain and swamps consist of the extensive Elephant Marsh in the north and Dindi Marsh in the south and cover an area of approximately 650 square km. The lagoon fishery includes the 650m^2 Bangula lagoon and lagoons north-east of the Elephant Marsh while the Shire and Ruo rivers are important to riverine fishery.

The catches from LSV fishery system contribute between 10% and 15% of the total national landings. The fluctuation in catches is attributed to high water levels and the spread of water hyacinth which increases siltation (Blackmore, et al. 1988; Terry, 1991). Because of its ease of access, the Elephant Marsh is more fully adapted to the regime of fluctuating water levels, highest catches being obtained when water levels are rising at the beginning of the rains, and falling in the dry season.

7.4.3 Elephant Marsh Fishery

Fishing is a main economic activity of households living in areas surrounding the Elephant Marsh and few alternatives exist for the majority of the population. Past research has indicated that expansion of the marsh fishery, except perhaps in the north-eastern area, is limited. The south-eastern area is fully exploited. At present, there is very high fishing intensity in those areas free of water hyacinth. The greatest scope forr expansion of fishing is in the river itself. The river has greater species diversity than the marshes. Out of the 61 species of fish found in the Lower Shire River only 3 species namely *Clarias gariepinus, Clarias ngamensis and Oreochromis mossambicus* are of economic importance. The River is lightly fished over long stretches because of difficulties with current and snags.

7.4.4 Fish Migration

There is no movement of fish from lower streams to upper streams and between rapids and waterfalls because of the vertical height that cannot be overcome by the fish. Kapichira Falls (with a total drop of 100m over a horizontal distance of around 50m), coupled with the extreme force of water forms a natural barrier for all fish species in the lower reaches of Shire River. Above Kapichira Falls, the

middle reaches of Shire River, the possibility of migration is when individuals (or eggs and larvae) from upstream are washed downstream by the force of water in the rainy season. For instance, a unique breed has been identified within Majete Wildlife Reserve that is a highbreed between the lower and middle reaches. In normal circumstances, fish species between these natural barriers are unique to their particular environment.

7.4.5 Fishing Methods

Fishing methods are essentially the same at all locations and include hook and line, multiple hooks baited with nematodes, fish traps with or without fences, and poison derived from plant materials, which is generally a small-scale activity in small streams. Fishing is carried out mainly in the dry season when currents are slow and fish are confined to a small and decreasing volume of water and are thus easier to capture. Men mainly carry out fishing activities, although women also fish in groups in shallow waters, using scoop nets. There are a small number of canoes, and there appears to be none equipped with outboard motors. Main species landed are Mlamba (Clarias spp), Chambo (Oreochromis spp) and Chikano (Tilapia mossambicus). It has been observed that the Nsanje section of the Shire River gives higher yields than the Chikwawa section through out the year. Most of the fish caught is consumed locally. Taking Shire Valley Agricultural Development Division as a whole, demand for fish is higher than supply. As a result, dried fish is imported from mainly Mozambique to satisfy demand.

7.4.6 Development of Fisheries Enterprises

Few smallholder farmers have ventured into fisheries however with limited extension services. In order to encourage adoption, a pilot project in aquaculture is being proposed in the project area. The project plans to set-up 25 commercial ponds. Two of these ponds will have an area of 5 ha, one will be a 3 ha unit, ten of them will be one hectare unit each, three will be of 0.3 ha each and nine of them with 0.1 ha each. This will take up a total of 24.8 ha of land. These commercial ponds will be run by entrepreneurs with skills in aquaculture. Local fishermen are expected to establish their own fish ponds. Currently there are no farmers practising fish farming. Figure 7.3 shows a typical fish pond.

The project also seeks to improve fisheries by promoting an integrated approach where agricultural development can be integrated with fisheries. The possible ways of integrating fish farming in the existing farming practices are with livestock and irrigated rice.

Figure 7.3: Fish Pond at Kasinthula

7.5 Vegetation

The vegetation within the study area including the immediate catchment areas, Majete Game Reserve and Lengwe National Park is composed of grasslands; natural forests and woodlands; marshes; and sparsely vegetated rock outcrops. Land cover is dominated by vegetation, comprising forest savannah mosaic with a mixture of zones produced by variations in rainfall, altitude, hydrology, topography and land use.

7.5.1 Forests

An estimated 67% of the project area is under natural or derived vegetation cover (Eishweiler. 1993). The association of tree species is a clear reflection of low rainfall, high temperature, soil parent material and type of drainage prevailing. Cultivation has cleared most of the natural vegetation. What remains consists mainly of fertile lowland savanna with remnants of forests or thickets. Common species are *Cordyla africana, Sclerocarya birrea, Sterculia appendiculata, Albizzia harveyi, Boscia salicifolia, Dalbergia melanoxylon, Tamarindus indica, Lonchocarpus capassa, Adansonia digitata, Acacia nigrescens, Acacia tortilis, Combretum imberbe and Ficus*.spp. Also common around villages is *Zizyphus*

mauritiana which is preserved for its fruit wherever riverine woodland is still present. Common associations are *Dodonea viscosa, Pterocarpus inervis, Strychnos potatorum and Kirkia acuminata*. To be seen in some poorly drained areas are pure stands of either *Acacia nilotica or Acacia xanthophloea.*

7.5.2 Flora of Lengwe National Park

Lengwe National Park, established in 1979 is approximately 887 km^2 and the elevation ranges between 30 and 100m amsl. The plant communities are mainly forests and thickets dominated by *Acacia welwitschii* and *Pterocarpus lucens*. The savannah communities are dominated by *Acacia* thicket and clump savannah with tall tree interfaces of *Acacia nigrescens*, *Albizia harveyi*, and *Dalbergia melanoxylon.* 90% of the Park is in the western uplands where vegetation consists of *Colophospermum mopane*, *Brachystegia/Combretum/Diospyrus/Isoberlinia* woodland. Woodland patches of *Pterocarpus angolensis/Afzelia quanzensis* also reside in the area.

Figure 7.4: Thicket vegetation within Majete Game Reserve

7.5.3 Flora of Majete Game Reserve

Majete Wildlife Game Reserve, established in 1976, is approximately 784 km^2, and the elevation ranges between 100 and 900m amsl. The Reserve has four major vegetation communities. These are represented by open canopy woodlands of the plateaus (*Brachystegia/Julbernadia/Isoberlinia*), open canopy woodland of hills and

scarps (*Brachystegia* sp.), thicket/savanna of poorer areas (*Combretum/Acacia*), and woodland/savanna (mixed species). Figure 7.4 shows typical thicket vegetation.

7.5.4 Flora of the Marshes

Marshes also harbour different types of flora. Studies carried out at James Beach and Ndondo Areas within the Elephant Marsh indicate that both areas had four distinct vegetation zones similar in physiognomy but slightly different in species composition, though dominant plant species were similar (Howard-Williams, 1972). The zones are: aquatic zone, the swamp, the marsh and the hygrophilous grassland.

(a) Aquatic Zone of the Marshes

Aquatic zone of the Marshes consists of floating "sudd" islands (*Echinochloa pyramidalis*), *Pycreus mundtii*, *Ludwigia stoloniferus* and *Ipomoea aquatica* and *Ottelia exserta* are the only submerged microphyte *Ceratophyllum demersum* and *Nymphaea* sp are only found in Ndombo. The true floating species include the fern (*Azolla nilotica*, *Salvinia hastata)*, the "Shire cabbage" *(Pistia stratiotes)* and the duckweed *(Spirodela polyrhiza)*. These are commonly found in lagoons or caught on "Sudd" island. The rooted plants include waterweed *(Ceratophyllum demersum),* water lily (*Nymphaea caerulea),* and N.sp; water chestnut (*Trapa natans*)

(b) The Swamp Vegetation of Elephant Marsh

The common swamp plants at James Beach include *Typha domingensis, Phragmites mauritianus* and papyrus among others. In the Ndombo swamp vegetation has different species in areas with different water depths. Generally species are *Pycreus mundtii*, *Echinochloa pyramidalis*, *Ipomoea aquatica*, *Ludwigia leptocarpa*. In deeper waters there is *Typha domingensis, Vossia cuspidata, Leersia hexandra* and *Pycreus mundtii*. In shallow water shrubs dominate and towards land *Phragmites mauritianus* replaces *Typha domingensis.*

(c) The Marsh Vegetation

This is the vegetation beyond the swamp where water depth is between 20cm and 1m (Figure 7.5). In both James Beach and Ndombo there is a rich variety of species. The dominant species is *Cyperus digitatus*. Other conspicuous species

are *Echinochloa haploclada*, *Leersia hexandra, Vossia cuspidata* (hippograss) and the floating stemmed *Ipomoea aquatica* and *Ludwigia stolonifera*. Plants found everywhere in this zone include *Azolla nilotica, Salvinia hastata, Pistia stratiotes* and *Ceratophyllum dermesum*. An interesting plant found in the zone is the insectivorous Bladderwort (*Utricularia inflexa var. inflexa)* which has small bladders on the leaves and bluish white flowers. It is found floating just below the water surface.

Figure 7.5: Marsh vegetation on the banks of the Shire River

(d) The Hygrophilous Grasslands

This is the vegetation towards dry land and has sub-zoning which depend on the water depth in the rainy season (seasonally flooded). The vegetation is dominated by grasses whose composition is related to the degree of disturbance by grazing animals. In shallow waters, the vegetation is dominated by *Sporobolus robustus.* In water areas the dominant species is *Echinochloa borumensis* and *E. haplacada. Sporobolous consimilis* is also present. Swards of *Cynodon dactylon, Eragrostis aspera* and *Eleusine indica* found towards drier land are indicative of typically disturbed areas perhaps from heavy grazing. In patches which are protected from grazing, there are clumps of palms *(Hyphaene ventricosa*) and the main grasses are *Hermarthria altissima, Setaria phragmitoides* and *Vetiveria nigratans.*

7.5.5 Effect of Human Activity on Vegetation

There have been changes in land use in the project area since 1997 as can be seen in Figures 7.6 and 7.7. Most of the area has been cleared by slash and burn for agriculture and the vegetation is now in various stages of re-growth. There has been a gradual increase in the area of forest regrowth/farmland and a corresponding decrease in mixed tree savannah, largely from an increase in land cleared and then left fallow, rather than an increase in cultivation. Surprisingly little of the land (3 %, 22 km^2) is under active cultivation in the mid reaches south of the Majete Wildlife Reserve and the fallow areas are left uncultivated for up to 5 years. Where mixed tree savannah has been severely degraded, grasses have replaced trees and there are isolated small patches of secondary forest alongside the river and on the slopes and crests of the surrounding hills.

Figure 7.6: Middle slope upland farming close to Majete Wildlife Reserve with evidence of slash and burn

What remains consists mainly of fertile lowland savanna with remnants of forests or thickets. Common species are *Cordyla africana, Sclerocarya birrea, Sterculia appendiculata, Albizzia harveyi, Boscia salicifolia, Dalbergia melanoxylon, Tamarindus indica, Lonchocarpus capassa, Adansonia digitata, Acacia nigrescens, Acacia tortilis, Combretum imberbe* and *Ficus. spp*., and associations of *Dodonea viscosa, Pterocarpus inervis, Strychnos potatorum* and *Kirkia acuminata*. Also common around villages is *Zizyphus mauritiana* which is preserved for its fruit wherever riverine woodland is still present. In some poorly drained areas can be found pure stands of either *Acacia nilotica* or *Acacia xanthophloea*.

Figure 7.7: Middle slope upland farming close to Majete Wildlife Reserve with evidence of slash and burn.

There has also been an increase in the transformation of swamp thicket into swamp grassland, as swamps have been cleared, cultivated and then returned to fallow. This is particularly common in the floodplains of the Shire River. This transformation follows the annual behaviour of the river as it changes course by cutting through meanders within its flood plain. Cultivation has been associated with heavy crop losses during unexpected flood events. Figure 7.8 shows cultivation of swamp thickets in the Shire River floodplain.

Figure 7.8: Changes in thicket cover within the Shire River floodplain due to cultivation

7.6 Wildlife

Wildlife in the project area is concentrated in Majete Game Reserve and Lengwe National Park. The Shire River and its marshes also harbour some wildlife.

7.6.1 Fauna of Lengwe National Park

Lengwe has a few ungulates including buffaloes (*Syncerus caffer*), kudus (*Tragelaphus strepsiceros*), warthogs (*Phachoecorus aethiopicus*), and impalas (*Aepyceros melampus*). Reptiles, small mammals, and birds are also common. The Nyala and buffaloes are the most common species in the Park. Population estimates are given in Tables 7.4 and 7.5.

Table 7.4: Animal Population Estimates and Trends, Lengwe National Park

Animal Type	1988	1989	1990	1991	1993	1994
Nyala	2938	3488	3404	4102	2746	1751
Warthog	822	1188	927	892	727	1332
Impala	694	1275	1194	1699	3699	1045
Buffalo	879	217	1293	1680	1125	1927
Kudu	138	217	381	280	307	-
Bushbuck	138	118	261	378	-	105

Source: Lengwe National Park Reports

The estimated carrying capacity is 6,000 kg/sq km, and the figures suggest that the current biomass is in the region of 15,229 kg/sq km, i.e. about 154% above the recommended limit. This is an extremely valuable example displaying what DNPW has achieved in conserving the wildlife resources of the park notwithstanding insufficient resources and intense human pressure on the Park.

Table 7.5: Estimated Animal Biomass in 1994, Lengwe National Park

Species	(a) Population	(b) Mean Live Weight (Kg)	Total Live Weight (Kg)
Nyala	1750	65	113,750
Warthog	1330	80	106,400
Impala	1045	60	62,700
Buffalo	1920	640	1,228,800
Kudu	300	240	64,200
Bushbuck	100	30	3,000
Others*			5,000
Total	11,183		2,174,870

Source: (a) Lengwe National Park
(b) Meissner (1982) except in case of Nyala and Mkanda and Munthali (1991)
* Include Livingstone Suni, monkeys, bushpigs, baboons, etc.

Little information is available on the large mammal populations in the western uplands since the area is infrequently visited and there is only one permanent scout camp covering 783 sq. km. Scouts from `Old Lengwe' patrol the area, but coverage is poor.

Water availability and security influence the distribution of the large herbivores in Lengwe. Most of the park fauna occupies the eastern salient where there are artificial water holes and law enforcement patrols are intense. In the eastern salient, the Nyala, Bushbuck and Livingstone Suni move between forest and thicket during the rains, and the thicket clump savanna during the dry season. The other herbivores occupy the savanna and savanna woodland. Most importantly are the thickets around the Main Waterhole. Therefore, about 90% of the animals are found in thickets surrounding this waterhole.

7.6.2 Fauna Of Majete Game Reserve

In Majete, the large herbivore biomass comprised elephants (*Loxodonta africana*), buffaloes (*Syncerus caffer*), zebras (*Equus burchelli*) sable (*Hippotragus niger*), waterbucks (*Kobus ellipsiprymnus*), and other mammals. Human interface with the wildlife had devastating effects such that some of the animals were completely exterminated by 1995 (Table 7.5 below).

Table 7.5: Animal Encounter Rates in Majete, January to March 1989 and 1995

Species	**1989**	**1995**	**% Decrease**
Waterbuck	8.90	0.60	-93.26
Elephants	3.90	0.00	-100.00
Warthog	4.90	0.40	-91.84
Kudu	4.50	0.70	-84.44
Sable	8.90	0.90	-89.89
C Duiker	2.60	0.40	-84.62
Buffalo	1.00	0.00	-100.00
Bushbuck	1.40	0.60	-57.14
Reedbuck	0.40	0.20	-50.00
Warthog	5.30	0.40	-92.45
Klipspringer	2.00	0.50	-75.00
Grybok	0.80	0.30	-62.50
Bushpig	1.10	0.50	-54.55

Source: Lengwe National Park Reports

In an effort to improve the management of the Game Reserve and open it up to tourism, the GoM through the Department of National Parks and Wildlife entered into a management contractural agreement with African Parks Conservation of the Republic of South Africa. Notable achievements since this agreement are the restocking of buffaloes, electric wire fencing of part of the Reserve, infrastructure development, improvement in security and scouts surveillance, and planned restocking of elephants. Tracks have also been opened within the Reserve for the use of tourist to view the animals in their natural habitat.

The large herbivore carrying capacity for Majete Wildlife Reserve has been estimated at 4,500 kg/km^2. The extent to which the carrying capacity could be achieved was dependent on elephants. Without elephants, the attainable biomass would be much less than 2,000 kg/km^2. Since elephants are to be re-introduced in the year 2006, buffaloes have been restocked and the population of other animals has improved due to good management by African Parks Conservation, the implication is that the present carrying capacity is adequate and the present Majete carrying capacity has been estimated at 2774 kg/km^2.

Water availability and security also influence species distribution in Majete. The animals are concentrated along rivers such as Mwambezi, Mkurumadzi and Chipudzu. The highest concentration was along the River Shire, particularly between the Mathithi and Mkurumadzi camps. There is evidence that animals have shifted in the recent past in the game reserve. The main shift is the recent occupation, by wildlife, of the southwestern part of the reserve around the Phwadzi River. Security seems to have influenced this shift. The scout camps at Phwadzi, Mkurumadzi, and Mathithi deter poaching.

7.6.3 Fauna of Rivers and Marshes

The major ones are crocodile and hippopotamus.

(a) Crocodiles

Crocodiles occur throughout the Shire River system but more plentiful in the marshes. One of the few attempts to take census of the species was carried out in the Elephant Marsh in 1989, when an estimate of 168 breeding female was made (Bruessow 1989). No other recent attempt has been made.

Bruessow (1989) carried out a brief survey of the Elephant Marsh in order to delineate suitable nesting sites based on the following criteria: dryland with a minimum clearance of 0.8 m above water level; close proximity to water and seclusion from human agricultural activity. Ideal areas are considered to be sections of major channels and delta regions. The primary nesting sites were found to be Namichimba North and Nsua Island West and perhaps, to a slightly lesser extent,

Nsua Island North and Nsua Island South. Therefore, the major concentration grounds appear to be north of the marsh. Crocodiles lay eggs in October when water levels are falling. Hatching occurs in January when water levels begin to rise. This reproductive behaviour of the crocodiles provides salient information to enable farmers avoid major attacks and what type of preventive measures to institute in order to keep these young crocodiles from finding their way into canals where they can grow and cause menace.

(b) Hippopotamuses *(Hippopotamus amphibious)*

Hippos are ubiquitous in the system. The Elephant Marsh supports between 1,369 and 2,601 hippos (average herd size of 4.50 out of a total population for Malawi of between 3,459 and 6,569 (Anon b. 1989). The Shire River, between Kapichira and the Mkurumadzi River, was residence to a population of approximately 50 hippos (Bell 1984). The current population has not been determined.

(c) Birds

Over 300 species of birds have been recorded in the Lengwe National Park (Sherry and Ridgeway 1984) alone. Within the Majete Game Reserve, the threatened Rock Praticonle *(Glareola nuchalis)* makes use of the boulders associated with the Shire River riverine strip (Clarke 1983a) as an incubating substrate (no nest being built) and gathers in breeding colonies in the August to November period. This strategy enables them to make full use of the flush of insects at the onset of the rains. The Shire from Mpatamanga to Kapichira is the only breeding area known in Malawi.

(a) Burrowing Animals

Banks are heavily vegetated by trees, savannah grass and other plants, which overhang the river and trap sediment which allows colonisation by burrowing animals. These include burrowing worms (Oligochaetes and Nematodes), molluscs (snails and bivalves), crustaceans (freshwater crabs), amphibians (frogs and toads), and insects.

(b) Insects

Insects dominate the fauna in terms of numbers of species and many are found in the shallow margins. These include those that are entirely aquatic, such as water

beetles and water-spiders, and others that spend only part of their lives in the river, normally as larvae. The latter include a wide variety of insects, of which the most common are the Odonata (dragonflies), Diptera (midges, mosquitoes and flies), Hemiptera (bugs) and Coleoptera (beetles). The semi-aquatic fauna include vectors of several major human diseases, most notably mosquitoes (Anopheles) which carry malaria and dengue fever, and the black-fly *Simulium damnosum* that lays eggs on rocks and vegetation in fast flowing water upstream, and carries the nematode *Onchocerca volvulus* which causes river blindness.

7.7 Human Population And Settlement

The 1998 demographic data from the National Statistics Office - Zomba (NSO) indicates that the Shire Valley Agricultural Development Division comprising Chikwawa and Nsanje districts has a total population of 537,145. The population in Chikwawa District was estimated at 356,682 with about 54.47% being children under the age of 20, 41.35% being between 20 and 64 years and 21.01% being those aged 65 years and above. The intercensal growth rate for Chikwawa District was 1.1% per annum; however, there was a variation in growth rates at T.A. level. Table 7.6 shows the 1998 population while Table 7.7 shows the population trends within the Phase I project area.

Homesteads are distributed along the main road and close to public utilities. The estimated number of farm families in Chikwawa District is 46,900 with an average family size of about 7 persons. The average available labour force per farm household is only 3. The family size and available labour force per farm household in Nsanje District is similar to that in Chikwawa District. Following this assessment, the estimated number of farm households in the Phase I project area is 18,213 providing a labour force of 54,639. There are about 325 villages in Chikwawa District of which 27 are in Phase I of the project area. In Nsanje District there are 305 villages and about 35 of these villages will be in the Phase II project area.

The current and projected population within Chikwawa District is shown in Table 7.6. Approximately 356,682 people live within the Chikwawa District, representing 68,000 households. The population is almost evenly split by gender, males

representing slightly less than 50 percent. The mean household size for the area encompassing all of Chikwawa District and Nsanje District is 4.57 (a minimum of 4.0 in Kasisi and Lundu TAs and a maximum of 5.2 per household in Ngabu). Approximately 23 percent of the households in the Shire Valley ADD have been classified as female-headed (compared to 28.4 percent at the national level) NSSA 1981.

Table 7.6: Population Figures for Chikwawa District Study Area, 1998

Region	Total Pop	Male Pop	Female pop	Number of HHs	People per HH	Area (km^2)
T.A. Ngabu	117,905	58,606	59,299	18812	5.2	1033
S.T.A. Lundu	42,045	22,807	19,238	8440	4	181
T.A. Chapananga	62,605	30,203	32,402	14899	4.6	873
T.A. Maseya	18,666	9,215	9,451	4119	4.2	145
T.A. Katunga	14,613	7,126	7,487	3528	4.1	158
T.A. Kasisi	24,306	11,910	12,396	5093	4	297
T.A. Makhwira	55,390	27,113	28,277	11748	4.4	386
Lengwe N.P	304	165	139	11	6.7	907
Majete Game Res.	65	35	30	-	-	731
Chikwawa Boma	6,765	3,449	3,316	911	4.8	10
Total	**342,664**	**170,629**	**172,035**	**68232**	**4.2**	**4,721**

Source: NSO, Zomba, 1998

Table 7.7: Population Trends in the Phase 1 Project Area

Area	1 - 19 yr			20 - 64 yr			over 65 yr		
	Number	%	2005 Est.	Number	%	2005 Est.	Number	%	2005 Est.
Chikwawa	**194,283**	**54.47**	**209,746**	**147,477**	**41.347**	**159,214**	**74,922**	**21.01**	**80,885**
Lundu	22,422	52.74	26,111	19,336	45.48	22,518	753	1.77	877
Maseya	10,279	53.49	11,020	8,162	42.48	8,751	775	4.03	831
Katunga	8,620	52.47	9,306	6,999	42.60	7,556	810	4.93	874
Kasisi	13,257	52.27	15,228	10,930	43.10	12,555	1,175	4.63	1,350
Majete	35	59.32	38	24	40.68	26	0	0.00	0
Chikwawa Boma	3,634	48.62	5,079	3,659	48.96	5,114	181	2.42	253
Chapananga	37,012	56.95	34,988	25,051	38.54	23,681	2,930	4.51	2,770
Total	**53,938**	**15.12**	**55,334**	**39,664**	**11.12**	**41,377**	**4,286**	**1.20**	**4,373**

Source: NSO, 1998

Urban population within the Shire Valley ADD is relatively small, especially within the Study Area. Within Chikwawa District, approximately 30,022 people are estimated to live in urban or residential areas, representing 9.6 percent of the population. Therefore, excluding Bangula, 90 percent of the population of the study lives in rural areas.

7.8 Health And Nutrition

7.8.1 Health Care Services

(a) Hospitals and Clinics

The health system services in the project area are based on a primary health care approach where communities are organized around primary health care units. Health posts and clinics are located within walking distance of villages. Villages in remote areas are connected by mobile clinics. There are also a few private hospitals sponsored mainly by religious organizations. Chikwawa District has three hospitals, ten health centres, nine dispensaries/clinics, twelve health outposts and forty-two outreach clinics. The Chikwawa District Hospital has a capacity of 210 beds and has 140% occupancy rate. The mission hospital in the town has 100 beds and 100% occupancy. The delivery of health care services is inadequate due to the shortage of staff. At the time of carrying out the field survey, there were two doctors in the entire LSV region with a population of over 500,000 people.

All hospitals and health centres have clinics which deal with child spacing, pre-natal and post-natal care. At the village level, there are also traditional birth attendants (TBAs). Improvement of health facilities include those proposed for ESCOM/HEP staff which could be made accessible to the people within the scheme.

(b) Health Committees

There are also 325 committees and 49 area health committees, one maternity centre and one public health centre. In Nsanje District, there are six hospitals, four health centres, five dispensaries and three health posts. There are also 305 village health committees and 32 area health committees.

(c) Diseases

The most common diseases include malaria, measles, tetanus, TB, pertussis, diphtheria, pneumonia and polio. Some of the disease problems encountered in the project area are also related to vitamin deficiency. Other diseases are related with poor sanitation and hygiene, such as diarrhoea, dysentery, and cholera. As a result of the prolonged drought experienced in the area, vitamin A deficiency is common, leading to blindness (Trachoma) among children. Another common disease is river blindness. Other nutrition-related diseases include diarrhoea and anaemia. The impact of these diseases is that in Chikwawa District, official statistics the infant mortality rate is of the order of 195 per 1,000. The corresponding ratio for Nsanje District is of the order of 143 per 1,000.

(d) HIV/AIDS and Sexually Transmitted Illnesses

Chikwawa District was estimated to have about 33,000 infected adults. Every year as many as 80,000 people die from AIDS and another 110,000 new infections of HIV occur, many of these among young people. Some HIV is associated with tuberculosis. Tuberculosis is now an HIV-associated disease since there are three times as many cases of tuberculosis with HIV/AIDS than uncomplicated TB. As with any major development project

HIV/AIDS preventive and mitigation measures must be implemented during implementation and execution of the SVIP.

There are other health programs in the project area, mostly concerned with provision of safe water, sanitation problems and hygiene education. They are normally run by local as well as international non governmental organisations.

7.8.2 Nutrition

The major staple food in the project area is maize which is often consumed with pumpkin leaves. Sorghum and bulrush millet are other staples in the region. Beans are not sufficiently produced and must be imported from up-country. 20 percent of farm families cultivate less than 0.5 hectare each. These families cannot realize sufficient food for their households and so they rely on selling their labour in order to realize more food. This group of farmers are the ones in with nutritional problems are severe, particularly during the dry season when their services are not required, which makes raising extra food for the family problematic. Thus, malnutrition is a serious problem.

Beef is found in small quantities in the markets but its price is out of reach for most inhabitants of the region. Farmers have goats and cattle but seldom slaughter them for home consumption. The major source of protein is fish caught from the Shire River.

There are a number of fruit trees in the area. Fruit trees are used for commercial purposes rather than for home consumption.

7.9 Infrastructural Facilities

Implementation of any project will depend on the availability of local materials, labour, capital as well as adequate infrastructural set up. Outlined below are the existing facilities and amenities. This forms the basis for assessing future needs within the proposed irrigation project.

7.9.1 Access Roads

The main access road to the project is the M1 which connects Blantyre with Nsanje through Chikwawa, Nchalo, Ngabu, and Bangula/Chiromo. The road is adequate for commercial purposes as it already handles heavy commercial vehicles to Nchalo and Mozambique. However, most of the road is in a state of disrepair and needs re-surfacing. ILLOVO maintains parts of this road to ensure accessibility for the extraction of sugar from Nchalo.

There are also rural access roads of which the major ones within Phase I include the Chikwawa/Kapichira Falls/Hamilton Rapids road (D135). This road is being rehabilitated by ESCOM as an access road to Kapichira Hydroelectric Power (HEP) plant. This road will be adequate for access to the noth-eastern part of the project area, and will need improving in the Kapichira Falls to Hamilton Rapids section to ensure all-weather accessbility to the intake works. This section of the road runs through Majete Game Reserve.

The western section is served by D134 which originates from Kakoma and follows the approximate north-western boundary of the project area to join M1 at Chikwawa. Another district road to the south of Phase I project area joins the Mlomba/Tomali road from Sande market, situated on the Mwanza River just north of Nchalo Sugarcane Estate. There is no bridge across the Mwanza River, and therefore this road is only accessibile during the dry season.

From Tomali, another rural access road runs parallel and South of the Mwanza River to the west of the project and beyond. These roads are currently adequate and with proper maintenance they can sustain light commercial vehicles. They are all earth roads and they may only require occasional grading and repairs especially following heavy rains. Within the project area there are also a number of smaller roads that join the various villages and are capable of handling light traffic. These roads will be affected by the irrigation development works as well as village relocation.

7.9.2 Water and Rail Transport

Within the study area, the Shire River is navigable to light crafts and canoes between Chikwawa and the Elephant Marsh, and to barges between Bangula and its confluence with the Zambezi River. This facility is now being exploited to form a major trade and transport route, the Shire/Zambezi Waterway, between Nsanje (Malawi) and the Indian Ocean ports. It is limited by the presence of hippos and crocodiles.

Availability of rail transport is limited to a railway line running from Mozambique to the southern border at Marka and through Nsanje, Bangula/Chiromo to Blantyre.

7.9.3 Air Transport

The study area can easily be accessed by air through light aircrafts landing at the existing airstrip at Nchalo which is well maintained by ILLOVO. Because of the proximity to Blantyre, where an international airport is located, there may be no need for expanding airstrip capacity beyond light aircrafts in the near future.

7.9.4 Electricity Supply

Currently the main urban district centres and markets of Chikwawa, Nchalo, Ngabu, Bangula, and Nsanje are served by a 33 KV power line connected to the National grid. ESCOM has developed the first phase of hydropower generation at Kapichira Falls to augument the power supply needs of the entire Shire Valley between Chikwawa and Marka. There is therefore adequate power supply to supply the needs of the Project. However, electricity is likely to remain unaffordable to most rural people, but will be utilized more by small scale industries and prosperous farmers within the project area.

7.9.5 Education

There are several pre-schools, primary, secondary and special schools in the project area. Many schools lack water and sanitation facilities; others are inadequately equipped with latrines of inappropriate design. The poor state of school latrines represents a danger to public health, and is one of the contributory factors to the high drop out of girls from primary education.

7.9.6 Sewage Disposal and Sanitation

The sanitation situation in LSV is still a matter of great concern as people traditionally shun the use of latrines. Other matters of significant concern include the use of refuse pits, dish racks, bath shelters, washing slabs, hand washing behaviour and other hygienic practices such as covering containers are also being advocated by both the Government and non governmental organisations.

General observations from data obtained indicate very poor hygienic standards in the entire Lower Shire River Valley region. In social terms, pollution, particularly faecal contamination, has contributed to the spread of water-borne diseases such as diarrhoea, dysentery, cholera, and typhoid which are leading causes of high morbidity and mortality rates in Malawi. Recorded deaths due to these diseases are only those reported cases in hospitals and health centres and ignore other incidents on adults and children above 5 years of age which are not reported in health establishments. The effects have economic costs for the country in terms of treatment costs, underdevelopment of human resources, low labour productivity and poverty. The GoM estimates MK1,600 per capita expenditure in the treatment of such diseases ithe Lower S. Cholera alone is estimated to cost the country about MK 43 million assuming 5% of the population is infected with the bacteria. The cost includes personnel treating the patients both at the hospital and in the field.

7.9.7 Solid Waste Disposal

Due to lack of proper sanitation practices such as the refuse pits mentioned earlier, there are no organized disposal methods for solid waste, even in townships. Solid wastes or sludge from septic tanks is dumped wherever convenient to the truck driver; there are no designated solid waste disposal sites. Sludge truck tankers are hired as far as Blantyre. There is now a proliferation of public services that generate a lot of solid and liquid waste, such as bars, night clubs, resthouses, motels, industries, schools, and residences with waterborne sanitation that warrant having a proper solid waste disposal service.

7.9.8 Housing and Lifestyles

Housing within the villages consists of simple traditional rectangular as well as circular shaped, grass thatched adobe brick or mud houses (Figures 7.9 and 7.10).

In some cases, the roofs are made of galvanized iron sheets. Windows and doors are usually wooden but sometimes glass and metal are used. Almost all building materials are recyclable such that when one has to move to another area, reusable items (doors, windows, iron sheets etc) are taken away and the remaining bricks and tiles are crushed into the soil which reverts back to agricultural land.

Figure 7.9: Traditional grass thatched house

Most Malawi soils are ideal for brickmaking such that anyone with a piece of land automatically has his own building materials. Housing conditions are therefore fairly homogeneous with the only difference arising from the dictates of the external environmental elements. Traditional houses are not normally partitioned internally into rooms.

Figure 7.10: Modern house with iron roof

Housing conditions are therefore fairly homogeneous with the only difference arising from the dictates of the external environmental elements.

People of the project area may be classified as having low income levels because employment is scarce. ILLOVO is the only major source of employment and a few individuals work as paid labour in a few existing estates (e.g ranches, etc) and commercial establishments. Consequently, crime rate is also low.

7.10 Land Tenure

7.10.1 Land Tenure Arrangements

Customary land tenure arrangements combined with matrilineal or patrilineal inheritance of land use rights are characteristic of the Shire Valley. The matrilineal (Mang'anja) system predominates in the area around Chikwawa, while the patrilineal (Sena) system is dominant in the villages near Mwanza and Nthumba rivers. In principle, all land is under the custody of the Traditional Authorities and their Village Headmen, and no person is allowed or supposed to make land transactions of his or her land without their consent. As custodians of the land, the Chiefs and the Village Headmen are vested with the ultimate authority to control and arbitrate over disagreements. In essence, their approval is essential prior to

cultivation of any virgin land, and in cases of disputes arising from the destruction of crops by neighbour's animals; they are called upon to do the arbitration.

The other type of land tenure arrangement in the project is leasehold for SUCOMA and the private ranches which applies to any private owned parcels of land of over 10 hectares and commonly known as estates.

7.10.2 Land Act and Customary Tenure

Customary land as a form of tenure arrangement is defined in the Land Act of 1965. Under this Act, the GoM can acquire any land public use and pay full compensation and carry out resettlement of the displaced people either before or immediately after declaring the customary land public. Compensation covers any development made on the land including crops and structures. Traditional customary land tenure arrangement is not conducive to irrigation development as it does not encourage long term capital investment. Currently, the farmers in the existing irrigation schemes including Kasinthula scheme do not own the land except user rights.

However, efforts are being made to improve security of land ownership under the customary land tenure arrangements. The Government of Malawi approved a new National Land Policy on 17th January 2002 where one of the major objectives is to allow customary land to be registered and protected by law against arbitrary conversion to public land. The policy is promoting a system of land registration under the customary land tenure arrangements, and also advocating the creation of private leasehold estates out of any private land including registered customary land. The policy is therefore creating some degree of private ownership under the customary land tenure arrangements. It encourages an environment conducive to more investment on the land which leads to more productivity.

Consultations with local communities revealed that both the traditional leaders and other members of the community are not willing to let people emigrate from other areas to the project area. The main reason for this feeling is that the locals do not want to lose their land to people from other areas. To ensure more efficient utilization of the land under irrigation however, there is need to

encourage farmers who have ability to invest in more intensive farming in the area. Such type of farmers would inevitably have to come from areas outside the project.

It is recommended therefore, that government should implement a land registration system which would allow the local members of the community to have title to their land. The titles they will have should provide them with legal authority to let out any piece of land that they are not able to utilize to other people on a rental basis. This will allow people from outside the project area who have ability to invest on the land more productivity and therefore promote more efficient use of the irrigation facilities. The tenancy arrangement could be executed within the framework of the traditional system and it will guarantee security of tenure suitable for investing in commercial farming under the irrigation system.

7.10.3 Property Ownership

The possession of a house and productive assets, such a land, livestock etc. are important components of household welfare and are also significant indicators of changing economic conditions and living standards of the households. Poverty status of a household is in part determined by possession of durable assets the households owns. Access to credit is also dependant on the assets owned by the household. The new National Land Policy will assist farmers to access credit for their economic development so long as they own property worthbeing used as collateral.

7.11 Agricultural Practices

7.11.1 Crop Production

Smallholder farmers in the project area solely rely on rainfall to grow their crops. Most rainfed crops are planted at the beginning of the rainy season, which starts in November and terminates in March/April. Farmers plant local varieties, with growing periods in excess of 120 days which render them susceptible to moisture stress in the short rainy seasons. Short rains are characterized by one or two weeks of dry spells.

Cotton is the commonly grown cash crop in the project area with SVADD accounting for 50 per cent of national output. Under the present rainfed conditions, cropping patterns are principally oriented towards maize and sorghum production as basic food crops. Sorghum and millet being drought resistant are traditional crops in the area. Most farmers do not grow hybrid maize varieties. Sorghum is another important crop in the project area, and the Shire Valley is the main producer at 75 per cent of national production. However, only little of it is sold outside of the region. Other crops grown include pulses, cassava, sweet potatoes and oil seeds. Sugarcane is grown by ILLOVO and by some smallholder farmers under an out-grower scheme by the Kasinthula Cane Growers Authority.

The marshy lands accommodate rice as a cash crop, while in the wet depressions called *"dambos"* maize, vegetables, and fruit trees including bananas are grown throughout the year. This "*dimba"* cultivation ensures the basic food availability for dry years, but is destructive to the wetland and wetlands biodiversity.

At present smallholder farmers in Chikwawa are growing a range of crops, mostly grown in the summer months (November to April). These crops are cereal crops, pulses, tobacco cotton, cassava and sweet potatoes (Table 7.8). Maize dominates the cropping systems, but with low adoption of improved varieties. Pulses are also widely grown, with cowpeas as the most preferred crop type. Other crops that can be grown include bananas, mangoes, oranges, spices, sugarcane, sunflower and vegetables. The area is not growing much tobacco, paprika wheat, or soybeans.

Table 7.8: Current and Potential Yield Levels (kg/ha) for Chikwawa for Summer and Winter Seasons

Crop Name	Crop Area, ha		Current Yields kg/ha		Potential Yield with Irrigation	
	Summer	Winter	Summer	Winter	Summer	Winter
Maize – local	34,635	-	427	-	-	-
Maize – OPV	18,732	-	639	-	-	-
Maize – hybrids	4,117	-	836	-	8,000	-
Total/average	**57,484**	**14,650**	**525**	**1,387**	**-**	**-**
Sorghum – local	6,284	-	541	-	-	-
Sorghum – improved	2,464	-	728	-	10,000	-
Total/average	8,748	-	594	-	-	-
Rice – local	3,376	-	917	-	-	-
Rice – improved	242	-	3,646	-	6,000	6,000
Total/average	**3,618**	**50**	**1,049**	**3,250**	**-**	**-**
Pear millet	3,159	-	390	-	-	-
Finger millet	35	-	580	-	-	-
Groundnuts	1,492	-	789	-	-	-
Pigeonpeas	6,067	-	791			
Phaseolus beans	68	995	638	831	-	2000
Cowpeas	13,154	-	249	-	-	-
Soybean	4	-	210	-	-	-
Dolichos beans	64	-	500	-	-	-
Ground beans	32	-	406	-	-	-
Green grams	103	-	406	-	-	-
Total pulses	**24,538**	**-**	**9,321**	**-**	**-**	**-**
Sesame	349	-	284	-	-	-

Tobacco	4	-	601	-	-	-
Cassava	484	-	10,666	-	-	-
Sweet potato	955	1,317	8,064	12,277	-	-
Cotton	27,254	-	1107	-	-	-
Grand Total	**123,434**	**17,012**				

Source: Chikwawa DAO Crop Estimates and Kasinthula Research Station

Individual household farm areas under cultivation have declined, even though there is more "cultivable" land than is currently cropped. This implies that producers have to cultivate the same piece of land from year to year thus, destroying soil structure and increasing chances of soil erosion.

7.11.2 Cultural Practices

The cultural farming practices carried out by farmers are still at low levels of technology and input usage. Fertilizer is hardly used, similarly agrochemicals which are vital in pest and disease management. It is only in cotton where agrochemicals are used to manage pests and diseases. The current agronomic practices include land preparation by hand-held hoe, manual planting and weeding. Ridging is practised to some extent.

7.11.3 Livestock Production

Shire Valley Agricultural Development Division (SVADD) has one of the highest concentrations of livestock in the country with cattle and goats being the major domestic animals (Table 15). The sheep population is very small compared to goats. Livestock mostly depend on roadside and riverine vegetation along Shire River. There is no organized grazing pattern. The land carrying capacity for some parts of the project area cannot sustain the population of livestock such that there is significant environmental degradation. People graze their animals in protected areas, thus being a threat to wildlife reserves.

Figure 7.11: Livestock grazing in forest areas

Table 7.9: Domestic Animal Population Trends from 2001 to 2005

	2001			2002			2003		
	SVADD	Malawi	%	SVADD	Malawi	%	SVADD	Malawi	%
Cattle	107,644	763,724	14.1	99,387	749,029	13.3	84,073	781,747	10.8
Goats	198,359	1,689,485	11.7	182,821	1,669,669	10.9	191,158	1,716,822	11.1
Sheep	4,898	111,539	4.4	3,881	115,247	3.4	3,256	104,450	3.1
Pigs	38,822	468,140	8.3	43,264	456,291	9.5	38,474	435,257	8.8
Chickens	375,753	7,065,482	5.3	331,776	7,348,450	4.5	334,998	8,871,625	3.8
G/Fowl							38,820		
Turkey							392		
Rabbits							1,835		

	2004			2005		
	SVADD	Malawi	%	SVADD	Malawi	%
Cattle	84,917	764,061	11.1	83,097	777,846	10.7
Goats	179,409	1,922,264	9.3	186,988	1,961,080	9.5
Sheep	4,073	227,363	1.8	4,029	156,714	2.6
Pigs	37,624	477,863	7.9	59,671	582,709	10.2
Chickens	270,983	9,947,612	2.7	412,222	9,946,591	4.1
G/Fowl	100,458			50,993		
Turkey	341			284		
Rabbit	1,857			944		

Source: Shire Valley ADD

Overall, livestock have seen a reduction in populations due to a number of reasons. Livestock is sold in order to generate hosehold income. Livestock is also used as a buffer for household food security during times of drought and famine.

7.11.4 Livestock Health Improvement Practices

In a bid to promote good animal health, both preventive and curative measures are being promoted. The current policy requires that dipping be done only when tick numbers rise. Surveys made in the Shire Valley in recent years, however, have shown that the tick population is insignificant and that there is no difference between dipped and undipped animals. This is thought to be due to the harsh climate which is injurious to the ticks and keeps their population down.

Important diseases include trypanosomiasis in areas adjacent to Lengwe and Mwabvi National Parks, African Swine Fever (ASF) and Newcastle Disease (NCD). Others are Lumpy Skin Disease (LSD), Pink Eye, Three-Day Sickness, Babesiosis, Anaplasmosis, Senkobo, Foot and Mouth Disease (FMD) and Worm Infestation. With the introduction of an irrigation system, it is expected that occurrence of roundworms and liverflukes will increase although these can be controlled by strategic deworming. Trypanosomiasis occurs in areas adjacent to the national

Parks. It is controlled on a regional basis by Tsetse and Trypanosomiasis Control Project which encompasses Malawi, Mozambique, Zambia and Zimbabwe. This program is based on the use of insecticide-impregnated target traps to kill the tsetse flies.

Common aspects of animal disease prevention and control in use include:

- Vaccination campaigns against Newcastle disease, rabies, and Lumpy Skin Disease
- De-worming
- Livestock movement controls
- Treatments
- Meat Inspection

7.11.4 Fish Farming:

ommercial fish farming was started at the Government fish farm at Kasinthula in early 1970s. At the same time, a fish farming estate at Nchalo was established by the Sugar Company of Malawi (SUCOMA). Kasinthula fish farm was established initially with an area of 22 ha to demonstrate the commercial viability of warm water fish farming in Malawi. A total of 13 ponds were constructed. In 1976, three 0.1-ha and nine 0.05-ha ponds were constructed for breeding and nursery purposes. `Growout' ponds are large, ranging in area between 1 and 4 ha. Although intended primarily as a demonstration and production farm, it was also planned as a research farm for the development of management procedures for large-scale aquaculture. The farm is now under a management agreement with a private entrepreneur for commercial production. A water supply of at least 40,000 cubic metres per ha per year is sufficient to compensate for seepage and evaporation losses from the ponds.

7.12 Agro-Processing Facilities

7.12.1 Maize Milling

The Shire Valley is expected to produce some 64,600 tonnes of maize in one growing season, under irrigation. This excludes any yield that would be derived from rain fed cropping. The current processing capacity may not be adequate

despite some of the produce being conveyed to storage centres outside the Shire Valley. Investment in maize processing will be left in the hands of private entrepreneurs.

7.12.2 Rice Milling

Currently there are three commercial mills owned by the Monsato, whose capacities stand at 26,000 tonnes per annum. In the 1995/6 production season, total national production of paddy rice stood at 72,600 tonnes. The implementation of project will bring an estimated additional 19,100 tonnes into national processing mills, which is likely to stretch the existing capacity. With the envisaged production, five machines with output of 550 kg/hr will need to be established under the project. The processing factories could be sited at Chikwawa. Due to the investment cost involved and the need to process rice to good quality export standards, smallholder producers may undertake the venture with training and management advice through cooperatives. This venture could be presented to OVOP for consideration of funding. Otherwise, the private sector would be the ideal investors.

7.12.3 Sugar Factory

Kasinthula Cane Growers Trust has already established a sugar cane plantation of about 750 hectares. Cane production is being supported by ILLOVO, who also transport and process it at their factory at Nchalo. The capacity at Nchalo is adequate for the current production levels. A review will be done during Phase II of the project to ascertain additional land to be put under cane and whether the additional production would warrant an additional factory or expansion of the existing facilities.

7.12.4 Processing of Vegetables

Tomatoes are expected to reach a level of 17,000 tonnes when irrigation is fully established. The production levels of onions and chillies are expected to be 15,400 tonnes and 790 tonnes respectively. Investment in the processing of these commodities, particularly for export, should be considered during the implementation of Phase I. This can be done by producer organizations or private entrepreneurs. Already there are several companies that process

vegetables, such as Nali which processes chillies, tomatoes and onions into chilli sauce and other products, Rab Processors which processes a variety of crops such as soya, maize, rice, beans, groundnuts, and fruits, Grain and Milling which processes maize, Madalitso Foods, Bowler Beverages, and Tambala Food Products. Arrangements could be made with these companies as to teir participation in the processing of the products from the project before other similar investment is considered.

7.12.5 Leather Industries

With the presence of large numbers of both small and large livestock, it will be necessary to introduce leather industries to process the by-products that currently go to waste. The industries to be introduced will include processing of hides and skins, processing of hooves and horns, and bone meal production for livestock feeds etc. These are simple industries to be established, and it is envisaged that the private sector can take up this challenge.

7.12.6 Smoking of Fish

The traditional method of fish preservation is by smoking. This technique is still used, but with improvements to retain the organoleptic qualities of the final product. Two alternative methods exist; these are smoking (hot or cold), either with open fire or with a smoke generator. The project will realize 1,085 tonnes of fish to be processed and excludes the catches from Shire River. Canning and filleting industries as well as fish meal production should be considered as potential industries that the fisheries enterprise will support. Investment in these industries can be carried out by producers with equity participation from GOM through the institution managing the project, or by established firms that are already in the fish processing business.

7.12.7 Fruit Processing

The Shire Valley has the potential of growing various tropical fruits including mangoes, citrus, pawpaw, bananas, strawberries, pineapples. The concept of this project during the colonial era was based on the development of a citrus industry for the production of juices and related citrus products. Research at Kasinthula has confirmed the suitability of this region for this type of industry. One farmer is

successfully growing bananas under irrigation at Kasinthula. Fruit processing will add to the food security by supplying the needed vitamins and minerals essential for human development and functioning. It is proposed that some of the land should be set aside for fruit production on a medium scale level. Figure 5.11.1 shows a successful irrigated banana grove at Kasinthula.

Figure 7.12: Banana farm at Kasinthula

8.0 THE ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

nvironmental impacts arising from the project are as a result of project activities which will occur in three phases namely, pre-construction, construction, operational and decommissioning stages. These impacts are identified in all the phases and discussed in this section. The areas where environmental impacts are expected to be felt include the immediate water catchment areas, protected areas including marshes and the project area.

8.1 Methodology

The EIA has been achieved through public consultations, literature reviews, data collection, and field interviews. The list of those consulted appears as Annex C. Occasion was also used to sensitise local traditional leaders in Chikwawa and Nsanje districts at various fora organised by the District Assemblies. Special meetings were also arranged to address specific pertinent issues that required immediate attention or emphasis. Figure 8.1 shows one of such special assemblies. Other public consultation methods used were focus group discussions as well as key informant interviews.

Figure 8.1: Public Consultation with Traditional Leaders in presence of the Minister of Irrigation and Water Development

8.2 SOCIAL AND CULTURAL IMPACTS

The most important social issue with respect to the development of SVIP is the resettlement and relocation of people where infrastructure will be developed. Where permanent structures, such as canals, roads, and drains, people will lose the land for it will no longer be available for cultivation. Some of the beneficiaries will be relocated to settlement sites in cases where the land would be put to agricultural development use. Separate Resettlement Action Plans (RAPs) will be developed for all the affected areas.

The project will also have significant impacts on the health of the `beneficiary' communities, particularly in relation to vector borne diseases.

8.2.1 Social Impacts

The main social impacts will be health, sanitation, education, and cultural implications of having a relatively large itinerant workforce within the project area during and after construction. The other social impact relates to the displacement and resettlement of people who are in areas where permanent project infrastructure will be developed. Other adverse cultural effects will include the following:

- ✪ Changes to inter-community relations due to resettlement in new locations.
- ✪ Interruptions of existing lines of communication and inter-community relationships due to the presence of the water conveyance structure.
- ✪ Impacts on cemeteries and associated ceremonies.
- ✪ Changes in the status of communities and families due to differences in the amounts of compensation received.
- ✪ Arrival of internal migrants to take advantage of new agroprocessing opportunities and easier access (by water) to other natural resources.

In addition there will be adverse socio-economic effects, such as:

- ✪ Changes to income due to loss of access to resources and/or changes in crops.
- ✪ Marketing problems due to severance of existing transport routes.
- ✪ Reduced productivity due to reduced fallow period on smaller area of farmland.

- ✪ Marked reduction in paid labouring opportunities at the completion of construction.
- ✪ Potential increases in malaria, bilharzia and gastro-enteritis.

Against these social problems there will be certain benefits, such as:

- ✪ New opportunities for fishing.
- ✪ New opportunities to earn incomes from tourism.
- ✪ Improved skills due to training elements of irrigated agriculture.
- ✪ Opportunities to buy new equipment (tools, fishing gear, etc) for livelihood support using compensation.
- ✪ Availability of clean and sweet water supply along the water conveyance route.

It is impossible to quantify these potential social impacts and therefore it will be critical to monitor the communities in the area of influence of SVIP in order to take early corrective action if problems arise. One encouraging observation is that people of the project area have experienced relocation and re-establishment of their livelihoods previously, for example during the construction of the Cane Spirit Factory, and there has been no adverse effect.

Following the fieldwork carried out in the study area, the following types of villages will be affected by the project:

- ➢ Villages not affected, no loss caused by the project.
- ➢ Built-up area of villages not affected, but community loses a small part of its land
- ➢ Built-up area villages not affected, but community loses a considerable part of its land
- ➢ Village at a critical elevation might have to be moved at least partly and loses a considerable part of its land.
- ➢ Households along the canal route will have to be relocated.

A considerable number of households will be affected by the development of the project infrastructures. Compensation packages will be provided, however, depending on the procedures as provided for on the laws of the country. The following compensation categories can be considered:

Category A - Individual households will be compensated for lost fruit trees, and an overall compensation for the lost land will be negotiated with the community. Since the amount of land lost is small, compensation does not necessarily have to be on a land-for-land basis, it could be anything else of equivalent value that the community considers as a priority (e.g. improved access, farming tools, etc.).

Category B – Households that have lost most of their land to permanent structures of the project. The question here will be whether agriculture on the remaining amount of land will be sustainable.

Category C – Households that will have to be relocated while their lands are virtually all not affected. These households will have to be relocated following an agreed resettlement plan. It is possible that such households could be relocated a short distance from the present site to a somewhat higher elevation, while remaining close to their lands.

Some of the socio-economic benefits that the community will be exposed to are as follows:

- ***Stabilised agriculture***: this is probably the most important of the benefits. Agriculture is the mainstay of the livelihoods of the entire population. However, rainfed agricultural land has reached its carrying capacity and slash-and-burn cultivation is no longer sustainable, aggravated by low and erratic rainfall distribution and flooding.

- ***Aquaculuture and Fish Farming***: Fish ponds could be installed in a number of villages and they could provide a source of income and protein to individual families. Fish is an important part of the community diet.

- ***Improving local markets*** would be an opportunity for a larger number of families in the project area to create an additional income. This has to be seen in relation to improved access.

- ***Improving footpaths*** is vital for the villages, and improved access could be a part of the compensation package for some of them. Ideally, construction of these paths should be undertaken by the villagers themselves.

8.2.2 Cultural Impacts

Cultural impacts will relate to the mixing of cultures and behaviours due to the influx of people into the project area especially during construction, and the impact on cultural sites such as cemeteries.

8.2.3 Health Impacts

Development of the SVIP will influence the health of the surrounding communities in the following ways:

- changes in the incidence of vector borne diseases, due to changes in vector habitat
- social impacts resulting in the increased incidence of Sexually Transmitted Illnesses (STIs),
- gastro-intestinal problems due to changes in water quality and water use.

The specific impacts to be considered are as follows:

Malaria is already by far the most prevalent identifiable disease of children and adults in the project area. The irrrigtion project will create additional breeding sites for the mosquito vectors. This could be particularly prevalent during periods of irrigation where there could be small isolated pools of water. In addition, some of the villages that are presently not near water bodies will be within mosquito flying distance.

Schistosomiasis (*Bilharzia*) is also prevalent in the project area. The slow-moving water at the margins of the Shire River, water conveyance structure and within the irrigated plots will create new habitat for the snails that are the intermediate hosts of schistosomiasis. The existing schistosomiasis problem is already worrying as there is currently no national schistosomiasis control programme and there are no immediate plans to introduce one. The control

programme that was in the project area was stopped possibly due to funding. It is espected that the project will resuscitate the programme.

Onchocerciasis (River Blindness) – The intake site could become or reduce "white water" effects which are breeding grounds for the *Simulium blackflies*, the vector of onchocerciasis. An Onchocerciasis Control Programme will have to be set up that will include entomological surveillance, prevention and curative actions.

Public Health: The construction and operation of irrigation project will attract people into the project area. They might settle in temporary housing having unsanitary living conditions and may not have access to proper health care. Once the irrigation project is commissioned, communities that had not previously had ready access to water resources, will find themselves adjacent to a very large water body. This will be very tempting both as a source of water and a site for washing, defaecation, waste disposal, etc.

Figure 8.2: Women washing clothes in an irrigation canal

This will demand a strenuous effort in public awareness to prevent the transmission of both gastro-intestinal disease and bilharzia. Proper water supply and sanitation will therefore need to be provided to the communities.

HIV/AIDS and Sexually Transmitted Illnesses - HIV/AIDS is nationally on the increase. National AIDS Commission estimated in 2003 that the prevalence of

HIV/AIS among adults (15 - 49 years) is 14.4% with a range between 12 % and 17%. The prevalence estimates also indicate that HIV infection among adults in urban areas is almost twice that of rural areas. The prevalence rates projected to year 2005 are 14.28 % at national level, 22.76% in urban areas and 12.13% in rural areas.

Chikwawa District was estimated to have about 33,000 infected adults. Every year as many as 80,000 people die from AIDS and another 110,000 new infections of HIV occur, many of these among young people. Some HIV is associated with tuberculosis. Tuberculosis is now an HIV-associated disease since there are three times as many cases of tuberculosis with HIV/AIDS than uncomplicated TB. Monitoring of HIV/AIDS is done at Chikwawa Hospital to a limited extent. It is important that the monitoring exercise be promoted to cover a wider clientele, in order that appropriate remedial measures could be instituted. There is a mandatory testing among sex workers in work places at regular intervals. It is planned to introduce mandatory testing of all sex workers irrespective of their work places. Use of condoms is being promoted as a mitigation measure. HIV/AIDS awareness and prevention campaigns among the public are being done by various non governmental organisations. As with any major development project HIV/AIDS preventive and mitigation measures must be implemented during implementation and execution of the SVIP.

8.3 Impact During Pre-Construction Phase

A major activity during pre-construction stage will be mobilizing the people and carrying out resettlements including compensation of property for those who will be relocated from their current dwellings. The approximate number of affected people is given in Table 8.1. During resettlement process levelling of land for building of new dwelling places will need to be carried out. There will also be social dislocation. It is expected that resettlement will be done close to existing amenities. It will involve building new structures which will require building materials. The impact of new buildings will be, cutting of trees (deforestation) that will expose the land and lead to soil erosion. Brick making will utilize soil and firewood which will add to soil loss. It is estimated that 5 mature trees will be required per household and this may

therefore involve about 2,000 trees. The proposed reafforestation programme will include replacement of the trees used for resettlement.

Table 8.1: Selected Resettlement Impact

Category	Affected households	Positive impact	Negative impact
A	380 out of 7,880	- closer to improved public facilities (roads,water, electricity) - more job opportunities - exposure to new skills - better living conditions	- loss of ancestral land - cultural isolation - loss of structures - exposure to changed environment and likelihood of increase in disease prevalence
B	2000 out of 14,000 people	As above in addition this category has access to irrigation facilities	As above
C	unknown	As category A	As category A

8.4 Impacts of Construction Projects on The Environment

8.4.1 Site Preparation

One requirement of irrigation farming is the need to clear fields of all vegetation including trees. The impact of this requirement is that wood products will be reduced in the project area, resulting in diminishing supply of fuelwood, fodder for livestock, shade for people and domestic animals, fruit trees, trees of medicinal value and source of construction materials. Apart from removal of trees within the crop fields, there will also be a lot of trees cleared in the process of constructing 36 kilometres of canal with a width of 60m. This will affect an area of about 216ha. The irrigation area in Phase I will cover another 7940 ha. In the Lengwe National

Park an area of 105 ha will be cleared by the canal while 25,000 ha will be cleared for farming activities.

Most of the project area falls on sparsely wooded area and where loss of trees/woodlands will be minimal. The greatest loss will occur where the canal passes through Lengwe National Park and Majete Game Reserve. According to earlier detailed study of tree loss carried out in the impoundment area of Kapichira HEP dam it was estimated that an area of about 180 ha would result in loss of trees worth MK 1 million (Dudley et al, 1991). By extrapolation 216ha would result in an apparent loss of revenue equivalent to MK 1.4 million in Majete Game Reserve alone, although none of these trees would ever have been felled for sale as fuelwood.

8.4.2 Loss of Biodiversity

Magombo, 1992, surveyed the vegetation of the Majete area around the Kapichira HEP and compared the plant species list with nationwide plant occurrence. No plant species were classified as endemic to the area. However, the degree of rarity of species in respect to their occurrence in the 24 administrative districts of Malawi was determined as shown in Table 8.2. Using the criterion above 9 plant species were recorded as rare. These are: - *Combretum heteroensis, Diospyros quiloensis, Acalypha ciliata, Garcinia livingstoniana, Holmskiodia spinescens, Acacia ataxacantha, Pterocarpus rotundifolia, Strophanthus nicholsonii, and Cissus petiolata*. However, survey of the canal alignment established a widespread occurrence of these trees and it is unlikely that the construction of the canal will bring about extinction of these species in the project area.

Table 8.2: Criterion used in declaring Plant Species Rare

Rare	Recorded in 3 districts or less
Uncommon	Recorded in 4-6 districts
Common	Recorded in 7-13 districts
Very common	Recorded in 14-24 districts

Source: **Magombo, 1992.**

To mitigate against this adverse effect the boundaries separating respective crop fields should be utilized for afforestation program. Tree species should be selected on basis of their capability to enhance soil fertility, provide wind breaks and control erosion. It is also proposed that trees of economic value for timber, fuelwood, ornamental, medicinal, poles and fodder be pre-harvested in the canal construction area. Money raised from sale of these trees should be invested in tree nursery establishment. Seedlings of rare plants should be raised for use in reafforestation programme in order to restore genetic stock. The cost of reafforestation programme is estimated at MK1,000,000, spread over five years.

8.4.3 Impact of Canal Alignment on Fauna

During construction, earthworks will involve rock blasting and quarrying to achieve the specified 3m depth. The parent rock within the Majete Game Reserve is composed of intermediate metamorphic rocks (gneiss and granite). Noise and vibration will be caused by blasting, machine operations and construction vehicles. Blasting activities will have noise impact on the fauna of both the Lengwe National Park and Majete Game Reserve. Work done by Nippon Koei Co. Ltd (1995) indicates that compounded noise levels involving quarrying and blasting is about 90-95 dB. The acceptable noise level in inhabited areas is around 55 dB. Blasting works will be taking place in uninhabited area and the impact will be minimal. Wild animals will however, be scared and animals will retreat away from construction site but this will be for short durations.

It must be noted here that some animals tend to follow river channels while other have established specific paths to drink water from the Shire River during dry season. As such construction of the feeder canal may obstruct some small animals to go to the river. As for big animals, like elephants, which will be re-introduced in Majete Game Reserve, experience has shown that these big animals do not like man-made structures such that the feeder canal structures might be broken time and again. Appropriate protection will need to be made for the entire 7km length of the canal. Allowance has been made to water the animals away from the canal by providing four watering points. The management of Majete Game Reserve will

assist in identifying the most appropriate sites to locate these watering points and the specific animal paths where the canal may have to be buried.

8.4.4 Impact on Landscape and Aesthetics

Special features such as the Hamilton Rapids and Kapichira Falls are of interest to tourists as observed during fieldwork and public disclosure. The SVIP will not affect the scenic beauty of the falls since water abstraction point is at Hamilton Rapids upstream of the Falls. Kapichira HEP will however have a major impact by inundating 180 ha. Only the volume of water will be reduced and this will have insignificant impact on the Falls. 17 villages will be affected in terms of aesthetics, cemeteries, ancestral land, and prayer/sacrifice sites in the forest. To militate against this loss the local people will be counselled and adequately compensated.

8.4.5 Labour

Immigrant workers are likely to negatively and positively impact on the socio-cultural set-up. Areas of impact include introduction of new diseases to the local community, susceptibility of the non-immune immigrant workers to local diseases, introduction of incompatible cultural values and attitudes. The immigrant workers will be housed in camps, and for convenience these will probably be near Chikwawa Boma from where they will be transported to their shifts. The large number of immigrant workers will increase the production of waste which would lead to serious water quality deterioration if released in the existing river systems. In order to militate against this, it is expected that pits and latrines will be constructed by the community.

It is suggested that community social workers be deployed from the Ministry of Gender, Child Welfare and Community Services and posted to the villages to sensitize and mobilize the local communities and the `immigrant' workers. The cost of mitigation is estimated at MK1,750,000.

8.4.6 Impact of Construction on Soil Erosion and Degradation

Majete Game Reserve is assessed to lose some 11-15 mt/ha/year under normal environmental conditions. The canal construction which will take place in the Game Reserve will be carried out during the dry season. Soil loss which will occur will be

through earth movement and wind erosion. The soil scooped will be re-used in filling of the gulleys along the canal route. The only significant loss will be through wind. Immediately the rain sets in, soil loss is also expected, but if canals are well lined and embankments properly stabilized, the loss will be reduced. It is estimated that 50 mt/ha/year will be lost during the first year of construction.

During the construction stage, water quality will be affected by an increase in silt load in the Shire River. This will increase turbidity downstream but will have negligible impact on the fish since silt load is not expected to exceed normal flood season levels.

8.4.7 Impact of Construction on Air Quality

During the construction stage, air pollution is expected to increase a few percentage points (less than 5%) above usual levels of carbon monoxide, sulphur dioxide and nitrogen dioxide due to emissions from diesel and petrol fuelled vehicles and machinery to be used within the area. The effect of gaseous emissions is however felt within 50m of the source as they are soon dispersed. Since the areas around the intake point and the feeder canal are uninhabited, no serious impact on air quality will be caused by operation of construction machines and vehicles. Air quality, however, will be affected by dust generated by the movement of vehicles but the levels will be kept low by periodical sprinkling of water on construction roads. The costs associated with sprinkling are usually incorporated in construction costs.

8.5 Operational Phase Impact

8.5.1 Impact of Water Abstraction at Hamilton on HEP Performance

These abstraction conflicts will largely be governed by the water flows in Shire River. The amount of water in the river is governed by the barrage at Liwonde, especially during the dry season. A number of studies have been conducted on minimum flows downstream of Liwonde barrage. The most recent study conducted by UNDP in 1986 on National Water Resources Master Plan indicated that Liwonde Barrage is capable of providing a firm flow in Shire River of 170 cumecs in 79 out 80 years. On an average year Shire River flows is about 300 cumecs. The five year return period has been calculated at 250 cumecs while a ten year return period is

estimated at 220 cumecs. The lowest river flows are experienced in the month of September. Table 8.3 gives a summary of water requirements in both phases of project implementation for irrigation and HEP generation, using three scenarios based on analysis of hydrological data downstream of Liwonde barrage.

Discharge requirements for power generation for both Phases of the Kapichira Hydro-electric power development are 172 cumecs. Intake structures and the feeder canal are designed for the maximum gross irrigation requirement of 55 cumecs which occurs in September when the entire SVIP Phases I and II have been developed. The first phase will require 23 cumecs for irrigation while the rest are meant for Phase II.

Table 8.3: Water Requirement in Phases I and II for Irrigation and HEP Generation (Cumecs)

Flow Level	**170[a]**		**220[b]**		**250[c]**	
	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II
Irrigation requirement	23	55	23	55	23	55
Balance	147	115	197	165	227	195
HEP requirements	86	172	86	172	86	172
Surplus (deficit)	61	(57)	118	(7)	141	23
% of Water use[d]	13.5	32.3	10.5	25	9.2	22.0

Notes: (a) 170 cumecs expected in 79 years out of 80 years

(b) 220 cumecs for 10 year return period

(c) 250 cumecs for 5 year return period

(d) % of irrigation water on total river flow

Phase I of power development at Kapichira Falls, comprising the first two turbines was commissioned year 2000. It requires 86 cumecs in this phase for HEP generation. From Table 8.3 it can be concluded that there will be no conflict

between irrigation and HEP generation at Kapichira during Phase I of project implementation, even assuming the lowest river flow of 172 cumecs. Phase II of project implementation will see some conflicts in the driest month of September. The conflicts increase as the dry season river flow decreases. To mitigate against these conflicts it is suggested that the flow regulation at Liwonde should include the irrigation requirements of 23 cumecs and 55 cumecs so that the minimum discharge or power generation and irrigation be revised to 200cumecs and 230 cumecs to satisfy the water requirement for Phases I and II respectively. The cropping pattern should also be carried out in such a way that most crops are harvested during the critical month of September. If this type of cropping pattern is adhered to strictly, the conflicts between irrigation and HEP generation will be minimized. Alternatively, certain portion of the land should not be irrigated during the critical month.

Utilization of tail race water pumped from below Kapichira Falls HEP plant would have several adverse environmental impacts which make it unattractive. It would be uneconomical to run both in terms of power required to operate the pumps, and in the size of the area that can be irrigated. Pumps are known to breakdown, sometimes when funds are not readily available for repairs, thus bringing stress to the irrigated land and the socio-economic set-up of the beneficiaries as exemplified by the Kasinthula Scheme. There is also a possibility of polluting the area with oils and grease, and other toxic substances emanating from the operation of the turbines. However, since there are several HEP stations upstream and they have not indicated any pollution in the Shire water, it is expected that pollution from Kapichira HEP tail race water would also be negligible.

8.5.2 Impact of Hydrological Changes of Lower Shire River on Agriculture

The flow of the Shire River is composed of two components: the outflow from Lake Malawi which makes up to 80% of the total river flow; and the inflow from the drainage of the catchment area below Lake Malawi. The contribution of the inflow during the dry season is almost negligible as most tributaries are either dry or at minimal flow. Lake elevation determines the outflow and the long term fluctuations are of primary importance in determining the use of the river either for irrigation purposes or for the generation of hydroelectric power.

Examination of the river flow at Maganga indicates that it follows the same pattern as that at Liwonde Barrage. Current studies indicate that the Shire River discharges at both Liwonde and Maganga stations were almost zero in much of 1957 and again in 1965. Maganga station which is located about 2.5 km below Kapichira Falls is more representative of the study area.

Records show that lake levels and river flow have continually been high in the last few decades with an average annual outflow of 653 cumecs, but it is also recorded that there was virtually no lake outflow from 1917 to 1935. What has not been documented are the effects of this drying up on the environment along the Shire River including the flora and fauna of the riparian zone, the Elephant and Dindi Marshes, and agriculture in general. Should low outflows occur in the future, they will have serious consequences on Kapichira HEP operations and agriculture in the valley. However, this scenariao has been taken care of by constructing a barrage at Liwonde.

Lake outflow has a seasonal component as does river flow originating below the lake. Highest river flows occur toward the end of the rainy season when lake levels are highest and significant flow in downstream catchment areas still occurs. Typically, the highest (average monthly) rainy season flows are 1.5 to 3 times the size of dry-season flows. Although flood episodes of local origin are important, a significant proportion of peak average flow is due to higher lake levels during the rainy season.

8.5.3 Impact of Reduced Shire River Water Flow on Riverine Vegetation:

Riverine vegetation depends mostly on the height of the water table in the riverine zone. Reductions in river flows by approximately 33% as expected of Shire River after water abstraction at Hamilton Rapids will reduce the width of this zone by a corresponding margin. This means that 15-20% of the vegetation on each river bank will lose their riverine characteristics. Currently, riverine and alluvial vegetation comprising the riverbed, riverbank and alluvial communities are *Acacia tortilis, Agalpinii, Breonadamicrocephala, Cordyla africana, Kigelia africana, Lonchocarpus capassa, Sterculia appendiculata and Hyphaene benguellenses, Allophylus sp., Cardiogyne africana, Combretum mossambicenses, C. paniculatum, Dalbergia*

arbutifolia, Grewia spp. *Cynodon, Digitaria, Leptichloa, Panicum, Phragmites and Urochloa.*

With reduced water flow in the Shire River, the community is likely to change to low altitude mixed tall deciduous woodland whose characteristic species are *Adansomia digitata, Acacia nigrescens, Combretum imberbe, Selerocarya caffra, Sterculia quiqueloba, Terminalia sericea ad Xeroderris stuhlmanni, Combretum mossambicensis, Grewia* spp. *Digitaria, Heteropogon and Urochloa*. Another effect of reduced flows is the lowering alluvial deposits which have so far been responsible for the LSV's fertility. It should be noted however, that the Shire River is not wholly responsible for riverine conditions since there is contribution from its tributaries below Hamilton Falls. Impact on the Dindi Marsh will be negligible as its water is contributed by the Ruo River and flooding from the Zambezi River in addition to the Shire River.

8.5.4 Impact of Reduced Shire River Flow on Fisheries

The effects of reduced water flow will significantly reduce successful spawning of the catfish species which make up 75% of fish yield. Spawning of this species is dependent on extensive flooding of the marsh areas early in the rains. Downstream hydrology will also be affected during dry-season flows when 30-40% of the dry season flow is diverted away from the marsh thereby seriously affecting catches. Positively, reduced flows in the greater dry season will help to keep water hyacinth under control and facilitate fish harvesting in open marshy areas.

8.5.5 Impact of the Canal on Wildlife

During the operational phase the most significant impact on wildlife will be those related to habitat changes and animal movements. The irrigation canal will create a wet environment that favours riparian vegetation or vegetation of wet fringes such as *Terminalia sericea*. The Majete and Lengwe flora and fauna are adapted to a semi-arid climate. Changes in the microclimate will certainly change vegetation species composition leading to changes in animal utilization of the habitat. There is a likelihood of exotic plants being introduced into the canal and transported to the protected areas where they would establish themselves in the park at the expense of the indigenous species.

8.5.6 Effect of the Canal on Wildlife Movements and Mortality

The presence of the canal within the Majete Game Reserve will cut off a portion of the Shire River currently utilized by wild animals. This impact will be minimal because most animals are found between Mathithi and Mkurumadzi rivers which are to the north of the intake. Other possible impacts relate to hinderance of animal movements from one side of the canal to the other. This will lead to isolation of populations. In the initial stages it is likely that a few of the smaller animal species will be swept away by the fast flowing canal water (Boulder & Bailey, 1979). If such a scenario occurred then it is assumed that survivors will soon get used to the newly introduced environment.

In Lengwe, before the park size was extended, research had shown a regular movement of animals from eastern salient into the Mopane woodland on the western side of the eastern salient (Hall Martin, 1972; Zimmerman, 1969). The extension allowed these movements. The bisection of the park into two will lead to overcrowding of wildlife and over usage of foliage and induced changes to the plant community structure. In extreme cases animal mortality may occur. The best mitigation against interrupting normal animal movement between the Eastern Salient and Western Upland is to have the canal reticulated, but this option is not cost effective. The second option is to provide crossing points directly opposite drinking points within the larger western upland ecosystem. These drinking points have been included and also costed in the design of the canal.

8.5.7 Human/Wildlife Conflicts

Once the project is operational conflicts between people and wildlife are expected to escalate due to crop damage and loss of human life or injury caused by the problem animals such as buffaloes, hippos and crocodiles. The DNPW is likely to experience increased human/wildlife conflicts due to increased cultivation and it is proposed that ranger patrols be intensified to keep off animals from agricultural fields. Other intervention measures such as fencing, sustainable cropping, shooting of problem animals etc could be tried on experimental basis but care should be taken to ensure that erected barriers do not interfere with animal movements to their natural habitats.

The recent erection of a retaining fence along 27 km of the boundary between Lengwe National Park and the local people has reportedly reduced crop raiding incidence though no actual statistics are available. Bell (1986) and Mkanda (1992) proved that an electric fence along the boundary of Kasungu National Park is more efficient in reducing human-wildlife conflicts than shooting. Similar fencing has been done in the Majete Game Reserve with similar effects. An elephant fence has been constructed on the left bank of the Shire River within the Game Reserve in order to mitigate human/elephant conflicts once they are intrudced some time in year 2006. Therefore, it is recommended that erection of electric fencing be completed.

As a mitigation measure for resolving human-wildlife conflicts, it is crucial that the DNPW and the project management initiate a campaign program to create awareness. Resolution of people-wildlife conflict requires participation of all stakeholders within the affected area. DNPW and the SVIP will jointly prepare simple brochures providing information on the magnitude and approaches to the problems

8.5.8 Impact of Canal on Fish Migration

The adoption of Hamilton site as a water abstraction point means that effective structures must be incorporated in the design to prevent fish migration upwards to the Lake Malawi. Two structures are incorporated in the design. One is that the canal will have a 30m fall in the Majete Game Reserve. This will act as a good barrier and play a role similar to that currently being played by cataracts and rapids on the Shire River itself. The abstraction point will have 15 gates with a height of 3m each. It is expected that these structures will be adequate to control Tiger Fish (*Hydrocynus vitatus*) migration upstream incase it is accidentally introduced into the 30m - water fall. It is also highly improbable that the Tiger Fish will reach Lake Malawi from the Shire Valley because of the already existing HEP stations and water falls upstream of Hamilton at Kholombidzo, Tedzani and Mpatamanga Gorge which form formidable barriers.

8.5.9 Impact of the Project on Protected Areas

The project will open up maintenance roads on each side of the main canal. Experience from Kapichira HEP has shown that increased access routes leads to poaching and tree cutting (Ndadzera, Pers.Comm). To mitigate against these the DPNW will step up ranger patrols and mobilize the local communities to participate in arresting the culprits. A sensitization program involving the communities in wildlife protection is already in place supported by DNPW.

8.5.10 Project Impact on Tourism:

Improved roads in the project area will improve access to the Park and Reserve thus attracting more tourists than at present. This will go a long way in achieving the goals of the Department of National Parks and Wildlife Master Plan which aims at increasing usage of these facilities by the public as touristic areas.

8.5.11 Impact of Irrigation on Waterlogging

Waterlogging is of common occurrence in intensive irrigation, especially in arid and semi-arid areas. In irrigation, recharge may occur as a result of seepage from canals, water courses and even higher placed irrigated fields. Waterlogging is known to affect plants in general by changing the rhizosphere from an oxidizing to a reducing medium, especially over a long period thus reducing potential yields. The reducing medium may lead to chemical reactions whose end products are toxic to the plants which are not adapted.

The water table in Kasinthula area is at present more than 20m below ground level. The rise in water table should not exceed a few centimetres a year. In the ILLOVO sugar plantation further downstream, the water table has risen only by 1.5 m in 10 years. The fact that the project design has incorporated all remedial measures (drainage system) to control any possibilities of waterlogging, it is unlikely that it will be an issue of concern provided monitoring is carried out frequently and proper management of the drainage system is put in place.

8.5.12 Impact of Irrigation on Salinity

Chances of salinity affecting the proposed SVIP are real. Irrigation induced salinity is a problem of management arising from poor on-farm water use efficiency; poor

construction, operation and maintenance of irrigation canals leading to excessive seepage; inadequate or lack of drainage infrastructure, and poor quality of construction, operation and maintenance of drainage structures. Since the detailed design of SVIP has taken into account the canal seepage and drainage system, problems are only likely to arise from negligence in maintenance of these systems. Some soils in the project area are currently affected by salinity in the root zone (first 100cm or less). Routine measurements carried out in the field (273 samples) reveal salt content levels that are likely to prevent root development occur in less than 10% of the soils sampled (SFCD, 1992 and Lockwood Survey Corporation, 1970).

In the project design, waterlogging and salinization problems were anticipated and preventive measures which have been incorporated include: the lining of the irrigation canals, field watering with minimal deep percolation losses, and improved surface drainage. Other solutions to salinity problem include choice of crop, mulching, double row planting, and use of biological fertilizers. These are cultural practices which do not require additional financial inputs. Mitigation for expected operational and maintenance failures reside in the training of farmers and personnel who will be responsible for the operation and maintenance of the scheme. The success of the scheme thereafter will depend on the dedication and vigilance of those responsible for monitoring to ensure that adverse effects are identified in a timely fashion and reversed. Salinity, in particular, is difficult to reverse once high levels have been attained.

8.6 Project Impact On Water Quality

8.6.1 Water Quality

Shire River which is the planned source of irrigation water for SVIP is the main source for water for domestic use. The Shire River has multiple uses by various users. It has been observed that much of the domestic activities, including livestock watering are carried out directly in the Shire River, despite the threats of crocodile and hippo attack.

Comparative water quality data from various Shire River sites reported by Hall et al (1977) and Water Department (1995) indicated that the Shire River can be classified as relatively rich in dissolved nutrients with a moderately high hardness and

alkalinity. The result also indicated a constant pH of about 7.54, making it less alkaline than other rivers in the system (Dudley et al 1991). These results were confirmed when water samples collected in December 1995/January 1996 from seven stations along the Shire River and within the existing irrigation schemes of Kasinthula and ILLOVO sugar cane estate were tested. High Ec values (3220µs/cm) from SUCOMA factory drain were an indication of a high degree of salinity. These high EC values were due to the direct release of molasses and other factory effluent into the Shire River. The fact that Mwala Beach values further downstream are lowest (280µs/cm) demonstrates the salt attenuation or self-cleansing ability of the river over long distances (over 100 km).

Other water quality tests were done on samples collected from the Shire River and boreholes in October 2005. Table 8.4 shows results of water quality tests.

Table 8.4: Water Quality Test Results

Location	Ph	Nitrate (ppm)	Ammonia (ppm)	Phosphorus (ppm)	Total Hard (mg/L)	Chlorine(mg/L)	TSS (mg/L)	TDS (mg/L)
Bereu *(bh)*	8.7	0.076	2.22	0.5	172.16	3.55	19	14
Kasinthula *(pit)*	9.8	0.108	2.67	2.94	171.15	2.57	11	10
KCGL *(canal)*	8.1	0.098	1.46		174.16	2.44	28	14
Majete *(bh)*	8.1	0.058	1.67	0.1	203.18	2.39	28	12
Maseya *(bh)*	8.1	0.067	1.41	0.16	166.15	1.86	26	13
Nchalo *(Shire R.)*	7.4	0.045	1.44	0.28	158.14	3.01	27	15
Ntondezo (Mlomba) *(Shire R.)*	7.7	0.117	2.78	0.37	182.17	3.1	16	11

Presently Shire River is characterized by a high silt load especially during the rainy and flood seasons. This indicates a high degree of erosion in the catchment area, as well as the cultivated fields. In most areas, the river has virtually little chemical pollutants from domestic and industrial waste water.

The alkalinity of the Shire water also analysed and was found to be between 108-186 mg in three of the sites examined. At SUCOMA factory drain, the alkalinity is as high as 350 mg which is very high considering earlier estimates of 110 mg (Hose, 1977). High alkalinity may induce calcium and other micronutrient deficiency

resulting in a decrease in net income from high yielding varieties of paddy of more than 85% (Umali, 1993). The end result is high costs of inputs especially gypsum (calcium sulphate) to redress the situation.

8.6.2 Suspended Solids (SS)

Hall (1977) observed that in general in the dry season, the suspended solids are mostly of organic content and consist of living matter, whereas in the flood season it is composed mainly of less easily decomposed plant debris. Values obtained in 1995/6 (25-29 mg/l) are much lower than those reported by Hall et al in 1977 of 106 mg/l and Water Department in 1985 of 108 mg/l at Chikwawa.

During the operational phase, water quality will be affected by the activities such as agricultural practices, including application of chemicals, fertilizers, and pesticides. Residual products of agrochemicals will be transported downstream where their pollution will be experienced. Ground water quality will also be affected by agrochemicals through seepage. Improper waste disposal methods will also affect water quality downstream. Details on these impacts are provided below.

8.7 Impact Of The Project On Health

During the rainy season 30% of patients treated in hospitals were observed to suffer from water-borne diseases. The presence of irrigation water will prolong the wet season conditions from four months to twelve months. With the prevalence of water-borne disease remaining at the level of 30%, the number of patients suffering from water-borne diseases will triple in any given year, thus worsening the current situation on bed occupancy in hospitals. To arrest the situation, the SVIP management in collaboration with other partners should intensify efforts to control water-borne disease vectors. The MoHPS and the SVIP management will have the following major functions in the control of malaria and schistosomiasis which are main water-borne diseases: conduct preventive vector borne disease-control activities including surveillance of vectors; application of molluscicides and insecticides to canals and picking up the molluscs and eradication of vectors; disseminate improved hygiene practices to the local people. Preventive disease control activities will involve the application of the chemicals to the stagnant water.

It is expected that several NGOs will assist in providing insecticide impregnated mosquito nets, drugs (through community based systems and pit latrines).

8.8 Impact Of Agrochemical Usage

8.8.1 Impact of Using Fertilizers on Ecosystem

Generally, fertilizer is used either at planting or as top dressing. Fertilizers used at planting are usually phosphate-based and are applied singly or in combination with nitrates. Phosphates alone have no serious detrimental effects on the environment but in the presence of calcium they may cause alkalinity. On the other hand, fertilizers used as top dressing are ammonium based and increase soil acidity. It is recommended that calcium nitrate that supplies water soluble calcium and has a non-acid reaction in soils be used in the fields. Regular application of calcium nitrate will reduce the need for lime application on acid soils. Other mitigation measures on chemical fertilizers are the use of green manure, compost manure and animal manure, which is already being promoted by the Ministry of Agriculture and Food Security. For those who cannot readily afford fertilisers there is need to encourage the use of organic fertilisers.

8.8.2 Impact of Pesticides and Herbicides on Ecosystem

Other agrochemicals commonly used include: biocides to control pests, vectors, weeds and diseases of plants and livestock. All agrochemicals fall into three major categories: organophosphates, organochlorines and pyrethroids. Pyrethroids are more environmentally friendly than others because they have a rapid rate of degradation. They may, however, cause hypersensitivity (allergy) in some humans. Examples of such pyrethroids are Fenvalerate (Sumicidin) and Permethrin.

Organophosphates are also environmentally friendly though they do not degrade as quickly as pyrethroids. They include Lebaycid (Nemacur), Pirimiphos methyl (used together with Permethrin in the preparation of Actellic), and Trichlorfon (Dipterex). They act by inhibiting the enzyme acetylcholinesterase thus blocking acetylcholine which is essential for the cell's functions.

Organochlorine or organochlorine-like chemicals include Endosulfan, and Chlorothiolonil (Daconil). The latter is also known to cause allergic reactions in

humans. Organochlorines are responsible for most environmental pollution as residue because they degrade very slowly. Fortunately, their effect may be achieved by the use of organophosphates and carbamates. Carbamates include carbaryl (Sevin). Carbaryl (Sevin), a carbamate, and Dithane m-45, which are used as acaricide and fungicide respectively, are known carcinogens with the latter being a goitergen in addition. Another commonly used chemical is copper oxychloride which is not recommended for use in horticultural crops because copper does not breakdown. Copper oxychloride is popular because it is both cheap and effective.

Generally, the use of herbicides should be discouraged mostly because many are non-selective, expensive, and very toxic, and have adverse effects on environment. Moreover, their effects can be cheaply and safely achieved by physical removal and burning, especially in areas where labour is freely available as is expected of SVIP. Herbicides however continue to be used indiscriminately as in a recent case near Alumenda where ten heads of cattle died after contact with herbicides (SVADD, DVO pers, Comm 1995). The most common and most dangerous is Paraquat (grammoxone) popularly known to farmers as "hit and go" because of its effectiveness. Grammoxone is so dangerous that it will seriously affect humans on contact with any part of the body. Several others which are also dangerous to humans include Glyphosate (round-up), 2-4-D, Linuron, Atrazine and Lasso (Alachlor). The last two can be combined or used as stand alone products.

Currently, the use of agrochemicals in the project area is minimal. Once the project is operational, the major concern will be the introduction of high yielding varieties which will demand heavy use of agrochemicals. Mitigating factors on the use of agrochemicals lie in the selection, which includes those that are degradable within 7-14 days. Other mitigating factors include integrated pest management.

8.8.3 Integrated Pest and Disease Management (IPM)

The key to a successful pest and disease control is to have a thorough understanding of the cause of each disease, its nature, and how it relates to each crop. Understanding how the causal agent (pathogen) is spread from place to place, how it infects the plant (plant-host relationship), and ways it may be affected by management techniques are essential for successful IPM. Use of resistant

varieties, cultural practices and chemicals as a means of managing certain diseases is also helpful in this regard. However, no one practice can be relied upon to manage pest and diseases. The pest and disease management, then, must be planned in advance of the crop year. Management decisions should include the careful consideration of the disease problems present and the degree of severity. Only with a combination of practices (integrated management) can farmers plan effective pests and disease management that will last. Some of the methods used when implementing the IPM are discussed below.

(a) Crop Residue Destruction

This practice has been effective in controlling pests like stock borers in maize, sugar-cane, sorghum and rice. It is also successful against earthworm in maize, leaf blight and leaf rot in rice, moulding and bacterial blight in cassava. This is best done by a combination of ploughing and dicing (harrowing) two - three times. In the case of maize the best form of crop residue destruction is burning. In addition, the destruction of old tissue exposes the pests to adverse environmental elements. For example, root-knot nematodes are very sensitive to drying. If the root tissue surrounding them decays, they are exposed to the drying action of the wind and sun. Mosaic virus particles become inactive quickly after they are freed from crop tissues. The method is also effective in controlling psyclids which are difficult to control by pesticides.

(b) Ridge Planting Wide Row or Bed

The development of a high ridge and wide bed for crops is important to provide roots with proper conditions for root development. It helps to provide for good irrigation channels and drainage for root systems in areas of fields that tend to become waterlogged. Most causal agents that affect the crop root systems are favoured by poor drainage or high moisture content. Ridging is a normal cultural practice in LSV and its wider use will not require extra financial inputs.

(c) Spacing

Spacing crops too closely provides a dense canopy where moisture is retained on lower leaves favours infection and disease development. This is especially true of above-ground diseases, such as Brown spot and Blue mould as well as other fungal

diseases. Pests also find it easier to move from one plant to another through the closed canopies. Wider spacing provides for more sunlight, better aeration and better drying conditions for the foliage.

(d) Balanced Fertilization

Disease causal agents are generally favoured by unbalanced fertilizer application. Some pests, such as root-knot nematodes, are favoured by deficiencies of potassium. On the other hand, other causal agents such as black shank fungus are favoured by excessive nitrogen. Usually, a healthy crop is one that has received balanced fertilization. This method has been fairly successful in controlling leaf rot and leaf blight in rice.

(e) Early Planting

This gives the crop enough time to develop the ability to withstand the destructive effect of pests and diseases. This method can be a good control measure for streak virus in maize and mealybug in cassava.

(f) Crop Rotation

This is a cultural practice that has been effective against nematodes. The objective of crop rotation is simply to deny the causal agent a suitable host. A longer rotation will result in more beneficial effects to the program. When a crop is grown continuously, pests and diseases populations feed and increase every year setting them up for devastating crop losses. Therefore, if the project adopts a cropping pattern whereby winter crops of different genetic family are grown, it will assist in reducing crop pests.

8.9 Impact Of Irrigation Project On Agro-Processing

8.9.1 Impact of Agro-processing Establishment on Ecosystem

There are few agro-industries in the Lower Shire Valley region some of which include the ILLOVO sugar plant, two cotton ginneries and three rice processing plants and a few maize mills. Rice milling will generate some husk which if not properly handled can be an environmental hazard. Various methods have been developed which can recycle husk. They include using them in making charcoal briquettes.

8.9.2 Cotton Processing

Virtually all seed cotton used to be ginned at either Bangula (capacity of 40,000 bales of lint) or at the new gin at Ngabu. The gins were owned by ADMARC. Cotton production will be increased with rainfed areas during the project operation and since cotton ginning produces dust, it is expected that dust volume will be increased. Some noise will be generated by the ginneries and maize/rice mills but this will be mitigated by locating them away from settlements. Positively, the organic residual material from rice, maize and cotton will be composted and re-used as natural fertilizer. Production of cotton seed cake as animal feed will be another positive impact. To mitigate for dust in both cases it is recommended that the workers be equipped with protective clothing such as overalls, face masks, gloves, etc.

8.9.3 Sugar Cane

It is expected that a new sugar processing factory will have to be constructed to process cane from 20,000ha and above of smallholder sector production. This will generate sugar by-products such as molasses, i.e about 70,000 kg per year, and bagasse. Bagasse is fully utilized to fuel the processing plant and the main environmental impact lies in the smoke produced which is soon dissipated. Considering that ILLOVO is now selling its residual molasses to an ethanol producing concern in Chikwawa, this has mitigated the impacts of dumping it in some river. The capacity of the ethanol plant may have to be increased to cater for additional volumes of molasses.

8.10 Decommissioning Phase Impact

The lifespan of any irrigation project depends on how well the canals are maintained and the replacement of equipment. It is unlikely that the project will become obsolete unless there is negligence and laxity on the part of management. The economic life of the equipment and machinery will however, be realized after a certain duration thus necessiting replacement and or disposal. Economic life of regulatory gates at the intake is estimated at between 25 and 30 years. Vehicles have an economic life of five (5) years after which they are sold. It is suggested that vehicles be disposed in serviceable condition as this will eliminate chances of

dumping. Un-utilizable metal from equipment will be used as scrap in the local industry. If dumping is unavoidable, then a dumpyard workshop site must be identified off the scheme.

8.11 Analysis Of Project Alternatives

Three options were considered in the analysis. These are: the No Project Option where the current status quo is maintained; the pump-fed irrigation option; and continuation of the self-help schemes. These options are assessed bearing in mind the invested capital, recurrent expenditure, institutional, training and monitoring requirements as well as their potential environmental impact.

8.11.1 No Project Option

In a natural environment and for the purposes of biodiversity conservation adoption of a `No Action' option is the most preferable. In a situation where development and environmental conservation are to compete, environment loses to development. It is for this reason that governments have formulated policies that control development to ensure a "sustainable development". The No-project scenario implies maintaining the current rainfed agriculture and the associated dimba cultivation. During the survey, the "no project" parameters assessed included the following: Local people's attitudes towards the project, soil erosion, habitat changes, local employment, local business, food security, fauna and flora, land-use, resettlement of people, water availability, and animal behaviour. Table 8.6 summarizes the "pump-fed" impact and Table 22 presents estimated costs of the alternatives.

Table 8.6: Assessment of Alternatives

	No Project	Pump-Fed
Design	- Not required - Rainfed agriculture - Dimba cultivation	- Easy to design - Requires many intakes and pumps. 669 pumps - Pump intake cost of MK13.6 billion - Pump pipes and sprinklers at 40% of cost MK5.44 billion
Site	All of the Lower Shire Valley region	<u>West bank</u> - Suitable for crop production - Will relocate and resettle human population - No impact on Lengwe and Majete <u>East bank</u> - Will require draining existing marshes with severe negative impact on flora and fauna especially fisheries - Will have no serious impact on settlements - Will be liable to seasonal flooding by the blockage effects of the Ruo River.
Technology and operation and management	- Oxen cultivation - Hand tools - Simple tools - Local varieties - Crop protection where necessary - Traditional marketing practices	- Mechanized agriculture - Canals and drains necessary - High yielding varieties - Crop-protection necessary - Developed market system
Training requirements	- Current T&V adequate - Field visits to groups by staff and NGOs	- Essential - Agricultural extension intensified - Staff training required
Institution requirement	- No T&V necessary	- Requires marketing institution - Input delivering systems
Suitability to local condition	- Suitable	- Suitable but training required
Monitoring	- Not required	- Simple monitoring

Table 8.7: Costs of Each Alternative

	No Project	Pump-Fed
Capital investment		MK 13.6 billion
Recurrent costs	MK 336 million p.a MK 10.08 billion for 30 years	MK 5.536 billion per annum @ MK166.08 billion for 30 years.
Environmental costs		MK 55.2 million per annum Total for 30 years is MK1.188 billion
Benefits	MK 360 million p.a MK10.8 billion for 30 years	Total for 30 years MK 201.6 billion

Table 8.8: Positive and Negative Impact of Selecting the West Bank

Positive	Negative
1. Most of land is suitable for crop production. 2. Interference with Majete and Lengwe National Parks.	1. Human relocation and resettlement. 2. Impact negatively on the protected areas (Majete/Lengwe NP).

Table 8.9: Positive and Negative Impact of Selecting the East Bank

Positive	Negative
1. Excellent fishing habitat.	1. Most of the land is marshy and unsuitable for crop production. 2. Mostly unsuitable for human habitation. 3. Fishery can not sustain the population. 4. Drainage of marshes will seriously impact on the hydrology of Shire River. 5. The Shirre River plain is liable to seasonal flooding.

8.12 Environmental Management And Training

8.12.1 Environmental Management

The environmental management and monitoring unit (EMMU) will be within the realm of the overall Project Management. It will be a management unit with environmental monitoring and laboratory sub-units. It will be operated by a total of 11 members of staff as shown in organogram in Figure 7.10. It will report directly to the Board of Directors of the Project Management agency. It is recommended that the existing laboratory facilities at Kasinthula Research Station be staffed and equipped to cater for SVIP environmental monitoring program.

The Environmental Management Unit will manage all environmental aspects related to the Project, including the following:

- Prepare short-term and long-term plans;
- Coordinate inter- and intra- institutional matters related to EMMU;
- Cope with expected/unexpected environmental programs;
- Establish environmental standards and criteria;
- Research and develop appropriate technology for environmental management and monitoring related to the project area.

Whereas all monitoring will be done on a continuous basis, some data will be needed for short term management decisions, such as disease epidemics. In such cases, emergency teams will have to be mobilized. Long term management decisions are expected to be dictated by the cumulative effects of baseline data. This data will be collected by continuous recording machines at preset intervals such as those dictated by seasonality, or the accumulation of diverse parameters (surveillance monitoring) as indicators of negative or positive trends in environmental productivity and health. Technical specification for environmental monitoring and management of water quality, vector-borne diseases and resettlement are shown in Tables 8.10, 8.11, and 8.12.

Table 8.10: Technical Specification of EMM (Water Quality)

Item	Water Quality in the Intake	Water Quality in the Irrigation Area and the Downstream Area
A. Purposes	1. To monitor water quality during the construction and operation period. 2. To check and review the quality of drained water for daily use by the local people. 3. To establish a management criterion of water quality.	
B. Targets	a) Conditions of reservoir water quality. b) Waste water discharge to the reservoir. c) Reservoir water use by the local people.	a) Water quality in the drainage canal. b) Conditions of river water quality. c) Domestic water use conditions of the local people.
C. Organization points	1. The EMM Unit of the Project in co-operation with Management Agency 2. The Unit reports the result to the Board of Directors regularly.	
D. Monitoring points	Points as below: 1. Main canal at reach 1-5. 2. Drainage water from irrigation fields. 3. Effluent from sugar factory and other processing industries.	
E. Monitoring period and frequency	1. One time per month from 3 months before the commencement of the construction works. 2. One time per month during the construction and operation period.	
F. Monitoring device and materials	1. Compact water quality analyzer of DO and COD. 2. Compact water quality analyzer of pH, Ec, NH4-N, NO_2-N, NO_3-N, T-N, T-P. 3. Thermometer and other goods for water sampling. 4. Necessary equipment and reagent for water quality analysis in LAB.	

Table 8.10: Technical Specification of EMM (Water Quality) cont'd

Item	Water Quality in the Intake	Water Quality in the Irrigation Area and the Downstream Area
G. Water sampling and analysis method	1. To get surface water by bucket and put water in a sampling bottle. 2. To put samples in a bucket and bring them to the laboratory as soon as possible. 3. To measure air and water temperature, pH and Ec in the field. 4. To avoid sampling in the rainy day and flood condition. 5. To measure river flow discharge and to record colour of water at the sampling time. 6. To analyze water quality by the standard analysis method in Malawi. 7. To analyze microbiological status <u>in situ</u> when necessary.	
	a) To analyze the following water quality items: (pH, DO, COD, T-N, T-P) b) To check type, number and location of a grid chamber and sedimentation pond c) To check a pollution source in and around the reservoir area	a) To analyze the following water quality items: (pH, Ec, COD, NH_4-N, NO_2-N, NO_3-N, T-N) b) To check type, volume, area, and time of fertilizer application in the irrigation area. c) To check a drainage system of irrigation water.
H. Data arrangement	1. To calculate the following basic data for evaluation. - Maximum value ($C_{max.}$), Minimum value ($C_{min.}$), Mean value (C_{mean})	

I. Analysis	a) To check a chronological change of water quality by month and year. b) To check and review the domestic water use of the local people c) To compare the values with a management criterion prepared by EMMU sub-unit. d) To check and review the pollution sources around the reservoir area. e) To check the effect of counter-measures taken by the project. f) To have annual meeting with SVIP Board to report and discuss the monitoring result.	a) To check a chronological change of water quality by month and year. b) To check and review the domestic water use of the local people c) Domestic water use conditions of the local people.
J. Possible measures to be taken	a) Treatment or interception of waste water. b) Control of land-use in the catchment area. c) Removal of vegetation in the reservoir d) Aeration of the reservoir water. e) Control of fishery in the reservoir.	

Table 8.11: Technical Specification of EMM (Vector-borne Diseases)

Item	Regional Public Health Conditions of the Local People	Conditions of the Vector Control (Malaria) and Schistosomiasis)
A. Purposes	1. To monitor water public health conditions of the local people in and around the Project areas. 2. To check the effect of preventive measures taken by the Project. 3. To provide basic data to EMA for the effective management of impact caused by the Project. 4. To provide basic data to the regional health authority for formulation of an effective management program related to the regional health and the control of vector-borne diseases.	
B. Targets	a) Number of patient and morbidity suffered from vector-borne parasitic diseases. (Malaria, Schistosomiasis and other water-borne parathtic diseases) b) Inquiry survey of the local people about vector-borne diseases and sanitary conditions.	a) Population and distribution of intermediate vectors. b) Preventive activities against the prevalence of intermediate vectors.
C. Organization in charge	1. The EMM Unit of the Project in co-operation with the regional health authority.	
D. Monitoring area	1. In the existing and newly developed irrigation areas.	
E. Monitoring period and frequency	a) Monthly data collection and inquiry survey during construction period and the first 3 years after completion. b) Bi-monthly data collection and inquiry survey after the first 3 years. c) Annual meeting with the regional health authority.	a) Monthly surveillance and inquiry survey during construction period and the first 3 years after completion. b) Bi-monthly surveillance and inquiry survey after the first 3 years. c) Annual meeting with the regional health authority.
F. Monitoring device	1. No specific device will be needed for monitoring	
G. Measurement method	1. To record data and information obtained from the concerned agencies and organizations. 2. To record data and information obtained from field surveillance and inquiry survey.	
H. Data arrangement	1. To arrange all relevant data and information for analysis and evaluation description in Item G.	

Table 8.11: Technical Specification of EMM (Vector-borne Diseases) cont'd.

Item	Regional Public Health Conditions of the Local People	Conditions of the Vector Control (Malaria) and Schistosomiasis)
I. Analysis	a) To check a chronological change of patients monthly and yearly. b) To check the effect of counter-measures taken by the Project. c) To analyze the relation between the Project and the prevalence of vector-borne diseases. d) To prepare a data bank for implementation of preventive countermeasures.	a) To check a chronological change of population and distribution of intermediate vectors monthly and yearly. b) To check the effect of countermeasures taken by the Project. c) To analyze the relation between the Project and the prevalence of intermediate vectors. d) To prepare a data bank for implementation of preventive countermeasures.
J. Possible measures to be taken	a) Implementation of public health services. b) Enforcement of preventive measures. c) Education and dissemination related to improved sanitation.	a) Enforcement of preventive measures. b) Eradication program.

Table 8.12: Technical Specification of EMM (Resettlement)

Item	Following up of the Compensation and Resettlement Plan	Socio-economic Conditions of the Displaced People
A. Purposes	1. To monitor the compensation and resettlement program of the Project succeeding to the role of the Task Force. 2. To support the displaced people socially and economically, and counsel to them. 3. To conduct a social indicator survey to obtain the basic data related to the current socio-economic conditions of the people around the reservoir area and the resettlement area. 4. To provide basic data to the EMA sub-unit and concerned agencies for the effective management of compensation and resettlement activities.	
B. Targets	a) Progress of the compensation and resettlement plan of the Project b) Finding of crucial problems and constraints among the displaced people.	a) Implementation of a social indicator survey. b) Effect of the resettlement plan c) Finding of crucial rattlers and the people living around the reservoir.
C. Organization in charge	1. The EMM Unit of the Project in co-operation with the concerned agencies.	
D. Monitoring area	1. Around the intake areas of Lower Shire Irrigation Project. 2. In the resettlement area.	

Table 8.12: Technical Specification of EMM (Resettlement) (cont'd)

Item	Following up of the Compensation and Resettlement Plan	Socio-economic Conditions of the Displaced People
E. Monitoring period and frequency	a) Monthly data collection and progress check of the compensation and resettlement plan from the preparation period to transfer period. b) Biannual meeting with the concerned agencies.	a) Annual social indicator survey during the transitional period. b) Annual meeting with the concerned agencies. c) A post evaluation in the self-sustenance period.
F. Monitoring device	1. No specific device will be needed for monitoring	
G. Measurement method	1. To record data and information obtained from the local people and the concerned agencies. 2. To record data and information obtained from a social indicator survey.	
H. Data arrangement	1. To arrange all relevant data and information for analysis and evaluation description in Item G.	
I. Analysis	a) To check the progress of compensation and resettlement plan monthly and yearly. b) To check the effect of supporting and counselling activities taken by the Project. c) To clarify socio-economic problems and constraints, and to propose a solution to them. d) To prepare the data bank for implementation of additional countermeasures.	a) To clarify socio-economic problems and constraints, and to propose a solution of them. b) To check the effect of supporting and counselling activities taken by the Project. c) To conduct a post evaluation of compensation and resettlement activities. d) To prepare the data bank for implementation of additional countermeasures.
J. Possible measures to be taken	a) Participation of the local people. b) Rigid and fair implementation of compensation and resettlement plan.	a) Enforcement of supporting services. b) Implementation of regional development program.

8.12.2 Environmental Management Training

The National Resource College in Lilongwe trains technicians in various fields. It is recommended that the College adopt an environmental oriented curriculum. It is expected that the trainees will be deployed from the College to carry out extension and training of the farmers.

(a) On the Job Training

On the job training for the staff will be organized in form of short courses (1-3 months); seminars (2-3 days) and day training centres which exist in Shire Valley ADD. Trainers of staff will be sourced from the Department of Environmental Affairs, University of Malawi NGOs and others. The total cost of training for both staff and farmers is about MK 800,000 per annum. Training schedule for staff will commence immediately after project approval and will consist of on-the-job training. Additional training for staff will follow after assessing needs and will be complemented with training programmes offerd by other stakeholders.

(b) Community Training

Farmer training schedules will start during the construction stage and will be a continuous exercise. After construction environmental training will focus on the implementation of the recommended mitigation measures such as afforestation. In Phase I, there are over 7,000 farmers in the project area. It is expected that 2,000 farmers will be trained per year for 5 days each.

(c) Organisation and Management Training

Farmers training will be organized by Field Assistants. The training venues will include day training centres where the majority of farmers will be trained. A few farmers will be trained in other training centres based in RDPs. These will be exposed to more detailed environmental management techniques.

(d) Village Woodlots Extension and Training

Participatory afforestation can be achieved when there is a change in attitude in smallholders from being only consumers to becoming producers of wood. The role of Forestry Extension involves intervening in social systems in order to bring about changes in attitudes and perceptions towards the restoration and conservation of

forest/tree resources. Forest Extension should therefore advocate the strategy of enabling rural people to acquire through training the knowledge and skills necessary for them to restore and manage forest resources. Fighting loss of trees/forests calls for appreciation that the emphasis should not only be of provision of fuelwood but emphasis should be broadened to embrace multiple functions of tree/forest.

Guiding a community to systematically plan, establish and manage a woodlot requires well trained Forest Extension workers. Over the years, Forestry Department has invested in training extension offices in participatory skills through short courses and hands-on experience and can therefore provide the necessary back-up assistance to the project management. The training process for smallholder farmers should aim at building capacities of individual households as well as communities.

(e) Maintenance Issues

Maintenance issues that require to be closely monitored are those that may lead to immediate operational failure. These may arise from blockage of canals due to siltation, prolonged droughts and lack of commitment by the local people. Commitment is proportionate to project benefits which could be either aesthetic or monetary. Other factors that could lead to operational failures include lack of skilled labour; lack of market outlets; use of poor quality seeds; use of improper agrochemicals; and lack of support by the Government.

In order to have an effective project maintenance program in both short and long term plans, the following resources need to be availed: well trained project maintenance technicians from the community benefitting from the project; attendants selected from small-scale farms and irrigation scheme. The responsibility of the attendants will be to report to the management any faults that may lead to failures.

An ad-hoc assessment of the level of commitment and capability of the local people and the GOM in maintenance during the operational phase was carried out by the EIA team and results are summarized in Table 8.13.

Table 8.13: Level of Commitment/Capability by GOM and Local People during the Project Maintenance.

Level of Commitment/Capability		
Maintenance Activities	**GOM**	**Local community**
Clearing vegetation	Capable*	Capable and committed
Detecting leaks and overflows	Capable*	Committed but not capable
Recording faulty gate valves	Capable*	Committed but not capable
Daily checking	Capable*	Committed but not capable
Servicing gadgets	Capable*	Not capable
Financing maintenance	Committed	Committed

*** indicates that although they expressed capability they require training.**

8.12.3 Organization Of Environmental Management And Monitoring (Emm)

Effectiveness of any monitoring programme will depend on the level of the personnel commitment that in turn is dictated by incentives availed to the staff. It is suggested that a functional multidisciplinary task forces or working groups comprising experts in the various issues to be monitored and consequently managed be formed. In the case of the Shire Valley Irrigation Project EMMP implementation staff will be sourced from an inter agency co-ordination team selected from the following Departments: Electricity Supply Corporation; Water Department; Fisheries Department; Department of National Parks and Wildlife; Department of Land Resources and Conservation; National Herbarium; Economic Planning and Development; Department of Forestry; Ministry of Health and Population Services; Department of Irrigation Services; interested and affected NGOs. It is important that each Agency appoint a member to the Task Forces to assure continuity.

Co-ordination will occur on two levels. The main co-ordination body will be set up within the SVIP Management Agency. Several subsidiary task forces or working

groups will plan and carry out monitoring programs in specific subject areas. The responsibilities of the Task Forces will include:

* Setting up mitigation or monitoring issue working group
* Defining environmental and corresponding mitigation activities
* Receiving additional mitigation and monitoring suggestions from the working groups
* Controling mitigation and monitoring funds
* Identifying additional funding
* Ensuring that mitigation and monitoring plan activities are carried out
* Updating all working groups on the progress and performance of the project (funding, construction schedule, changes in plan and other duties as agreed by the Task Force).

Working groups will establish, co-ordinate and carry out through their mother departments monitoring and mitigation activities related to their specialization. Some of the working group's activities will include:

* Preparing and updating of monitoring programs;
* Planning and co-ordinating field data collection,
* Data analysis;
* Report writing and making recommendations to the main task force.

Working Groups will hold regular meetings and workshops to review progress. Since monitoring and mitigation plans are built into the overall project from the proposal to the implementation and operational stages, it is suggested that the first meeting should occur within one month after project funding approval. Follow up meetings should be scheduled every six months.

8.12.4 Cost Estimates of Establishing Environmental Monitoring Unit

The total cost of establishing the environmental monitoring unit is estimated at MK 21.412 million of which MK17.986 million is for capital costs and MK3.426 million is recurrent cost per annum.

8.13 The Phasing And Implementation Schedules Of Interventions On Environment

Since the GoM has proposed to implement the project on a phased basis, environmental management interventions will also be implemented in phases to ensure equity in the use of the resources. The phasing and implementation schedule of major environment interventions fall under three project stages, namely; preparatory stage, construction stage and operation stage.

8.13.1 Preparatory Stage

During this stage the local project community will be mobilized and sensitized on environmental issues through participatory programs such as establishment of community tree nurseries. The second part of the preparatory stage will involve the establishment of the organization to oversee the construction works including monitoring of the environment. The third part will involve resettlement, and compensation of private properties. It is emphasized that any measures to counter negative impact will be incorporated in the project from this early preparatory stage.

8.13.2 Construction Stage

This stage will involve construction of new settlements, pit latrines, farm irrigation and drainage facilities, construction of auxiliary works such as water harvesting dams in catchment areas, water treatment works, and crossing paths for animals in game parks and access roads. Committees comprising professionals from the impacted departments, the contractor and an independent overseer will be formed to ensure that construction proceeds as per EIA recommendation; for instance, ensuring that safety measures for draining excess water to avoid creation of breeding places for waterborne diseases's vectors.

8.13.3 Operational Stage

The procurement of equipment and O/M equipment will take place after completion of construction works. Environmental Management and Monitoring (EMM) equipment will be procured as soon as possible during the construction period. Incorporation of the EMM during the initial planning stage ensures that key environmental concerns are built in the overall project design and this makes it easy to implement mitigation measures.

8.14 Establishment Of A Review Commission

The procedures involved in an environmental assessment are to ensure that development options are environmentally sound and that future alterations of the environment with possible significant consequences are taken into account from the outset of the project. Environmental assessment starts from the screening stage to appraise the project or components to the project according to the amplitude and sensitivity of the environmental issues examined. The screening process determines the category where the expected impacts belong, and whether a full EA is necessary. It is carried out through an environmental impact study culminating in the environmental impact statement (EIS). The Environmental Management Act, 1995 has prescribed the minimum requirements for EIA as a description of the proposed activity or project and of activities it is likely to generate; a description of the segment of the environment likely to be affected by the proposed activity; a description of the technology and processes that shall be used and the main alternatives and the reasons for rejecting them; reasons for selecting the site and rejecting alternative sites; environmental impact of the proposed activity including the direct, indirect, cumulative, short-term and long-term effects; an identification and description of measures proposed for elimination, reducing or mitigating the anticipated adverse effects; an indication of whether the environment of any other state or area beyond the limits of national jurisdiction are likely to be affected and the mitigating measures to be undertaken; a brief description of how the information has been generated; an identification of gaps in knowledge and uncertainties which are encountered in compiling the required information; and any other matter that may be prescribed.

The processes referred to above constitute an environmental review process which determine the environmental impact analysis of alternatives, mitigation plans and environmental management and training and monitoring plans. This is the process which lays the foundation for the execution of an environmentally sound project.

Another process is the Review of the EIA which is aimed at assessing the adequacy of the EIA prior to the commencement of the project implementation phase basing the assessment on the minimum EIS requirements. According to the Environmental Management Act, 1995, the review of the EIA will be carried out by the Director of

Environmental Affairs who will then invite public comments, require the holding of a public hearing if he/she deems necessary, approve the project if he/she is satisfied that the project in respect of which the environmental impact statement is submitted shall not result in significant injury to the environment, require, if necessary that the developer re-design the project taking into account all environmental factors and the comments made and reject the project where he/she has reasonable cause to believe that the project may cause significant and irreparable injury to the environment.

The Environmental Management Act, 1995, also defines the Terms of Reference of the Review Commission. It is recommended that the Team be composed of Government representatives from the core ministries and departments co-ordinated by the Department of Environmental Affairs including the Ministry of Natural Resources and Environmental Affairs, with its Departments of Forestry, Geological Surveys, Fisheries and National Parks and Wildlife; the Ministry of Agriculture and Food Security; the Ministry of Economic Planning and Development; the Ministry of Irrigation and Water Development; the Office of the President and Cabinet; Ministry of Lands, Physical Planning and Surveys; District Administration and Rural Development; Ministry of Housing; Ministry of Finance; and the Ministry of Local Government. This core team will be supported by professional bodies such as the Malawi Bureau of Standards (MBS), University of Malawi, Parastatal representatives and members from the private sector including industry, the NGOs, the press and other interested parties who will be co-opted from time to time as the need arises.

Table 8.1.1: Summary of Environmental Impacts of the SVIP and Proposed Mitigation Measures

Highly Negative | Negative | No Impacts | Positive | Highly Positive

CONCERN		CONSTURCTION & PRE-OPERATION			OPERATION		
Issue	**Location**	**Impact**	**Significance**	**Mitigation[1]**	**Impact**	**Significance**	**Mitigation**
Climate		No change in local climate. No effect globally		No mitigation necessary	Generally local climate will be changed, as area will be humid. Crop diseases favouring this condition may increase (vegetables)	Will contribute to reducing crop yield if no crop management is put in place	Plant crop varieties resistant to crop disease
Hydrology	Above weir	There will be a backing up ow ater due to the weir as soon as construction is completed. There wil be some inundation of the immediate banks upstream of the weir.	Changes will only affect the immediate banks of the Shire River.	No mitigation necessary	Seasonal fluctuations in the water depth depending mainly upon the river discharge.	Hydrology upstream of Hamilton Falls will be unaltered	No mitigation necessary
	Downstream	As the weir is filling a minimum downstream environmental flow of $170m^3/s$ will be maintained to meet the requiorements of downstream users.	There will be minimal changes in the hydrology of the river system. The major impact will be an increase in suspended solids and bed load due to construction activities.	Minimise the discharge of silt and other suspended load. No other mitigation is necessary.	Since river flow depends on discharge control at Kamuzu Barrage, Liwonde, there will be no significant water flow reduction.	Rainy season impacts will not be significant as peak flood flows and downstream inundation will not change.	No mitigation necessary.
Sediment load and channel morphology	Above weir	River sediment will be retained by weir once impoundment begins. The bed and suspended load will not affect the river as self flushing gate will be constructed	Only small amounts will be retained during the short filling period	No mitigation necessary	Most sediment in the river upstream will be retained by the weir	Data suggest that sediment carried by the river has increased, so sediment retention in the reservoir could be an important issue. There has been wanton cutting down in the catchment and wild fire	Will be investigated further by water quality and sedimentation studies, mitigated by improved land management in catchment
	Downstream	Excavation of riverbed below the weir to create the profile necessary to allow safe passage of peak flood flows. Addition of riprap and gabions to protect the river bed	Disturbed material could be carried downstream by river flow, but this will be a temporary impact and is thus not greatly significant. Caution will be given to reducing sediment loading in Kapichira Hydro-Electric Dam		Reduced sediment load will not cause erosion downstream because most flows will not be strong enough to mobilize mainly coarse sediments.	There will be insignificant changes in the river morphology as normal donstream flows will be maintained.	No mitigation necessary

CONCERN		CONSTURCTION & PRE-OPERATION			OPERATOPN		
Issue	**Location**	**Impact**	**Significance**	**Mitigation[1]**	**Impact**	**Significance**	**Mitigation**
Geology	Above weir	There is no likelihood of landslips because filling behind the weir will be gradual.	Landslips are unlikely as weir will fill gradually, so soils will adjust to changing hydraulic conditions	River bank slopes will be monitored during impoundment for early detection of earth movements	No impact on the foundations and banks of the river.	Unlikely to be a major issue.	There will be minimum disturbance of the environment.
Wildlife, soil and land use	Above weir	Gradual inundation, there will be no loss of wildlife as weir impoundment progresses.	No significant impacts.		Access for wildlife to the Shire River will be maintained. Poor land use within the catchment may continue bringing sediments into the river.	Increase in sediments flowing into the river will have a significant effect on the life of the structures on the Shire River. There will be slight inundation and minimum loss of land within the game reserve.	Environmental conservation and sustainable land use techniques to be promoted. Involve the community in environmental management. Collaboration between concerned departments, the Project Management Authority, and concerned stakeholders to be established for common action.
	Downstream	No change in existing situation	No impact	No mitigation necessary	No change in the situation.	No impact.	No mitigation necessary
Water supply	Above weir	No change.			No change, no settlements within the game reserve.	No change, no impact.	No mitigation necessary.
	Downstream	No change; riparian environmental flows to be maintained during construction.	Provision of minimum environmental flow should ensure that water continues to be available for downstream users	No mitigation necessary	Water use will continue normally. Irrigation communities will benefit from new source of domestic water supplies as well as irrigation	Major benefit	No mitigation necessary. However, the water must be treated to kill water borne disease and bacteria
Groundwater	Upstream	Water table will gradually rise in vicinity of reservoir as impoundment proceeds.	No impact on water supply for wildlife however, seepage may allow some grass to sprout and provide wildlife with feed during dry season.	No mitigation necessary	No significant change.	No significant change.	No mitigation necesary.
	Downstream	Environmental flow should ensure that groundwater downstream is not affected	No impact	No mitigation	Irrigation may gradually reduce the depth to groundwater table.	Not significant with respect to groundwater	Maintain working drainage sytem to avoid detrimental rise in groundwater levels.

CONCERN		CONSTURCTION & PRE-OPERATION			OPERATION		
Issue	**Location**	**Impact**	**Significance**	**Mitigation[1]**	**Impact**	**Significance**	**Mitigation**
Water quality	Upstream	No significant changes. Mixing of waters to maintained since normal flows will be maintained.	Temporary impact, especially during construction.	There will be no need for removing any other vegetation apart from that around the construction site.	No stratification expected in the impoundment behind the weir.	No significant impact.	No mitigation measure.
	Downstream	Excavation of riverbed and provision of concrete & riprap bank protection downstream of dam could contaminate the river.	Possible spills of fuels, cement etc could be toxic for aquatic organisms and human users. Increased sediment could affect aquatic plants and animals. No major significance as impact will be temporary.	Construction site to be secured from normal diversion channel in order to reduce contamination.	Improved quality river water as weir will retain suspended sediment.	Benefit for aquatic ecology and human users of river water	No mitigation necessary
Terrestrial Flora					Some loss will be experienced along the route of the canal and around the intake site. No exotic species identified that will require specific environmental protection.	No major significance. Conservation and re-afforestation to be done in the upper catchments in order to ensure dependable flows in the tributaries and the Shire River.	Intensify conservation campaigns involving the communities. EMM strategies and actions to be promoted. These are to: protect remaining riparian forest in the Middle Shire catchment by raising awareness; promote community reforestation programmes, allow trees to regenerate
Other Terrestrial Fauna		Some animals inhabiting the intake site will move further upstream and downstream because of human activity. Possible impacts with large animals such as elephants and buffaloes.	There is likelihood of negative impacts due to human/wildlife relationships and encounters, loss of life on both sides.	Intesify surveillance by game guards and designate dangerous zones with visible signs. Hunting will be banned during this period.	Access to the Shire River will be limited to particular areas because of the open canal. Watering sites upstream of the intake site will still be maintained. There will be concentration of animals especially during the dry months as they access the river. Animals drowning in the canal.	Negative impact, but not highly significant as these habitats are small numbers of animals will be affected. Animals may eventually get used to the new environment and maintain an new status of equilibrium with the environment.	Watering points will be provided at strategic poits along the canal route. Specific animal paths will be maintained and all river beds to provive access to the Shire River. Canal to have provision for animals to walk out when they have accidentally fallen in. Consider fencing of the canal to avoid animal loss.

CONCERN		CONSTURCTION & PRE-OPERATION			OPERATION		
Issue	**Location**	**Impact**	**Significance**	**Mitigation[1]**	**Impact**	**Significance**	**Mitigation**
Forest		Clearing vegetation from intake site and the canal route will remove a significant amount of forest trees of various diameters within the game reserves.	Loss of trees along the canal corridor will have minimum efffects. Most of the vegetation outside the game reserves has been trimmed due to cultivation and use of tmber for construction. Trees in the game reserves are not accessible to the local community by regulations.	Trees to be cleared should be clearly marked after survey and setting out of intake site and canal route to avoid wanton felling of trees. Contractor to minimise vegetation destruction by heavy equipment turning.	No significant impact in the vicinity of the prokect. Significant impact if the upstream catchment areas continue to be depleted of forest vegetation causing further loss of soil and land degradation.	Soil loss and land degradation will increase sedimentation and will affect adversely any impoundment on the Shire River exacerbating existing problems.	Catchment conservation and sustainable land management practices to be promoted with full involvement of the communities in the project area and those in the upper catchment areas. Community forestry in the immediate catchment to manage existing forest and promote reforestation and afforestation.
Catchment Management					Increased conversion of forest to cultivated land, use of trees for charcoal manufacturing, and cultivation of hillslopes, will increase soil erosion and further reduce soil fertility	Further soil degradation could be very significant because apart from reducing agricultural productivity, any increased sediment carried by rivers upstream will increase the sediment in the Shire River.	Appropriate conservation strategies to be owned and implemented by the communities for value adding.
Aquatic Ecology	Upstream	No significant change apart from moving away from animals construction sites because of noise and human activity. Habitat will be maintained undisturbed.	Little significance because there will be minimum disturbance of the aquatic ecology.	No mitigation measure.	No significant impact, aquatic equibrium will be restablished after constructioon works.	The weir will not significantly affect fish migration.	No mitigation measure.
	Downstream	Downstream flora and fauna will not be significantly affected. Water turbidity during construction will be experienced but iwill be temporal.	Direct losses by excavation will affect a relatively small area and thus be of little significance. No significant impacts on most aquatic flora.	Contractor to be advised to avoid contamination of the water resources.	The flora and fauna will regenerate in around all the construction sites and a new equilibrium will emerge. Aquatic animals will come back to their habitat when human activity has ceased.	Plants and animals will re-establish permanent communities at river margins this will be a significant increase in habitat and populations.	Operation guidelines to enforce discharge of environmental flow at all times as minimum discharge of the river in order to maintain the river ecosystem.

CONCERN		CONSTURCTION & PRE-OPERATION			OPERATION		
Issue	**Location**	**Impact**	**Significance**	**Mitigation**[1]	**Impact**	**Significance**	**Mitigation**
Socio-economics	Weir	Some employment opportunities for local unskilled labour during construction.	Small scale socio-economic benefits from increases in income in the local community.		No impact.	Living conditions will improve significantly for those people will be employed.	No mitigation measure.
	Canal line routes	Displacement of people inhabiting land along canal routes to allow access for construction and avoid potential health and safety impacts to people living near the conveyance lines.	Relocation of the affected people to adjacent areas close to the farm lands so that they reap the benefits of the new agricultural enterprise. Adjustment to new environment.	Resettlement and relocation to be fully compensated and to be done with full collaboration with the local leaders. Voluntary resettlement principles will e adopted.	The SVIP will provide water for irrigation to potential irrigable land noth of Mwanza River and to ILLOVO sugar cane estate at Nchalo.	All year round agriculture will be pssible. Water supply for domestic use will be available from a reticulation system. Living conditions will improve significantly with added incomes and clean water.	Sanitation campaigns to be mounted in order to maintain a healthy environment and reduce waterbourne disease infections. Planting and maintaining woddlots to be encouraged. New methods of integrating livestock with agriculture and agro-processing to be promoted.
Tourism and Recreation	Weir and canals	No significant impact.	Not a significant impact.	No mitigation necessary	Touristic attractions associated with animals and the rare engineering feat. Hamilton Rapids at intake point will create new features of potential tourism interest, road network to facilitate tourism.	Opening up opf the project impact area to socio-economic development to cater for increased volume of visitors and immigrants. New facilities will be catalyst to economic growth of the community.	Community and Project Management Authority to maintain impact area attractive to tourists.
Public Health	Weir and canal	Safety of workers and children, livestock and other animals, falling into water bodies and drowning.	A man-made river close to local populations, an open canal that might be very attractive for domestic use.	Saftey measures to be enforced by the contractor and engineer during this phase.	A man-made river close to local populations, an open canal that might be very attractive for domestic use. Use of canal by women, children and men foe bathing, washing, swimming, water supply. Issues of good sanitation and hygiene to be promoted. Animals attracted to canals to drink.	Saftey of people and animals to be promoted at community level and by the Project Mnagement Authority. Minimise drowning hazards and loss of life. Increased contact with slow moving water by swimming, bathing, washing clothes, etc, may increase both urinary and intestinal Schistosomiasis, especially the latter. This would be a significant negative impact.	A public health awareness, education and protection programme will be implemented in the project impact area. This will include prevention and curative initiatives, surveillance for disease vectors, keeping drainage channels open to allow improved drainage of all pools of standing water.

ANNEX A

REQUIREMENTS OF THE PUBLIC CONSULTATION AND DISCLOSURE PROCEDURES (PCDP)

REQUIREMENTS OF THE PUBLIC CONSULTATION AND DISCLOSURE PROCEDURES (PCDP)

Public Consultation and Disclosure ProcedureS (PCDP)[1] present a technically and culturally appropriate approach to consultation and disclosure. It was therefore prepared at the beginning of the EA studies and acted as a guide to the effective and efficient management of the consultation and disclosure programme. The goals of the PCDP are to ensure that:

- Adequate and timely information is provided to project-affected, `primary' stakeholders at the local-level and `secondary' stakeholders who have legitimate interests in the project at the national level;
- These stakeholders are given sufficient opportunity to voice their opinions and concerns;
- These concerns are considered in determining the EIA work and project decision-making.

The PCDP prescribes consultations at four main stages, reflecting World Bank policy and procedural requirements and international best practice. The stages are:

- Consultations on the ToR (known as `Scoping');
- During conduct of the additional EIA studies;
- On the draft EIA report; and
- During the period when the project is completed, commissioned and begins operation.

Consultations on the Draft EIA Report

In accordance with the requirements of the PCDP, the report will be subjected to review by various stakeholders to determine whether all concerns made during the scoping process are valid and have been included. The report will be placed in the offices of the implementing ministries as well as other stakeholders of the Shire Valley Irrigation Project in order to increase the opportunity for informed

[1] Preparation of a PCDP is also a requirement of the International Finance Corporation (IFC), a member of the World Bank Group. A PCDP prepared early in the recent study, helped to ensure that adequate and effective consultation occurred within the tight timescale. Particular reference has been made to the 1997 Environmental Impact Assessment Study Report.

stakeholder comments. At the same time, the Executive Summary will be placed in locations to be determined by the Ministry of Irrigation and Water Development.

Additional publicity will be through posting of public notices in local communities and through the administrative structures of the District Assemblies and Traditional Chiefs. Thereafter, an open public meeting will be organized to present and triangulate the findings as true reflections of what people in the area expect and feel about the project. An independent chairperson from an area not affected by the project will chair the public meetings, facilitated by an EIA team member.

Consultations on the Final EIA Report

The final EIA report will be subjected to review and consultation according to the national EIA Procedures. The Department of Environment Affairs will be responsible for this process and the DoI is mandated to assist by providing the following support:

- Making available sufficient copies for review and consultation;
- Providing clarification on issues during this consultation period; and
- Responding to comments and recommendations made during this consultation period.

Consultation during Completion, Commissioning and Operation of SVIP

During these public consultations, but particularly with the local stakeholders, discussion should focus on principles that should apply to consultation in the post-EIA phase. The proposal is that the outcome of the discussion should form the basis for the establishment of a consultation framework such as a Community Liaison Committee and Grievance Procedures. These mechanisms are compatible with the current national and local-level institutional and regulatory context.

A Community Liaison Committee (CLC) is proposed because it is increasingly important that environmental management of large-scale projects be socially responsive. Experience has shown the important role that can be played by a forum, in which local communities, the project operator and national and local

government agencies meet regularly to discuss issues and problems, and agree on possible solutions. The need for a CLC is indicated by the history of previous project/community interactions related to the Kapichira Hydro-Electric Power (many of them considered to be adverse by local and national stakeholders), the nature of the issues and concerns expressed during scoping and the expectations of people locally and nationally in relation to project benefits.

Such a committee can only concern itself with issues that have a community-wide focus and are of medium to long-term duration. `Community-wide', in this context, refers to settlements or significant community groups and not to individuals. A liaison committee, even one that meets regularly, will not have sufficient resources to deal with issues that pertain only to individuals.

To deal with possible complaints and grievances from individuals, it is necessary to establish grievance procedures that provide a speedy, transparent and effective mechanism for resolving disputes without recourse to legal redress. The proposed procedure does not reduce or restrict the rights of individuals to resort to judicial means of dispute resolution.

ANNEX B

NATIONAL ENVIRONMENTAL ACTION PLAN WORKING GROUPS

s/n	NAME		CHAIRING INSTITUTION
1.	National Context	-	Chancellor College
2.	Fisheries	-	Department of Fisheries
3.	Forestry	-	Department of Forestry
4.	Water Resources	-	Department of Water
5.	Agriculture	-	Ministry of Agriculture and Food Security
6.	Energy and Mining	-	Min. of Energy & Mining
7.	Industry	-	Min. of Trade & Industry
8.	Tourism	-	Min. of Information & Tourism
9.	Transport & Communication	-	Ministry of Transport & Communications
10.	Health	-	Ministry of Health and Population Services
11.	Land Use Planning & Management	-	Department of Land Resources and Conservation (MoAFS)
12.	National Hazards	-	Ministry of Gender Children Welfare and Community Services
13.	Population and Human Settlements	-	Ministry of Gender Children Welfare and Community Services
14.	Wildlife and Institutional Conservation	-	Dept of National Parks and Wildlife
15.	Legislation & Biodiversity	-	Dept. of Research and Environmental Affairs
16.	Research	-	University of Malawi
17.	Education & Public Information	-	Min. of Education and Culture
18.	Pollution & Waste	-	Polytechnic (University of Malawi)

ANNEX C

LIST OF INSTITUTIONS AND INDIVIDUALS CONSULTED

s/n	Organisation	Name	Rank
1.	**Ministry of Irrigation and Water Development**	Hon. S. Mia	The Honourable Minister,
		Mr. G. M. Malunga	The Principal Secretary
		Mr. O.M. Kankhulungo	Director of Water Supply and Sanitation
		Mr. S. C. Maweru	Director of Irrigation Services
		Mr. A. B. Chirwa	Deputy Director of Water Resources (Surface Water)
		Mr. A. T. Khonje	Deputy Director of Irrigation Services
		Mr. Champiti	Head of the Integrated Water Resources Management Project
		Mr. B. N. C. Gondwe	Deputy Director Water Supply and Sanitation
		Mr. Nakanga	Director of Administration and Finance
		Mr. P. W. R. Kaluwa	Chief Hydrologist
2.	**Ministry of Economic Planning and Development**	Mr. Ben A. Botolo	Chief Economist
		Ms Elizabeth Pulu	Economist
3.	**Ministry of Agriculture and Food Security**	Dr. P. Daud	Principal Secretary
		Mr. Chavula	Director of Crops
		Ms Erica E. Maganga	Programme Manager, Blantyre ADD
		Mr. Bodzalekani	Programme Manager, Shire Valley ADD
		Mr. Ngauma	Deputy Programme Manager, Shire Valley ADD
		Mr. Isaac Fandika	Officer In Charge, Kasinthula Research Station
		Mr. D.M. S. Kadyampakeni	Research Officer, Kasinthula Research Station
		Mr. Andy Kawanjere	Land Resources Conservation Officer, SVADD
		Mr. R.J. D. Taibu	Agriculture Officer, SVADD
		Mr. N. Mlenga	Director of Land Resources and Conservastion
		Mr. M. J. Manda	Deputy Director of Land Resources and Conservation
		Mr. Nthenda	Principal Land Resources and Conservation Officer, Blantyre
		Mr. Mchinkho	PjO, Nsanje RDP
		Mr. R. Chiutsi	DO, Makhanga EPA
		Mr. C.C. Phiri	Animal Husbandry Supervisor, Nsanje RDP
		Mr. B. Kautale	DO, Mpatsa EPA
		Mr. R.A.K. Nyirenda	Cotton Supervisor, Nsanje RDP
		Mr. L.Y. Lipenga	Horticultural Field Officer, Nsanje RDP
4.	**Department of Environmental Affairs**	Mr. Raphael P. Kabwaza	Director of Environmental Affairs

5.	**ESCOM**	Mr. Lamek Nshambe	Projects Manager, Blantyre
		Mr. Stephen Kaira	Plant Manager, Kapichira HEP Station
		Mr. Archibald Kandoje	Mechanical Engineer, Kapichira HEP Station
		Mr. Kalombola	Liwonde Barrage Operator
6.	**Ministry of Lands, Housing and Surveys**	Mr. F. S. Majankono	Commissioner for Lands
		Mr. G. Mchoma	Regional Commissioner for Lands, Blantyre
		Mr. Longwe	Department of Physical Planning, Lilongwe
7.	**Majete Game Reserve**	Mr. Michiel van Hasselt	Project Coordinator, African Parks Conservation
		Ms Jeanette Batiste	Extension Coordinator, African Parks Conservation
8.	**Department of Parks and Wildlife**	Mr. Patricio Ndadzera	Division Manager, Lengwe National Park
		Mr. Connex Mbewe	Head of Wildlife Education, Lengwe
		Mr. Tull Makanjila	Head of Wildlife Management, Lengwe
9.	**Illovo Sugar Group**	Mr. Howard Theobald	Agriculture Manager
		Mr. Mike Whitbread	Regional Agronomist
		Mr. Pookie van Lelyveld	Land Development Manager
		Mr. Winston Ligomba	Irrigation Controller
10.	**Kasinthula Cane Growers Association**	Mr. Stewart W. Michael	General Manager
		Mr. Brian E. Namata	Operations Manager
11.	**Southern Region Water Board**	Mr. Edward Mbesa	Operations Manager
12.	**Chikwawa District Assembly**	Mr. H. M. Lende	The District Commissioner
		Mr. B. Nkhoma	District Planning and Development Officer
		Mr. W. G. Ndlhovu	District Agricultural Development Officer
		Mr. G. F. Nyali	District Hydrologist-Chikwawa
		Mr. Alfred R. Palitu	District Education Office
13.	**Ministry of Health, Chikwawa District Hospital**	Dr. Lide	Medical Officer
		Mr. Ignatius Mtambalika	Assistant Environmental Health Officer
		Mr. Cornelius Muhama	Environmental Health Assistant
14.	**Department of Geological Surveys**	Mr. Kankhuzi Mr. D. Magetsi	Publications, Zomba STA, Geological Surveys, Bangula
15.	**Ministry of Forestry**		Deputy Director

	and Natural Resources	Mr. G.H. Mulaliya,	TA, Fisheries Department, Nsanje
		Mr. N.H. Moyo	DFO, Forestry Department, Nsanje
16.	**World Vision International**	Mr. Esau Phiri	Project Officer, Zomba
17.	**Malawi Investment Promotion Agency (MIPA)**	Mr. Victor Mponda	Lilongwe
18.	**Beneficiary**	Mr. Christopher Makhaza	Banana Farmer, Kasinthula
		Dr. S. Pala	Fisheries, Kasinthula
		G.V.H. William	Community Leader, Chikwawa
19.	**Ministry of Transport and Public Works**	Ms Jana	Clerk, Chikwawa Office
		Mr. R.D. Kamanula	Mechanic, Public Works, Nsanje
		Mr. W.D. Kulapani	Road Foreman, Nsanje, Public Works
20.	**Malawi Prison Services, Chikwawa**	Mr. Felix Simwaka	Officer-in-Charge
		Mr. W. Y. Mankhusu	Station Officer
		Mr. C. J. Mantchelani	General Discipline Officer
21.	**Department of Tourism**	Mr. Msyani	Tourism Officer
22.	**National Statistics Office**	Mr. S.J. Nyumali	Statistics Assistant
		Mr. Banda	Statistics Officer
23.	**Wildlife Society of Malawi**	Mr. D. D. Mauambeta	Executive Director, Wild Life Society of Malawi
24.	**Individuals**	Mr. Charlton Jeke	Farmer, T.A. Chimombo
		Mr. A. Semu	Scheme Manager, Muona Irrigation Scheme
		Mr. M. Msona	MEFONSO Filling Station, Nsanje

ANNEX D

BENEFICIARY RESPONSES DURING THE COMMUNITY SCOPING PROCESS

BENEFICIARY RESPONSES DURING THE COMMUNITY SCOPING PROCESS

1.0 INTRODUCTION

The Survey was conducted in Ngabu ADD, Ckikwawa District in two EPAs Mitole and Mbewe. Five Group Village Headmen were visited. Each GVH had his Village heads. The village heads brought in their village members. Group interviews, focus group and key informant discussions were conducted. Attendance during interviews in the villages was as follows:

Group Village Headman	Persons in Attendance		
	Total	Female	Male
Salumeje	241	81	160
Fombe	112	66	46
Chambuluka	193	97	96
Mbande	17	6	11
Mbenderana	270	120	150

There was one interview for all government ministries and departments where the following were represented: District Assembly, Health, Education, Labour, Agriculture, Works, and Police. Two Non-governmental organisations, Aqua-Farms and CADECOM, were also interviewed.

One farmers organisation, Nkhate Irrigation Cooperative Society (NICS), was visited and the Farm Manager was interviewed. Nkhate Irrigation Cooperative Society used to be a rice scheme under the Ministry of Agriculture and Food Security.

2.0 ACCEPTANCE AND BENEFITS OF THE PROJECT

The majority of the people discussed with responded that the proposed project will be beneficial to them in the following ways:

- Reduced cattle theft rate because people will have some income from proceeds of the farming activities of the project

- Availability of ready cash for the communities
- Cultivating more than once per year
- Increase in food production (bumper yield).
- Improved nutrition status of the communities
- Increased school enrolment due to food availability for school going children
- More water for Irrigation
- Hunger reduction
- Source of employment
- Good water supply for the animals
- Assist in provision of water for fish farming
- Those who currently do not have land will be allocated land as the project is allocating land in the project
- Poverty will be reduced
- There will be reliable water supply

3.0 ISSUES PROBLEMS AND MITIGATIONS

Local leaders and communities mentioned the following tabulated problems and mitigation measures on the outlined issues.

ISSUES	PROBLEMS	MITIGATION MEASURES
Land	• Demolition of houses • Uprooting of crops during canal construction • Reduction of plot sizes • People not willing to release land for canals • Encroachment into the land by foreigners • Loss of land to other people • No money to hire tractors for land preparation • Land sharing • Loss of land to canal construction • Displacement of inhabitants • No grazing land for animals • Government taking away land • Change of land ownership • Some people may not be allocated to land • Conflicts for land • Selling of land without consulting village headman	• Compensation • Compensation • T/A and the D. C. should assist in all land related issues • Village headman to reallocate land • Village headman to control foreigners • Government to provide assistance • Government should not force people to share land • Liaise with the affected farmers • Village headman and farmers to sort out grazing issues • Taking the issue to the D. C. • Need for civic education • Management committee should put in place proper land allocation procedures • T/A and the D. C. should assist in all land related issues

ISSUES	PROBLEMS	MITIGATION MEASURES
Labour	• Provision of labour will be affected by lack of food • High labour demand will need use of time saving machinery • Funds for clearing, digging canals and watering of the plots • Ignorance on proper time for land preparations • Lack of funds for additional labour in the first year of project • When employment is offered to people outside the districts of project this may cause discontentment and bring some conflicts • Injustices brought about employment procedures • Increase in accidents in the project • People will be involved in canal construction neglecting their plots	• Government should provide food until people harvest • Government should provide appropriate machinery and assistance for the work • Provision of enough extension workers • Government to provide either free services or loans in the first year • People in the districts of the project should be given first chance of employment • Labourers should be changed to allow others to benefit • Offer of employment should be through Labour Office • Good health facilities and compensation for victims • Cash for work and the cash will be used to hire casual labour

ISSUES	PROBLEMS	MITIGATION MEASURES
Water borne diseases	Dysentery, Malaria, Bilharzia, Cholera, Whookworm, Scabies, Trachoma (Maso)	• Provision of drugs in hospitals and clinics • Sanitary facilities such as pit latrines, waste disposal pits and bathrooms • General cleanliness • Mosquito nets • Health advice to be provided • Children to be controlled from swimming in stagnant water • Discourage defecating and urinating in the water • Health facilities should be closer to the people • provision of protective clothes • Sensitisation of the communities on dangers of water borne diseases
Water supply	• High possibility of drowning • Use of untreated water • Possibility of floods • Low supply of water in Shire River	• Sensitisation messages about dangers of water • Sensitisation on proper uses of canals and drains • Provision of more boreholes • Provision of piped water • Children to be accompanied • Afforestation in the Shire River's catchment area • Low levels and silting. • Canals to be situated away from villages

ISSUES	PROBLEMS	MITIGATION MEASURES
Community organisation	• People will be scattered when reallocating plots and it will be difficult to organise them • There may not be enough time to organise the people • Some people may be associated with vandalism making it difficult to organise • People will be more interested with irrigation and may not be interested in organisations • Division of communities by canals • Differing views from the community • Those with large pieces of land not willing to share • Untrustworthy leaders • Lack of credit facilities • Lack of markets • Lack of proper crop varieties • Lack of transparency • Petty jealousy	• The District Assembly must take part in community organisation • Capacity building • Time allocation for club and plot work • Police to assist with formation of Community policing • Sensitisation the importance of community organisation • Community organisations should distribute farm inputs • Crossings (bridges) over canals • Sensitise people on importance of cooperation • Encourage communal use of land • Leadership training • Government and NGOs should offer some input loans • Extension work to source proper varieties • Regular meetings will help • Community training on organisation skills • Community based factories

ISSUES	PROBLEMS	MITIGATION MEASURES
Marketing	• Lack of markets	• Encourage cross border trade • Government to assist in providing stable and capable markets • Formation of OVOP committees to identify markets
	• Low prices • Prices not justifiable • No right to decide price • Price fixing by traders	• Farmers must decide on the price
	• High supply	• Provision of factories to process produce to add value
	• Lack of transport	• Formation of transport associations
	• Lack of competition of buyers	• Advertise produce to other districts
	• Lack of cooperation among farmers	• Formation of associations and cooperatives
	• Late opening of seasonal markets	• Associations to negotiate with buyers in time
	• Long distances to markets	• Buyers to come closer to markets
Availability of inputs	• Lack of farm inputs • Lack of funds to buy inputs • Delay in input distribution	• Government to assist with inputs on loan • Arrange with input distributor in time
	• Lack of improved varieties	• Train people on seed multiplication techniques and on proper use of inputs
	• Lack of training on use of inputs	• Associations to open up Input outlets
	• Lack of markets to buy inputs	• ADMARC markets to sell inputs
	• Planting recycled highbred seed	• Extension workers to teach people problems associated with recycled seed • Encourage farmers to plant open pollinated varieties (OPV)

ISSUES	PROBLEMS	MITIGATION MEASURES
Gender	• Men embezzling money on extra marital affairs • Men like to claim for all the money realised • Male dominance • Some women are illiterate do not understand that the money realised has been shared equally • Broken families due to heavy drinking on part of men • Men working on lighter duties • Women unwillingness to work as assigned by their husbands • Lack of cooperation between men and women • Lack of women contribution in decision making due to cultural inclinations. • Problems associated with land ownership between men and women • Jealousy between the married couples during the growing season • Self esteem that each can survive without the other • Women are not given chance to contribute production ideas • Sidelining of women and children from benefits realised	• Consulting villager elders • Village headman and gender organisations to conduct sensitisation meetings • Provision of adult literacy classes • Advice from extension workers • Regular discussions to reach compromise • Women to be involved in decision making processes • Men should allow their wives to participate in community activities • Introduce cooperatives for men and women • Money realised from sell of produce should be shared equally • Deliberate main-streaming of gender in all irrigation activities • Formation of irrigation constitutions • Civic education for men and women on their roles • Division of labour on equal terms • Love for one another is the solution to conflicting ideas • Understanding between men and women, husbands and wives • Training women in leadership skills • Involvement of faith based organisations

ISSUES	PROBLEMS	MITIGATION MEASURES
HIV/AIDS	• Both men and women will be tempted • Multiple sexual partners • Increased number of orphans • Prostitution will increase • Lack of employment • Poverty • Drop in labour • Proliferation of the disease brought about by increased population from other districts and increased income from employment • Resistance in behavioural change • Engineers and some skilled workers leave their families behind	• Advocacy campaign • Trust each other • Husband and wife to be faithful to each other • Total abstinence • Health advice • Use of condoms to be intensified • Sensitisation meetings before and during project implementation • Voluntary Counselling and Testing centres within walking distances • Planners to look at sensitisation of dangers of HIV/AIDS • Specific components on behaviour change • Need to introduce by-laws in Hotels, Motels, Lodges and Rest houses

4.0 LAND TENURE AND UTILISATION

4.1 There is customary land tenure system but the ownership depends and arrangements are through the village headman . This may follow matrilineal system, or Patrilineal system. Matrilineal system is the dominant system in this area.

4.2 The livestock will be separated from other crops by using or establishing paddocks .Chiefs, people and government should at first advise and consult each other for identifying grazing area .Conversion of land use will be handled by concerned parties through negotiations and should start with civic education before project implementation .

4.3 In order to avoid conflict between livestock and crops, the following measures will be put in place:

- Introduction of stiff penalties when livestock destroy crops.
- Restricting movement of livestock.
- Livestock should have one area of grazing.
- Reducing livestock to manageable numbers.

- Farmers should migrate to higher areas suitable for grazing.
- Farmers should construct secured kraals to control the animals and should employ an aged heard boy to control them.
- Protect the farming land.
- Advising farmers to take care of their animals.
- Demarcation of land to carter for each enterprise (to allow apportion of grazing)
- Government should provide a common place for grazing animals.
- Owner of livestock to compensate the victim.

4.4. The following problems will be forecast in the event that people have to be resettled to give to canal or release land for farming. When people are resettled there may be needed to make the following provisions to make their resettlement comfortable:

- Resettlement processes
- Funds to construct new dwellings
- Grazing and cultivation land
- Good domestic water
- Social services including schools, clinics and trading centres
- Land for graveyard
- Need for enough time to resettle them
- disturbance allowances

The Local leaders will play the following roles in trying to resolve the above problems:

- Messages disseminated before hand (giving them time) with assistance from government like building houses and compensation. T/A will play intermediately role in resolving conflicts.
- Need for the village head to allocate land to the victims.
- Committees should be set up and trained in conflict resolution.
- Discussions are the best remedy to the problem .
- Government should provide social services in all new settlements.
- Chiefs should do their job of land allocation

5.0 ROLE OF LOCAL LEADERS

- Liasing with implementers with the implementers.
- Mediatory, Education, & supervision of the project activities.
- Settling down conflicts.
- Help people with land demarcation.

6.0 ROLE OF SUBJECTS

- Being responsible by taking part in the project.
- Following the plans and whatever is supposed to happen.
- Willingness to discuss and implement resolutions and adopt changes.
- Making sure that the project works out without interfering in the work and contributing to the success of the project.
- Protect the project (as they are owners)
- Dedication, hardworking and cooperative.

7.0 LAND DEMARCATION AND FARMER ORGANISATION

7.1 In order to change production systems, the following activities will take place:

- Setting up of clubs, cooperatives & Associations.
- Setting them up in groups of 10 to 20 people each.
- Setting up committees to take lead.

7.2 Changing of production systems will cause the following problems:

- Lack of money (contributions)
- Crop management advice
- Lack of proper varieties
- Need for enough inputs
- Lack of land to allocate to other necessary plants
- Arise of conflicts
- Government will be issuing loans with high interest
- Lack of proper crop care

7.3 To consult with Government to consider another piece of land for other crops and that, government should provide loans and assist farmers in their production.

7.4 Transparency and Unity

- Chiefs & Official from government should be involved

7.5 Committees or Board of Directors will help in reducing these problems.

7.6 Govt should provide farm input at fair prices and should find markets for the groups.

- Transparency.
- Making arrangements like contracts for marketing

7.7 Proper structures and leaders for the groups

- Leaders should make arrangements for usage of machinery
- Leaders to connect with extension workers
- Introduction of membership fee

7.8 Planning

- Government should do land preparation before handing over to the farmers and make sure that each and everyone has received a land
- Training in irrigation management
- Market structures have to be put in place
- Making deliberate controls of animals
- Canals should be made of concrete

7.8 Implementation

- Provisions of extension workers
- Government should make sure that each farmer is growing according to the group
- Cash to be given during sell not credit
- The project has been implemented as expected

7.9 Evaluation

- Regular visits by extension workers
- Management structure should make sure that markets are available for each crop
- Making sure that plans have been implemented
- Committee should record for its proceedings for easy evaluation

7.10 Collaboration

- Management structures should make sure that all existing organisation within the scheme are interacting
- Govt to work together with stakeholders will assist people as leaders
- Govt to assist people with loans from other stakeholders

8.0. LINKAGE MECHANISM

- Clubs should be a link between people and the government
- If workers agree, then there will be no problem with linkage
- Extension workers
- Committees
- Field assistance
- Technical committee

9.0 ENVIRONMENT

- Re-afforest ration
- Creation of woodlots
- Hilly areas should be demarcated for wild animals
- Protected areas should be strengthened so that no wild animals shall trod out free.

10.0 NON-GOVERNMENT AND GOVERNMENT ORGANISATIONS

10.1 The following groups of people are likely to loose out in this project initiative:

- The poorest of the poor lose out
- Women
- Low resource
- Those who will show no interest in the early stages of the project

10.2 The roles of government and non-government organisation will be as follows:

- Guiding the victimised to organisations that provide justice
- Assembly to be involved in every sector of the project
- Advocate to people to take issues to human rights activists
- Training farmers (Nkhate Irrigation)
- Educational visits to already established irrigation schemes
- Water management

10.3 MRFC, NGOs operating in the areas, ministry of agriculture, Irrigation, Health , Community development , Forestry and Human rights groups.

- Transparency in carrying out all project activities
- Linkages should be same as government structures
- The assembly should take a leading role in the implementation of the Project

10.3 Consultative meeting and Multi- sectral meetings with collaborators

- Agricultural stakeholders should look at agricultural issues technically.

10.4 Board comprising of opinion leaders, traditional leaders, and political leaders.

- Technical committee which will comprise of heads of government departments.
- This is to ensure total transparency.
- There should be sector set up in different categories (i.e. health and agricultural stakeholders)

(a) Planning

- Technical committee will be responsible
- Training of local leaders and the communities

- Management should involve all stakeholders.

(b) Implementation

- Right equipment should be put in place.
- Facilitate stakeholders meetings.
- Coordinate roles to various stakeholders to avoid duplication of efforts .

(c) Marketing

- Initiate association for farmers to sell their produce properly
- Marketable crops must be identified

(d) Monitoring and Evaluation

- Ensuring that collaborators to take their part in monitoring and evaluation .

(e) Collaboration and Linkages with other Stakeholders

- Collaborate with associations like NASFAM, Irrigation department and Illovo , World Vision International , ELDS, Eagles Relief, CADECOM and Malawi Rural Finance Company.

11.0 COMMENTS AND CHALLENGES

- The communities were very much concern that the project should not be politicised and that they want it as soon as possible.
- People have the fear of unknown on what is really going to happen in terms of Chieftainships, change of land ownership and displacement.
- Some wish they could go back to younger days so that they can see the project taking shape.

12.0 NKHATE IRRIGATION COOPERATIVE SOCIETY (NICS)

Nkhate Irrigation Cooperative Society is situated on the Eastern Bank of Shire river. It is run under the Ministry of Agriculture. It is being managed by farmers under the guidance of the Farm Manager. There are plans that funding will be

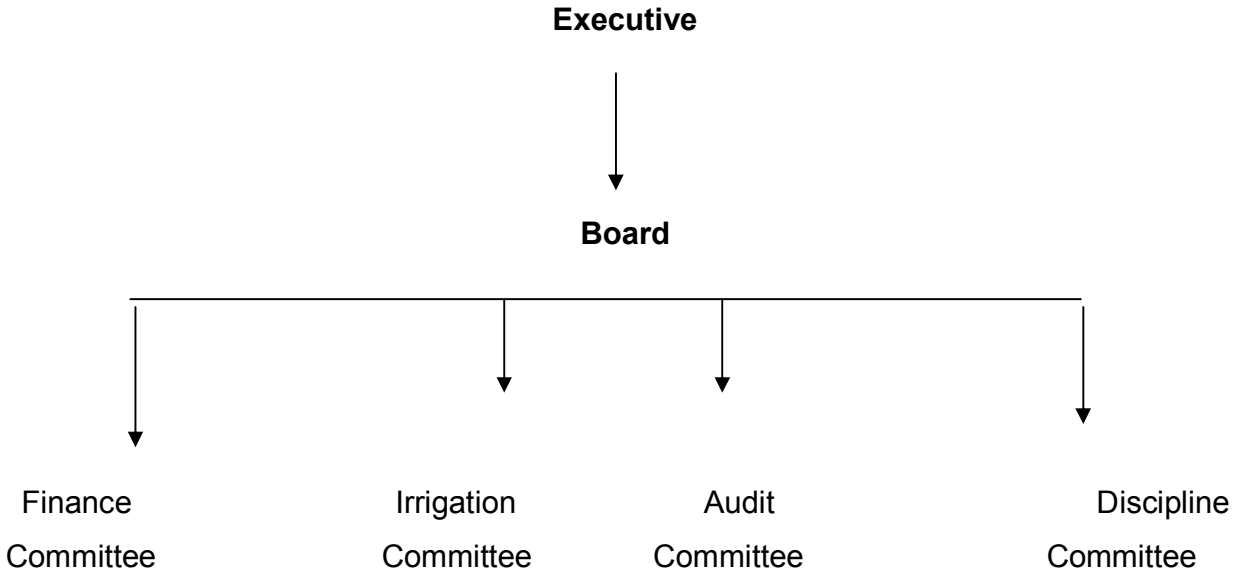
sourced to rehabilitate the scheme. After rehabilitation, the scheme will completely be handed over to the farmers to be managed and guided by them.

The Cooperative has 1165 members of whom 75 are widows. Land size is 243 hectares of which 10 ha. are covered by canals and roads.

The recommended farmer organisations for the coming project should be Farmers Associations and Cooperative Societies. NICS recommended that all farmers involved in irrigation project must go under training and be given chance of touring the existing irrigation schemes, cooperative societies and associations. After visiting of existing already forms cooperatives then there is need to organise their groups in the form of Cooperative Society.

It will be for the Cooperative to find extension services that will provide guidance on demonstration plots, soil fertility and overall crop production methodologies. The Cooperative should also be mandated to look for markets well before production.

The committee of the cooperative should set up rules and regulations governing proper running of the project. Proper penalties should be put in place for culprits. Conflicting parties should be brought before the disciplinary committee.
The management structure of NICS is as follows:



Planning

The structure organisation of NICS helps very important role in that it decides on which crops to plant in consultation with the Farm Manager and the Extension worker

Implementation

The structure looks into matters of carrying out agreed activities following the laid out programme.

Markets

The structure organisation of NICS helps in identifying markets before production. Possible companies, buyers and vendors are contacted and contract agreement are processed.

Monitoring and Evaluation

The structure organisation of NICS helps in over seeing that agreed programmes are carried out successfully and inform right authorities in time for any other action. At the end of the year the activities are evaluated whether successful or not so that changes for the coming season are effected accordingly.

Collaboration and linkage with other stakeholders

The stakeholder that NICS collaborates with include Ministry of Agriculture and previously it was Malawi Rural Finance Company that provided loans.

Members and management of NICS are of the opinion that the planned Shire Valley Irrigation Scheme will be beneficial to the communities in the shire valley. They feel thet hunger and poverty will be reduced greatly.