PART 4
NYARUPAKWE PILOT PROJECT

4.1 General

The Lower Munyati River Basin Agricultural Development Project is a large-scale irrigation project including large-scale water resources development and would be a pioneering irrigation project for smallholder farmers in Zimbabwe. However, smallholder farmers have had almost no experience in irrigation cultivation. Furthermore, the implementation of this large-scale project until the completion of the on-farm irrigation facilities will take a long time. Therefore, in order to ensure maximum positive impact, step-by-step implementation of the project should be considered. To this end, it is important to establish a pilot project serving as a place of technical training and trial-and–error learning for farmers in the Area so as to promote smooth transition to irrigated agriculture.

For selection of the Pilot Project Area, the relations between the national development plan and the pilot project plan, and opinions of two provincial governments involved in the Project were taken into consideration. The following criteria were adopted for selection of priority area for the Pilot Project:

(1) The area should be located in a communal or resettlement area;

(2) The area must have an importance as the model and have spread effects and be replicable;

(3) The area should be located near water sources as much as possible. The pilot area is a part of the Kudu Dam irrigation area, therefore, the water sources for the pilot project should be within the Kudu Dam irrigation system, but have a function as independent water source;

(4) Beneficiary farmers should be willing to participate with the project;

(5) The effect of the project should appear immediately;

(6) The area must have the size that enables the project to be implemented with appropriate and reasonable cost; and

(7) The project can be implemented immediately after the survey and study.

Based on the above criteria, two Pilot Project Areas were selected through the Phase I Study; one is Nyarupakwe area on the left bank of Munyati river and the other is Seke area on the right bank of Munyati river. In the Seke area, a medium-scale dam has already been constructed on the Seke river and the irrigation facilities covering about 150ha are planned to be constructed at the lower reach of the Seke dam by Rio Tinto, a Private Company. It was recommended that a part of this new irrigation area be taken as the Pilot Project Area. However, it was observed that the rehabilitation works of Seke dam were required due to leakage through right

abutment of the dam and erosion of spillway wall; consequently, construction of irrigation facilities will be delayed. It was therefore decided that the Seke area be excluded from the proposed pilot plan. Considering this situation, the agricultural development study for the pilot project was conducted in the Nyarupakwe area. For formulation of the development plan for the Pilot Project Area, a participatory social environmental survey was carried out during the Phase II Field Work from February to April 2000.

4.2 Survey on the Incorporation of Social Dimensions

4.2.1 Objective of the Survey

A survey on the incorporation of social dimensions into Nyarupakwe Pilot Project Area was carried out with the following objectives:

(a) to clarify the needs and demands of the population of the local communities in the Pilot Project Area;

(b) to assess anticipated positive and negative effects and commitments by the beneficiaries of the Nyarupakwe Pilot Project;

(c) to develop a sense of participation among the local communities in the Pilot Project Area and reach consensus of local population toward the Nyarupakwe Pilot Project through public hearing, dialogues and other activities of the survey; and

(d) to support and realize measures necessary to incorporate social dimensions into the Nyarupakwe Pilot Project and thereby the measures, which help to ensure a high quality of final project design of the Lower Munyati River Basin Agricultural Development Project.

4.2.2 Selection of Survey Team

Selection process of the local contractor, experienced and capable to carry out socio-economic survey of the Pilot Project Area took place during the last half of January 2000. As a result, "Intermediate Technology Development Group(ITDG)-Zimbabwe" was awarded contract. The selection process was based on an open competition made out of four nominated NGO organizations operating in Zimbabwe. The Survey Team consisted of four staff experienced in research for rural development namely, Team Leader in Rural Development, Sociologist, On-farm Development Specialist and Agricultural Economist.

4.2.3 Schedule of Survey Period

(1) Schedule of Survey

As is shown in Figure 4.2.1 "Schedule of Survey on the Incorporation of Social Dimensions", the survey for baseline information based on Participatory Rural

Appraisal (PRA) for the Pilot Project Area was scheduled to start in the beginning of February and completed at the end of May 2000. During this period an individual household survey was also carried out in order to obtain quantitative statistical data for socio-economic profile and its analysis.

(2) Definition of Survey Period

Definition of the social dimensions survey was roughly subdivided into three stages as follows:

(a) Stage I Survey

This was a survey period of "Probing and Understanding of the Needs and Demands of the Survey Area". Based on the interview survey with key informants, the following was conducted:

- Broadly defined survey area was selected;
- Within the selected area, public hearing and PRA exercise was held;
- Local residents' views on the needs and demands in terms of rural development was probed based on the PRA exercise; and
- Survey on the socio-economic profile was carried out.

Data obtained on the local needs and demands were analyzed and interpreted into a generalized rural development project package which was presented during the Stage II Survey's public hearing.

During this Stage I Survey period, there were two public hearing meetings held in the survey area. First public hearing was held on 17 February and the second on 25 February 2000.

(b) Stage II Survey

This was a survey period of the "Presentation of the Outline of the Project Based on the Local Needs and Demands". The outline of rural development project package generated during the Stage I Survey was presented at the public hearing for further discussion. Upon presentation of the outline of the Project, local demands may change relative to the Project. These demands were further analyzed and incorporated into the project package. Beneficial effect as well as adverse effect were known to the local residents at this stage. Major part of engineering design was carried out at this stage for their details as final proposal. Any changes in the survey area were made, and dealt with at this stage.

Public hearing meeting for the Stage II Survey was held on 16 March 2000 for this purpose.

(c) Stage III Survey

This was a survey period of the "Acceptance and Agreement of the Detailed Project Components by the Local Community". Detailed project package was presented during the public hearing and discussed from implementation point of view. Point of discussion was the possibility of implementation with current knowledge and other conditions imposed and available to the community. Any solutions that could make the project implementation possible and over come the adverse effect associated with it was discussed for possible ways toward acceptance of the Project.

Final public hearing meeting was held on 14 April 2000.

4.3 Present Conditions of the Nyarupakwe Pilot Project Area

4.3.1 Location

The Nyarupakwe Pilot Project Area is roughly located in the middle of Chisina I Ward of Gokwe South District, Midlands Province. The location of the Area is about 25 km northeast of Gokwe which is the biggest town in the Gokwe South District, and is relatively easy to access due to a rural road running between this area and Gokwe town.

The Pilot Project Area includes 15 villages which are located from upstream and downstream stretch of the Nyarupakwe River. Figure 4.3.1 shows the location of the Nyarupakwe Pilot Project Area, and Table 4.3.1 presents areas, populations and numbers of household of 15 villages. Most of the population lives in the middle and lower part, and farmers cultivate cotton, maize, groundnuts etc., on the alluvium-covered flat land. The present land use of the Pilot Project Area was identified through the interpretation of aerial photo(scale:1/15,000), topographic map (scale:1/50,000) and some ground check. The Area can be categorized into three land uses, i.e. arable land, residential area and bush / others which is used as grazing land by farmers as given below. The present land use map is presented in Figure 4.3.2.

Present Land Use in the Pilot Project Area

1. Arable areas	6,700 ha
2. Residential areas	100 ha
3. Bush / Others	8,100 ha
Total	14,900 ha

4.3.2 Natural Conditions

4.3.2.1 Topography

The Pilot Project Area is located within the basin of the Nyarupakwe River. The Nyarupakwe River flows into the Munyati River about 35 – 40 km from its source in

Mafungabushi Plateau, of which top flat land near Gokwe has the elevation of about 1,300 m. The constantly moving bed of the river is incised by some ten meters into the open savannah lands through which it runs.

The elevation of upper part of the Pilot Project Area extends from 1,100 to 960 m and the area is characterized by escarpment and deep valley which are formulated by uplift and erosion. On the other hand, middle and lower parts are relatively flat lands with the elevation of 960 – 840 m, which are formulated by deposit from plateau.

4.3.2.2 Meteo-Hydrology

(1) Meteorology

Meteorological data at the Meteorological Station of Gokwe were collected from the Meteorological Office in Harare. Mean monthly climate and rainfall records at Gokwe Station are in Table 3.1.1. The mean annual rainfall is recorded at 734.8mm. Rainy season (from October to March) and dry season (from April to September) is obviously distinguished by rainfall distribution, about 95% of annual rainfall is concentrated in rainy season. According to this meteorological record, the Pilot Project Area has cool and dry winter and hot and wet summer.

(2) Hydrology

Since there is no runoff gauging station on the Nyarupakwe River, hydrological data are obtained from "An Assessment of the Surface Water Resources of Zimbabwe and Guideline for Development Planning" which was published by Ministry of Water Resources and Development. According to the guideline, Zimbabwe is classified into six (6) hydrological zones namely Zone A to Zone F. The Pilot Project Area is located in Zone C in this classification, and Zone C is further classified into 23 sub-zones as shown below.

Hydrological Sub-Zones in Zone C

Name of Sub-Zone	Number of Sub-Zone	Area (km^2)	M.A.R (mm)	Major River in the Sub-Zone
CA1-CA2	2	9,479	52	Angwa
CH1-CH5	5	14,339	116	Munyati
CS	1	9,657	60	Sanyati
CUF1-CUF4	4	11,866	64	Umfuli
CUG1-CUG2	2	6,925	57	Musengesi
CUN1	1	7,203	40	Munyati
CUN2-CUN6	5	14,568	57	Munyati
CUS	1	3,215	50	Umsweswe
CZ1-CZ2	2	13,271	35	-
TOTAL	23	90,523	62	

In this classification, the Pilot Project Area is located in Sub-zone CUN1. In Sub-zone CUN1 area, mean annual runoff is estimated as 40 mm and coefficient of variation of runoff as 120%.

4.3.2.3 Geology

According to the geological map of Mafungabusi, the bed rock of the Nyarpakwe dam site and reservoir area consists of sericitic schists of the Upper Arenaceous Formation in the Deweras Group, hydromusocovite which was weathered from sericitic schists in pre-Upper Karoo times, overlying grit of Escarpment Grit Member in Stormberg Series in Karoo Group, and Fine Red Sandstone of the Stromberg Series in the Karoo Group,

Most of the area is covered by thick Alluvial deposit, but rock outcrop are seen sporadically on both banks along the river channel. Terrace deposit is distributed along the river channel below 895 m approximately, composed of sandy-clayey silt with gravel. The distribution area is estimated to be several 10 m in width on both banks, and the thickness is estimated to be 1 to 2 m. The slope of the both banks above EL. 895 m is covered by slope wash / residual soil / decomposed rock. The thickness is estimated to be 1 to 3 m. Riverbed deposit is formed by mainly sand with rare gravel, estimated to be 1 to 3 m thick and 10 to 15 m width.

4.3.3 Agriculture

The main data source on agriculture in the Nyarupakwe area are farm surveys done by the agronomist of the JICA Study Team from 29 to 30 March and from 10 to 12 April 2000. Sixteen samples, eight for the proposed Pilot Irrigation Area and eight for the surrounding area were selected randomly from the 103 in Magonyo and Hlamba villages.

4.3.3.1 Land Use and Landholding

Most of arable land is cultivated or lie fallow. Non-arable land is in steep slopes or in poor soils such as sodic soils, and is jointly utilized for grazing. The survey area is communal land and the government allocated land to farmers. There is no ownership of title by farmers and land is not held in perpetuity. In most cases, the land can be inherited by male offspring. There are neither formal surveys of farmers plots or registrations of land holdings.

Landholding ranges from 4 to 17 ha per household. The average landholding size per household is 8.2 ha for the proposed Pilot Irrigation Area and 7.3 ha for the surrounding area. Within the total landholding, there are fallow areas of 1.3 ha for the proposed Pilot Irrigation Area and 0.7 ha for the surrounding area. Fallow is primarily due to the lack of draft power. There is no share cropping in the Area. There is rent-in area of 0.1 ha per household for the proposed Pilot Irrigation Area. The total cultivated area is calculated at 7ha per household for the proposed Pilot Irrigation Area and 6.7 ha for the surrounding area.

There are communal grazing areas for the villagers and, on average, a household in the Pilot Area has 23.4 ha of grazing land shared by 35.5 farms. Utilization of the grazing land seemed to be biased in favor of farms with lager herds.

4.3.3.2 Soils and Land Capability

The Pilot Irrigation in Nyarupakwe is under the soil-mapping unit of Q1. Soils under this category are mainly well drained soils, deep (more than 150 cm), dark reddish brown to reddish brown, light to medium textured (medium loamy sands over medium sandy clay loam) and occurring on flat to almost flat terrain. Parent materials are quaternary fluvial deposits from various sand stones. Topography is almost flat. Irrigability is mainly Class B, downgraded because of the light surface horizon. The Class C is defined as being suitable for irrigation with special precautions and practices. Sustained productivity is attainable with good management and maximum efficiency in the use of irrigation water, but risks are higher than with Class A owing to moderate soil and/or topographic limitations.

4.3.3.3 Demography

Hlamba village consists of a single tribe, namely Kalanga tribe. While, Magonyo village consists of several tribes, namely from the dominant ones, Zezuru, Venda, Ndebele, Karanga, Kalanga, Tonga, and Changani.

Average family size is 9.8 members for the proposed Pilot Irrigation Area and 9.6 for the surrounding area. Age of the interviewees, most of which are household heads, are from 33 to 82 years old. An average age of the household is 52 years old. Twenty-five percent of the household heads are female. In a female-headed household, decision-making on expenditure and crop husbandry are made by the husband staying outside of that household.

Educational backgrounds of the interviewees are rather high. Twenty-five percent of them are college graduates. Most of these settled in this area as retirees from public offices. Thirty-eight percent of the households have not completed primary education. Illiteracy rate of the respondents is 25%. Seventy-five percent can read leaflets from extension workers. There is no difference in literacy rate between sexes. The main source of agricultural information is government extension workers covering 69% of the respondents followed by parents covering 19%. AFC, COTCO, media and NGOs play only a small role in the dissemination of agricultural information to farmers in the proposed Pilot Irrigation Area. Farmers have no experience in irrigation agriculture; hence have no knowledge on irrigated crops. Produce is marketed in Sanyati or Gokwe or delivered to COTCO or other marketing agencies.

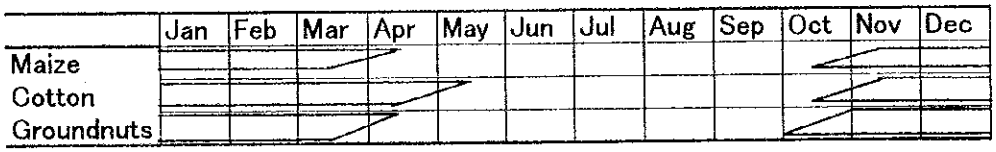
4.3.3.4 Cropping Pattern and Crop Production

Crops grown in the proposed Pilot Irrigation Area are cotton, maize and groundnuts. Sunflower and sorghum are also grown, but their acreage is negligible. Their distribution in the proposed Pilot Irrigation Area are cotton: 63.1%, maize: 25.6% and groundnuts & others: 11.3%.

The present cropping is done in the wet season. The only irrigation is for small-

irrigated vegetable gardens near homesteads. There are no substantial perennial crops grown in the Pilot Area. The crop calendar is shown below.

Present Cropping Calendar



Crop yields in the normal season are presented in the following table :

Crop Yields in Normal Season

(Unit : ton/ha)

Crop	Two Villages	Pilot Irrigation Area
Maize	0.87	0.90
Cotton	0.95	1.00
Groundnuts	0.60	0.80

Crop yields are very low due to low inputs of chemical fertilizers and the unstable rainfall pattern. Fertilizer application rates are shown in the next table.

Fertilizer Application

(Unit : kg/ha)

Crop	Fertilizer	Two Villages	Pilot Irrigation Area
Maize	Chemical Fertilizer	67	32
	Manure	560	1,007
Cotton	Chemical Fertilizer	122	109
	Manure	292	445
Groundnuts	Chemical Fertilizer	0	0
	Manure	0	0

Draft power shortage is a significant problems in the Pilot Irrigation Area. Seventy-six percent of the respondents reported the shortage in draft power, of which 38% experienced it frequently and 38% occasionally. As cotton covers 55.8% of the total cultivated area, the draft power shortage was most pronounced in cotton cultivation. Available draft animal are 2.2 head per ha and 25% of farmers have no draft animal. There are no agricultural tractors owned by the farmers.

4.3.4 Livestock

4.3.4.1 Introduction

The study on livestock subsector in the Pilot Project Area was focused to the villages located in the areas where there exist chances to avail water resources developed through the irrigation development under the Pilot Project, in accordance with the considerations taken to establish the development approaches in the livestock development plan in the Kudu Dam Irrigation Project. Accordingly, four villages of

Magonyo, Hlamba, Murandu, and Sekema villages are selected as the target areas for livestock development in the present Pilot Project.

4.3.4.2 Livestock Population and Holding Size in the Pilot Project Area

The primary important livestock in the Pilot Project Area are cattle and goats, although other livestock such as poultry, sheep and pigs are kept by farmers to a lesser extent. The population of livestock in the Area is partly obtained by way of the livestock inventory survey in the three villages (Magonyo, Hlamba and Murandu) and the same on the remaining 12 villages are estimated based on the results of the socio-economic environment survey conducted by the Study Team as shown in Table 4.3.2 and summarised below.

Estimated Livestock Population in the Pilot Project Area

Village	Livestock Population (heads or LUs)			
	Cattle	Goat	Others	LUs
Magonyo, Hlamba & Murandu	614	193	22	324
Other 12 Villages	4,137	3,746	-	2,356
Pilot Area Total	4,751	3,939	22	2,681

The total population of livestock expressed in LUs in the Pilot Area is estimated at some 2,700 and the grazing stocking rate is calculated at 30 ha/LU, which is at the similar level to the rate of 3.5 ha/LU in the communal areas of the Study Area of the Kudu Dam Irrigation Project. The average holding sizes of livestock per household in the Pilot Area are estimated based on Table 4.3.2 at cattle 4.6 heads, goat 3.8 heads, and 2.6 LUs as shown in the following table.

Average Livestock Holding Size per Household in the Pilot Area

Area	Holding Size (heads or LUs/household)		
	Cattle	Goat	LUs
Target 4 Villages	3.3	2.5	1.9
Other 11 Villages	4.9	4.1	2.8
Pilot Area Total	4.6	3.8	2.6

4.3.4.3 General Characteristics of Livestock Production in the Target Villages

All the target villages for the development of livestock sub-sector under the Pilot Project, Magonyo, Hlamba, Murandu and Sekema villages, are located along the proposed irrigation main canal and the proposed dam site for the irrigation development is in Sekema village.

The types of livestock held by the target villages include cattle primarily and secondarily goats. Most households keep chickens for household use (with one or two doing broilers for sale in winter) and also a very few farmers keep donkeys and pigs. The numbers of livestock held by the four villages is shown in Table 4.3.2 and summarised in the following table.

Livestock Population in the Target Villages

Village	Livestock Population (heads or LUs)			
	Cattle	Goat	Others	LUs
Magonyo	227	59	5	120
Hlamba	140	92	17	77
Murandu	247	42	-	127
Sekema	165	385	-	116

The three villages of Magonyo, Hlamba and Murandu share a common grazing area to the south of their fields and the north of the Nyarupakwe River (Murandu and Magonyo Villages) and to the east of the Hlamba Village area and north west of the Nyarupakwe River. The villages, on their own initiative, raised money from their own resources to build the wall of their Mahacha Dam. This dam covers about 11.5 ha when full. Village members have also subsequently stocked this dam with some fish for the enjoyment of recreational purposes.

The grazing areas in the target villages are vegetated with such trees as *Acacia* spp., *Colophospermum mopane*, *Combretum* spp., *Commiphora* spp., *Brachystegia boehmii* (on heavier textured soils) and grasses such as *Urochloa trichopus*, *Setaria pumila*, *Heteropogon contortus*, *Chloris pychnothrix*, *C.virgatus* and *Sporobolus ioclados*. They are found mainly on light coloured sandy to reddish sandy loam sodic soils or soils prone to sodicity. Erosion, typical of that found on sodic soils leading to gully formation, is found throughout where the soils have become unstable. Noticeable in the gullied areas is that the animals have been licking at the soil for its salty flavour.

In terms of grazing value, the potential grazing capacity for these areas is of the order of 1 LU:5 to 7 ha, whilst in their present condition and with an excess of tree shrubs the current grazing capacity is about 1 LU:8 ha on the better areas and about 1 LU:10 to 12 ha on eroded areas or areas where there is little grass. These grazing areas in the past have been the source of timber for the construction of houses, livestock kraals, fuel wood and other tree products. However, the larger mopane and other useful trees have been largely used up. Apart from a reduction in useful timber, the amount of grass for grazing has been reduced, and especially on the sodic patches, there has been a steady increase in the amount of erosion and gully formation - these gullies, which may be up to three or four metres deep in places, and the erosion, which may cover quite extensive areas, sometimes threaten infrastructure such as roads etc.,.

The members of Murandu, Magonyo and Sekema villages make use of the dip at the Nyarupakwe Centre whilst members of Hlamba Village dip their animals at the Ganyungu Centre. The dips are about 4.5km from the villages in each case. There is the start to the formation of Livestock Development Committees as proposed by the Livestock Development Trust, based around the villages using each dip tank.

The building of the Mahacha Dam was a repeat of an earlier attempt to ensure

security of a water source within the grazing area by the three. The building of this dam was the accomplishment of the first phase of a collaborative project between the three villages. The second phase of this collaborative project is the development of a fenced grazing scheme in the grazing area shared by the three villages. Other livestock enterprises planned in these villages are a dairy starting first by milk production and the production of broilers and eggs, especially by women and unemployed youths during the winter dry season period.

Sekema Village would like to develop a grazing scheme in its grazing area to the north of the Nyarupakwe-to-Nyamacheni Road and west of the stream leading from this road past St Paul's School to the Nyarupakwe River.

4.3.4.4 Villagers' Perceived Needs

The perceived needs for livestock development of the target villages are identified through the interview and discussion with the village leaders, representative of farmer groups, individual livestock farmers, FAEOs and field staff of VET as shown in Table 4.3.3, along with some of the villagers' comments about livestock development options.

In crude terms, farmers have listed their livestock development needs as being of either "high" or "medium" priority; all other livestock development needs, whilst being listed of "low" priority by comparison, are still needs which require to be worked on in the future nonetheless the categories of high, medium and low indicate the immediacy of the perceived needs.

In broad terms, the lack of credit facilities that would allow the timely purchase of inputs was perceived to be a major drawback to development generally, including livestock development, in the Area. Lack of knowledge and extension was also a drawback - "organised field days with visiting farmers coming to speak" or "farmers visiting other areas where there are developments" were said to be good ways of passing information to local farmers.

4.3.5 Agro-Economy and Marketing

4.3.5.1 Agro-Economy

There are 15 villages in the Pilot Area. The total number of households is 1,043 and the total population is 6,307 with an average household size of 6.0. Literacy levels are relatively low with about 25% of the population having no formal education. Over one-half of the population settled in this area over 30 years ago. Over 50% of the population is below 20 years of age. Living conditions are difficult due to the lack of adequate transport and communications and other basic social amenities. There is no electricity for most of the Pilot Area and cooking is done using fuel wood with only 2% using paraffin. Almost half of the population has access to boreholes for drinking water and another quarter have access to dug wells. Only 20% rely on the river for drinking water. Almost half of households have their own toilet facilities.

The economy is largely based on agriculture at the primary level. There are no major secondary or processing activities. The average size of holding is about 5.6 ha and ranges from 2.6 to 7.5 ha. Cotton is the predominant crop accounting for over one half of agricultural production annually followed by maize that accounts for about a quarter. All cotton produced is sold commercially while about 40% of maize, on average, is marketed. The rest of the maize is retained for home consumption. There is high variability in the marketed volume of maize from one season to another. Other crops cultivated are groundnut, sorghum/millet and vegetables. Livestock is an important element of the rural household and is a source of wealth. Livestock is also an important source of income. Cattle are the most important livestock and average 7-9 head per household. Goats (averaging 7 head per household) and chicken (averaging 20 birds) are also important in the household economy. Average household income based on the Social Dimension Survey conducted in early 2000 is around Z$ 55,000 per household per year. More than half of household income is derived from crops (57.0%). Salary and wages (off-farm income and farm labour) account for another one-fourth (26.2%) while livestock, remittances and pension payments contribute the rest.

Many agencies are involved in agricultural development in the Pilot Area. These include AGRITEX with an Agricultural Officer stationed in Nyarupakwe, and the Department of Vetinerary Services also having an officer stationed there. In addition, GMB, COTCO, COTPRO, Cargill, Seedco, Natfoods, District Development Fund, AFC, and ZFU conduct business in the Pilot Area. There are four business centers in an around the Pilot Area namely Nyarupakwe, Chiumbu, Ganyangu and Marungu. There are several stores and group activities in these centers such as the Umniati Producers Cooperative Store. In addition, farmers have organized themselves into Lending Groups of Muza, Chitendereno, Muchina and Simbanebadza and the Vanavevhu and Tambanevhu Clubs. The main purpose of these groups is to enable them to obtain group production loans from COTCO and Agribank. The Area also benefits from the inter-village groups such as the Umniati Producer Cooperative, Nyarupakwe Cattle Fattening and Marketing Group and the Tongwe Young Farmers Club.

The Pilot Area has little non-agriculture based economic activity. There are four grinding mills in the Pilot Area, two in Magonyo, one in Yasino and one in Hlamba. These are diesel powered and the availability of grinding mills is constrained by the lack of electricity in some of the villages. In the past, there was some gold panning in Chima but this has now ceased. There is one brick making unit in Umniati, and another at Crows Head (near Gunde), limited welding and iron mongering works at Ganyungu, Sekena and Nyarupakwe and some commercial poultry production in Muza. There is also a small carpentry unit in Nyarupakwe business center. About 10% of farmers belong to some group. Such organizations were set up with a view to starting up agricultural processing activities, but have had little success to date.

Overall, the Pilot Area has been constrained by lack of electricity, poor road network, long distance to towns and lack of basic facilities such as post office and banks.

4.3.5.2 Marketing

Farmers are adequately served with marketing facilities for cotton, the main cash crop, although distances to markets and the cost of marketing appear to be exceptionally high. The towns closest to the Pilot Area are Sanyati (60km) and Gokwe (64km). The roads to Sanyati and Gokwe traverse many low bridges and access to both towns are frequently disrupted, especially during the rainy season. Over 13,000 bales of cotton (2,700tons) and 29,000 bushels (1,400tons) of maize are sold by Pilot Area farmers each season. COTCO is the major purchaser of cotton in the Pilot Area. COTCO has collection depots at Sanyati and Gokwe as well as collection points in Ganyungu and Namacheni and has set up a collection point at Nyarupakwe this year. COTCO is also the largest provider of farm inputs to cotton producers in the Pilot Area through the operation of a group loan scheme. Over half of the cotton farmers in the Pilot Area benefit from this facility. COTPRO also has a collection point at Namacheni and also operates a group loan scheme but with much less coverage. More recently, Motherly Care has also entered the market but on a much smaller scale. Farmers who do not participate in the COTCO or COTPRO loan schemes dispose of their cotton either to traders or sell their produce at Sanyati or Gokwe.

Maize marketing is handled by GMB. GMB has a bag depot and a collection center in Sanyati and Gokwe and arrange for collection of farmers produce at temporary collection points. GMB also procures sunflower from farmers. Natfoods and Cargill are also active in the Pilot Area and have a representative in Nyarupakwe. The arrangements for both cotton and maize are for the village chairperson to designate a certain point at the meeting of a link and main road as a collection point. Farmers move produce from farm by scotch cart or small truck to the designated point. Distances from farm to the designated point vary but ranges from one to seven kms. Transporters arrive at these points at harvest to transport farmer's produce for a fee to either COTCO or GMB collection points or even Sanyati. Transport to Sanyati is usually in 8-ton trucks and there appear to be an adequate number of transport agents. The charges for road transport are as follows:

Transport Costs for Produce to Sanyati

(Unit : Z$)

Commodity	Masoro	Nyarupakwe	Ganyungu
Cotton (per bale)	91.00	80.00	72.00
Maize (per 50kg bag)	40.00	35.00	30.00

Cattle are important though milk is not usually sold but often exchanged between households when in excess. Cattle marketing are through sales at cattle sales pens in Nyarupakwe. Sales are held once every month and are organized by the Animal Production Officer. Sales from the Pilot Area were high prior to the 1992 drought,

but have declined since then. There are very few buyers at these monthly sales, the main buyers being Brandts and Beatties from Kwekwe and Kadoma, respectively. The CSC has not been active in the market. Cattle sales in recent months are as follows:

Cattle Sales at Auctions in Nyarupakwe Sales Pens

Month	Number of Cattle	Price Range ($ per Head)
September 1999	18	5,000-13,000
October 1999	23	5,000-12,000
November 1999	-	-
December 1999	-	-
January 2000	-	-
February 2000	25	5,000- 9,100
March 2000	32	5,000-13,000

There is no organized marketing for goats and chickens and farmers make their own arrangements for sale either at business centers, roadside stalls or by moving these to Sanyati or Gokwe by truck, scotches carts or bus.

4.3.5.3 Input Marketing

In the case of cotton, the majority of farmers obtain inputs from COTCO under the group loan scheme. COTPRO also provides inputs to farmers under a similar scheme, though on a much smaller scale. For maize, groundnuts and sunflowers, farmers have access to a range of services through agro-companies such as Pannar, Seedco, Cargill, Red Star and Windmill as well as traders in the business centers. The Umniati Producer Cooperative also provides inputs to its 800 members, which it purchases in bulk. Many farmers also obtain inputs directly from Sanyati.

Most farm households obtain their consumer goods for daily requirements from the stores in the business centers or other village stores. For bigger items most farmers visit Sanyati or Gokwe periodically. The transport system is poor and buses to the main towns are few and infrequent. In addition the road traverses many low lying bridges that are often impassable, especially during the rainy season.

4.3.5.4 Market Information

With open market pricing and competition among buyers and sellers, farmers now follow market information made available by the farmer organizations such as CFU and made available through the media. Farmers also have contact with representatives of major purchasers and agro-companies operating in the Area who pass on market information.

4.3.5.5 Agricultural Trade

Most trade takes place within the Pilot Area. Cotton and maize are traded by farmers and disposed of to COTCO and other buyers from the Pilot Area collection points. Cattle are also sold at the cattle pens at Nyarupakwe. Cattle find their way

to the butcheries in Kadoma and Kwekwe. However, some cotton or maize may find its way to export markets through the operations of COTCO, GMB or other buyers.

4.3.6 Irrigation and Drainage

There are no irrigation and drainage schemes in the Pilot Project Area. The Pilot Irrigation Area is selected from the present cultivated land with rain-fed condition and comprises around 37.5 ha of land of the village Magonyo and 22.5 ha from the village Hlamba. The Area is horizontally bisected by a village road, leaving some area of both the villages on the north side of road and remaining on the south side. Village boundary bisects the Area vertically. The intersection of the village boundary and the road has been taken as the reference point for the planning purposes.

Most of the farms are distinctly separated by rows of trees laid in the north-south direction (with reference to road), generally, in disorderly manner and the distance between two farms (intercepted with trees and intense bushes) is found to be around 10-20 metres. The land slopes of Pilot Irrigation Area vary from 1 in 230 to 1 in 250. On the north and south side of the Pilot Irrigation Area lands are sloping with steep slopes up to 1 in 40 or even less. No drainage problem is observed.

Farmers, in the whole of the Pilot Irrigation Area are having rainfed cultivation. The crops mainly include cotton about 60%, the remaining area being covered with maize, groundnut, millet grains, etc. Most of the farmers were found to be fully aware of the cropping practices. A bit of training will be sufficient to facilitate change from rainfed cultivation to irrigated one. As far land formations, most of the Area would need land grading except for some reaches that would require land levelling. The soils vary from sandy-loam to loam and as such land formation will not be difficult.

4.3.7 Rural Infrastructure

4.3.7.1 General

The infrastructure in the Pilot Project Area is poor in general. As common infrastructure, there are roads, boreholes, dugwells, business centers and collection points in the Pilot Project Area. Also, there are 2 secondary schools, 4 primary schools and 1 clinic in the Area, however, they have poor facilities and equipment. Electricity is available only at very limited places. Due to a lack of marketing facilities in the Area, farmers have to carry their agricultural products to the collecting points away from their farmlands or to the markets in Sanyati and Gokwe either by themselves or by means of hiring private transporters. Transportation distance from the Pilot Project Area to Sanyati or Gokwe is about 60km, which forces the farmers to shoulder the difficulty in daily life, agricultural activities, as well as in transportation and selling their agricultural products.

As for water resources in the Pilot Project Area, there area three types of water supply facilities, such as boreholes, dugwells and small dams. Another water

resources are rivers and springs of underflow water which are called "Tsime" in Shona Language. Usually, people lives in the Pilot Area gets drinking water from borcholes and dugwells, domestic water from dugwells, rivers and dams and livestock water from rivers and dams. Principally, priority order of water resources seem to be 1) borehole, 2) dugwell, 3) tsime, 4) river and 5) small dam from the point of view of its water quantity and quality. But the order is depend on the condition as shown below, and they are now on very hard condition to get secure and enough water.

Water Sources in the Pilot Area

Villages	Drinking Water	Domestic Water	Livestock Water
Marumbe	Dugwell, Tsime	Np.River[1)]	Np.River
Muchina	Borehole,Dugwell,Np.River	Np.River	Np.River
Makarichi	Dugwell	Dugwell	Np.River, Nc.Dam[2)]
Muza	Dugwell	Np.River	Np.River
Sekema	Dugwell	Np.River	Np.River, Nc.Dam
Magonyo	Dugwell	Dugwell	Mh.Dam [3)], B.Dam [4)]
Hlamba	Borehole	Borehole, Dugwell	Dugwell,Np.River,Mh.Dam
Murandu	Dugwell	Dugwell	Mh.Dam, B.Dam
Jeffrey	Borehole, Nc.River	Borehole, Nc.River	Nc.River
Mateuro	Borehole	Dugwell, Mt.Dam[5)]	Dugwell, Mt.Dam
Mujubeki	Borehole(Ganyungu B.C.)	Dugwell, Mt.Dam	Dugwell, Mt.Dam
Mahvondo	Borehole, Dugwell	Borehole, Dugwell	Borehole,Mt.Dam, Streams
Komboni	Borehole	Borehole	Nc.River
Gunde	Borehole	M.River[6)]	M.River
Mabharani	Borehole	Borehole,Dugwell,M.River	M.River

1) Np. River : Nyarpakwe River
2) Nc. River / Dam: Nyamachene River / Dam
3) Mh. Dam : Mahacha Dam
4) B. Dam: Bohopota Dam
5) Mt. Dam: Matanda Dam
6) M. River Munyati River

The following are brief descriptions of the rural and social infrastructure in the Pilot Project Area.

4.3.7.2 Roads

The road network in the Pilot Project Area consists of tertiary roads and others, namely, District Development Fund Roads, Local Authority Roads and footpaths. These roads are not paved. The width of district development fund roads ranges from 6.0 to 8.0 m, local authority roads 4.0 to 6.0, and footpaths 1.0 to 2.0 m in general. Out of which, local authority roads and footpaths are under control of Rural District Councils and Village Development Committee. These road networks play an important role for transportation of agricultural products either by animal or trucks. However, transportation system in the Pilot Project Area is yet to be developed.

District Development Committee and Village Development Committee are responsible for operation and maintenance of the road network in the Pilot Project Area, utilizing their budget allocated to each road section. However, due to shortage of the budget, no satisfactory operation and maintenance of the road

network has ever been achieved. Small scale operation and maintenance of the road network is being carried out in several places in the Area on FWP (Food for Work Program) basis. The operation and maintenance work carried out under the program is simple. It only includes leveling of the road surface by labors or grader, and compaction of the leveled surface by road roller.

4.3.7.3 Boreholes and Dugwells

(1) Boreholes

There are 17 boreholes in the Pilot Project Area. These boreholes are functioning as sources of drinking water and agricultural activities as well. A typical borehole in the Area has a diameter of 150 mm, and depth of 30.0 to 60.0 m, 40.0 m on average. BUSH type pumps and galvanized pipes with a diameter of 75mm are installed in all the boreholes. Data on the yield from each borehole are not available. Most of these boreholes were installed in 1954, since then, maintenance works such as replacement of parts, repairs of broken pumps, etc., have been made several times according to the maintenance record, which is kept at Gokwe South District Office.

The field survey, however, revealed that nearly half of the boreholes in the Area are not functioning well due to loss of parts, damages to pipes etc. And even some of the boreholes, which are functioning now, face the problem of decreasing yield due to drawdown of the groundwater table. These conditions justify the need of urgent repair works of the boreholes in the Area. The existing boreholes in the Area are listed below.

Boreholes in the Pilot Area

Name	Location	Year Installed	Depth (m)	Status*	Remarks
BH-004	Jeffrey	1954	60	×	Not function from Apr. 2000.
BH-005	Gunde	1955	54	×	Not function from Jan. 2000.
BH-006	Hlamba	1954	39	○	Good condition
BH-007	Mahvond	1954	45	△	Very hard to get water in dry season
BH-008	Mateuro	1954	42	○	Good condition
BH-009	Mujubeki	1954	51	×	Not function from 1999
BH-011	Ganyungu B.C.	1954	49	○	Sheared by Mabarani, Mujyubeki, Mujyubeki villagers
BH-012	Mabalani	1954	42	×	Pump is under repair in Gokwe (from Apr. 2000)
BH-013	Ganyungu B.C.	1954	42	×	Not function from Jan. 2000. This was shifted in a few meter from original location for repair in 1994.Pump is under repair in Gokwe (from Apr. 2000)
BH-153	Muchina	1954	51	△	Water table is so deep. Villagers don't use so often.
BH-155	Muza	1954	51	×	Not function from 1999.
BH-156	Nyarpakwe B.C.			○	This borehole is equipped mortar pump and 4 water tanks, and deliver to B.C. pipe water without any treatment.
BH-158	Magonyo	1954	45	△	Very hard to get water, even in rainy season. Villagers don't use this borehole now.
BH-161	Sekema/ Makarichi	1954	36	×	Not function from 1995.
BH-162	Komboni	1989	69	○	Sheared by Komboni and Gunde villagers
Not Recorded	Komboni	?	?	×	Sheared by Komboni and Mushegahande villagersNot function from 1997 or 1998.
Not Recorded	Murandu	?	?	×	Not function from 1998

* ○ : Accessible without any problem, △ : Accessible with some problems, × : Not function

District Development Fund is responsible for excavation, installation as well as operation and maintenance of the boreholes. However, due to lack of the district's budget, Village Development Committee, in place of District Development Fund, are now taking over operation and maintenance of the boreholes, which is not being carried out satisfactorily because of shortage of the funds, thus, the condition of the boreholes is getting worse year by year.

(2) Dugwells

Usually, villagers in the Pilot Area use water from dugwell for domestic use and for livestock only. No subsidies are given to construction of dugwells, accordingly farmers who want to have a dugwell have to bear all the cost. Due to drawdown of the groundwater table in dry season, deeper excavation is required for getting water, which forces the farmers to bear the additional cost. There are 57 dugwells in the Pilot Project Area, which are all owned by private persons and neighbors can access to dugwells free of charge with owners permission. Breakdown of dugwells in each village is shown below.

Dugwells in the Pilot Project Area

Village	Marumbe	Muchina	Makarichi	Muza	Sekema	Magonyo	Hlamba	Murandu
Nos. of Dugwell	3	2	9	7	2	7	2	12
Village	Jeffrey	Mateuro	Mujubeki	Mahvondo	Komboni	Gunde	Mabharani	Total
Nos. of Dugwell	0	3	3	2	0	1	4	57

A typical dugwell is 30 m in depth and it has a diameter of 1.0 to 2.0 m covered with sun-baked bricks. Water can be got by use of reeling well bucket.

4.3.7.4 Business Center and Collecting Point

There are three business centers and four collecting points in and around the Pilot Project Area as shown in below. Out of which, electricity is available only at Ganyungu business center.

- Business Center : 3 places at Nyarupakwe, Ganyungu and Marundu
- Collecting Point : 4 places at Nyarupakwe, Nyamacheni (COTCO and COTPRO) and Ganungu

4.3.7.5 Electricity

Electricity is not available in and around the Pilot Project Area except some limited places, such as at Ganyung business center, Gwamure secondary school, a part of Tukwayo village, and at a grind mill, being supplied electricity from 33 KVA lines of ZESA (Zimbabwe Electricity Supply Authority) passing nearby Ganyung business center. According to the official of ZESA (Zimbabwe Electricity Supply Authority) in Gokwe South District, electricity will be supplied to Nyarupakwe business center in the year of 2003 utilizing the governmental budget.

Rural electrification projects in Zimbabwe are being carried out under the Rural

Electrification Program. Under the present policy by ZESA, if a community wants to have electricity, the cost for electrification must be shared by each other, namely, 50% by the community and 50% by ZESA. According to ZESA, the cost for electrification, in the case of receiving electricity from nearby 33 KVA line, is about Z$ 200,000/km including provision of transformers.

4.3.8 Rural Society and Institutions

4.3.8.1 Administrative Structure

The administrative structure in Zimbabwe consists of five tiers namely central, province, district, ward, and village. The Pilot Project Area administratively consists of 15 villages (kraals) in the Ward GS 23 Chisina I, Gokwe South District, Midlands Province as shown below.

Administrative Tiers of the Pilot Project Area

District / Ward	Village (Kraal)			
Gokwe South GS 23 Chisina I (46 villages)	Villages in Pilot Project Area	1. Marumbe	2. Muchina	3. Makarichi
		4. Sekema	5. Muza	6. Murandu
		7. Magonyo	8. Hlamba	9. Jeffrey
		10. Komboni	11. Gunde	12. Mahvondo
		13. Mabharani	14. Mujubeki	15. Mateuro
	Villages Outside	31 villages		

Beside the above administration structure, traditional leaders consisting of Chiefs, Headmen and Kraal Heads are important component of the local government process and activities in the communal land. The Pilot Project Area is under Chief Njelele, Headman Chisina I and 15 Kraal Heads. They will form a communication link between the Rural Development Council (RDC) and the local people. The organisational set-up for the rural development is illustrated in Figure 4.3.3.

4.3.8.2 Rural Institutions

(1) Project Related Rural Institutions

Major institutions involved in rural administration and/or development activities in and around the Pilot Project Area include: (a) Gokwe South RDC, (b) Rural District Development Committee (RDDC), (c) WADOC of Chisina I, and (d) VIDCOs of project 15 villages. The major functions and activities of the institutions are summarized below:

(a) Gokwe South RDC

The RDC is the administrative body at district level representing the central government and the local population. The council has committees for special purposes as creatures of central government and currently it has eight such committees. Among the committees, the ones related with the present Project are Planning & Development Committee, Road Committee, RDDC and WADCO.

(b) RDDC

The RDDC is mainly composed of technocrats and this committee acts as the technical arm of the RDC with special responsibility to consider development plans submitted to council and make recommendations to it.

(c) WADC of Chisina I

The WADC is established in each ward of the Council area and it prepares and submits a ward development plan. Such a plan, however, evolves from the lowest planning unit at village level, the VIDCO. The WADCO is organised by Chisina I Ward councillor as a chairperson and chairpersons of VIDCOs.

(d) VIDCOs

The VIDCO is the planning and implementation committee of development plans at a village level, which is organised by Kraal Head as a chairperson and 7 – 10 village representatives selected at a Village Assembly. The Assembly, which is organised by all villagers above 18 years of age and chaired by Kraal Head, supervises the activities of the Committee.

(2) Rural Organizations for Social Services

A number and variety of rural organizations are formed in the project villages as shown in Table 4.3.4. These are mainly for agricultural purposes and such organisations for social services are rather limited in number in the Project Area. Further, the estimated participation rates of villagers in such social organizations appear to be low in general. Among the organizations, the ones having active functions with substantial membership include Nyarupakwe Bridge group of Gunde village, Gunde Football Club, Nyamacheni Bakery group (inter-kraal group) and Zvitirei Club (inter-kraal group).

4.3.9 Agricultural Supporting Services

4.3.9.1 Agricultural Extension

The main institutions providing agricultural extension services in and around the Pilot Project Area are the district offices of AGRITEX and VET located in Gokwe as shown in Figure 4.3.4. Of the two, the institution having most important role in agricultural extension is AGRITEX. The private sector extension activities in and around the Area are also carried out by commercial companies, but to a limited extent.

(1) AGRITEX

The public sector technical and extension services on crop and animal husbandry sub-sector in and around the Pilot Project Area are provided by the Gokwe South AGRITEX District Office. The services of the Office are rendered through FAEOs (Field Agricultural Extension Officers) deployed at ward/village level, who were formerly assigned as AES (Agricultural Extension Services) or AEW (Agricultural

Extension Worker). The Pilot Project Area is located within the service areas of three FAEOs of the Munyati Sub-area Team as shown in the organizational set-up of AGRITEX illustrated in Figure. 4.3.5.

The extension system employed by the FAEOs is a group and participatory approach, in which they usually work through farmer groups on a regular contact basis as shown in Table 4.3.5. However, the results of the survey on socio-economic environment indicate that farmers are aware of the availability of AGRITEX extension services but seldom received the services in the past as shown in Table 4.3.6.

The main extension programs conducted by the FAEOs deployed in the Pilot Area include Master Farmer Training (MFT) and field guidance to farmer group. In the Gokwe South AGRITEX Office, one FAEO trains 10 MFs every year on average. The weaknesses of the AGRITEX's extension services in the Pilot Area are: (a) inadequate number of extension staff deployed, (b) poor logistic support for providing extension services, and (c) limitation of budget for operation.

(2) VET

Veterinary services in the Pilot Project Area are offered by the Veterinary District Office in Gokwe. In the Area, the Sub-area VET Office is established at Nyarupakuwe and one VEA (Veterinary Extension Assistant) and Dip Attendant (D/A) are posted. The main services provided by the Office through field staffs include : (a) disease control & surveillance and (b) disease diagnosis. The District Office is poorly equipped without any vehicle for field works and with limited drugs and veterinary kits.

(3) Private Sector

The private sector involved in the agricultural extension services in and around the Pilot Project Area includes COTCO, Windmill, Zimbabwe Fertiliser Corporation (ZFC) and other farm input suppliers or dealers. Among the private companies, COTCO is most important and the activities of others are still limited. It provides farm inputs together with technical services to the beneficiaries of its Group Lending Credit Scheme.

4.3.9.2 Agricultural Research

In the Project Area, the agricultural research services are carried out by the Sub-station of the PPRI located in Gokwe. The Sub-station is engaged in the surveillance and forecasting of pest and disease of food crops and is providing technical services in the District. It appears that currently the Project Area has limited access to the research and technology development services.

4.3.9.3 Agricultural Credit

The major formal credit institutions operating in the Pilot Area are the Agribank and

COTCO. The Agribank has its branch in Gokwe, and provides credit services to the Pilot Area. The bank offers credit to smallholders through the Group Lending Credit Scheme. The interest rate of the Scheme is 62 to 66%, depending of credit status of clients. The Scheme has been promoted by the bank as a means of reducing credit delivery costs and improving repayment performance and the credit disbursement under the group loan arrangement increased markedly in recent years in Gokwe South District. The number of beneficiary groups and recovery rate of the credit rendered by the Gokwe branch in 1999 are, respectively, 167 groups and 95% as shown in Table 4.3.7.

The COTCO provides loans through the Group Lending Credit Scheme to registered cotton growers in the large-scale commercial and small holder sectors. For small holders, loans are provided to groups of registered cotton growers to enable purchase of seed, fertilizer, agro-chemicals and farm implements. In the Pilot Area, it operates such credit service mostly from its Sanyati Ginnery and partly from its Gokwe Ginnery. The mark-up rate is 25% per season, below the market interest rate of about 70% per year. In 1999, the Gokwe Ginerry provided the credit to 150 groups and the recovery rate was as high as 96% as the loan is repaid as a deduction from the sale of the crop on delivery to COTCO. In the Pilot Area, lending groups for the credit are formed in 12 villages and the total membership of the groups is 297.

The weakness in the provision of agricultural credit to smallholders is that individual smallholders is still excluded because bank lending policies are based on viability, proven past performance and the provision of collateral. Group lending of the Agribank and the COTOCO have overcome some of these problems but has not yet become widespread. In an overall sense, it is clear that credit available to farmers in the Project Area is still inadequate.

4.3.9.4 Farmers Organization

The Zimbabwe Farmers Union (ZFU) which is the apex organization of farmers clubs and associations, Umniati Producers Cooperative Society and lending groups of cotton growers organized by the COTCO are the major farmers organizations actively operating in and around the Pilot Project Area as shown in Table 4.3.8 and summarised below.

(1) Zimbabwe Farmers Union (ZFU)

The ZFU is an apex organisation of farmers association/clubs established under "the Social Welfare Act" and is composed of five tiers of organisations; Union at national level, provincial, district and ward farmers associations and farmers club at a village level. In the Project Area, the Union provides its services operated from the Gokwe district office to members through associations and clubs. In Gokwe South District, the Union has 180 clubs and 30 ward level farmers associations with some 14,000 active members and in the Chisina 1 there are six farmers clubs, including three clubs

in the Area.

(2) Umniati Producers Cooperative Society Ltd.

The Cooperative is established under "the Cooperatives Society Act" in 1961 and has its head office in Nyarupakwe. Its membership totals 865 and 400 to 500 members are active members. Its service areas include purchasing and marketing of farm products, farm inputs supply, provision of loan, operation of cooperative shop and tractor hiring and transportation services.

(3) Lending Group

Twelve lending groups for the COTCO Group Lending Credit Scheme are formed in the Pilot Area. The membership of the groups is 297 in total. The groups are organised by the company as the objective organisations of its credit services. They have supply of farm inputs prior to cropping season in kind and in return to the credit services deliver their products (cotton) at collection points of the company located in Ganyungu and Nyamacheni in the Pilot Area.

(4) Women's Participation

Women participation in farmers organisations is common in the Pilot Area and the women members account for 708 or 47% of the total membership of some 1,500 of the agricultural organisations excluding Umniati Producers Cooperative Society in the Area. In addition, four women's groups are formed for gardening, poultry, vegetable, and oil seeds production.

4.3.10 Environmental Background

4.3.10.1 Baseline Social and Environmental Conditions

(1) Social and Geographical Features

The Pilot Area is located in Natural Region III in an area of dry, slightly undulating flatlands dissected by the Nyarupakwe River. This river flows into the Munyati River about 35-40 km from its source in the Mafungabusi Plateau. The constantly moving bed of the river course is incised by some ten metres into the open savannah lands through which it runs. The river does not flow throughout the year, being dry from June to November. Average rainfall is 700mm.

The Pilot Project location in the Gokwe Communal Area is in an area formerly infested with tsetse flies. After eradication it was a destination area for resettlement in the 1950s, during the British colonial period. Therefore, those now living in the area have come into the area in recent historical times from southern areas of Midlands Province and Masvingo.

(2) Natural Vegetation

The description below of the vegetation of the proposed Nyarupakwe Dam pilot

scheme covers both the upstream and downstream areas.

(a) Nyarupukwe River Course and Riparian Land

The dominant tree species in this habitat are those that have a degree of tolerance of the fluctuating water table. The Fig tree (*Ficus capensis*), monkey bread (*Piliostigma thonningii*) and Mukute (*Syzium quineense*) and the weeping willow (*Salix subserata*) are the major trees occupying the river basin. Other trees found along the river banks are the Combretum species, Mushumha (*Diospyros mespiliformis*), Mupfuti (*Brachytegia boehmii*) and Mopane (*Colophospermum mopane*). These trees provide various uses to the local communities, namely shade, fruit, cattle feed, timber and medicinal purposes. The common grasses include the Hereropogon contortus, Digitaria species, other annuals and shrubs.

(b) Tree Species on Savannah Grazing Land

The main trees and bushes occupying the upland and the river bank edges are Mopane which is valued for firewood, building timber and also hosts the edible caterpillar, 'madora', Mupangara thickets (*Dichrostachys ceneria*) whose fruit and fresh leaves are eaten by cattle, Mususu (*Terminalia sericea*) used for construction timber and cattle yokes. Other tree species found in this habitat are Mupembere (*Combretum molle*), Mutondo (*Julbernadia globiflora*), Muruka (*Combretum zeyheri*), Mushamba (*Lannea discolor*), Muzeze (*Peltophorum africanum*) with medicinal properties and also associated with sacred rituals, some Bauhinia and Acacia species plus Murara used in basket, hats and mat making. The common grass species are Heteropogon, Eragrostis, Aristida, some pockets of Pogonarthria squarosa, Digitaria, other annuals and shrubs.

4.3.10.2 Potential Social and Environmental Impacts

(1) Dam and Reservoir Area

As indicated above the main impact on the natural environment will be the creation of a water body in place of the riparian woodland. The woodland should not be entirely lost from the margin of the dam. However, the reservoir will lead to the loss of 21 ha of cultivated land and appropriate compensation will have to be found for those losing their fields. It may not be possible to offer irrigation land because of the distant location of the Pilot Irrigation Area and possible resistance to division of plots in the potentially irrigable area.

Total population of three villages of Makarichi, Muza and Sekema affected by the dam construction is 1,381. Total number of household is 231. There are 19 farming area owners affected by the construction of dam. Total inundated farming area is 21.1 ha i.e. average land lost to the reservoir is 1.1 ha per family.

There is limited use of the existing river stretch for livestock watering, in part because it is dry in the dry season and also because of distance from settlements; access is currently also difficult because of steep slopes along the river bank. Near to the Pilot Irrigation Area is a smaller dam (Mahachi) used for livestock watering. There is evidence of local erosion from trampling around access areas but barbed wire fences have been erected to protect other sides of the reservoir from livestock trampling.

The dam is sufficiently far away from habitation not to present a direct threat of malaria transmission. Bilharzia occurrence is an inevitable hazard of dams in Zimabawe. Diversion of the main road along the dam wall will present some minimal inconvenience to road users including many pedestrians and particularly local school children.

(2) Pilot Irrigation Area

Total population of two villages of Magonyo and Hlamba affected by the irrigation area development is 783. Total number of household is 103. There are 16 land owners in the proposed irrigation area of 60 ha in net.

Managing the re-allocation of land will be the major problem in the downstream area. There may be resistance if a proposed re-allocation to put a ceiling on irrigation plot size is not handled very sensitively. It is proposed that NGOs might be contracted to provide the necessary facilitation skills so that the community can propose for itself how land might be re-allocated. Top-down approaches involving the Rural District Council only as arbiter must be avoided at all costs.

The potential impacts of the use and handling of chemicals are not considered to be very great. Farmers are already accustomed to using chemical sprays in their cotton crops. In the circumstances it is very unlikely that farmers will use excessive fertilisers which would then be washed into the river. This would represent a financial cost or loss to themselves but under extreme precipitation events this occurrence cannot be precluded.

The range of other potential impacts and the potential risks of a negative outcome after mitigation measures have been adopted are presented in Table 4.3.9 with its list of accompanying explanation of terms. The scale of the Pilot Project suggests that there will be a limited impact on the social ecological and natural resources of the area selected.

4.4 Formulation of Development Plan of Nyarupakwe Pilot Project

4.4.1 General

Although the Lower Munyati River Basin Agricultural Development Project is a large-scale irrigation project to assist smallholder farmers in Zimbabwe, smallholder

farmers have had almost no experience in irrigation cultivation. The implementation of this large-scale project and completion of the on-farm irrigation facilities will take more than a decade. Therefore, in order to ensure successful irrigated agriculture, step-by-step implementation of the project is necessary, and it is important to establish a pilot project serving as a place of technical training and trial-and-error learning for farmers in the Area.

A Pilot Area has been selected in the western extremity of the main project zone, near Nyarupakwe in Gokwe South Rural District through the Phase I Study conducted in 1998-1999. For formulation of the agricultural development plan in the Pilot Project Area, a survey on the socio-economic structure of the area was carried out based on the active participation of the local population to the Pilot Project. The survey including public hearing meeting and individual household interview survey was conducted by a NGO "Intermediate Technology Development Group(ITDG)" under supervision of the JICA Study Team in order to clarify the needs and demands of the local communities in the Pilot Project Area and to assess anticipated positive and negative effects, and obligations and commitments by the beneficiaries of the Pilot Project.

This chapter shows the basic development plan of the Nyarupakwe Pilot Project comprising development of water resources, irrigation, livestock, rural infrastructure, agricultural support services and institutions, based on local peoples' intentions obtained through the above survey.

4.4.2 Result of Survey on the Incorporation of Social Dimensions

4.4.2.1 Identification of Local Needs

As a major part of Stage I Survey, prior to carrying out the field works, key informants were selected and asked various questions in order to narrow down the Study Area. Table 4.4.1 shows key issues, key informants and key questions for the purpose of identifying specific survey area. As a result, the area known as Nyarupakwe within Chesina I Ward was selected as initial target survey area.

No specific project components nor its purpose were known at this stage of survey to key informants except for which it would be an agricultural development project. This was a practice imposed on the Survey Team in order to begin the survey without any prior information that may lead the team members pre-judging the existing plan of Pilot Project, or prejudice the key informants. This was also a way to elicit the local population's needs and demands for their day-to-day life and economic activities.

Chesina I Ward is approximately 10km from northwest to southeast, and 30km from northeast to southwest. It is bordered by Mudzongwe River in the north, Nyamachene River in the south, Munyati River in the east and 1,100 m contour which forms the edge of Mafungabusi Plateau i.e. escarpment belongs to Chesina I Ward. Since Chesina I Ward is a part of Gokwe South District, interview survey to

key informants was then held among the staff of Gokwe South District Administration. Major key informants were the staff of Gokwe South District Administration, including AGRITEX Extension Officers for Gokwe South District. The representatives of Veterinary Services Officers, District Development Fund, Ministry of Transportation, Ministry of Water for Gokwe South, and Gokwe Hospital were also interviewed.

Based on the information obtained from the above key informants of district and ward level, local needs and demands in terms of economic development were roughly identified. One of the most important needs was water resources development for agricultural use including livestock rearing followed by road network for better communication and marketing, including community telephone system, supply of clinic and others.

The rivers within Chesina I Ward have been exploited one way or other in the past for impoundment of water by the local community. However, although its tributary has to some extent been exploited for water resources, the main stream of Nyarupakwe River has not been exploited. While local population within its catchment area were in need of water for their agriculture and livestock rearing as well as for domestic use. Therefore, survey area was further narrowed down to the area along Nyarupakwe River, which has not been fully exploited for its water resources to date for the communities within its catchment area.

4.4.2.2 Identification of Specific Administration Units as Survey Area

Based on the roughly selected survey area of Nyrupakwe River Basin, the Survey Team paid a visit to Nyarupakwe Business Center and asked the local administrative staff for cooperation to hold public hearing in respect of the area along Nyarupakwe River. As a result, nine (9) villages of Marumbe, Muchina, Makarichi, Muza, Sekema, Murandu, Hlamba, Magonyo and Jeffery were selected as specific administrative units subject to survey for local needs and demands.

The first public hearing meeting was held on 17 February 2000 for 5 villages of Marumbe, Muchina, Makarich, Muza, and Sekema villages. These villages were grouped as "Survey Area - A". They are generally located in the upper half of Nyarupakwe River. The second public hearing meeting was held on 25 February 2000 for four villages of Murandu, Hlamba, Magonyo and Jeffrey. These villages were grouped as "Survey Area - B". They are generally located in the mid-stream area of Nyarupakwe River.

Based on the first public hearing meeting, the most aspired needs and demands of the "Survey Area - A" was to have a small scale dam within the accessible distance of the villages of Marumbe, Muchina, Makarichi, Sekema and Muza. They began forming dam committee in August 1999 for promotion of a small scale dam construction in the upstream area of Nyarupakwe River. Main purpose of the dam was to maintain watering point for livestock in the vicinity of the community during the dry season.

In comparison to the needs and demands of the people in the "Survey Area - A", those of the "Survey Area - B" are comparatively content with what they have at the moment. They own a small dam, Mahacha Dam, constructed in 1995, storing water during dry season for cattle rearing. It makes them feel secure about the way they raise livestock. It is their feeling that they are ready to take further step in development, in this case an irrigation scheme. Mahacha Dam constructed on the tributary of Nyarupakwe river within the "Survey Area - B" is a communal possession of Murand, Magonyo, and Hlamba village.

As a result of initial public hearing meetings and individual household survey, another six villages of Gunde, Mujubeki, Mateuro, Komboni, Mabharani, and Mavhondo became necessary to be surveyed. They are located in the downstream area of Nyarupakwe River and may be indirectly affected by the Project. Thus, total number of villages subject to survey became 15. Increased number of villages were grouped as "Survey Area - C".

4.4.2.3 Individual Household Survey

In addition to the public hearing meetings, an individual household survey was carried out for analysis of the socio-economic profile of the Pilot Project Area with the following criteria:

- Select 10 or all whichever is smallest of those ranked as wealthy class as a result of wealth ranking exercise during the public hearing followed by PRA exercise. Any excessive number is carried over to the middle class.
- Select 20 or all whichever is smallest of the middle class households. Based on random numbers obtained from hand calculator, households are selected from the numbered wealth ranking list generated through PRA exercise. Any excessive number is carried out to the poor class.
- In the case of Marumbe, where the villagers subdivided the households into four classes, 10 households are selected from each class. Where the households are not more than 10 in one class, excessive number is carried over to the next lower class.
- Select 10 or all whichever is smallest of those ranked as poor class.
- Half of the selected number of households are visited with quantitative questionnaire while the other half are visited with open-ended qualitative questionnaire.

Result of the analysis of individual household interview survey is illustrated as shown below.

(1) Present Needs and Demands

Present problems needed to be solved within the survey area are largely reflected from the attendance of the public hearing. It would therefore be sensible to review and substantiate these local needs and demands based on the data obtained through

individual household survey carried out over 15 villages using quantitative and qualitative survey questionnaires. Table 4.4.2 shows the result of overall household survey in terms of the ranking of the items revealed as the local needs and demands.

(2) Ranking of Needs and Demands

The item 1 of Table 4.4.2 shows the ranking of needs within the survey area. Except for communication system such as telephone, the result is essentially the same as that of the statement made during the initial public hearing meetings. Among them, water is the item most needed followed by road and/or bridges, health care services, transportation, stock farming.

(3) Availability of Water

The item 2 of Table 4.4.2 shows the ranking of availability of water in terms of its severity within the survey area. The people in Marumbe did not state that availability of water is not very severe while other villages feel it is very severe. However, those villages in the downstream area stated that it is not very severe. It appears that water is seeping through the escarpment of Mafungabusi Plateau and this is the water the people in Marumbe obtain for most time of the year. It is not surprising to note that they are settled at this location before 1954, when people in other villages began to settle down. Those in the midstream area feel it is very difficult to obtain water and these villages are in the marginal area of development in terms of water resources development. Among them, Hlamba, Magonyo and Murandu did not express shortage of water. This is substantiated by the fact that they have constructed Mahacha Dam on the tributary of Nyarupakwe Rive by the three village's effort. Thus, they are quite content with availability of water. Those in the downstream area do not state that availability of water is not severe as they have access to Munyati River, where permanent surface water is available.

(4) Use of Water

The item 3 of Table 4.4.2 shows the ranking of the use of water within the survey area. Use of water in the river is for domestic purposes in Marumbe and Muchina while other villages use the river for cattle watering or fishing. This is not surprising based on the fact that Marumbe was the indigenous tribe settled in the up-stream area of Nyarupakwe River as it produces relatively constant amount of water throughout the year at the foot of escarpment. No village stated that the river water is used for farming.. Where there is borehole or well, either one of them is exclusively used for domestic purposes. No village stated that they use water from dugwell or borehole for farming. This implies that the villagers would like to think if any surplus water would be made available, it would be for vegetable gardens, irrigation for cash crops, and cattle watering purposes in order to avoid the severity of water availability. There are no bore-holes being used in Marumbe, Makarichi, Sekema, and Murandu. They are therefore using dugwell for their domestic use of water.

(5) Road Transportation

The item 4 - 6 of Table 4.4.2 shows the ranking of road transportation in terms of its severity within the survey area. Lack of proper road is paired with the lack of proper bridges that can make the villagers go across rivers during the rainy season. Those villages near the main road do not state that the lack of cargo and/or passenger transportation make their economic activities difficult while they state road and bridge are the cause of problems. Thus, it appears that rehabilitation of the road is their interest followed by passenger or cargo transportation. However, those who stated that there is a lack of cargo transportation are concerned with marketing of their agricultural products.

(6) Health Services

Health service, which is available at Nyarupakwe Business Center is a focus of attention. With a lack of ambulance or passenger transportation for sending patient to the hospital in Gokwe, clinical services and its supply are considered as one of the important community services.

(7) Stock Farming

Needs on stock farming is clearly expressed in the section above. The local population unanimously stated that watering area for cattle during dry season is the most needed facility. Fenced grazing area, development of paddocks, and development of dairy industry are the requests made by the local population for implementation.

(8) Others

There have been a number of other request that the local population feel necessary to develop for which raising the standard of living is their aspiration. Better program at the school, banking system, postal services, electrification of the village, income generation project for women are other requests of the local population.

4.4.2.4 Presentation of the Outline of the Pilot Project

Based on the identified needs and demands during the Stage I Survey, outline of the project was presented to the local residents during the public hearing as a major part of Stage II Survey: Presentation of the Outline of the Project Based on the Local Needs and Demands. The following is the suggested outline of the pilot project:

- Construction of medium scale dam,
- Development of irrigation area,
- Construction of small scale dam for a dual function of silt-trap and water storage for livestock,
- Livestock development,
- Rehabilitation of 24 km short-cut road linking to Gokwe, and
- Rehabilitation of the existing boreholes.

4.4.2.5 Response of the Community

During the Stage II Survey public hearing, held in Nyarupakwe Business Center on 16 March, 270 people from 12 villages attended. Based on the suggested project outline, the following is a list of summarized and broadly generalized initial responses:

(1) Beneficial Effect

- Water for livestock is maintained throughout the year;
- Increased farming activities for cash income;
- The scheme allows producing sufficient food during dry season;
- Fish farming in the reservoir will provide animal protein food;
- Improves standard of living;
- Enable planting fruit trees;
- It could increase employment opportunities;
- Water for domestic use may increase;
- Cattle fattening, dairy cattle keeping and dip tank maintenance will become easy; and
- Piped water to near-by school will be constructed.

(2) Adverse Effect

- Since we do not have sufficient land for our children, land exchange in the irrigation area may become a difficult part of the pilot project;
- Farming area, at the same time it becomes dry season grazing area, is lost;
- If the dam gives in during the high rainfall, downstream area is damaged;
- Water canal passes through homestead and subdivide the area;
- Fragmentation of the farming area may cause land owners suffer from reduced farming area;
- Increase of Malaria is very likely because of breeding area for mosquito is increased;
- Children and livestock may drown in the reservoir;

(3) Other Requests

- To engage in dairy industry;
- Piped water to individual household;
- Electrification of each household;

- The reservoir and the near-by hills should be developed as tourism/recreational area;
- Water canal passing through the village should be made available for community and primary school's vegetable gardening and orchard;
- Those who give up land for irrigation area should be given priority to obtain irrigation plot;
- Those who give up land but do not take up irrigation plot should exchange land with those who is willing to do so;
- Those who lose farming area to the reservoir should be encouraged to voluntary relocation; and
- Irrigation area should be developed in the area near dam.

4.4.2.6 Presentation of the Pilot Project Components and Acceptance

Public hearing for the Stage III Survey was held in Nyrupakwe Business Center on 14 April 2000. Attendance was 191 from 13 villages. General session for explanations of the detailed project components followed by questions and answer session was held during the meeting. At the meeting, it was informed that the beneficiary farmers of the irrigation development shall bear the expenses for operation and maintenance of the project facilities as well as water charge. As a result of discussions, the following project components were generally accepted by the local population and early implementation of the project was strongly requested:

(1) Surface water development

(2) Irrigation development

(3) Livestock development

(4) Rural infrastructure development

4.4.3 Surface Water Resources Development Plan

4.4.3.1 Nyarupakwe Dam

It is proposed to construct a medium scale dam at the middle reach of Nyarupakwe River in order to exploit water resources to the maximum extent for the Pilot Project Area. The proposed dam site is located at about 400 m downstream of the existing main rural road running between Nyarupakwe and Njelele/Gokwe/Empress Mine.

(1) Water Resources Development Potential

A catchment area of the proposed damsite is estimated at 80 km^2. H – A (Water surface elevation – Water surface area) and H – Q (Water surface elevation – Storage capacity) at the proposed damsite are shown in Figure 4.4.1 based on the topographic map with a scale of 1 to 5,000. From this figure, the gross capacity of the proposed

reservoir is expected to be 1.65 x 10^6 m^3 with the full water level of El.898 m.

Since there is no hydrological data in the catchment area of the Nyarupakwe River, water resources development potential of the catchment is estimated using data described in "An Assessment of the Surface Water Resources of Zimbabwe and Guideline for Development Planning, Ministry of Water Resources and Development". Zimbabwe is classified into six (6) hydrological zones namely, Zone A to Zone F. The Pilot Project Area is located in Zone C in this classification. Zone C consists of 23 sub-hydrological zones and the proposed Nyarupakwe Dam is located in UN1 sub-zone. Based on the data obtained from the above hydrological zone, the yield of the proposed Nyarupakwe Dam was calculated as follows:

(a)	Catchment area	:	80.0 km^2
(b)	Mean annual runoff (MAR)	:	40 mm
(c)	Coefficient of variation (CV)	:	1.20
(d)	Full water level	:	El. 898.0 m
(e)	Low water level	:	El. 893.5 m
(f)	Reservoir surface area at FWL	:	47.5 ha
(g)	Gross storage capacity	:	1,650,000 m^3
(h)	Live storage capacity	:	1,450,000 m^3
(i)	Sediment volume	:	200,000 m^3
(j)	Yield at 10% risk	:	638,000 m^3
(k)	Yield at 20% risk	:	850,000 m^3

For water allocation of the available water of 850,000 m^3 per annum at 20% risk level, first priority is given to livestock and domestic water supply, and the remaining amount is used for irrigation depending on local population's intention obtained through the participatory social environmental survey as shown below.

-	For livestock	:	48,000 m^3
-	For domestic water supply	:	37,000 m^3
-	For irrigation	:	765,000 m^3

(2) Design of Dam

The design of dam was made based on the result of geological and soil mechanical investigation at the proposed damsite conducted by a local contractor on sub-contract in May and June 2000. "A Guide to Design and Construction of Medium Sized Earth Dams in Zimbabwe" was used for the design.

(a) Geology

Foundation rock in and around the damsite is composed of silt stone, sand stone and conglomerate originating Mesozoic sedimentary rock. Overburden of more highly weathered rock and top soil covers with 1 to 2 m thickness as the surface layer. Quaternary deposits such as talus, terrace and river bed deposit

exist in and around the damsite. Talus is very thin and river bed deposit is composed of sand and gravel. These materials are suitable for filter. According to drilling log and test pit profile, foundation rock is classified into three zones namely highly weathered rock, moderately weathered rock and slightly weathered rock as shown below.

Dam Foundation Rock

Description	Location (Depth)	N Value	Permeability (cm/s)
Highly Weathered Rock	less than 7m depth in hill area	20 – 50	4×10^{-4}
Moderately Weathered Rock	7 to 10m depth in hill area and less than 5m at river bed	more than 50	1×10^{-5}
Slightly Weathered Rock	about 15m or more depth in hill area and more than 5m depth at river bed	–	$< 1 \times 10^{-6}$

(b) Dam Type

The design flood discharge of spillway was estimated at 400 m^3/s with 250 year return period. No gate type of the spillway is recommended considering safety for the flood and easiness of operation and maintenance. As overflow depth at the spillway was determined to be 1m due to the topographic condition and reservoir capacity, the crest length of overflow weir was calculated to be 200 m. The scale of spillway became relatively big comparing to the dam scale, therefore the following two alternatives for dam design were considered:

Alternative 1 : Combined type of concrete gravity dam and fill dam

Alternative 2 : Fill type dam with side spillway

The construction costs of these two alternatives were roughly estimated, and the result of comparative study shows that Alternative 1 has economic advantage with about 90% of the construction cost of Alternative 2. Therefore, the combined type of concrete gravity dam and fill dam was applied for the Nyarupakwe Dam.

(c) Main Features of Dam

The main features of the Nyarupakwe Dam are summarized below based on the dam design.

(i) Dam type : combined type of concrete gravity dam and fill dam
(ii) Free board : 2.2 m (wet free board - 1.0m and dry free board - 1.2m)
(iii) Dam crest elevation : EL.900.20 m
(iv) Dam crest width : 8.0 m
(v) Dam height : maximum 15.5 m from base rock to the dam crest
(vi) Concrete gravity dam portion : length – 226 m in center portion,
upstream slope - 1 : 0.1
downstream slope - 1 : 0.68

(vii) Fill dam portion : length – 356 m
upstream slope - 1 : 2.5
downstream slope - 1 : 2.0

(viii) Spillway : design discharge – 400 m^3/s
overflow section at concrete gravity dam portion
- 1.0 m depth x 200 m width

(ix) Intake : design discharge – 0.074 m^3/s

The plan, profile and standard cross section of the Nyarupakwe dam are shown in the "Drawings" attached to this report.

4.4.3.2 Small Scale Dam at Upstream of Nyarupakwe Dam

In order to provide water for livestock for the upstream community, a small scale dam is proposed to be constructed at about 5 km upstream of the proposed Nyarupakwe Dam. This dam will be expected to have a function as a sand trap for the Nyarupakwe dam, where local peoples shall be required to remove sediment periodically.

At the proposed damsite, hard rocks are exposed at both river bed and side slopes. The width of river bed is about 15 m and the height of both banks is about 5 m. In consideration of topography, geology and scale of dam, a concrete gravity dam is proposed. The main features of the proposed dam are summarized below.

(a)	Catchment area	:	58 km^2
(b)	Dam type	:	Concrete gravity dam
(c)	Dam height	:	7.2 m from base rock to the dam crest
(d)	Dam crest length	:	61.0 m
(e)	Overflow section	:	W 20 m x H 1.0 m at the center of the dam wall

4.4.4 Agricultural Development Plan

4.4.4.1 Land Use and Land Allocation

Total area for irrigated farming is 60 ha in net, consisting 37.6 ha in Magonyo and 22.4 ha in Hlamba. These are presently rain-fed farming areas. According to present regulations on land use for agriculture, farmers have to surrender their lands to the government when their lands become irrigable.

4.4.4.2 Cropping Pattern

The following recommended cropping pattern in the Interim Report was evaluated in the intention survey of the farmers by the JICA Study Team. Fifty-seven percent of the farmers selected cotton as their first priority crop in the irrigation followed by maize. Forty-three percent of the farmers selected maize as the second important crop followed by vegetables. As the winter crop priority was given to vegetables and wheat. Individual cropping patterns would be different farmer by farmer

according to the specific landholding, labor availability and crop preference. But, given the subsistence orientation and need for each income it is likely that, on average, a cropping pattern similar to that proposed would emerge.

4.4.4.3 Target Yield of Crop

The future crop yields with project were estimated taking account the crop records in the existing irrigation areas as shown in the following table;

Crop Yields in the Existing Irrigation Areas

Crops	Yields (ton/ha)
Maize	5.8
Wheat	5.2
Cotton	2.4
Groundnuts	2.7

Source : The Agricultural Sector of Zimbabwe Statiscal Bulletin – 2000

The target yields of crops were set as follows:

Target Yields of Crops

Crops	Yields (ton/ha)
Maize	6.0
Cotton	2.5
Groundnuts	2.5
Wheat	4.2
Tomatoes	75.0
Cabbage	50.0
Dry beans	2.0
Paprika	3.0
Baby corn	1.0

4.4.5 Irrigation and Drainage Development Plan

4.4.5.1 Irrigation Area

(1) Pilot Irrigation Area

The Pilot Irrigation Area is selected among the existing rein-fed cultivated lands in two villages of Magonyo and Hlamba. This area is relatively easy to access due to farm roads running between this area and Gokwe town, which is passable by vehicles. A medium scale dam is proposed on the Nyarupakwe River, which would service the proposed Pilot Irrigation Area.

The central portion of the identified cultivable area is moderately sloping with land slopes varying from 1 in 230 to 1 in 250. On the north and south side of the Pilot Area, lands are sloping with steep slopes up to 1 in 40 and even less. As such, the central portion was considered for irrigation development.

(2) Delineation of Pilot Irrigation Area Boundary

Water available for irrigation is 0.765 MCM, which is able to irrigate 60 ha in net.

For pilot study it is desirable to have irrigation area in a compact block rather than having in scattered segments. With this in view, out of the available area of 88.10 ha which fit for irrigation in Magonyo and Hlamba villages, a compact contiguous block covering net irrigation area of 60 ha was selected. Net distribution of areas amongst two villages is as follows :

Mogonyo village	:	37.57 ha
Hlamba village	:	22.43 ha

Total area acquired would be around 72 ha to cover up other requirements of watercourses, laterals, drains, and farm roads, etc. The proposed Pilot Irrigation Area is shown in Figure 4.4.2. The Area may need some change/adjustments to accommodate some changes in water availability, or existence local high/low patches or jungle/tree growth or homesteads, etc.

4.4.5.2 Irrigation Water Requirements

While working out the irrigation water requirements for the feasibility study on the Kudu Dam Irrigated Agriculture Development Project, the meteorological data of Gokwe Meteorological Station was utilised. The same data is very much valid for the pilot project also. Further, the cropping pattern proposed for the irrigation area is same as adopted for the mentioned study. As such the unit irrigation water requirements worked out for the above project was adopted in this case also.

The average monthly diversion irrigation requirements as worked out for the irrigation area of 60 ha are given in the following table:

Month	Irrigation Water Requirement (million litres)
January	33.28
February	53.80
March	90.40
April	62.38
May	18.47
June	76.79
July	127.94
August	135.22
September	72.68
October	22.82
November	23.68
December	22.53
Total	739.99

The unit design water discharge was estimated at 1.2 l/s/ha which was evaluated in 10-day basis from diversion irrigation requirement of 5-year return period, by applying planned cropping pattern and the meteorological data having been observed at Gokwe Station from 1966 to 1997.

4.4.5.3 Main Conveyance System from Dam to Irrigation Area

Water from the dam outlet to the head of the irrigation area could be carried through either by the open/covered canal system or pipeline or a combination of both, suitably aligned depending upon the available terrain as encountered and other requirements.

(1) Main Canal Alignment

While proposing the canal alignment, consideration was given to the following aspects:

(a) The irrigation area is only 60 ha and the section of the open canal if adopted would be very small. The section being small, even if a little more length becomes necessary to avoid huge drainage crossings or low level areas, it should be preferred. The balanced section in respect of cut-fill would be ideal where ever possible, with due regard to the command area. The incremental cost of the additional length would be much less than the additional incremental cost on the specialized structures.

(b) Heavy structures for such a small size canal should be avoided as far as possible, because such structures require higher technology and sophistication, which is not easily available locally. Simple structures that could be constructed with local know-how should be preferred.

(c) Although an open channel is cheaper per metre length than a pipeline, the latter could be selected when the topography of the land is highly uneven or undulating, which would make the construction of an open canal either very expensive or even impossible/unworkable.

(d) It is a Pilot Irrigation Area situated in the remote location and it would be desirable to avoid high filling sections, so as to avoid drainage problem enroute.

(e) The system is to be maintained by the farmers, who are new to irrigated agriculture and maintenance of related structures, as such the system should be sturdy without any complications.

With the above considerations two sets of alignment plans was marked on the contour plan: one with open canal and other with the pipeline. These alignments could be used individually or in combination as shown in the following options:

(i) Pipeline in full length of 4,678 m

(ii) Pipeline in first 770 m and open/covered canal in the remaining 4,883 m, total length being 5,653 m

These are shown in Figure 4.4.3.

(2) System Designs

This being a small scheme, the water conveyance system could be designed either for delivering water for 12 hours during the day-time, there by avoiding night irrigation

or alternatively for delivering continuous supplies i.e. day & night - for 24 hours.

(3) Comparative Study

Based on the above options of canal alignment and system design, the following alternatives were studied :

Alternative I : System design for only day-time irrigation (12 hours)

Alternative I – (a) : With night storage reservoir

Alternative I – (b) : With Pipeline from dam to irrigation area

Alternative I – (c) : With Pipeline and open canal from dam to irrigation area

Alternative II : System design for continuous irrigation (24 hours)

Alternative II – (a) : With Pipeline and Open Canal from dam to irrigation area

As for Alternative I – (a), in Zimbabwe, sometimes, on small projects, night reservoirs are constructed at the head of the distribution system to store water during times when there is abstraction in the system from the water source, but water is not taken by the farmers for irrigation. This practice is being adopted in some schemes where farmers do not take water during the night-time. In these small schemes, the flows in the main canal during the night-time are contained in these so called night reservoirs. During the day-time this stored water is utilized for irrigating a separate section of irrigation area.

The Night reservoirs result in loss of water through seepage and a potential health danger in respect of diseases like malaria and bilharzia and as such, it is not advisable to promote them. But incidentally, in this pilot project, no head is available enabling constructing any night reservoir for storing water coming in the main canal during the night-time for its utilization during the day time.

Table 4.4.3 shows the summary of 3 alternatives excluding for Alternative I – (a) and Table 4.4.4. to 4.4.6 present the design figures of three alternatives of Alternative I – (b), (c) and Alternative II – (a).

(4) Adaptability of Alternatives

For day-time irrigation, three cases have been discussed viz. night storage reservoir, pipeline for the whole length from dam outlet to the Pilot Area; and combination of pipeline and open canal.

The first case Alternative I - (a) is not recommended in consideration of loss of water, health danger and insufficient head between dam and irrigation area.

The second case Alternative I - (b) is very costly and investment will not commensurate with the benefits. There are problems in the availability of the bends, sluice valves and air relief valves of 0.7m diameter. Use of reducers is restricted due to head limitations. Even for minor maintenance heavy machinery will be required. Normally, unless other wise required for some specialized considerations, pipelines

are found to be feasible where available head is more and flow through it passes at a high velocity. Here both the water head and the velocity of flow are very low.

The third case Alternative I – (c) shows the lowest cost among 4 alternatives. However, there is loss of water, which would result in a reduction of irrigation area. In this alternative, farmers will apply water for 12 hours during the daytime only. During the remaining 12 hours, farmers will not take water and as such the supplies will be closed. As per the operational criteria, full supply in terms of designed discharge with the designed water depth should be available in the main canal in the daytime period of 12 hours so that the farmers are able to take full discharge during their allotted time. Water regulation will be carried out at the dam outlet / off-take of the open canal.

The Pilot Irrigation Area is located at a distance of about 5.7 km from the dam outlet. When the regulation is carried out from the dam outlet (assuming the pipeline as empty), water will take about 3 hours and 45 minutes to reach the tail end of main canal. Further, it would be necessary to allow some response time for the gate operation and also to avoid damages in the pipe resulting due to water hammer, and open canal from back pressures, etc., on sudden opening / closing of the gate. This would depend upon the gate opening / closing mechanism and the type of soil supporting lining. This can only be precisely determined on the basis of analytical / experimental data. In case half an hour time is assumed for this purpose, the operation of gate will have to be started about 4 hours before the starting of irrigation by the farmers.

Similarly, for the closing time, the operation of closing of the gate should be started about just before the ending time of irrigation so that the reduction of flow at the regulation point does not affect the flow depth at the tail end during the irrigation time period. The period of advance closure of gate may be assessed suitable as 30 minutes.

The total loss of water before the start of irrigation and the after the close of irrigation time work out equivalent to 3 hours and 15 minutes in a day. This loss works out to about 25%, which is likely to reduce the irrigation area.

In the fourth case Alternative II - (a), the cost is almost same as of Alternative I - (c) but no loss of water is expected if the farmers come to irrigate during inconvenient time. In this alternative water will be supplied continuously in weekly rotations. It implies that during the seven days of 'ON' period, the system would be working round the clock, that is day and night, all the 24 hours or 168 (7x24) hours in a week and each and every farmer would get water in turns (turn by turn) for its allocated time once in this period of one week. In this process irrigation will be carried out by the farmers during inconvenient night-time also. Irrigation time will be suitably rotated after every crop season so as to distribute the inconvenient time periods equitably.

Comparative study of these alternatives shows that the continuous irrigation as per

Alternative II - (a) is most appropriate and as such it is proposed to design the system for continuous day-night irrigation.

4.4.5.4 Tertiary Canal Network

(1) Field Water Application Practices

In the existing irrigation projects, the fields are being irrigated from the watercourses by using siphon pipes. Siphon pipes are usually made of plastic or rubber hose. Siphons are easy to install and to remove without disturbing the canal bank. They are portable and the total water supply into the field varies according to the number of siphons used at a time.

The discharge through the siphon pipe depends upon its diameter, the length and the difference in water level between the water level in the watercourse and the water level in the field or the center of the pipe if it is not submerged in water in the field. The size of siphon pipes, as being adopted by the farmers is 50 mm which delivers a discharge of around 2 l/s under working head varying from 15 to 18 cm.

(2) Size of the Tertiary Section and Discharge

The size of siphon pipes as being adopted by the farmers is 50 mm diameter which delivers a discharge of 2 l/s. The size of the tertiary network and the discharge of the corresponding watercourse would depend upon the capacity of the farmers to manage maximum number of siphon pipes at a time to siphon off and apply all the flow-water running in the watercourse. During visits to some of the existing irrigation projects and discussions with the farmers, they (farmers) mentioned that they have been able to use 25 siphon pipes of 50 mm diameter at a time. However, on close examination it was observed that the farmers, including women farmers were comfortably using 10-15 pipes of 50 mm diameter, there by indicating the discharge range of 20-30 l/s. With these considerations the tertiary networks have been planned.

The Pilot Irrigation Area covers a part area of village Magonyo and a part of village Hlamba. The net irrigation area relating to the Magonyo village is 37.57 ha and it is proposed to irrigate it with two sets of tertiary sections with separate watercourses and their corresponding tertiary networks. The net irrigation area relating to Hlamba village is 22.43 ha and will be irrigated through one separate watercourse with its tertiary network. As such, as water reaches the Pilot Area, the flow is distributed in three parts viz. (i) for the Section-A covering whole of the area of Magonyo village north of the dividing road, and a part of Magonyo village south of the dividing road; (ii) for the Section-B covering remaining portion of Magonyo village south of the dividing road and (iii) for the Hlamba village. Proportional distributors are proposed to be provided at desired locations.

(3) Layout of Tertiary Canals

Field layout should permit proper conveyance of irrigation water from the source to each corner of every farm efficiently so that the crops grown should not suffer due to water stagnation or the scarcity of water. The objective is to ensure that the opportunity time of water absorption is same throughout the Plot Area. Each field layout depends on local situation. Generally it is governed by the topography and possible lengths of furrows or borders.

For precise layout, contours at 15-25 cm intervals are required. The available data shows contours with 1m intermediate interval, which are almost parallel to each other. The land is slightly sloping. As such, tentatively the tertiary canals may be proposed parallel to the contours and the fields may be proposed perpendicular to the tertiary canals. The distance between the two tertiary canals would depend upon the lengths of the furrows and borders.

The soils of the irrigation area comprise sandy loam to loam and the land slope is slight. For irrigation farmers use, 50 mm diameter siphon pipes giving a discharge of 2 l/s. The cropping pattern indicates maize, cotton, groundnut and vegetables in the rainy season for which furrow method of irrigation is considered as most suitable. In the dry season wheat crop has been proposed for which border method of irrigation is considered suitable. Under such conditions long/medium furrows and medium borders are preferred.

Presently, most of the farms are distinctly separated by rows of trees laid in the north-south direction with intense bushes, generally in disorderly manner. This may restrict the realignment of field boundaries. If need be, the fields in between the rows of trees can be aligned at an angle rather than straight lengths. The net irrigation area covers 60 ha which will be distributed amongst the farmers. The process of the distribution of land is being discussed among the farmers. After the distribution of land is finalized by the farmers, field layouts would then be decided in consultation with them.

(4) System Operations

The Pilot Irrigation Area has been divided in 3 tertiary sections. The village Magonyo is served through two sections and village Hlamba through one section. The area is irrigated through a main canal taking off from the dam outlet and leading to the head of the irrigation area. On reaching the irrigation area the flow is suitably diverted from the main canal to respective tertiary sections through the provision of suitably located proportional distributors. The system has been designed to cater for irrigation water requirements during peak periods of demand. During this period of peak demand (multiples of 7 days), the main canal and correspondingly all the three tertiary sections will draw water continuously to their full-authorized discharges, ensuring water to each and every farmer once every week. These are called as weekly 'ON' periods.

During non-peak period of demand, or when the supplies are short, the flows in respective channels would be made intermittent, they would be either 'ON' or 'OFF'. For regulation in non-peak/short supply periods, the gates provided at the distributors will be suitably operated. The 'OFF' periods may last 7 or 14 days depending upon the situations. The intervals are kept in seven day multiples so as to maintain weekly turn schedules amongst the farmers. This implies that during the seven days of 'ON' period, the distributors would deliver the authorized discharge to its tertiary sections. The quantum of supplies in the system will be regulated at the dam outlet / off-take of the main canal.

For the distribution of water amongst the farmers in each of the tertiary sections, suitable schedules called as 'Turn Schedule at Tertiary' would be prepared. Turn Schedule at Tertiary canals, called as 'TST', of any tertiary section may be defined as a system of equitable distribution of water in a rotational cycle of 7 day-nights (7x24 = 168 hours) by turns according to fixed schedule, specifying the day, time and duration of supply to each farmer in proportion to land holding sizes. Thus, every farmer in his tertiary section has fixed number of hours for which he is entitled to water in a weekly cycle of 7 days, i.e. 168 hours. Based on this concept, TST schedules will be prepared separately for the three tertiary sections.

4.4.5.5 Drainage Plan

(1) Drainage Needs of the Irrigation Area

The irrigation area is only 60 ha and comprises sloping and well drained lands. The land slopes vary from 1 in 230 to 1 in 250. On the north and south side of the Pilot Area lands are sloping with steep slopes up to 1 in 40 or even less. The Area may be categorized as well drained area. However, suitable provision for drainage was made.

(2) Determination of Runoff from Rainfall

A unit runoff factor of 1.76 l/s/ha has already been worked out for the design of drainage system for the Kudu Dam Irrigated Agriculture Project. It is proposed to adopt the same for the drainage design of the Pilot Area.

(3) Drainage Design

At the end of the furrows, a drain has been proposed which would lead excess water to the side un-irrigated areas, which are located at lower levels. Where the field drain touches the cultivated area, a link/collector drains have been proposed to lead water to the main/natural stream. The area to be drained is very small as such a minimum section with each of bed width and depth of 0.5m with side slope of 1.5 (horizontal) : 1 (vertical) is proposed to be adopted. The same minimum section will also be sufficient for the collector/link drains.

Farm drains have also been marked on the Figure 4.4.2.

4.4.5.6 Farm Roads

The irrigation area is bisected by a wide earth road. This road has been proposed for rehabilitation and further development to the concerned sectors. With in the irrigation area a provision for the farm roads has been made as a comprehensive plan along with irrigation channels and drainage.

The farm roads have been aligned along the watercourses to facilitate the operation and maintenance of watercourses and also for carriage of agricultural inputs and outputs from the fields.

These are shown in Figure 4.4.2.

4.4.6 Livestock Development Plan

In accordance with the approaches for the development of livestock sub-sector in the Study Area of the Kudu Dam Irrigation Project, which have been established in considerations of availing water resources developed through irrigation development for livestock development and contribution of livestock development plan to the irrigated agricultural development under the Project, the implementation of the grazing area development scheme and the livestock water development scheme on pilot bases are proposed under the present Pilot Project. In addition to the schemes, the fishery development scheme in the proposed dam reservoir is proposed as such a development activity has been initiated by the villagers of Magonyo, Hlamba and Murandu in the Mahacha Dam.

The grazing area development scheme is to be in the communal grazing areas of Magonyo, Hlamba and Murandu villages and the livestock water development scheme is to be implemented in the target four villages.

Other development options perceived by the target villagers of the Pilot Area including beef fattening, pasture & veld establishment and agro-forestry development are proposed to be implemented as demonstration activities and are accommodated in the strengthening plan of agricultural support services.

4.4.6.1 Grazing Area Development Scheme

The grazing areas of Hlamba, Magonyo and Murandu villages are becoming increasingly eroded, in part due to past poor grazing management but this has also been exacerbated by the fact that the grazing area is essentially on sodic soils which is very prone to sub-surface erosion in turn resulting in topsoil slump and gully formation. The grazing area development scheme aims to establish the fully fenced pilot grazing areas of some 860 ha extending mainly along the proposed irrigation canal and to introduce controlled grazing management system.

The anticipated benefits of the grazing area development scheme are:

- It will greatly reduce the amount of time farmers have to spend in herding

their animals,

- By the introduction of controlled grazing management, surface run-off and erosion in the areas will be mitigated,
- Improvement in carrying capacity of the grazing areas, and
- Animals can be put in grazing areas for longer periods than at present, which will result in improved productivity of them.

The scope and components of the scheme are as follows.

Scope and Components of Grazing Area Development Scheme

Scope	Establishment of fully fenced pilot grazing areas of some 860 ha	
Components	Fencing	29 km
	No. of paddocks fenced	5 paddocks

The locations of the target areas of the scheme are shown in Figure 4.4.4..

4.4.6.2 Livestock Water Development Scheme

The limited availability of water sources for livestock in the grazing areas in the target villages is one of the most serious constraints restricting the efficient utilisation of range resources. The scheme aims to construct a water trough for livestock to ensure water in the proposed grazing paddock of the grazing area development scheme of the Hlamba, Magonyo and Murandu villages and to build a trough for the grazing areas of Sekema village as shown in Figure 4.4.4. The provision of water for livestock in range lands will enable efficient use of grazing resources and also allow animals to extend the length of their grazing in an area. Especially in the dry season, this will have great advantage of enabling farmers to continue to use grazing areas otherwise inaccessible due to shortage of water.

4.4.6.3 Fishery Development Scheme

The scheme aims to introduce fish farming in the proposed Nyarupakwe Dam. The Dam will cover an area of approximately 47 ha when completely full; at its low level it is expected that the surface area will be about 10 ha. Within these extreme changes of surface area, there will be widely fluctuating potentials for fish populations. Thus, for calculation purposes, an average seasonal water area of 20 ha is assumed.

The scope and components of the scheme are as follows:

Scope and Components of Fishery Development Scheme

Scope	Establishment of fish farming in the Nyarupakwe Dam	
Components	Water surface for fish farming	20 ha
	Fish species	Bream
	Induction of fish fingerings	20 kg/ha; 400 kg/20 ha
	Fishing boat & net	1 set

The fishing operation in the Dam will be done by a fishing group who would use nets for catch, however, fish resources in the Dam will be kept open also for the Pilot Area communities as a recreational facility using a rod and line.

4.4.7 Rural Infrastructure Development Plan

4.4.7.1 General

In formulation of the rural infrastructure development plan, reference was made to the results of analysis and evaluation on the local peoples' request. The basic components of the rural development are (i) road improvement, (ii) rehabilitation and installation of boreholes, and (iii) construction of a community development center as described below.

4.4.7.2 Road Improvement

Road improvement plan will include (a) improvement of main road from Nyarupakwe to Gokwe and (b) improvement of link roads from farms to collection points on the main motorable roads.

(1) Main Farm Road to Gokwe

There is a farm road from Nyarupake to Gokwe that was once in operation about 40 years ago, but is not used at present. This road passes through Muza and Mafungabusi Plateau before it reaches Gokwe. The length of this road has a length is about 24 km and its width is 3.0 to 4.0 m with no pavement. Rehabilitation of this road will provide not only financial gains to the community and increase farm income but also incentives for the increasing economic activities and access to a range of social facilities such as better education, health services and other social amenities. It would also provide incentives for increased crop and livestock production through easier access to input and output markets and better technical services. The rehabilitation plan of this road is to have a width of 6.0m with gravel-metalling of 20 cm thickness. Special measures such as land slip protection work and asphalt pavement will be required for the steep section of about 1.0 km in the mountainous area. Figure 4.4.5 shows the typical section of the road to be rehabilitated.

(2) Farm to Market Link Roads

There are many link roads from farmer's fields connecting to the main roads in the Pilot Area. Farmers need to use these link roads to bring their produce to designated collection points and also for transport of inputs. Scotch carts are often used for transport from farm to collection point. Average width of these farm roads is 4.0 m and it is partially gravel-metalled. The improvement will be done to the following sections of the existing farm to market link roads in the Pilot Area;

(a) from Nyarupakwe to Muza past school to the Chiumbu business center and to Muchina and back to Nyarupakwe, a distance of 7.0 km;

(b) from Hlamba to Matuero to Magonyo and south to Marandu, a total of 7.0 km;

(c) to Aron from Namacheni, a distance of 2.0 km; and

(d) from Namacheni past Nayarupakwe Primary School to Jeffry and Gunde, a total distance of 6.0 km.

These gravel roads of 4 m width will be filled and compacted and made road worthy to enable scotch carts or small vehicles to move produce from farms to the collection point on the main road.

4.4.7.3 Rehabilitation and Installation of Boreholes

The boreholes in the Pilot Project Area constructed before 1970 should be replaced with new ones, because casing pipes of those boreholes are badly corroded. Also, the boreholes constructed after 1970 should be repaired for hand pumps, etc. In addition, it is proposed to additionally install new boreholes not only at the important social facilities, such as at schools, clinics, business centers, and community center etc., but also in the densely populated housing areas where presently no boreholes exist.

(1) Rehabilitation and Replacement

Rehabilitation will be done for 4 existing boreholes, BH-007, BH-013, BH-153 and BH-158, and replacement will be done for 9 boreholes, BH-004, BH-005, BH-009, BH-012, BH-013, BH-155, BH-161, and other 2 boreholes located in Komboni and Murandu village which are not listed in the record. In the replacement, BH-161 is now located far from housing area of both Sekema and Makarichi village, then it will be replaced to in and around housing area of Makarichi village. Likewise, BH-004 will be sifted close to Nyarpakwe primary school. All pumps, pipes, and casing will be renewed in the replacement.

(2) Additional Installation

New 6 boreholes are proposed to be installed at the following locations:

(i) Marumbe village : In the housing area near Nyarpakwe river
(ii) Chiumbu primary school : Beside the sports field
(iii) Sekema village : In the housing area near main road
(iv) Murandu primary school : Beside the sport field
(v) Proposed community development center : Beside the building
(vi) Gwamure secondary school : Beside the sports field

Specification of the borehole to be installed is as follows:

(a) Depth : 60 m
(b) well diameter : 150 mm
(c) pipe : 75 mm diameter, Galvanized pipes
(d) Pump type : BUSH type

It is recommended that water quality test and yield test for the excavated boreholes should be made prior to use by the people in the Pilot Project Area.

4.4.7.4 Construction of a Community Development Center

It is proposed to construct a rural development center designed for multi-purpose use by the local population at the Nyarupakwe Business Center. The proposed center shall have accommodation capacity of about 300 people and be furnished with full roofing, lowered walls for free ventilation and concrete-paved floor as shown in Figure 4.4.6. Also, it will be equipped with potable generators and bench-type chairs and desks to serve as the place to hold meetings and workshops with audiovisuals, and to serve as the place to issue small pamphlets that may help bridge the prevailing information gaps among the farmers. In addition, a small office cum storeroom will be annexed to the building, where the equipment such as audiovisuals, motorcycles, bicycles, all of which are needed as tools of information transmitter, will be kept.

4.4.8 Institutional Strengthening Plan

4.4.8.1 Basic Concept for Institutional Strengthening

The basic concepts established for institutional strengthening under the present Project are as follows:

- Capacity building of both the institutions and groups/organisations directly involved in the Project, as a priority in institutional strengthening,
- Need for capacity building in the critical areas for the planning, implementation and management of the proposed development plans under the Project,
- Enhance the capacity of key institutions to act as service providers at planning, implementation and management stage of development, especially to enhance the capacity of AGRITEX to carry out its core functions in the Project,
- Institutional strengthening of women groups and youth groups, and
- Establishment of a project management committee to ensure the provision of public sector services in integrated manner and to amalgamate development efforts of both the public sector and the local communities in the Pilot Project Area.

The institutional framework for development under the Pilot Project and the overall approach for the institutional strengthening under the Project is illustrated in Figure 4.4.7 and 4.4.8, respectively.

4.4.8.2 Plan for Strengthening of Rural Institutions

The plans for strengthening the key project related rural institutions involved in development plans while duly addressing the weaknesses of planning, implementation and management of plans are presented in the following sections. The program descriptions are presented in Table 4.4.7.

(1) AGRITEX

The plan for strengthening AGRITEX is directed to the enhancement of the capacity of its Gokwe South District Office and the field extension officers that are expected to take core functions under the Project. The objectives and components of the plan are as follows:

Strengthening Plan of AGRITEX

1. Establishment of Agricultural Extension Center (AEC)	
Objectives	-To establish a nucleus place for agricultural extension, especially for irrigated agriculture, in the Pilot Area -To establish an office/place to accommodate all the field extension officers in the Area in order to make possible their integrated approach for extension
Components	-Construction of AEC with office rooms, meeting room & demonstration field -Provision of a 4 wheel vehicle, training equipment, office facilities/equipment
2. Logistic Support Strengthening	
Objectives	-To enhance capability of FAEOs in the Pilot Area and to strengthen technical guidance to FAEOs from district or provincial AGRITEX
Components	-Provision of motorcycles to FAEOs and a 4-wheel vehicle to District Office
3. Capacity Building of Field Extension Staff	
Objectives	-To improve capability of FAEOs in the Area through in-service training
Components	-Periodic in-service training of FAEOs at province level
4. Recruitment of FAEO	
Objectives	-To meet farmers demand for technical guidance and training on irrigated agriculture
Components	-To post a FAEO well experienced in irrigated agriculture, water management and high value crops in the Area
5. Strengthening of Technical Guidance of Provincial Staff (SMS)	
Objectives	-To strengthen technical guidance to FAEOs and farmers, especially on irrigated agriculture, water management, animal husbandry and marketing
Components	-Periodic visit of provincial staff to the Pilot Area for delivering technical guidance to FAEOs and farmers

(2) VET

The improvement of the logistic support status of the District Office and its Sub-area office and the enhancement of capacity of extension officers are envisaged under the institutional strengthening of VET. The objectives and components of the plan are as follows:

Strengthening Plan of VET

1. Logistic Support Strengthening	
Objectives	-To enhance field operation capability of an extension staff (VEA) and Animal Health Instructor (AHI) in the Project Area and to strengthen technical guidance and support from the district VET
Components	-Provision of motorcycles to VEA and AHI & a 4-wheel car to District Office
2. Capacity Building of Field Extension Staff	
Objectives	-To improve capability of VEA and AHI in the Area through in-service training
Components	-Periodic in-service training of VEA and AHI at province level

(3) Pilot Project Area Community (VIDCOs & Village Assemblies)

With the aim to effectively mobilise communities, organise them and build their capacity to manage the development within the Project in a sustainable manner, the strengthening plan of the Pilot Project Area Community, represented by the VIDCOs and Village Assemblies, has been formulated in the following areas.

Strengthening Plan of Pilot Project Area Community

1. Awareness Program	
Objectives	-To aim at initial mobilisation of the communities through raising awareness of their grass root institutions of the Village Assemblies
Components	-Public hearings at the project related Village Assemblies; Consultation meetings with influential people in the Pilot Project Area; Participatory workshop (PCM workshop or else) of selected participants
2. Capacity Building of VIDCOs	
Objectives	-To enhance of technical and managerial capacity of VIDCOs so that they will be established as planning, implementation and management institutions for rural development at village level
Components	-Capacity building training of representatives of project related VIDCOs; Mass guidance to all members of VIDCOs; Workshop & study tour of representatives of VIDCOs
3. Formation of Project Management Committee (PMC)	
Objectives	-To support formation and establishment of a project management committee of the community that is responsible for the implementation, management and sustainability of the Project
Components	-Public hearings at Village Assembly level; Formation guidance to representatives of Village Assemblies and VIDCOs; Workshops of representatives of VIDCOs; "Learning by Doing" under the support of the Project Office; Study tour of representatives of the organisation
4. Establishment of Multipurpose Community Development Center	
Objectives	-To establish a multipurpose community development center
Components	- Construction of a multipurpose community center; Provision of motorcycle, bicycle, generator, equipment & facilities (Details are discussed in 4.4.7)

4.4.8.3 Plan for Strengthening of Farmers Organizations

In accordance with the basic concept for institutional strengthening, the plan for the strengthening of farmers organisations is aimed primarily at establishment, nurturing and maintaining the development process management capacity of the primary development beneficiaries. The components of the present strengthening plan include the execution of support programs for: (a) formation and establishment of the WUG and IMC in the irrigated area, (b) strengthening or formation of farmers organisations for livestock sub-sector development plans, (c) awareness program at village level, and (d) strengthening and formation of farmers organisations. The objectives and components of the plan are as follows:

Strengthening Plan of Farmers Organisations

1. Formation of WUG and IMC	
Objectives	-To support formation and establishment of WUG and IMC in the irrigated area responsible for the implementation, O&M and sustainability of the irrigation scheme
Components	-Awareness program; WUG & IMC formation guidance; "Learning by Doing" under the support of the Project Office; Study tour
2. Strengthening/Formation of Farmers Organisations for Livestock Development Plans	
Objectives	-To strengthen or support formation of farmers organisations of beneficiaries of livestock development plans
Components	-Awareness program; Farmer to farmer guidance; Farmers organisation strengthening or formation guidance & workshops; Follow up guidance & support
3. Awareness Program at Village Level	
Objectives	-To support the formation and establishment of farmers organisations in the Pilot Project Area such as producers group, marketing group, lending group, farm inputs purchasing group, women farmers group, youth group and etc
Components	-Awareness program for target groups at village or Pilot Area level
4. Strengthening/Formation of Farmers Organisations through Extension Services	
Components	Guidance & support by extension staff and by the Project Office

4.4.9 Agricultural Support Services Strengthening Plan

4.4.9.1 Strengthening of Agricultural Extension Services

The productivity of crop and livestock subsectors in the Pilot Project Area remains at substantially low level due to technical and socio-economic constraints. Such constraints are partly addressed through the institutional development proposed in the section 4.4.8. The strengthening plan of the agricultural extension services under the present Pilot Project is formulated on the basis of the basic concepts enumerated below.

- Extension services of the AGRITEX and VET to be strengthened under the current extension system and within the framework of its institutional strengthening plans proposed in the section 4.8.3 and extension services to be operated from the proposed Agricultural Extension Center (AEC),
- Strengthening plan of agricultural extension services to be primarily directed to support the agricultural development plan and the development plans of livestock subsector and targeted to the beneficiaries of the plans,
- Placing emphasis on the irrigation technology development and transfer and on-farm oriented and practical programs,
- Assist and encourage private sector involvement in agricultural extension activities,
- Strengthening plan of agricultural extension services to be reviewed to meet the actual needs of the service users through the workshop for the formulation of annual program plans through farmer-extension officer

workshop/meetings, and

- Strengthening of guidance and support of senior extension and technical staff from the provincial offices should be envisaged.

On the basis of the above concepts, the strengthening plan of agricultural extension services consists of field programs, farmer training programs, workshops, field guidance and strengthening of guidance and support of senior staff as presented in Table 4.4.8 and summarised as follows:

Strengthening Plan of Agricultural Extension Services

Program	Descriptions
Crops Field Program	-Demonstrations/trials; Training cum field guidance
Livestock Field Program	-Demonstrations (beef fattening, pasture & veld establishment, agro-forestry development)
Farmer Training Program	-Crop Production (practices, pest control, chemical use etc.)
	-Livestock (animal husbandry, animal health etc.)
Other Programs	-Workshops; Field Guidance on Farmers Organisation; Guidance & Support of Senior Staff

4.4.9.2 Improvement of Marketing System

(1) Basic Concept and Scope

In view of recent Government policy of encouraging a free market system with little or no public sector involvement in marketing, public sector support for processing or agri-business activities has not been incorporated in these proposals. Consideration has been given to proposals that would enhance market efficiency by bringing together buyers and sellers for making cost effective transactions.

(2) Plans for Improvement of Marketing System

On the basis of the said concept, the plans for the improvement of marketing system under the Pilot Project are for the rehabilitation/upgrading of the farm-to-market roads, the establishment of a collection points, the construction of a open market and the formation of producers groups/associations.

(a) Rehabilitation of Farm-to-Market Main Road

As the Pilot Area farmers are seriously handicapped due to the distance to the nearest marketing town center, a road to Gokwe from Nyarupakwe is proposed to be rehabilitated for providing financial gains to the community and increase of farm income. This road improvement was indicated as the most important need by farmers at the public meetings. The detail plan is discussed in the section 4.4.7 Rural Infrastructure Development Plan.

(b) Rehabilitation of Farm-to-Market Link Roads

There are many link roads from farmer's fields connecting to the main roads in the Pilot Area. These roads will also be rehabilitated for transport of

agricultural produce, inputs, etc., as described in the Section 4.4.7.

(c) Establishment of Collection Points

All major agencies involved in marketing have provided some facility for setting up collection points in and around the Pilot Area. COTCO has decided that it sets up a collection point in Nyarupakwe in the forthcoming season. Natfoods and Cargill also have some arrangements through agents to collect produce from farmers. Private abattoirs also visit the cattle auctions. Overall, for cotton, there is adequate number of collection points. But for maize and sunflower, farmers have to move produce to Sanyati, and have to bear the heavy cost of transport of output and inputs. In this regard, it is recommended that GMB should have a collection point in Nyarupakwe business center after dam construction as production is expected to increase.

(d) Development of Open Market

With the availability of water for a second crop, the production of vegetables and high value crops is expected to increase. There is a need for some central marketplace for farmers to bring produce from their homestead for sale. Even today it is common for farmers to bring their produce to the Nyarupakwe business center for sale. A central place would attract traders who could purchase large quantities. With the objectives to support farmers in marketing their produce, the development of an Open Market with the following specification as illustrated in Figure 4.4.9 is proposed in the Nyarupakwe business center.

(i) 4 units of marketplace of 20 x 4m, each comprising 5 stalls of 4 x 4m
(ii) Structure: roofed with concrete floor & 3 open sides
(iii) Facilities: water & electricity supply, drainage & waste disposal facility, blair toilets and a loading bay for trucks

A stall fee would be charged for daily use and the proceeds could be utilised for maintenance of the facility.

(e) Formation of Producers Groups/Associations

While there are a number of farmers groups operating in the Pilot Area, most of these are for the purposes of qualifying for group loan schemes operated by COTCO and Agribank. Umniati Producers Cooperative Society is a producers organization in the Area. However, its membership is limited and services are for its members. There is therefore a need especially in the irrigated area to set up producer associations because a substantial volume of production of vegetables or high value crops is expected and the current outlet of such produce in and around the Area is limited. The formation of the associations should be promoted through the agricultural extension services and the support of the Project Office in cooperation with purchasers of the produce on need and

demand basis. The involvement of private sector is essential for the formation of the organizations.

4.4.9.3 Approaches for Improvement of Agricultural Credit Availability

The method of disbursing agricultural credit to the smallholders sector had changed drastically in the last few years in Zimbabwe and most of the credit to the sector provided by the Agribank and COTCO are now given out as group loans. This highlights the importance of the group formation under the institutional development plan of the Project. The group loan arrangement should be promoted for credit institutions as a mean of reducing transaction cost as well as improving loan recovery rate. The following approaches should be taken for the improvement of the agricultural credit availability in the Pilot Project Area:

- Formation or strengthening of farmer organizations eligible under agricultural credit schemes of the financial institutions and other formal credit suppliers through the awareness program of the institutional development plan and the farmer training through strengthening of agricultural extension programs,
- Implementation of training on credit administration which is currently conducted by the Agribank as a pre-condition for group loan eligibility under the collaboration of the AGRITEX and the Agribank,
- Encouraging and assisting farmer groups applying for agricultural credit by the field extension staff of the AGRITEX, the FAEOs, and
- Encouraging and assisting the Agribank, COTCO, COTPRO and other institutions in and around the Project Area involved in marketing of farm products, farm input suppliers and firms with outgrowers scheme in expanding their credit operations or in involvement in the same.

4.4.10 Environmental Impact Mitigation Plan

4.4.10.1 Protection and Management of Reservoir and Water Resources

(1) Removal of Vegetation

In the inundation area all the vegetation needs to be removed to avoid subsequent oxygen depletion in the reservoir negatively affecting any medium term potential for fisheries development and destroying aquatic life. The inundation area should be demarcated by the Department of Water Development and AGRITEX. The Rural District Council is the land owner and should offer open access to the local community to exploit any tree species in the area. They could also offer free access to licensed timber merchants on their books.

It is possible that no merchant would bid for rights to cut in the area yet it is in the interests of the Project that as much vegetation is removed. For this reason free access is suggested. Certain utilisable species have been identified but the area has

constraints of distance from urban centres and there is possibly not sufficient economically useable species. The Project should reserve contingency funds to employ contractors to remove remaining vegetation.

Very careful monitoring of all such activities by the Gokwe South Natural Resources and Forestry Officer is required so that trees outside the inundation area bordering the reservoir edge and behind are preserved. These may be more economically interesting to timber merchants but for a multitude of conservation reasons should be protected at all costs. There may be a role for the Forest Commission Officer for Gokwe in surveillance and monitoring. Woodland remaining above the full supply level should be protected as a conservation area. Access points for livestock will be identified by the AGRITEX and DNR Officers to minimise erosion around the dam.

(2) Managing for Siltation Control and Livestock Watering

The dam can provide benefits in the dry season for livestock watering to those living in the Chiumbu and Murandu school areas and surrounding populations. Upstream of the Pilot Area dam site it is suggested that a small check dam is provided to trap silt and cater for livestock watering needs of those living in the Chiumbu area.

Downstream releases in the dry season to fill existing pools (with possible small weir) can provide local benefits for livestock watering to those in the Murandu school area. Others living to the northwest of the Dam in the direction of Nyarupakwe Rural Service Centre or, alternatively, to the east (settlement 500m distant) can benefit from direct access to the new dam. The dam wall area needs to be fenced off with barbed wire to protect it from livestock trampling and consequent erosion and other interference.

Upstream of the pilot dam a monitoring of siltation into the proposed livestock watering /check dam can be undertaken after the first few years of construction. Rough calculations suggest siltation in the first 10 years could amount to 6% of the volume of the pilot dam. This is not significant but review of the true extent of siltation into the upstream livestock dam is easily done.

4.4.10.2 Irrigation Area Environmental Management

Very limited significant additional impacts form pesticide and fertiliser use can be expected which would warrant special measures. Naturally it is appropriate for extension advisers to reinforce messages relating to safe handling of chemicals and mechanical equipment.

Fair delivery of water to all intended irrigation beneficiaries is critical. Experience from other schemes, including that at Nyanyadzi, Manicaland, invariably suggests "inequitable water supply and competition for water discourages farmers form co-operating with management and with each other" (Smallholder Irrigation: Ways Forward - Guidelines for achieving appropriate scheme design, Hydraulics Research 1997, page 17).

Normal maintenance with respect to restricting erosion from access roads and keeping canal drains clear apply. Generally, soils appear to be free draining sand loams. Managing water efficiently according to scheme design is essential to avoid dispute between top-enders and tail-enders is critical as also between more influential members of the community and those with less ability to insist on their fair allocation during times of peak demand and periods of water restriction.

Women farmers especially where they hold plots in their own right may be less able to insist on their fair water allocation. In general, women's involvement will be critical to success of the pilot scheme such is the importance of their role in farming especially in all cultivation activities.

Provision of potable water and sanitation facilities is advised. Health extension messages should discourage drinking of canal water.

4.4.10.3 Management of Socio-economic Environment

(1) Relocation of Farming Area within the Reservoir

Compensation for farming area inundated by the reservoir will be carried out with the "Land-to-land Exchange" concept. There is 21.1 ha of farming area that belong to the local farmers living in Makarichi, Muza and Sekema village. There are 19 owners who are affected by the dam construction. Based on the socio-economic survey result, most of them are willing to move their farming area within the three villages i.e. if one who own a piece of land in Makarichi will agree to acquire equivalent of land in Sekema as these villages are located on the right bank of Nyarupakwe River. Those in Muza prefer to acquire land within their village so that they do not have to go across the river for cultivation. If no land is available within the adjacent villages for compensation, one will agree to acquire land within Chesina I Ward.

(2) Compensation and Reallocation of Land in the Irrigation Development Area

Compensation of the area affected by the irrigation area development is carried out with the "Land-to-land" concept. There are 16 land owners within the 60 ha of irrigation development area. Each land owner is expected to give up their land for irrigation area development and acquired the same amount of land, rain-fed agriculture area, within the village they live.

Those interested in acquiring irrigation plot for their new agricultural activity is so decided by the Pilot Project Management Committee intended to establish for the Pilot Project. Any villager interested in acquiring "One Unit" of irrigation plot should give up "Two Unit" of his/her rain-fed farming area as was agreed upon among the villagers who attended the final public hearing.

This coordination will be carried out by the Pilot Project management Committee as so established prior to the implementation of the Pilot Project.

(3) Gender Issue

Where female work load is increased as a result of the implementation of the Pilot Project, the organisation intended to be established should function as an organisation for empowerment of the female members of the community concerned with the irrigation area development.

The sub-committees established within the organisation of the Pilot Project Management Committee will also have to deal with gender issues that directly and indirectly affect the community in general. It would be ideal to maintain more than 30% of the representation of female within the each sub-committee.

4.4.10.4 Conclusions

The pilot proposal is for a comparatively small scheme, particularly in relation to the main project. As a result there will be by definition limited impacts - positive and negative - on the existing natural environment. There will also be no resettlement requirement because there is nobody living in the inundated area. However some form of compensation, or alternative land distribution, will be required for those losing arable fields after the reservoir has filled.

Removal of vegetation in the inundated area is important if the potential for a rich aquatic resource including fishery is not to be forfeited. Another major potential benefit is for dry season cattle watering to surrounding communities. The proposed upstream dam can provide benefits both as a silt trap and for dry season watering.

Occasional downstream releases in the dry season can serve watering requirements for those living around Murandu school, while controlled access directly to the reservoir lake shore from each side of the potentially flooded Rural Council road will serve other adjacent communities. Protective fencing around the dam wall itself is recommended.

In the irrigation area potentially negative impacts are minimal and special management measures are probably not required beyond environmentally sensitive agricultural extension advice. However, new potable water and sanitation facilities are recommended to mitigate potential occurrence of water-related diseases.

4.4.11 Proposed Organizational Set-up for the Pilot Project

As the Nyarupakwe Pilot Project is a part of the Kudu Dam Irrigation Project, the Pilot Project Office will be established as the under organization of the LMADA proposed in the previous section of 3.2.10. Therefore, the proposed organization for implementation and O&M of the Pilot Project Office is same with that of LMADA as shown in Figure 3.2.12.

4.4.11.1 Proposed Organization for Pilot Project Implementation

Functions of four divisions during construction period would be as follows:

(a) The Engineering Division would be responsible for planning, survey, design, tendering and construction supervision of medium and small scale dams, irrigation facilities, livestock development works, rural infrastructure and agricultural extension center, etc.

(b) The Agricultural Division would have responsibility for executing institutional strengthening plan and agricultural support services strengthening plan.

(c) The Community and Environmental Management Division will consist of only two sections excluding resettlement section from the LMADA, because no resettlement will be expected due to construction of the Nyarupakwe dam. This division will be in charge of environmental impact mitigation plan.

(d) The Administration and Finance Division would be responsible for contracting works, budget management, accounting and auditing during the construction period.

4.4.11.2 Proposed Organization for Pilot Project O&M

The role of the Pilot Project Office for O&M stage would be as follows:

(a) The Engineering Division would be responsible for the hardware O&M of medium and small scale dams and irrigation system. The Rural Infrastructure Section would be excluded from the Pilot Project Office, because O&M of roads and boreholes would be undertaken by DDF.

(b) The Agricultural Division would take charge of O&M for soft aspect as the coordination body between related rural institutions such as AGRITEX and VET, and farmers' organizations (project management committee, water users group, etc.).

(c) The Community and Environmental Management Division would be responsible for monitoring environmental impacts to natural and social conditions. The Community Participation and Plot Allocation Section which will have a function of land re-allocation during the construction period would be excluded from the Project Office in this stage.

(d) The Administration and Finance Division would be responsible for procurement, O&M budgeting including water charge and O&M fee management, monitoring/reporting and general administration.

The relationship between the Pilot Project Office, government supporting institutions and farmers' organization is shown in Figure 4.4.10.

4.5 Project Cost and Implementation Plan

4.5.1 General

Basic conditions and assumptions used for cost estimate of the Kudu dam irrigation project were applied for the Pilot Project Cost Estimation (see section 3.3).

4.5.2 Project Cost

The project works comprise six components: (i) water resources development works, (ii) irrigation development works, (iii) livestock development works, (iv) rural infrastructure works, (v) institutional strengthening works, and (vi) agricultural support services strengthening works as shown in Table 4.5.1.

(1) Cost for Water Resources Development Works

The water resources development works consist of construction cost of Nyarupakwe dam and a small scale dam. Construction costs of Nyarupakwe dam and a small dam were estimated at Z$146,233,000 (US$ 3,848,200) and Z$ 4,127,000 (US$ 108,600), respectively. Therefore, the total cost for water resources development becomes Z$ 150,360,000 (US$ 3,956,800).

(2) Cost for Irrigation Development Works

The irrigation development works comprise construction of main irrigation canal of 770m pipeline and 4,883 m open canal and canal related structures, and on-farm facilities for 60 ha of net irrigation area. Construction cost was estimated at Z$ 14,307,000 (US$ 376,500).

(3) Cost for Livestock Development Works

The livestock development works consist of grazing area development scheme, livestock water development scheme and fishery development scheme. The estimated of construction cost is Z$ 854,000 (US$ 22,500).

(4) Cost for Rural Infrastructure Works

The rural infrastructure works are composed of rehabilitation of roads, construction and rehabilitation of boreholes, and communication of community center. The estimated cost is Z$ 80,517,000 (US$ 2,118,900).

(5) Cost for Institutional Strengthening Woks

The institutional strengthening works consist of construction of agricultural extension center and execution of institutional strengthening program. Cost of these works was estimated at Z$ 9,328,000 (US$ 245,500).

(6) Cost for Agricultural Support Services Strengthening Works

The agricultural support services strengthening works include construction of open market and execution of agricultural extension program. The estimated cost for

these works is Z$ 2,286,000 (US$ 60,200).

Consequently, total amount of project cost becomes Z$ 257,652,000 (US$ 6,780,300) as summarized in the following table. The break down of the project cost is shown in Table 4.5.2.

Pilot Project Cost

Item	Construction Cost (Z$1,000)
Water Resources Development Works	150,360
Irrigation Development Works	14,307
Livestock Development Works	854
Rural Infrastructure Development Works	80,517
Institutional Strengthening Works	9,328
Agricultural Support Services Strengthening Works	2,286
Total Amount	257,652

4.5.3 Operation and Maintenance (O&M) Cost and Replacement Cost

O&M cost comprises labor costs, fuel expenses, material costs and administrative costs, etc., and 1.2% of the total pilot project cost is taken as the annual O&M cost in this project. In addition, 1.0% of the total project cost is evaluated in every ten years for replacement of various equipment with shorter life than the project evaluation term.

4.5.4 Implementation Schedule

The Pilot Project should be started earlier as soon as possible, therefore, construction work of the Nyarupakwe medium-scale dam will be started from July 2002 after finishing the detailed design and preparatory works. All works of the Pilot Project shall be completed at the end of 2003 at the same time with completion of the Nyarupakwe dam construction. Institutional strengthening program and agricultural support services strengthening program will be started at the beginning of 2003 and continued for three years upto 2005.

4.6 Project Evaluation

4.6.1 General

Project evaluation is made through assessment of the project feasibility in view of economic and financial aspects. The economic viability of the project is found by estimating Economic Internal Rate of Return (EIRR) taking into consideration of the difference of the benefit for the overall Kudu dam Irrigation Project with and without Pilot Project. Financial evaluation of typical farm household economy is made to examine the capacity to pay for the water charges and O&M cost at the farm level.

4.6.2 Economic Evaluation

4.6.2.1 Basic Assumptions

Basic assumptions for the Pilot Project evaluation are same with those used for the Kudu Dam Irrigation Project

4.6.2.2 Economic Costs

(1) Project Cost

The economic construction costs was estimated at Z$ 206,122,000 by applying construction cost conversion factor (CCF) of 0.80.

(2) Replacement Cost

Replacement Cost was estimated at Z$ 1,752,000 which is appropriated every 10 years after completion of construction works.

(3) Operation and Maintenance Cost

Operation and maintenance costs were estimated at Z$ 2,102,000/year.

4.6.2.3 Economic Benefits

(1) General

The benefit of the Project will be derived from (i) irrigation development, (ii) livestock and domestic water supply, (iii) maize stalk/residues supply, (v) road rehabilitation, and (vi) livestock development.

(2) Benefit from Irrigation Development

The irrigation benefit of 60ha net irrigation area was estimated as shown in Table 4.6.1 and summarized below.

Incremental Net Benefit from Irrigation Development

(Unit: Z$ 1,000)

Financial/Economic Value	Without Project Condition	With Project Condition	Incremental Net Benefit
Economic Value	816	3,618	2,802

(3) Livestock and Domestic Water Benefit

Construction of Nyarupakwe dam and a small dam and rehabilitation/construction of boreholes will provide water for livestock and domestic use of local people. The economic benefit derived from water supply was estimated at Z$ 2,123,000.

(4) Benefit from Maize Stalk/Residues

Maize stalk is expected as a stable source of fodder for livestock. The benefit expected from maize stalk was calculated Z$ 82,000.

(5) Benefit from Road Rehabilitation

The proposed road rehabilitation works consist 22km of farm to market link roads and 24km of main farm road from Nyarupakwe to Gokwe. The benefit from these roads rehabilitation works was estimated at Z$ 3,188,000 as an economic basis taking account of saving cost in vehicle operation and transportation of farm products, etc.

(6) Benefits from Livestock and Fishery Development

Livestock benefit is expected from savings in herding livestock, surface soil conversion and livestock water development scheme. The fishery benefit will be obtained through fish production by use of Nyarupakwe reservoir. The economic benefit from livestock and fishery development was estimated at Z$ 921,000.

4.6.2.4 Economic Evaluation

The Pilot Project is indispensable for smooth transition to irrigation cultivation for beneficial farmers so that the whole Kudu Dam Irrigation Project will success in increasing crop products. The evaluation of the Pilot Project is, therefore, made considering the difference of period for obtaining irrigation benefit with and without Pilot Project conditions as shown below.

- With Pilot Project : full benefit will be obtained 7 years after completion of construction works of irrigation facilities.
- Without Pilot Project : full benefit will be obtained 14 years after completion of construction works of irrigation facilities.

Based on the above assumption, the Economic Internal Rate of Return (EIRR) of the Pilot Project is estimated at 26% as shown in Table 4.6.2, which shows the Pilot Project is justified economically.

4.6.3 Financial Evaluation

The financial evaluation of typical farm household economy is made and the result is summarized below.

Household Budget

(Unit: Z$)

Particulars	Without Project	With Project
Net Agricultural Income	19,395	61,653
Net Livestock Income	781	781
Off Farm Income	8,410	8,410
Total Net Income	28,586	70,844
Living Expenditure	16,577	19,064
Net reserve	12,009	51,780

In the above calculation, it is assumed that the standard farm household will have an irrigation area of 1ha and 5 ha of rainfed area after irrigation development. As shown in the above table, the net annual income of typical farm will be increased to

about 4 times of the present, and the beneficiary farmer will have enough capacity to pay of water charge and O&M cost of about Z$ 4,000/year as mentioned in the previous part 3.4.3.

4.6.4 Socio-Economic Impacts

There are various intangible benefits expected from the implementation of the project. Major impacts expected after the implementation of the project are similar to the impacts for the whole Kudu Dam Project Area described in the previous section 3.4.4.

The improvement of rural road between Nyarupkwe and Gokwe will stimulate the economy of the Pilot Project Area. Presently the farm products are exported to Sanyati which lies at a distance of 64 km. The road to Gokwe with a distance of 24 km will be used for the transportation of agricultural outputs/inputs as well as person trips contributing a big saving of transportation cost as mentioned before. Local transportation will be improved by the construction of the farm roads along the canals and the rehabilitation of village roads. The expanded road system will not only enhance the economic activities but also contribute inter-regional accessibility and communication.

The successful implementation of the Pilot Project including operation, maintenance and water management will bring the demonstration effect not only to the whole Kudu Dam Project but also to other similar irrigation projects. Especially, technical knowledge on operation, maintenance and water management for irrigated agriculture can be transferred to others.