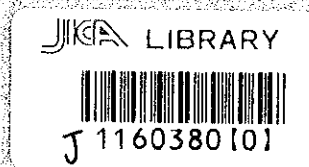


Japan International  
Cooperation Agency

Ministry of Lands and Agriculture  
Republic of Zimbabwe

THE FEASIBILITY STUDY  
ON  
THE LOWER MUNYATI RIVER BASIN  
AGRICULTURAL DEVELOPMENT PROJECT  
IN  
THE REPUBLIC OF ZIMBABWE

Volume - I  
MAIN REPORT



November 2000

Nippon Koei Co., Ltd.  
Kokusai Kogyo Co., Ltd.

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Japan International  
Cooperation Agency  
(JICA)

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ON THE LOWER MUNYATI RIVER BASIN  
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**Volume - I  
- MAIN REPORT -**

NOVEMBER 2000

Nippon Koei Co., Ltd.  
Kokusai Kogyo Co., Ltd.

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## **CURRENCY EQUIVALENT**

( As of June 2000 )

US\$ 1.0 = Z\$ 38.0 = ¥105.0

## PREFACE

In response to the request from the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct The Feasibility Study on the Lower Munyati River Basin Agricultural Development Project, and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Zimbabwe a study team headed by Mr. Takeshi Kawaguchi, Nippon Koei CO.,LTD., five (5) times between October, 1998 and October, 2000.

The team held discussions with the officials concerned of the Government of the Republic of Zimbabwe, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zimbabwe for their close cooperation extended to the team.

November, 2000



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Kunihiko Saito  
President  
Japan International Cooperation Agency



November 2000

Mr. Kunihiro Saito  
President  
Japan International Cooperation Agency  
Tokyo, Japan

## LETTER OF TRANSMITTAL

Dear Sir,

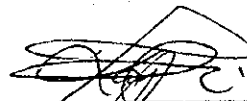
We have the pleasure to submit you herewith the Report of the Feasibility Study on the Lower Munyati River Basin Agricultural Development Project in the Republic of Zimbabwe. This report presents the results of all works performed in both Zimbabwe and Japan during a total period of 24 months from October 1998 to October 2000.

The objective of the Study is to formulate the irrigated agricultural development plan for the smallholder farmers in the communal and resettlement areas in the Lower Munyati River Basin located in two provinces of Mashonaland West and Midlands. The main development components formulated in the Study consist of creation of Kudu Dam Reservoir on the Munyati River to provide water for irrigation and urban use in surrounding towns of the Study area and of provision of an irrigation system to introduce irrigation farming in areas downstream of Kudu Dam. The number of beneficial population is estimated at about 440,000. However, as the small-scale agricultural sector has had little experience in irrigation cultivation and farmers in communal and resettlement areas have generally little sense of participatory development, the comprehensive agricultural development plan including establishment of farmers' organizations and improvement of agricultural support services is established in this study. Furthermore, for successful implementation of the Kudu Dam Irrigation Project which has an important role as a pioneering irrigation project for smallholder farmers in Zimbabwe, it is recommended to establish the Nyarupakwe Pilot Project, which will serve as a place of technical training and trial and error learning for farmers in the Study area.

We believe that the project implementation will help to improve farmers' living standards in the Study areas and to develop socio-economy in the rural area, and to prosper the cordial relations and good-will between Zimbabwe and Japan.

We wish to express our deep appreciation and sincere gratitude to your Agency, the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry and Fisheries for the kind co-operation extended to us. We also wish to express our deep gratitude to your Zimbabwe Office, the Embassy of Japan, the Ministry of Lands and Agriculture and other authorities concerned of the Government of the Republic of Zimbabwe for the close co-operation and assistance extended to us during our field investigations and studies.

Very truly yours,

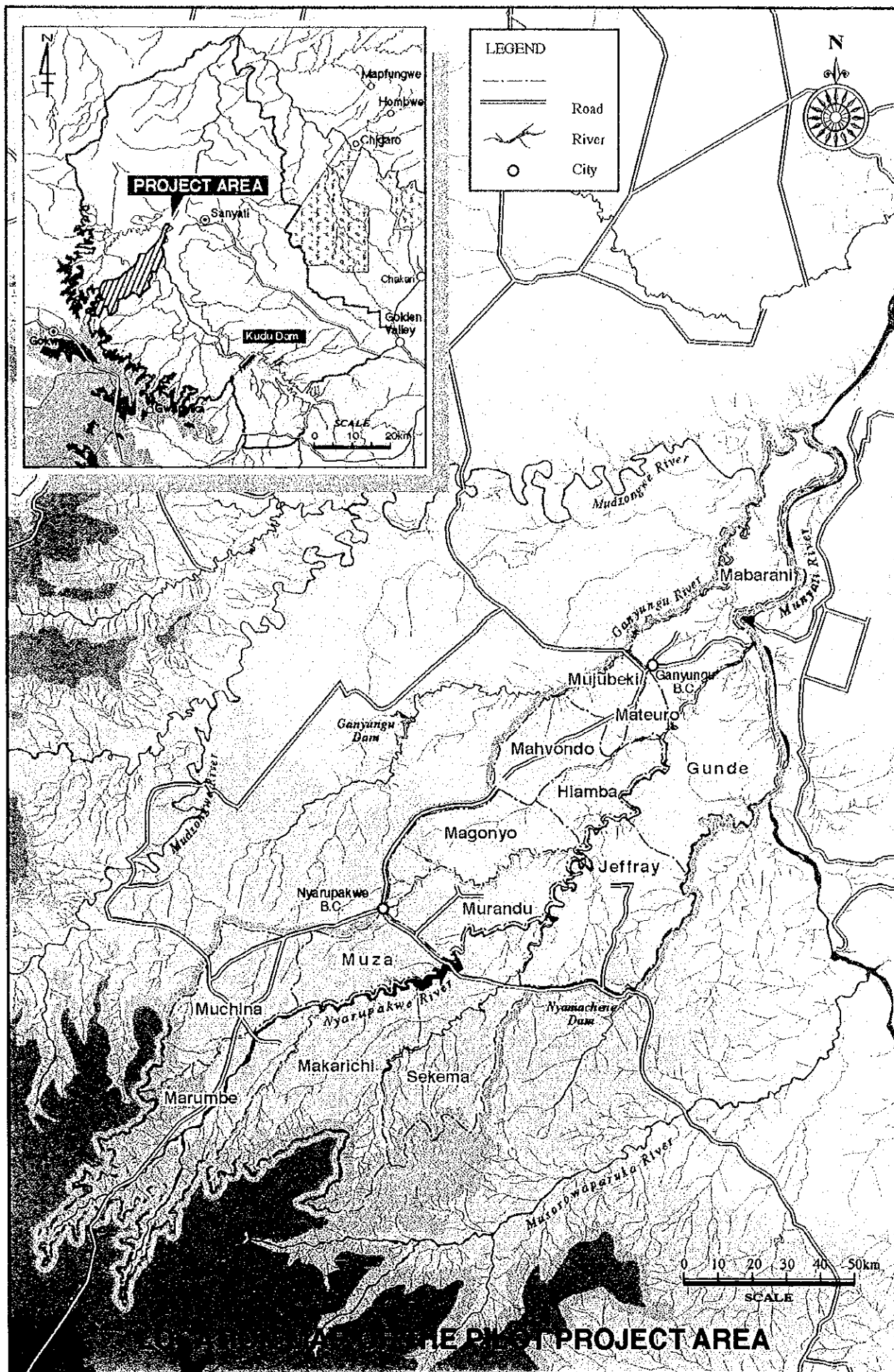


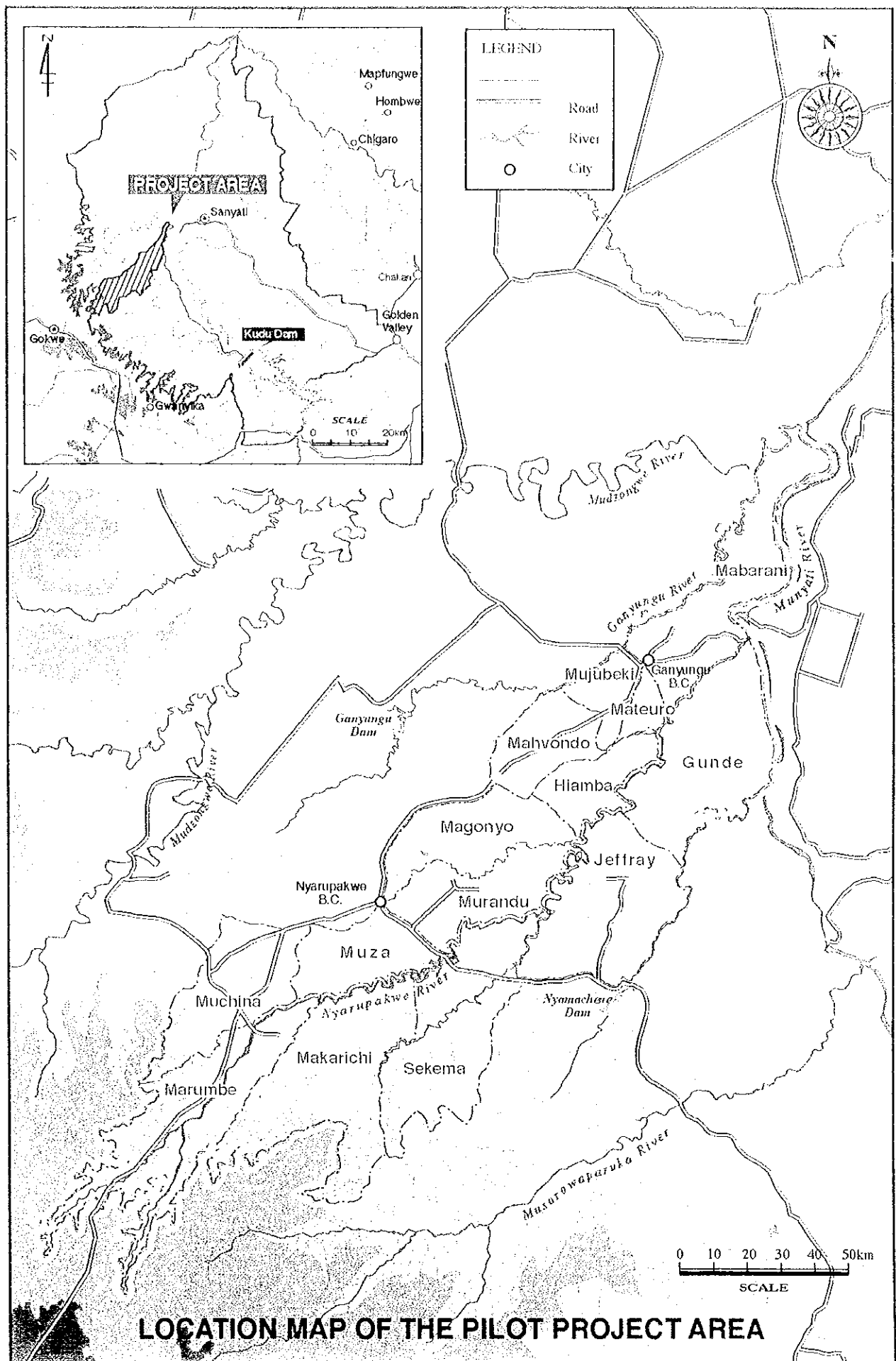
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Takeshi Kawaguchi  
Team Leader  
The Study Team for the Lower Munyati  
River Basin Agricultural Development  
project in the Republic of Zimbabwe











Kudu Damsite



Munyati River



Sprinkler Irrigation Facility of the  
Existing Pazavamba Cooperative Farm



Cotton Cultivation



Maize Cultivation



Paprika Cultivation



Grazing Area



Existing Borehole



Main Farm Road in the Left Bank of  
the Munyati River



Social Environmental Survey  
(Public Hearing)



Ngondoma Existing Irrigation Scheme



Seminar for Technology Transfer



## **I Introduction**

### **Authorities**

1. This Final Report is prepared in accordance with Clause VI-3 of the Scope of Work (S/W) for the Feasibility Study on the Lower Munyati River Basin Agricultural Development Project agreed upon between the Government of the Republic of Zimbabwe (GOZ) and the Japan International Cooperation Agency (JICA) on April 15, 1998.

This report presents the result of the Phase I Study Work for "Agricultural Development Plan in the Kudu Dam Irrigated Agricultural Development Project" and the result of the Phase II Study Work for "Agricultural and Rural Development Plan in the Nyarupakwe Pilot Project".

### **Background of the Project**

2. In the agricultural sector of Zimbabwe before independence in 1980, the large scale commercial farms played a predominant role, and the government gave them support through development of water resources, etc. However, since independence, the government has started to change its basic agricultural policy as it recognized that domestic foods security as well as the sustainability of the country's agriculture would be threatened without developing self-support of smallholder farmers in the communal and the resettlement areas and the small scale commercial farms, who make up the majority of individual farmers in the country. In the Agricultural Policy Framework in Zimbabwe (1995 – 2020) issued in 1995, the middle and short-term targets are mainly : twofold increase of crop products and transfer to value added crops in small farms, promotion of woman participation, revolution of public agricultural organizations, increase of total irrigation area of smallholder farmers by 40,000 ha, improvement of efficiency on water utilization, and improvement of efficiency in purchase and utilization of fertilizers by smallholder farmers.
3. Under the governmental policy to develop the limited water resources in the country, the construction of the Kudu Dam for agricultural development in Munyati River, which flows in the middle part of the country, has been planned since the 1960s. The GOZ conducted a feasibility study to evaluate technical and economical suitability of the Kudu Dam. After the feasibility study, a detail design of the dam itself was carried out by Zimbabwean budget and resources in 1993. However, the required study on agricultural development plan in the benefited area of the Kudu Dam Irrigation Project has not been undertaken. The GOZ made a request to the Government of Japan (GOJ) to carry out a Master Plan Study in March 1991. In response to this request, the Master Plan Study on the Lower Munyati Basin Agricultural Development was conducted from 1994 to 1995. It presented three development scenarios, namely with and without Kudu Dam cases, as follows:

Scenario A, large scale irrigated agriculture project with Kudu Dam; Scenario B-1, small scale irrigated agriculture project with eight medium scale dams; and Scenario B-2, large scale agriculture project without irrigation. In the Master Plan Study, the development plan was worked out for each scenario, and the project evaluation for each plan was comprehensively estimated from the synthetic point of view, i.e., economy, finance, technology, organization, society, and environment, from estimation of project costs and benefits. As a result of the evaluation, the Scenario A was given first priority. It plans to raise the living standard of smallholder farmers at the communal and resettlement areas in the Project Area through irrigation development including the water source development of the Munyati river, i.e., the Kudu Dam. The Master Plan Study recommended promoting the agricultural development in the Lower Munyati River Basin by the scenario with Kudu Dam case.

Outline of Development Scenarios in Master Plan Study

Scenario Code	A	B-1	B-2
Kudu Dam	With	Without	Without
Other Water Sources	-	With	Without
Development Purpose	Agricultural & Rural Development through Wide Area Irrigated Agriculture	Agricultural & Rural Development through Spot Irrigated Agriculture	Agricultural & Rural Development without Irrigation
Development Component	1. Irrigation Facilities Construction according to Available Water Source in Kudu Dam 2. Agricultural Extension, Marketing, Agricultural Credit 3. Rural Infrastructure	1. Water Source Development in Tributaries and Irrigation Facilities Construction 2. Agricultural Extension, Marketing, Agricultural Credit 3. Rural Infrastructure	1. Agricultural Extension, Marketing, Agricultural Credit 2. Rural Infrastructure

4. Considering the result of the Master Plan, the GOZ requested technical cooperation for the Feasibility Study on the Project to the GOJ. In response to this request, the GOJ dispatched a preparatory study team and had a series of discussions with the GOZ on the Scope of Work (S/W) for the Feasibility Study on the Lower Munyati River Basin Agricultural Development Project. As a result of these discussions, both sides agreed on the S/W on April 15, 1998.

## II Development Needs and Constraint

### Development Needs

5. Most of the Study Area is classified as NR III of which annual rainfall is less than 650mm and rainfall pattern is unstable. Under this condition, smallholders perform rain-fed cultivation and extensive livestock farming. In addition to this, urban/industrial water demand around the Study Area is increasing year by year, and

it is forecasted that serious water shortage will occur in 2010. Therefore, the development of water resources is urgently needed to meet the demand for irrigation and urban/industrial water.

## Constraints

### 6. Physical Constraints

- (1) Annual rainfall is limited to about 650mm and in the winter season there is almost no rain because about 95% of annual rainfall is concentrated in the summer season from October to March.
- (2) Crop productivity is low and unstable due to unreliable rainfall distribution and wide range fluctuation of annual rainfall year by year.
- (3) In the communal and resettlement areas, existing plots of cultivated land are generally small and scattered depending on the undulating topography and soil conditions.

### 7. Technological Constraints

- (1) There is no comprehensive irrigation system except small scale schemes where irrigation water is taken from small reservoirs and boreholes, so farmers in the Study Area have almost no experience in irrigation cultivation.
- (2) Farming activities such as ploughing, land grading and carting, etc., depend on manpower and domestic animals, especially cattle, and farmers in the Study Area use few input materials such as fertilizers, chemicals and high yield seed varieties, resulting in low agricultural productivity in the area.
- (3) The road network in the Study Area is not developed well, which hampers the transportation of farm input materials and agricultural products. Although asphalt paved roads link the central locations in the district and some roads connecting business centers of villages are paved with gravel, most roads within the Study Area are not paved, which means traffic is difficult on them during the rainy season.

### 8. Socio-economic and Institutional Constraints

- (1) The short-term and medium-term loan schemes are available to buy farm input materials and machinery for smallholder farmers, however these loans are not utilized well by farmers in the Study Area due to high interest rate and insufficient assets.
- (2) In the Study Area, solidarity in the community is rather weak and there is no wide range farmers' organization. The agricultural cooperative expects to fill a important role to request agricultural credit and guarantee for loan in

agricultural development of the communal and resettlement areas, but presently only a few cooperatives are being operated.

- (3) The Study Area belongs to the Mashonaland West Province on the right bank side of Munyati river and to the Midlands Province on the left bank side. There exist differences in level of institutional set-up as well as level of recognition on the proposed project among local offices of concerned ministry and provincial offices as well.

### **III Kudu Dam Irrigated Agricultural Development Plan**

#### **Basic Development Concept**

9. The Lower Munyati River Basin Agricultural Development Project is a large irrigation project including large-scale water resource development for smallholders. This Project is expected to play a pioneering role in the future directions of small-scale agricultural development in the country. However, the small-scale agricultural sector has had little experience in irrigation cultivation, and farmers in communal and resettlement areas are generally said to have little sense of participatory development. Therefore, when implementing the irrigation project, comprehensive agricultural development including establishment of farmers' organizations and improvement of agricultural support services is indispensable.

The basic development concept of the Project is shown below.

- (1) Creation of Kudu Dam Reservoir on the Munyati river at an optimum scale to provide water for irrigation mainly in communal and resettlement areas and urban use in surrounding towns of the Study Area;
- (2) Provision of an irrigation system with open canals to introduce irrigation farming in areas downstream of Kudu Dam;
- (3) Effective land allocation to increase farm income per household;
- (4) Crop diversification for attaining self-sufficiency of staple food, import substitution and export earnings;
- (5) Efficient use of land and water in all irrigated lands;
- (6) Introduction of farming practices focused on environmental conservation including environmentally friendly farming practices;
- (7) Improvement of agricultural support services;
- (8) Reinforcement of social services especially infrastructure such as rural roads and water supply system;
- (9) Establishment of a new organization under inter-agency committee for smooth implementation and proper O&M of the Project;
- (10) Provision of an environmental conservation plan in respect of natural and social environments, and development of an environmental monitoring plan;

and

- (11) Establishment of a pilot project to assist in project formulation, which will serve as a place of technical training and trial-and-error learning for farmers so as to promote smooth transition to irrigation farming.

### Water Resource Development Plan

10. It is expected to secure water not only for irrigation but also for urban/industry demand in and around the Study Area, and in the Project, the large-scale Kudu Dam is proposed to be constructed on the Munyati river. Based on the review of the previous study and the latest data of river discharges, water rights, water demands for irrigation and urban requirements collected during field survey period, the study on water resources development is conducted through the water balance study to optimize dam capacity and the size of irrigation command area.

Results of the water balance study for optimization of Kudu Dam and irrigation area are shown below.

**Results of Water Balance Study for Optimization of Kudu Dam**

Dam Height (m)	Full Supply Level (EL.m)	Storage Capacity (MCM)	Irrigable Area (ha)	Storage for Urban/Industrial Water (MCM)
72.70	947.00	1,551.4	25,000	60.00
67.70	942.00	1,266.6	20,000	60.00
62.70	937.00	972.6	16,000	60.00
57.70	932.00	732.6	11,000	60.00
52.70	927.00	542.6	7,500	60.00
47.70	922.00	393.6	3,700	60.00

### Optimum Scale of Kudu Dam and Irrigation Development

11. For determining the optimum scale of Kudu dam, environmental impact and project economy should be considered. The construction of Kudu Dam will force a maximum of 3,000 persons to leave their own land and houses. Judging from the result of villagers' intention survey in the proposed submerged area and public consultation meetings held twice during the First Field Survey, the local inhabitants are not enforced to oppose the dam construction. In case of resettlement, the local inhabitants want to remove on a village or ward level than on a personal level. The result of inventory survey in and around the submerged area shows that there are neither animals/plants to be conserved strictly nor cultural or historical heritages, and therefore it can be judged that both natural environment and social environment would not be affected greatly by the dam scale.

12. For optimization of Kudu Dam, the following case study was made for examining the project economy.

Case-1: Dam scale is the maximum (dam height: 72.70m) and irrigation water

allocation rate is following the Master Plan Study. (Total irrigation area: 25,000ha)

- Case-2: Dam scale is the maximum and irrigation water is supplied to commercial & resettlement area and large scale commercial farm without allocation for small scale commercial farm to reduce the length of main irrigation canal. (Total irrigation area: 25,000ha)
- Case-3: Dam height is 10m lower than the maximum and irrigation water allocation rate is according to the Master Plan Study. (Total irrigation area: 16,000ha)
- Case-4: Dam height is 10m lower than the maximum and irrigation water is supplied to only communal & resettlement area including high head pumping irrigation area. (Total irrigation area: 16,000ha)
- Case-5: Irrigation water is supplied to gravity irrigation area and low head pumping irrigation area in communal & resettlement area only. (Total irrigation area: 13,230ha)
- Case-6: Irrigation water is supplied to only gravity irrigation area in communal & resettlement area.

**Result of Comparative Study**

Case	Economic Cost (1000Z\$)	Economic Benefit (1000Z\$/year)	EIRR (%)
1	7,478,603	1,393,711	10.1
2	7,550,910	1,393,711	10.0
3	5,489,150	891,975	9.0
4	5,290,612	891,975	9.3
5	4,845,261	737,552	8.5
6	3,970,703	501,290	7.2

As shown in this table, Case-1 and Case-2 have advantage of the project economy providing the largest irrigation area of 25,000 ha with the maximum dam scale. The difference between Case-1 and Case-2 is the different allocation of irrigation water to irrigation areas and there is little difference between their project economics. Taking account of the agreement between Government of Zimbabwe and JICA Study Team at the meeting on Progress Report (I), water allocation rate which was fixed in the Master Plan Study is adopted.

Water resources development and irrigation development will be designed as following scale.

- (1) Dam Height : 72.7 m
- (2) Storage Capacity : 1,551.4 MCM
- (3) Embankment Volume : 9,557,000 m<sup>3</sup>
- (4) Irrigation Area : 25,000 ha
  - Communal & Resettlement Area : 14,500 ha
  - (Gravity Irrigation Area : 8,992 ha)

(Pump Irrigation Area	:	5,508 ha)
Large Scale Commercial Farm	:	4,500 ha
Small Scale Commercial Farm	:	6,000 ha
(5) Main Irrigation Canal	:	Right Bank Canal: 74.1 km
	:	Left Bank Canal: 103.8 km

13. The soil survey which was carried out in the First Field Survey found about 23,000 ha of irrigable areas in the communal and resettlement area, however, out of them, only 8,992 ha in net can be irrigated by gravity due to water level of the proposed irrigation main canal. Although pumping irrigation requires more cost for facilities and operation and management compared to the gravity irrigation, the Project aims to develop irrigated agriculture mainly focused on smallholder farmers, of which policy is to select irrigation area from the communal and resettlement areas as much as possible.

#### **Land Allocation**

14. According to the regulation on land use for agriculture, farmers have to surrender their land to government when their land becomes irrigable. Land to be irrigated is re-allocated to farmers according to the guidelines summarized below.
- (1) People affected by the Project get priority.
  - (2) A farmer who wants to join the irrigation scheme must be a full-time and active farmer. He must be either a master farmer or member of a known farmer group under training.
  - (3) The community through the local authority should be involved in the selection of farmers and the land allocation.
  - (4) The local people in consultation with relevant government departments will determine the actual land allocation to farmers in each scheme.

Taking these guidelines into account, the local government policy and precedents of land re-allocation in irrigation project, basically the land re-allocation of 1.0 ha per household will be applied to full-time farmers.

#### **Proposed Cropping System**

15. For determining the proposed cropping system, the following factors were considered:
- (1) Subsistence requirements of foods such as maize and groundnuts,
  - (2) Available family labor for farming,
  - (3) Profitability of a crop per ha,
  - (4) Marketability of a crop, especially for export crops, and

(5) Irrigation water balance.

The optimum combination of crops to produce maximum return were worked out from those factors as follows:

Proposed Cropping System			
Rainy Season		Dry Season	
Cotton	70%	Wheat	63%
Maize	18%	Vegetables	7%
Vegetables	7%		
Groundnuts	5%		
Total	100%	Total	70%

### Irrigation Plan

16. Irrigation water being impounded in Kudu Dam is conveyed to Left Main Canal through the dam's intake, and diverted to Right Main Canal 6.4 km downstream of the beginning point, where a siphon is provided for crossing the Munyati River. The length of Left Main Canal and Right Main Canal is 103.8 km and 74.1 km, respectively, and total length becomes 177.9 km. The trapezoidal concrete lining type of canal was selected taking account of efficiency of the irrigation water use, labor requirements and O&M cost, construction works, construction experience in Zimbabwe, and financial profitability.

Total irrigation area in communal and resettlement area is 14,500 ha and breakdown is as follows.

Proposed Irrigation Area			(Unit : ha)
Area	Right Bank Area	Left Bank Area	Total
Gravity Irrigation Area	4,791	4,201	8,992
Pump Irrigation Area	2,192	3,316	5,508
Total	6,983	7,517	14,500

An unit design water discharge of 1.20 l/s/ha is adopted which was worked out from 10-day basis peak of diversion irrigation requirements of 5 year return period.

The furrow irrigation method is considered most suitable for maize, cotton, groundnuts, and vegetables which are proposed in the rainy season. For wheat which will be the main crop in the dry season, the border method of irrigation is considered suitable. In pump irrigation area, water is proposed to be pumped in bulk from the main irrigation canal and conveyed to the respective high areas, which will be served by gravity irrigation method.

### Livestock Plan

17. Livestock rearing is the second most important economic activity next to crop production in the Study Area and the livestock subsector has substantial potential for

further development. The livestock development plan proposed in the Project consists of the livestock water development scheme and grazing area development pilot scheme as shown below.

(1) Livestock Water Development Scheme

The scheme aims to construct 72 units of water troughs for livestock along the main and secondary irrigation canals. The provision of water for livestock in range lands along the canals will enable efficient use of grazing resources and also allow animals to extend the length of their grazing in an area.

(2) Grazing Area Development Pilot Scheme

In order to improve the low grazing capacity of range lands and to control the over grazing, the establishment of fully fenced grazing blocks in the project related 10 wards is proposed. A size of a block is proposed to be 600 ha and length of fencing will be about 17 km per block.

### **Rural Infrastructure Improvement**

18. Rural infrastructure improvement plan under the Project will take care of improvement of rural road, rural water supply facilities (boreholes) and communication system, though the Project is agriculture-oriented.

(1) Rural Road Improvement Plan

In order to improve the access to the existing social infrastructure as well as access to the markets for transportation of agricultural crops, existing rural roads of about 279 km will be upgraded by paving with gravel of 20 cm thick and having a width of 3.0 m.

(2) Rural Water Supply Improvement Plan

According to the criteria of Zimbabwe, one borehole for 250 persons should be provided, but the number of boreholes in the Study Area is insufficient. Rural water supply improvement plan under the Project will tentatively cover the rehabilitation of 90 existing boreholes and construction of 101 new boreholes.

(3) Communication Improvement Plan

Communication improvement plan under the Project is to improve communication systems by use of audiovisuals and cars where necessary. These equipment will be utilized as the movable tools for dissemination of information on agriculture-related technology to the farmers.

## Review of Kudu Dam Design

19. Major four items which were reviewed in the Study are as follows:

(1) Dam Axis

The appropriate dam axis shall be selected in consideration of (i) examinations in terms of deformation and shear strengths as the dam foundation and (ii) examination of maximum storage with minimum excavation/filling volume. The designed dam axis by DWD satisfies the above conditions, however a steep branch exists on the left bank of the designed dam axis. As there is some anxiety about seepage failure (piping phenomenon) at the left bank abutment in the original design done by DWD, it is recommended that the original dam axis should be shifted 100m upstream from the original position, if the geological condition allows. In this case, the reservoir storage capacity will decrease, but only by an estimated 0.26% of the original total storage volume.

(2) Stability Analysis of Dam Body

Based on the data from construction material investigation, stability analysis by slip circle slice method was made for four cases of reservoir water level; design flood level, full supply level, intermediate water level, and just after completion. For analysis, two safety factors are considered: (i)  $F_s \geq 1.2$  in case of non-seismic force and (ii)  $F_s \geq 1.1$  in case with seismic coefficient of 0.05 g. From the results of stability analysis, it is proposed to change the dam body slope on the upstream side from 1:2.4~2.6 to 1:2.6~2.8.

(3) Foundation Treatment

Many boring tests were made by DWD, but permeability analysis was not made. Thus, the foundation treatment was examined from the results of observation of boring core, geological column and field investigation. In original design, single line of curtain grouting is planned, however, two lines of sub-curtain grouting and blanket grouting were proposed in order to improve permeability near the surface of the foundation and to make water tightness along the boundary between core zone and foundation, respectively.

(4) Spillway

In the original design by DWD, the only part of overflow weir section of spillway was designed as the concrete structure with the design flood discharge of 2000-year return period. The flood discharges after overflow portion will be running through the natural ground and then flow into the river and the overflow flood will erode and devastate the natural ground gradually. It is proposed to install service spillway and emergency spillway in consideration of the frequency of use. The service spillway is designed to be able to release the flood discharge of 250-year return period, and is designed

as a concrete structure so as to keep the stable flow condition of the discharge. The emergency spillway is designed to be able to release the flood discharge of a 2000-year flood. The channel is not lined with concrete except the inflow section.

### **Proposed Organization for Project Implementation and O&M**

20. For the implementation and O&M of the Kudu Dam Irrigation Project, it is proposed to establish an independent legal authority called the Lower Munyati Agricultural Development Authority (LMADA) which basically will play the role of ZINWA and AGRITEX. Proposed organization of LMRBA would consist of four divisions: (i) Engineering, (ii) Agricultural, (iii) Resettlement, Community and Environmental Management, and (iv) Administration and Finance. The LMADA for project implementation stage would be responsible for design and construction supervision of the project facilities, preparatory works for supporting farmers and execution of farmers' training on the irrigated agricultural extension, and planning and facilitation of resettlement and land re-allocation, etc. During the O&M stage, the LMADA would have responsibilities for the hardware O&M of the reservoir and irrigation systems, adaptability research, extension and training, and market promotion, all of which would be for proper O&M and production activities to be undertaken by the beneficiary farmers, and environmental management and monitoring of natural and social environment. LMADA would recruit required staff for these engineering and administration activities. For dealing with important policy matters relating to the operations or financing of LMADA, it is proposed to set up a Steering Committee comprising representatives of the government agencies related to the Project as well as representatives of farmers.

### **Agricultural Support Services**

21. Agricultural support services such as adaptive research trials, extension and training of farming practices, to assist for establishment of water users' association and improvement of marketing system are planned to be provided by Agricultural Division in the proposed LMADA. The reasons for recommendation to install new organization are low activities of existing extension services, recent structural reform of relevant agencies aiming at commercialization of their services. Present AGRITEX's structure which consists of two provinces and three districts relating to the Project is also considered to be difficult to provide services effectively to the one unit of proposed irrigation system.

The proposed Agricultural Division in the LMADA would be basically responsible for agricultural extension services in the irrigation development area, instead of the present agencies of district AGRITEX, and it also would be responsible for research of adaptability of technologies. This is because the existing agricultural research system in Zimbabwe is well established, but the system of research-extension

linkages is not established and functioning. Proposed work items of the Agricultural Division are shown below.

- (1) Adaptability Trials: to establish proper production technologies under irrigated conditions by carrying out field trials and adaptive research trials particularly on farmers fields based on the results from existing agricultural research centers/institutes.
- (2) Extension and Training of Farming Practices: to extend and train the farmers in technology for irrigated cultivation and water management and support to organize WUAs.
- (3) Improving Credit Availability: to support the establishment of farmers' organization and training as a pre-condition for group loan eligibility.
- (4) Market promotion: to collect and analyze market trends, monitor market for farm inputs and prices of suppliers and provide advise to farmers, provide advise in formation of producer associations, and assist farmers and producer association in obtaining legal advise on contract provisions.

With the objective of establishing technical guidance and extension services on irrigated agriculture to beneficiary farmers of irrigation development, two technical centers called Irrigated Agricultural Extension Center (IAEC) are proposed to be established in the both banks of the Munyati River. One is at the left bank by expanding the Agricultural Extension Center (AEC) to be established under the Nyarupakwe Pilot Project. The other is in the irrigation area of the Seke dam at the right bank under construction by Rio Tinto Private Company. The IAECs should be established as the bases for the farmers' training and extension services under the Project and be managed by the LMADA.

#### **Water Uses' Association (WUA)**

22. As a operation organization of the above mentioned O&M at the field level, establishment of WUA would be needed. The organization activities will be focused initially on each minor or each part distributary through outlet commands, and after that extend to the secondary level. A three-tiered organization is envisaged: (i) Outlet Committee, (ii) WUA, and (iii) Federation. WUAs should be established before implementation of the Project, and in the organization activities, farmers and AGRITEX should cooperate closely.

#### **Environmental Management and Mitigation Plans**

23. The proposed environmental management and mitigation plans are as follows:
  - (1) Resettlement Plan: The construction of Kudu Dam will force a maximum of 500 households (about 3,100 persons) to leave their own lands and houses. The LMADA must take full responsibility for managing its own resettlement

requirement in liaison with the District Administrators office as well as through discussions with local peoples so that all affected persons are fairly treated. It is strongly recommended that a reliable NGO preferably with international accreditation is employed to facilitate the resettlement process.

- (2) **Land Re-Allocation Plan:** The plan of land re-allocation in the proposed irrigation areas should be formulated paying attention to ; (i) involvement of ward leaders and traditional leaders, (ii) inclusion of women as potential plottolders, and (iii) transparency in plot allocation.
- (3) **Reservoir Area Management:** It is proposed that there should be as little disruption to local people's use of resources as possible commensurate with sustainable use of these natural resources. An appropriate management plan for the reservoir area should be developed by the Department of National Parks and Wild Life Management (DNPWM). Investigations must be done by the Fisheries Department to see how the project can capitalise on the potential economic value of the fisheries resources.
- (4) **Catchment Management:** Environmental Management and Monitoring Section (EMMS) of LMADA should monitor river and reservoir siltation processes on a periodic basis. It is necessary to give a guidance to farmers for appropriate use of fertilizers and pesticides to avoid a risk from poor and wasteful practices in chemical use which could lead to downstream pollution of the Munyati and ultimately Lake Kariba.
- (5) **Health Programme:** It is proposed to be rehabilitated and newly constructed a number of boreholes, which will provide clean water to local people in the project area, to mitigate the impacts of waterborne disease, particularly malaria and bilharzia, already important health problems affecting people.
- (6) **Project Implementation Monitoring:** EMMS of LMADA should undertake environmental monitoring of all project activities with negative implications whether impacts be temporary in duration or long term impacts during the project implementation. The EMMS should keep the project manager of LMADA informed at all times, formally and informally, of important environmental and social concerns and will be pro-active in seeking to resolve emerging problems.
- (7) **Post-Implementation Monitoring:** At the operation and maintenance stage of the Project, EMMS of LADA should monitor the check items on water quality and ecology, land and reservoir resources management, and beneficiary health programmes and welfare status.

#### IV Project Cost and Project Evaluation

##### Project Cost

- 24 The proposed project components and costs are summarized as follows:

Project Cost	
Item	Construction Cost (Z\$1,000)
Kudu Dam	3,640,574
Irrigation and Drainage Development	5,707,680
Livestock Development	5,544
Rural Infrastructure Improvement	286,017
Agricultural Support Strengthening	21,797
Pilot Project	257,653
Total Amount	9,919,264

The economic cost is estimated at Z\$ 7,935,411,000 by applying construction cost conversion factor of 0.80.

##### Benefits

- 25 The economic benefits of the Project are estimated as follows:

Economic Benefit	
Item	Economic Benefit (Z\$1,000)
Benefit from Irrigation Development	1,386,892
Urban/Industrial Water Benefit	53,460
Domestic Water Benefit	10,319
Benefit from Maize Stalk/Residues	31,062
Benefit from Road Rehabilitation	17,833
Benefit from Livestock Development	5,590
Total Amount	1,505,156

##### Project Evaluation

- 26 Based on the economic cost and benefit, the result of economic evaluation is summarized below.

Results of Economic Evaluation		
Particulars	Results	Remarks
EIRR (%)	10.5	
B/C Ratio	1.06	Discount Rate 10%
B-C (1,000 Z\$)	337,753	Discount Rate 10%

27. The farm budget analysis is made to examine the payment capacity of the standard farmer for water charge and O&M cost, and the result is shown in the following table:

## Summary

### Household Budget

(Unit: Z\$)

Particulars	Without Project	With Project
Net Agricultural Income	8,487	45,566
Net Livestock Income	636	636
Off Farm Income	7,486	7,486
Total Net Income	16,609	53,688
Living Expenditure	13,615	15,657
Net reserve	2,994	38,031

In the above calculation, it is assumed that the standard farm household will have an irrigation area of 1 ha after irrigation development. In this case water charge and O&M cost will be about Z\$ 4,000/year, for which the beneficiary farmer will have enough capacity to pay .

28. Number of beneficiaries are estimated as below.

### Number of Beneficiaries

Particulars	Number of Beneficiaries
Beneficiaries from Irrigation Development	around 110,000 persons
Beneficiaries from Urban/Industrial Water Supply	around 330,000 persons
Total	around 440,000 persons

## V Nyarupakwe Pilot Project

### Necessity of the Pilot Project

29. 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.

### Pilot Project Area

30. A pilot area is selected in the western extremity of the main project zone at the left bank of the Munyati River in consideration of the following:
- (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;
- (4) Beneficiary farmers should be willing to participate with the project; and
- (5) The area must have the size that enables the project to be implemented with appropriate and reasonable cost.

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 of the Nyarupakwe River, and there are 1,043 farm households in the 15 villages of the area with a population of 7,185.

### **Participatory Social Environmental Survey**

31. For formulation of the development plan for the Pilot Project Area based on needs and demands of local population, a participatory social environmental survey was carried out during the Phase II Field Work from February to April 2000. The survey was conducted by the selected NGO operating in Zimbabwe with the following three stages:
  - (1) Stage I: Probing and understanding of the needs and demands of the survey area. The first and second public hearing meetings were held to obtain data on local needs and demands.
  - (2) Stage II: Presentation of the outline of the Project based on the local needs and demands. The third public hearing meeting was held to present and discuss the outline of the project components.
  - (3) Stage III: Acceptance and agreement of the detailed project components by the local community. The final public hearing meeting was held to confirm acceptance and agreement of the detailed project components from implementation point of view.
32. As a result of discussions, the following project components were generally accepted by the local population and early implementation of the Pilot Project was strongly requested:
  - (1) Surface water development
  - (2) Irrigation development
  - (3) Livestock development
  - (4) Rural infrastructure development

### Water Resources Development plan

33. It is proposed to construct a medium scale dam, called Nyarupakwe dam at the middle reach of Nyarupakwe river in order to exploit water resources to the maximum extent for the Pilot Project Area. The catchment area at the proposed damsite is 80 km<sup>2</sup>. The gross capacity of the reservoir is expected to be  $1.65 \times 10^6$  m<sup>3</sup> with the full water level, and the live storage capacity is estimated at  $1.45 \times 10^6$  m<sup>3</sup>. The proposed dam type is the combined type of concrete gravity dam and fill dam considering the design flood discharge of spillway. The maximum dam height is 15.5 m from the base rock to the dam crest, and dam crest length is 582 m.

For water allocation of the available water of 850,000 m<sup>3</sup> 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 <sup>3</sup>
- For domestic water supply	:	37,000 m <sup>3</sup>
- For irrigation	:	765,000 m <sup>3</sup>

34. 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. In consideration of topography, geology and scale of dam, a concrete gravity dam with the maximum height of 6.1 m from the base rock to the dam crest is proposed. This dam will be expected to have a function as a sand trap for the Nyarupakwe dam.

### Irrigation Development Plan

35. Water of 0.765 MCM available for irrigation will be able to irrigate 60 ha in net. The proposed irrigation area is selected in Magonyo and Hlamba villages. The main irrigation facilities are as follows:
- (1) Net Irrigation Area: 37.6ha in Magonyo village and 22.4ha in Hlamba village
  - (2) Main Canal Length: 5,653m from the Nyarupakwe dam to the proposed irrigation area
  - (3) Design Discharge of Main Canal: 72 l/sec for continuous irrigation (24hrs)
  - (4) Main Canal Type: 770m of pipeline (fiber cement concrete pipe  $\phi$  0.5m) and 4,883m of open canal (reinforced concrete flume 0.5m x 0.5m)
  - (5) On-farm Facilities: tertiary canals, watercourses, farm drains and farm roads

### Livestock and Fishery Development Plan

36. The following three schemes are proposed in the livestock and fishery development plan:

- (1) Grazing Area Development Scheme: to establish the fully fenced pilot grazing areas of some 860 ha (fencing - 29km and number of paddocks fenced - 5) extending mainly along the proposed irrigation canal and to introduce controlled grazing management system.
- (2) Livestock Water Development Scheme: to construct a water trough for livestock to ensure water in the proposed grazing paddock of the grazing area development scheme of Hlamba, Magonyo and Murandu villages, and to build a trough for the grazing area of Sekema village.
- (3) Fishery Development Scheme: to establish fish farming (fish species - bream) in the Nyarupakwe reservoir. The fishing operation will be done by a fishing group who would use nets for catch, however fish resources in the reservoir will be kept open also for the pilot area communities as a recreational facility using a road and line.

### **Rural Infrastructure Development Plan**

37. Based on the results of analysis and evaluation on the local peoples' request, the following development plan for rural infrastructure are proposed:

- (1) Road Improvement
  - (a) Improvement of main road from Nyarupakwe to Gokwe : 24 km
  - (b) Improvement of farm to market link roads : 22 km
- (2) Rehabilitation and Installation of Boreholes
  - (a) Rehabilitation of the existing boreholes including replacement : 13 nos.
  - (b) Installation of new boreholes : 6 nos.
- (3) Construction of a Community Development Center with an accommodation capacity of about 300 persons designed for multi-purpose use by the local population at the Nyarupakwe Business Center.

### **Institutional Strengthening Plan**

38. For effective and efficient operation and management of the Pilot project, the institutional strengthening plan are formulated as follows:

- (1) Plan for Strengthening of Rural Institutions
  - (a) AGRITEX strengthening plan
    - (i) Establishment of Agricultural Extension Center (AEC)
    - (ii) Logistic support strengthening
    - (iii) Capacity building of field extension staff
    - (iv) Recruitment of Field Agricultural Extension officers

- (v) Strengthening of technical guidance of provincial staff
- (b) VET strengthening plan
  - (i) Logistic support strengthening
  - (ii) Capacity building of field extension staff
- (c) Pilot project area community (VIDCO & Village Assemblies) strengthening plan
  - (i) Awareness program
  - (ii) Capacity building of VIDCOs
  - (iii) Formation of Project Management Committee
  - (iv) Establishment of multipurpose community development center
- (2) Plan for Strengthening of Farmers Organizations

The components of the strengthening plan will include the execution of support programs for: (i) formation and establishment of the Water Users Group (WUG) and Irrigation Management Committee (IMC) in the irrigated area, (ii) strengthening or formation of farmers organizations for livestock subsector development plans, (iii) awareness program at village level, and (iv) strengthening and formation of farmers organizations.

#### **Agricultural Support Services Strengthening Plan**

39. The strengthening plan of the agricultural support services under the Pilot Project is formulated placing emphasis on the irrigation technology development and transfer and on-farm oriented and practical programs through the proposed AEC. The main components of the plan are shown below.
- (1) Strengthening Plan of Agricultural Extension Services: to provide field program, farmer training program, workshop and guidance, and to strengthen guidance and support of senior extension and technical staff from the provincial offices.
  - (2) Improvement of Marketing System: to improve farm-to-market main and link roads, and to develop an open market at the Nyarupakwe Business Center for supporting farmers in marketing their produce.
  - (3) Approaches for Improvement of Agricultural Credit Availability: to formulate and strengthen of farmer organizations eligible under agricultural credit schemes of the financial institutions and other formal credit suppliers through the farmer training program of the institutional development plan, and to assist farmer groups applying for agricultural credit.

### Environmental Impact Mitigation Plan

40. 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.

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.

### Proposed Organization for Pilot Project Implementation and O&M

41. 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 for the whole Kudu Dam Irrigation Project. Therefore, the proposed organization for implementation and O&M of the Pilot Project Office is same with that of LMADA. For smooth implementation and efficient O&M of the Pilot Project, it is very important to keep close relationship between the Pilot Project Office under the LMADA, government supporting institutions, and farmers' organizations.

### Pilot Project Cost

42. The total cost of the Pilot Project is estimated at Z\$ 257,652,000 as summarized below.

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

The economic cost is estimated at Z\$ 206,122,000 by applying construction cost conversion factor of 0.80.

### Pilot Project Benefit

43. Economic benefits derived from the Pilot Project are estimated as follows:

## Summary

Pilot Project Benefit	
Item	Economic Benefit (Z\$1,000)
Benefit from Irrigation Development	2,802
Benefit from Maize Stalk/Residues	82
Benefit from Livestock and Fishery Development	921
Benefit from Road Rehabilitation	3,188
Benefit from Livestock Water and Domestic Water Development	2,123
Total Amount	9,116

### Pilot Project Evaluation

44. The Pilot Project is indispensable for smooth transition to irrigation cultivation for beneficial farmers so that the whole Kudu Dam Irrigation Project will succeed 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.

The Economic Internal Rate of Return (EIRR) of the Pilot Project is estimated at 26% based on the above assumption, which shows the Pilot Project is justified economically.

45. 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

As shown in this table, the net annual income of typical farm will be increased to about 4 times the present, and the beneficiary farmer will have enough capacity to pay water charge and O&M cost of about Z\$ 4,000/year.

## **VI Conclusions and Recommendations**

### **Conclusions**

46. The Kudu Dam Irrigation Project is justified to be sound technically and viable economically with 10.5% of EIRR. From the financial viewpoint, the Project is also justified showing that the net annual income of typical farm will be increased to about 12 times the present. As a conclusion, the Kudu Dam Irrigation project will contribute to a large extent to the improvement of income and living standards of the local people in the Project Area and to give farmers an incentive to farming. The Project will also contribute to supply stable food through increase of crop products and to attain the development target of the national agricultural policy. Therefore, the early implementation of the Project is expected. However, prior to implementation of the Project, it is indispensable to conduct the detailed Environmental Impact Assessment (EIA) including establishment of resettlement program for local people in the submerged area due to the construction of Kudu Dam.
47. The Nyarupakwe Pilot Project is essential for successful implementation of the Kudu Dam Irrigation Project which has an important role as a pioneering irrigation project for smallholder farmers in Zimbabwe. In order to serve as a place of technical training and trial-and-error learning for promotion of smooth transition to irrigation cultivation for farmers in the area, the Nyarupakwe Pilot Project should be started as early as possible.

### **Recommendations**

48. Based on the result of the Study, the following are recommended for the project promotion and sustainability:
- (1) Early Establishment of Resettlement Program
- The construction of Kudu Dam will force a maximum of 500 households (about 3,100 persons) to leave their own lands and houses. It was confirmed through the social survey in the submerge area conducted during the Phase I Field Work that people have been aware of the Kudu dam proposal and have avoided any property investment for fear of not being properly compensated, and most households in the area would like to be moved as a group. Since no detailed discussions on the resettlement between the Government and local people have been made at present, the resettlement program should be established as soon as possible prior to implementation of the Project. It is recommended that a reliable NGO preferably with international accreditation is employed to facilitate the resettlement process.

(2) Consensus of farmers for Land Re-allocation in Irrigation Areas

According to the regulation on land use for agriculture in Zimbabwe, farmers have to surrender their land to the Government when their land become irrigable. This system is to lessen impartiality in income caused by the introduction of irrigation water. In the existing irrigation projects in Zimbabwe, the allocated irrigation areas are various according to the project conditions. Therefore, it is recommended that the land re-allocation in the proposed irrigation areas should be made based on the consensus of beneficiary farmers taking the existing land holding conditions into consideration. AGRITEX should facilitate the planning process and draw plot maps with NGO assistance.

(3) Establishment of Lower Munyati Agricultural Development Authority (LMADA)

It is proposed to establish a new independent organization of LMADA for the smooth implementation and efficient O&M of the Project in due consideration of the project scale and recent changes of organizational and management structure of the government agencies. For dealing with important policy matters relating to the operations or financing of LMADA, it is proposed to set up a Steering Committee comprising representatives of the government agencies related to the Project as well as representatives of farmers. The LMADA should be established prior to the project implementation and move into action from the initial stage of the Project.

(4) Early Completion of Seke Dam Irrigation Project

At the interim stage of the Study, it was proposed to establish two (2) pilot project areas. One is Nyarupakwe area on the left bank of Munyati river and the other is Seke area located on the right bank. In the Seke area, a medium-scale dam has already been constructed on the Seke river and the irrigation facilities covering about 150 ha are planned to be constructed at the lower reach of the Seke dam under contribution of Rio Tinto Private Company. So it was recommended that a part of this new irrigation area be taken as the project area. However, as leakage through right abutment of the dam and erosion of spillway wall were observed, so rehabilitation works become necessary and construction of irrigation facilities will be delay. From these present conditions, the Seke area is excluded from the proposed pilot project plan for the Phase II Field Work. Though the Nyarupakwe Pilot Project with an Agricultural Extension Center will serve as a training place for farmers in the Project Area, it is strongly recommended that the Seke Irrigation Project should be completed as soon as possible so that farmers in the right bank can get training of irrigation cultivation more easily before completion of Kudu Dam Irrigation Project. An Irrigated Agricultural Extension Center is

proposed to be established at the Seke area within the framework of the overall Kudu Dam Irrigation Project.

(5) Further Study of Kudu Dam Design

Through the review works of the Kudu dam design made by DWD in 1993, it is recommended to make the further study on; (i) shifting the dam axis to about 100 m upstream from the viewpoint of safety to the seepage failure at the original dam site, (ii) confirmation of permeability at the dam site and foundation treatment, (iii) adoption of a service spillway for 250-year flood with an emergency spillway in consideration of frequency of use, and (iv) necessity of a diversion tunnel for safety of dam embankment during the construction period.

**THE FEASIBILITY STUDY  
ON  
THE LOWER MUNYATI RIVER BASIN  
AGRICULTURAL DEVELOPMENT PROJECT  
IN  
THE REPUBLIC OF ZIMBABWE**

**Volume I  
- MAIN REPORT -**

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## **Abbreviations**

AFC	Agricultural Finance Corporation
AFDB	African Development Bank
AGRITEX	Department of Agricultural, Technical and Extension Services
ARC	Agricultural Research Council
ARDA	Agricultural and Rural Development Authority
ART	Agricultural Research Trust
ASIP	Agricultural Sector Investment Program
CCGA	Commercial Cotton Growers' Association
CFU	Commercial Farmers' Union
CMB	Cotton Marketing Board
COTCO	Cotton Company of Zimbabwe
CSC	Cold Storage Commission
CSO	Central Statistical Office
CTC	Cotton Training Center
DAEO	District Agricultural Extension Office
DBZ	Dairy Board of Zimbabwe
DDF	District Development Fund
DEAP	District Environmental Action Plan
DMB	Dairy Products Marketing Board
DNPWLM	Department of National Parks and Wild Life Management
DNR	Department of Natural Resources
DR&SS	Department of Research and Specialist Services
DSC	District Services Center
DWD	Department of Water Development
DZL	Dairiboard Zimbabwe Limited
EC	European Community
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ESAP	Economic Structural Adjustment Program
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FDT	Farmers' Development Trust
GDP	Gross Domestic Product
GMB	Grain Marketing Board
GOJ	Government of Japan
GOZ	Government of Zimbabwe

HYV	High Yielding Variety
IA	Irrigator's Association
IBRD	International Bank of Reconstruction and Development
ICFU	Indigenous Commercial Farmers' Union
IDA	International Development Association
IMC	Irrigation Management Committee
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
LSCF	Large Scale Commercial Farm
MLGNH	Ministry of Local Government and National Housing
MMET	Ministry of Mines, Environment and Tourism
MNAECC	Ministry of National Affairs, Employment Creation and Cooperatives
MOF	Ministry of Finance
MOLA	Ministry of Lands and Agriculture
MRRWD	Ministry of Rural Resources and Water Development
NARS	National Agricultural Research System
NCS	National Conservation Strategy
NEPC	National Economic Planning Commission
NGO	Non-Governmental Organization
NR	Natural Region
NRB	Natural Resources Board
O&M	Operation and Maintenance
PSIP	Public Sector Investment Program
RBZ	Reserve Bank of Zimbabwe
RDC	Rural District Council
RDF	Rural Development Fund
RRA	Rapid Rural Appraisal
RSC	Rural Service Center
SAP	Structural Adjustment Program
SSCF	Small Scale Commercial Farm
TMB	Tobacco Marketing Board
UNDP	United Nations Development Program
UNESCO	United Nations Education, Science and Culture Organization
USAID	United States Agency for International Development
VIDCO	Village Development Committee
WADCO	Ward Development Committee
WHO	World Health Organization
WUA	Water Users' Association

WUG	Water Users' Group
ZESA	Zimbabwe Electricity Supply Authority
ZFU	Zimbabwe Farmers' Union

(Note) Names of Ministries have been changed on 15 July 2000 as shown below.

Old Name	New Name
- Ministry of Local Government and National Housing (MLGNH)	- Ministry of Local Government, Public Works and National Housing
- Ministry of Mines, Environment and Tourism (MMET)	- Ministry of Mines and Energy - Ministry of Environment and Tourism
- Ministry of National Affairs, Employment Creation and Cooperatives (MNAECC)	- Ministry of Youth Development, Gender and Employment Creation
- Ministry of Finance (MOF)	- Ministry of Finance and Economic Development
- Ministry of Lands and Agriculture (MOLA)	- Ministry of Lands, Agriculture and Resettlement

## **Conversion Factors**

	<u>Metric to Imperial</u>			<u>Imperial to Metric</u>		
Length	1 cm	=	0.394 inch	1 inch	=	2.54 cm
	1 m	=	3.28 feet	1 feet	=	30.48 cm
	1 km	=	0.621 mile	1 mile	=	1.609 km
Area	1 m <sup>2</sup>	=	10.76 sq.ft	1 sq.ft	=	0.0929 m <sup>2</sup>
	1 ha	=	2.471 acre	1 acre	=	0.4047 ha
	1 km <sup>2</sup>	=	0.386 sq.mile	1 sq.mile	=	2.59 km <sup>2</sup>
Volume	1 lit	=	0.22 gal (imp)	1 gal(imp)	=	4.55 lit
	1 m <sup>3</sup>	=	35.3 cu.ft	1 cu.ft	=	28.33 lit
	1 MCM	=	811 acre-ft	1 acre-ft	=	1,233.5 m <sup>3</sup>
Weight	1 kg	=	2.20 lb	1 lb	=	0.4536 kg
	1 ton	=	0.984 long ton	1 long ton	=	1.016 ton
Derived	1 m <sup>3</sup> /s	=	35.3 cusec	1 cusec	=	0.0283 m <sup>3</sup> /s
Measures	1 ton/ha	=	891 lb/acre	1 lb/acre	=	1.12 kg/ha
	1 m <sup>3</sup> /s	=	19.0 mgd	1 mgd	=	0.0529 m <sup>3</sup> /s
Temperature	°C	=	(°F-32) x 5 / 9	°F	=	1.8 x °C + 32
Local Measures	1 lit	=	0.22 gantang	1 gantang	=	4.55 lit
	1 kg	=	1.65 kati	1 kati	=	0.606 kg
	1 ton	=	16.5 pikul	1 pikul	=	60.6 kg

## **Currency Equivalent**

(as of June 2000)

US\$ 1.0 = Z\$ 38.0 = Yen 105.0

