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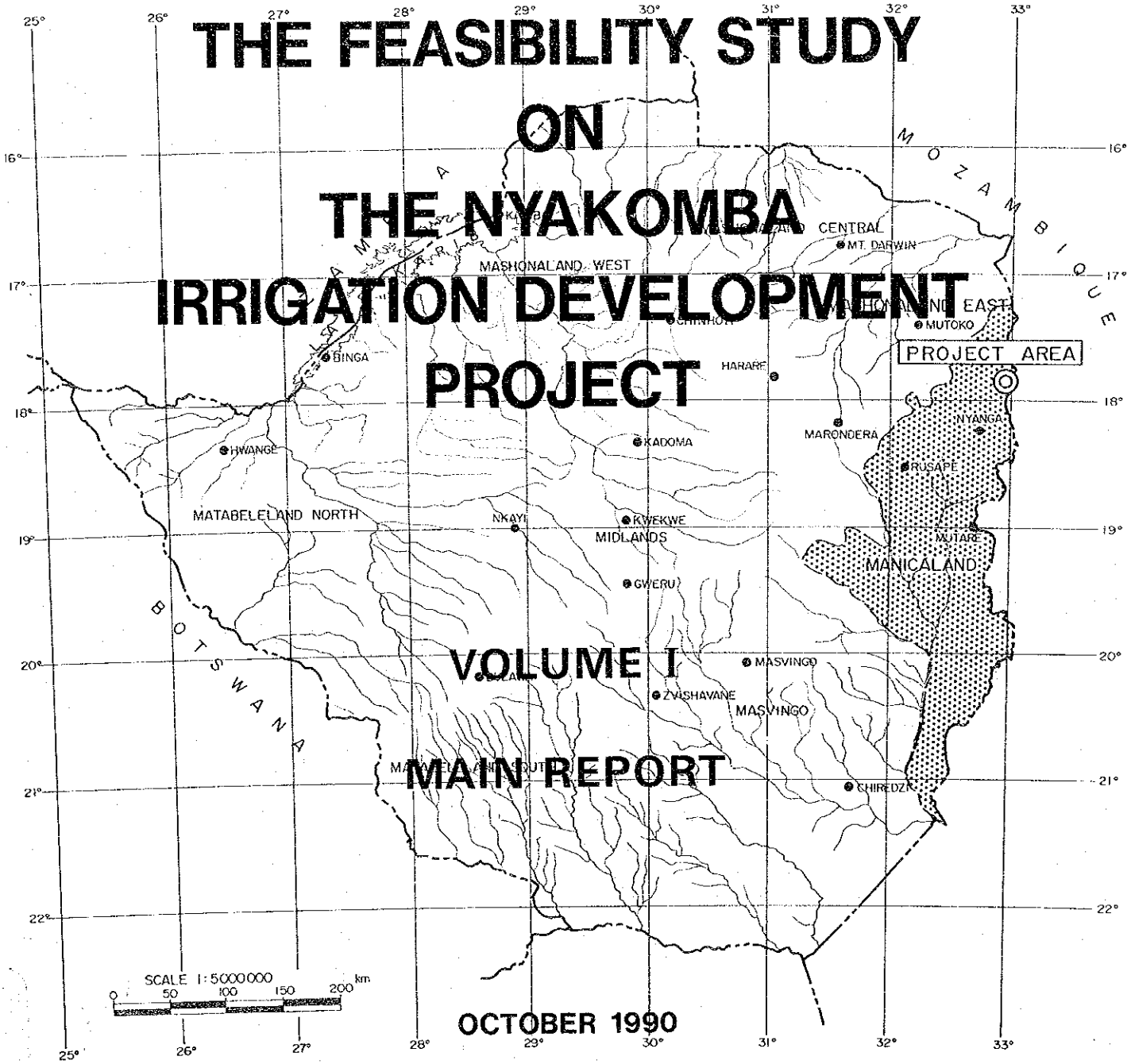
REPUBLIC OF ZIMBABWE

THE FEASIBILITY STUDY ON THE NYAKOMBA IRRIGATION DEVELOPMENT PROJECT



VOLUME I

MAIN REPORT

OCTOBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF ZIMBABWE THE FEASIBILITY STUDY ON THE NYAKOMBA IRRIGATION DEVELOPMENT PROJECT VOLUME I MAIN REPORT OCTOBER 1990
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THE FEASIBILITY STUDY
ON
THE NYAKOMBA IRRIGATION DEVELOPMENT PROJECT

LIST OF VOLUME

VOLUME I · MAIN REPORT

VOLUME II · ANNEX REPORT

A. METEOROLOGY AND HYDROLOGY
B. SOIL AND LAND CAPABILITY CLASSIFICATION
C. LAND USE
D. AGRICULTURE
E. IRRIGATION AND DRAINAGE
F. FACILITIES PLANNING
G. PROJECT MANAGEMENT AND IMPLEMENTATION
H. COST ESTIMATION
I. PROJECT JUSTIFICATION
J. OTHERS

VOLUME III · DRAWINGS

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REPUBLIC OF ZIMBABWE

THE FEASIBILITY STUDY
ON
THE NYAKOMBA IRRIGATION DEVELOPMENT PROJECT

VOLUME I

MAIN REPORT

OCTOVER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct a feasibility Study on the Nyakomba Irrigation Development Project in Manicaland Province and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zimbabwe a survey team headed by Dr.Yoshizo MOCHIZUKI, Taiyo Consultants Co., Ltd. from August to November 1989 and from January to March 1990, during both dry and rainy seasons, respectively.

The team held discussions with the officials concerned of the Government of Zimbabwe and the Department of Agricultural Technical and Extention Services (AGRITEX), and conducted field surveys in the study area. After the team returned to Japan, further studies were made and this report was prepared.

I hope that this report will serve as a model development project in communal land and contribute to the promotion of friendly relations between our two countries.

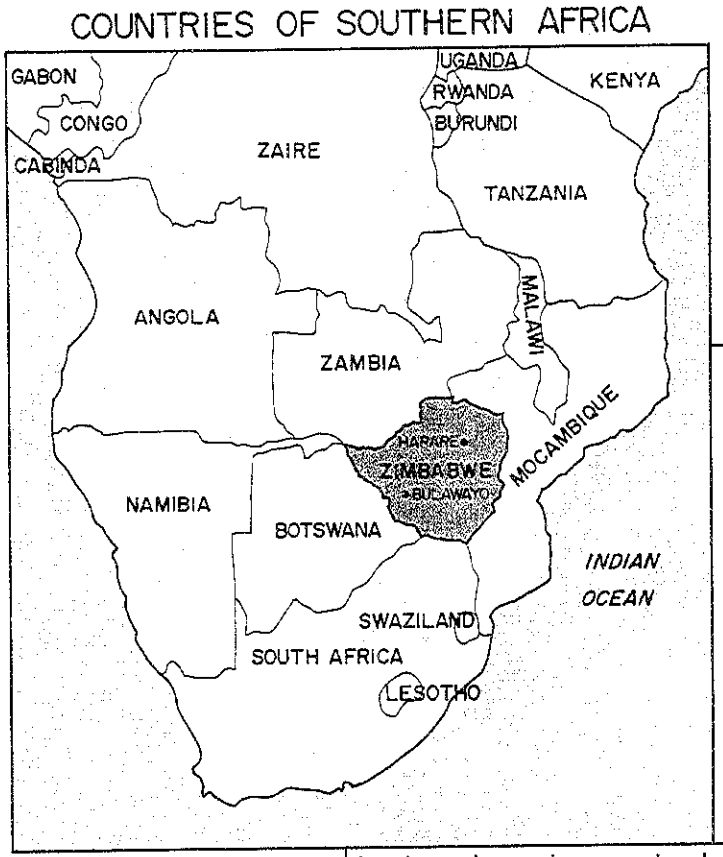
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zimbabwe for their close cooperation extended to the team.

October, 1990

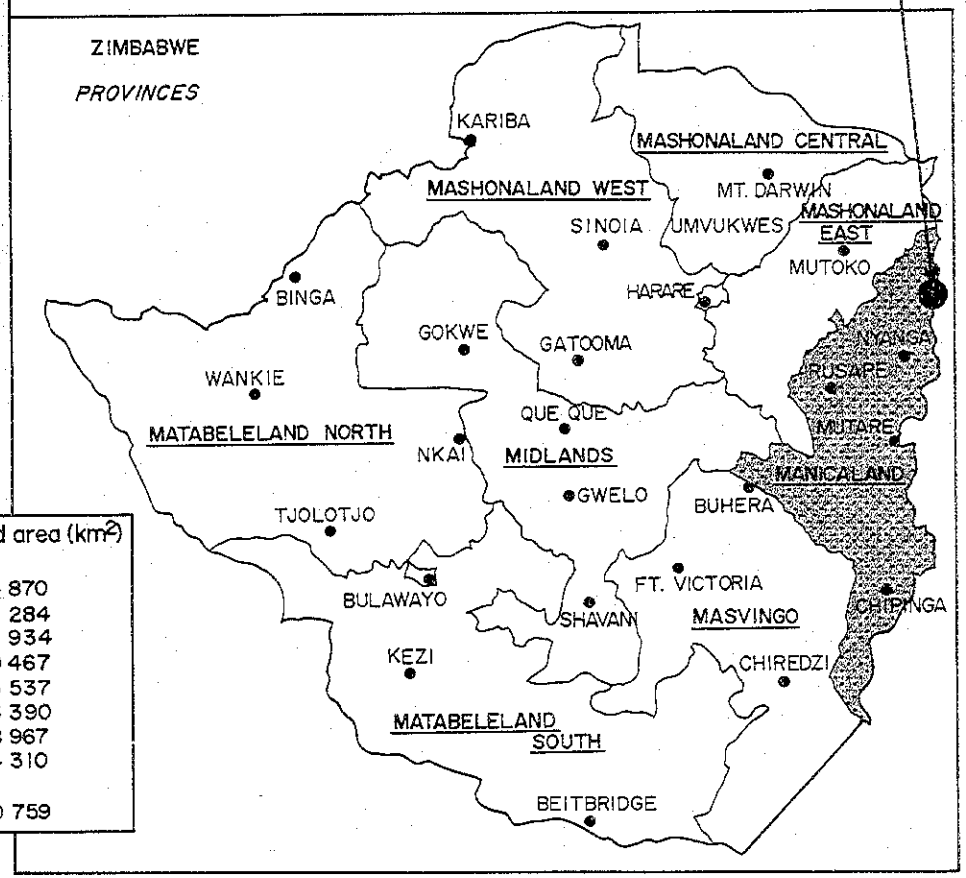
Kensuke Yanagiya

Kensuke YANAGIYA
President
Japan International Cooperation Agency

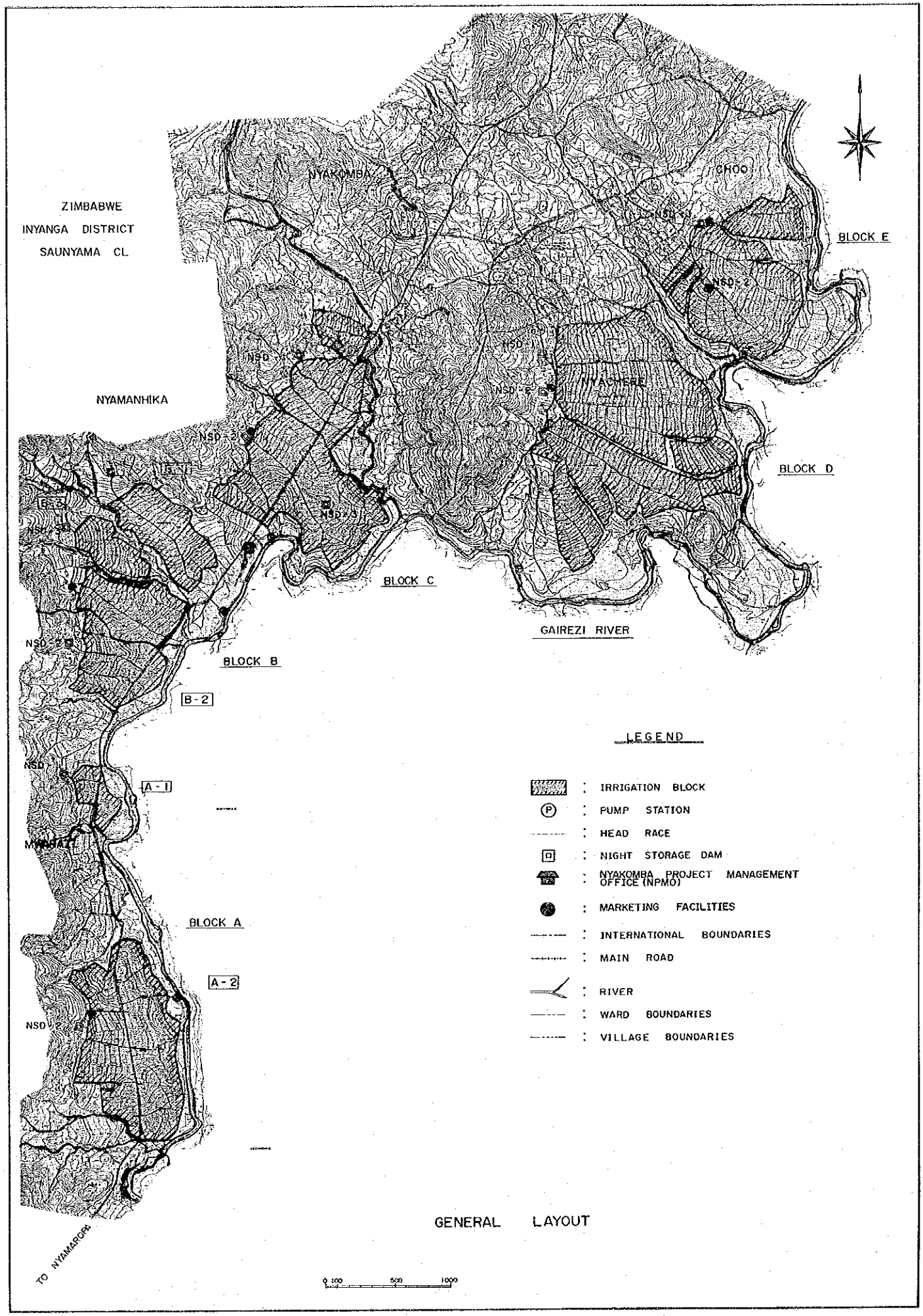
LOCATION MAP



PROJECT AREA

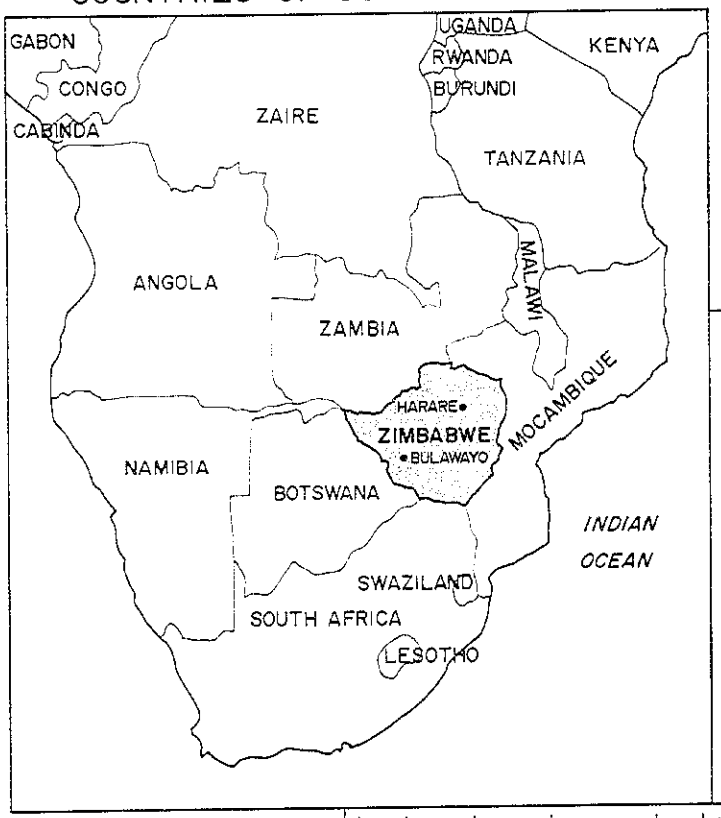


Land area by provinces	Land area (km^2)
Manicaland	34 870
Mashonaland Central	27 284
Mashonaland East	24 934
Mashonaland West	60 467
Matabeleland North	73 537
Matabeleland South	66 390
Midlands	58 967
Masvingo	44 310
Total	390 759

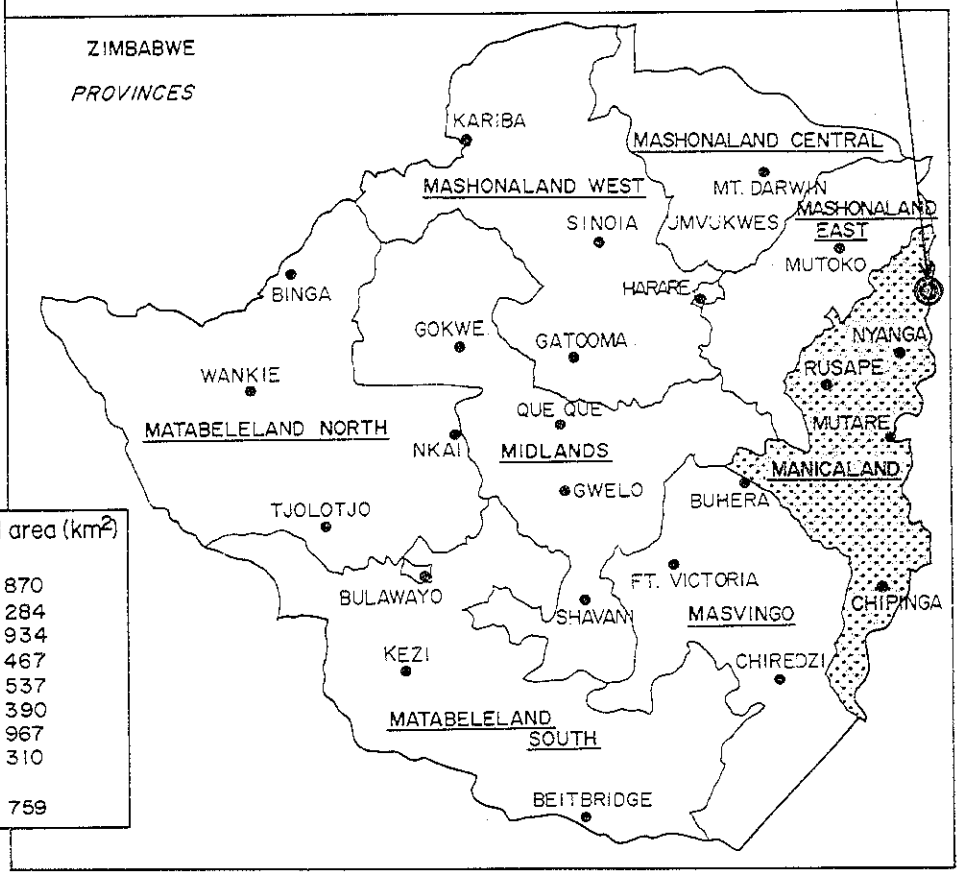


GENERAL LAYOUT

LOCATION MAP



PROJECT AREA



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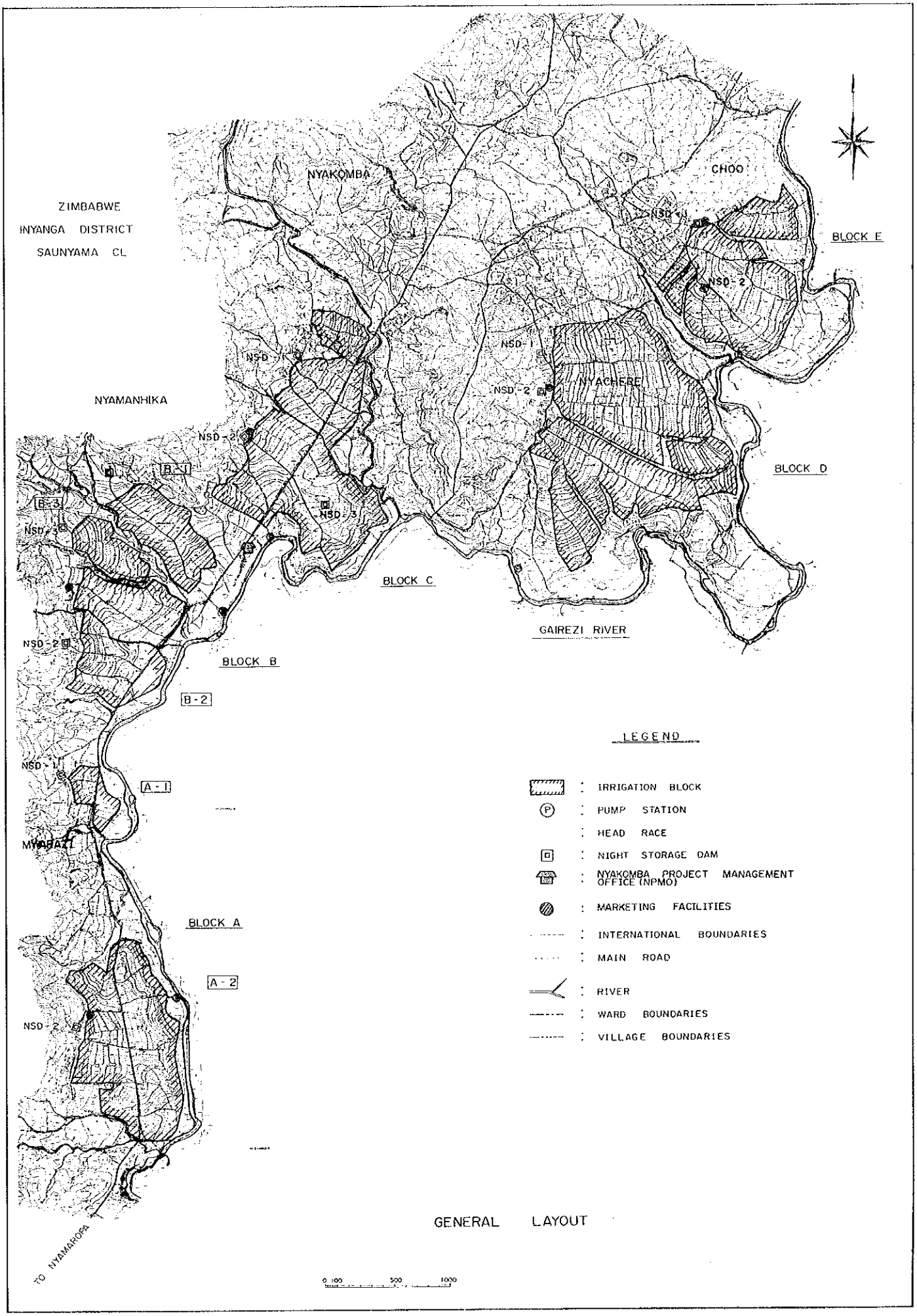

GENERAL LAYOUT

SUMMARY

SUMMARY

INTRODUCTION

[Authority]

1. This Report is prepared by the Japan International Cooperation Agency (JICA) in Accordance with the Scope of Work, which was agreed upon between the Government of Zimbabwe and the Government of Japan on 8 March 1989, for a Feasibility Study on the Nyakomba Irrigation Development Project. The Project is expected to be a pilot project for integrated rural development on Communal Lands.

[Communal Land]

2. To improve the agricultural productivity and the livelihood of Communal Land inhabitants are the most important policy for the national economy. Therefore, the Government distributes 17.0% of Public Sector Investment Programme for the agricultural sector, next to electricity and water sectors at 19.1%, in the 5-Year Plan.

[Feasibility Study]

3. The Feasibility Study (F/S) started on 16 August 1989. The Phase I study was completed on 24 December 1989 during the dry season. The Phase II study also started on 12 January 1990 and was completed on 9 July 1990 during the rainy season.

4. The objectives of the study are to formulate the development plan and to prepare the Feasibility Study Report for the Nyakomba Irrigation Development Project in the Manicaland Province, which will be justified from view points of technical feasibility, economic viability and socio-economic acceptability, for the increase and improvement of agricultural production.

ECONOMIC AND AGRICULTURAL BACKGROUND

[National Economy]

5. The Republic of Zimbabwe received independence from the British in 1980 and it is now a part of the Commonwealth.

Zimbabwe has 391 thousand sq.km of national land and the population stands at 8.64 million.

6. The Gross National Product (GNP) in 1987 was US$ 5,265 million, and the major sectoral shares in the Gross Domestic Product (GDP) were 27.5% in manufacturing, 13.7% in agriculture, 13.1% in distributive services, 6.9% in public administration, 6.7% in transportation, 5.8% in mining and quarryings, and 26.3% for others. Agriculture is still an important sector for the Zimbabwe national economy.

7. In the trading sector agriculture also has a very important role to play namely within the total amount of US$ 1,000 million in exports and also US$ 960 million in imports, food occupies 35.8% or US $ 358 million in exports and 7.0% or US$ 67 million are imports, respectively.

8. The employment rate in Zimbabwe is rather low, according to the Statistical 1987 Year-book and the labour force participation rate in 1982 including communal farmers and excluding communal farmers are 63.5% and 50.3% respectively.

This means that employment creation is a priority, especially for those on Communal Lands.

[5-Year Development Plan]

9. The First Five-Year National Development Plan 1986-1990 was formulated in April 1986, for which the second part was added in April 1988 as VOLUME II.

This 5-Year Plan emphasizes the promotion of the following 6 items;

(a) Transformation and control of the economy as well as economic expansion;
(b) Land reform and efficient land utilization;
(c) Raising the standards of living for the entire population and, in particular, the peasant population;
(d) Enlargement of employment opportunities and manpower development;
(e) Development of science and technology;
(f) Maintenance of a correct balance between the environment and development.

[Climate]

10. The climate of Zimbabwe is divided into four seasons which are the hot season (Sept.-Nov.), the rainy season (Dec.-Feb.), the post rainy season (Mar.-

Apr.) and the cold season (May-Aug.).

The hottest month is October, and the average daily temperatures is 21.3℃. Annual rainfall is 863 mm on average and this amount is concentrated in the rainy season, the total of out of rainy season rainfall is less than 100 mm. In the post rainy season rainfall steadily decreases and the temperatures drop. The cold season comes after mid May and lasts until the middle of August. The weather is mainly fine with sunny days and cold nights. On calm nights ground frosts is fairly widespread.

[Agriculture]

11. Agriculture, which has been the backbone of the economy in the past, will remain the dominant sector in the economy over the 5-Year Plan period. This is borne out by the fact that 76.0% of the population lives in rural areas and their main source of livelihood is farming. In addition , the growth of the economy is largely conditioned by the performance of the agricultural sector, which in addition to providing more than 90.0% of the food requirements at 41.0% of the total merchandise exports. Therefore, meaningful development must place the agricultural sector in the center of the development strategy.

12. During the Plan period, agricultural output is expected to grow at 5.0% per year. This is well above the average projected population growth of 2.76%. This level of output will enable the country to increase its export of agricultural products by 6.0 to 7.0% annually and also to increase the processing of agricultural raw materials.

13. There has been insufficient emphasis on irrigation schemes. During the Plan period the Government will take measures to promote irrigated cultivation on communal lands.

THE PROJECT AREA

[Location]

14. The study area in the Nyakomba ward belonging to the Saunyama Communal Land, Nyanga District, Manicaland Province, and it is located about 170 kilometres from Mutare which is the capital of the province.

The Nyakomba ward lies at about 73-100 kilometres range from the Nyanga township that is the center of the Nyanga District in the Nyanga-

Ruwanger road via Troutbeck and the Nyamaropa Irrigation Project.

[Nyakomba Ward]

15. The Nykomba ward is comprised of 6 villages as summerized blow.

VILLAGE		AREA (in ha)						
No.	Name	Total	Arable	Irrigable	Grazing	Others	Population	Households
1.	Nyatsawe	1,169	367	(-)	771	21	831	129
2.	Nyakomba	729	186	(95)	518	23	638	108
3.	Choo	790	290	(110)	491	9	720	115
4.	Nyachere	885	402	(215)	472	11	807	140
5.	Nyamanhika	855	228	(155)	610	17	756	130
6.	Mwarazi	897	264	(105)	620	13	637	125
TOTAL		5,323	1,737	(680)	3,482	104	4,390	747

16. A village road system is set up and each village is connected to the main road and public facilities. But almost all of the roads are still in poor condition. There are no all weather roads and commuting traffic in limited to the dry season except the main road (Nyanga-Ruwangwe).

There are no electrical services from the Zimbabwe Electricity Supply Authority (ZESA) at present. There is a plan by ZESA to bring power from Mutoko to Nyamaropa via Ruwangwe and Nyakomba, but the time is not yet scheduled. No post office or telephone services are in the study which area highly desirable.

As for the marketing system, all grain and cotton are sold at the Nyamaropa Growth Center about 11 km away by the Marketing Boards which are under Goverment control.

Tabacco leaves are sold on the Harara Auction Floor. The price of tabacco is not regulated . Horticultural products are sold locally or in the Nyanga town.

17. The other existing major public facilities in the study area are summarized as follows.

Facilities	Number
Primary school	2
Secondary school	1
Hotel	2
General dealer shops	10
Restaurant	1
Grinding mills	4

[Natural Conditions]

18. The Topography of the ward is characterised by a major mountain range.

There is Chitowa hill on the east part of the Nyakomba township and the Mazumba range that runs East to West. The low lying areas of the mountain skirt are characterised by fairly arable plains parallcling the Gairezi River.

The lowest plain altitude is around 800 meters and the highest mountain is 1, 350 meters. Arable land in the area is mostly within the range of 800 meters to 850 meters.

19. The Gairezi River runs along the eastern edge of the area from south to north and many small tributaries run from the mountains towards the Gairezi.

The run-off water on land is led by the tributaries to the Gairezi, but most of the tributaries dry up in the drought season.

20. The mean annuual rainfall for the study area is 956 mm, which falls mainly from mid Octomer to mid April.

Annual maximum and minimum rainfall are recorded as 1,495.8mm and 425.9mm respectively.

The mean annual temperatures range from 19.4℃ to 25.6℃.

[Soil Survey]

21. SOIL TAXONOMY was applied for the soil classification study. Field surveys at 30 sites and the analysis of 44 samples were carried out by the Team.

The soil types in kaolinitic order, ranged from moderate to very leachy soils with clay fractions and mainly kaolinite in nature.

The Soils range from deep reddish brown to dull reddish brown or red, and range from sandy clay loam to clay.

[Land Use Survey]

22. According to the Ward Development Plan for the Nyakomba Ward provided by AGRITEX, the land's capabilities were classified into five categories.

Land Class I and II in total 1,737 ha are an arable land for cropping. Class II area is only down-graded due to it's slope percentage.

VILLAGE	LAND CLASS					
No. Name	I	II	VI	VII	VIII	Total
1. Nyatsawe	-	367	451	320	31	1,169
2. Nyakomba	-	186	281	237	23	727
3. Choo	-	290	322	169	9	790
4. Nyachere	-	402	425	47	11	885
5. Nyamanhika	-	228	324	286	17	855
6. Mwarazi	38.5	225.5	396	224	13	897
TOTAL	38.5	1,698.5	2,199	1,283	104	5,323

[Agriculture]

23. The total planted area, 1,141ha is occupied by maize (54%), cotton (40%) and other crops (6%). These crops are grown only in the summer (rainy) season. In the dry season, winter crop(s) are not grown in the study area because no irrigation facilities are available. The planted crops are not much different between villages.

The Average yields for main crops are maize 2.8t/ha, cotton 1.5t/ha and sunflower 1.0t/ha.

The major cropping systems are : Maize-Cotton (2 crops with 2 year rotations) and Maize-SunFlower-Cotton (3 crops with 3 year rotations), each system occupies 65% and 25% of the total planted area, respectively. These two types of cropping systems occupy the total area.

THE PROJECT

[Basic Concept of Development Plan]

24. This "Nyakomba Irrigation Development Project" has the role of pilot project for integrated rural development on the Communal Lands.

Traditional subsistence farming in the Communal Lands should gradually be improved to a commercial based agriculture. These improvements are possible with the introduction an effective irrigation system and the diversification of profitable crops as well as the application of improved technology.

Therefore, it is neccessory that the Project's plan is adaptable contents to other types of Communal Land situations.

For the successful execution of irrigated agriculture measures such as technical and marketing systems should be established.

In planning, stress will be placed on lowering costs and employing technology appropriate for smooth construction, maintenance and operation in the future.

[Meteorological Standard]

25. Unexceedance of Probability 1/10 is applied for the irrigation plan and 1/4 is applied for the water consumption, 557.9mm of rainfall in 1986/87 is adopted as the design drought year, it is equivalent to the unexceedance of probability 1/10.

The Base flow of Gairezi river is 7.48㎥/sec, and the Nyakomba river is 0.007㎥/ sec.

[Water sources]

26. In the beginning, the following 3 water sources were considered as alternative plans for irrigation water.

(1) Plan for pumping stations in the Gairezi River.
(2) Plan for a weir system in the Gairezi River.
(3) Plan for a dam construction in the Nyakomba River.

The Water supply demands is 10,667 thousand ㎥ which includes domestic water at 172.5 thousand ㎥.

According to the study, it was decided to adopt the pumping stations plan in the Gairezi R. as the irrigation system for the Nyakomba Project.

Because, a weir system plan in the Gairezi R. is too large a scale and too costly and a dam construction plan the in Nyakomba R. cannot store enough water and is also too costly.

Therefore, pumping stations are the most suitable plan from economical and technical view points.

[Land Use Plan]

27. Total 1,142ha of 5 villages are decided as the project area, of which 680 ha are planed as the irrigable area and the remaining 462ha are left non-ir rigable.

There are 618 households, and a population of 3,559 persons, therefore a typical farmer holds 1.85ha of cultivated land.

[Agriculture Plan]

28. Cropping system Type Ⅰ: Seven principal crops with three year rotations are proposed for this system occupying 90% of the irrigated land. This area is split equally into three zones a, b and c and each occupies 30% of the land. In these zones, the same cropping system will be practiced with each zone starting with a different crop.

Cropping system Type Ⅱ: Five crops consisting of a vegetable and cereals with two year rotations are proposed. The adaptable area occupies 10% of the irrigated land which is further divided into two zones d and e (5% of the land each). In these zones, cropping systems are the same but starting with different crops similarly to Type Ⅰ. In the future, some within of these cropping systems may be replaced with other crops which will be more suitable to the marketing conditions of that time.

29. The target yields per hectare were carefully decided based on cases from both farm land and technological considerations are as follows.

Maize 6.0 tons/ha, cotton 2.8 tons/ha, tobacco 2.4 tons/ha, sugar beans 1.6 ~1.7 tons/ha wheat 3.5 tons/ha, groundnuts 3.0 tons/ha and onion 20 tons/ha.

[Farm Plot Size]

30. The cropping ratios for each type have been scheduled to each be thirty percent for patterns a, b and c in cropping system type Ⅰ and five percent each for patterns d and e in cropping system type Ⅱ. Thus, the unit plots sizes are to be 0.3 hactare each for patterns a, b and c in type Ⅰ system and 0.05

hectares each for patterns d and e in type II system, because of the irrigated land holding scale for each farmer one hectare is scheduled.

[Irrigation and Drainage]

31. Crop water requirements were calculated with the Modified Penman Method. The Major irrigation factors the peak water months of July and August are shown below.

Crops	ETC(mm/day)		Intervel(day)	
	July	August	July	August
Sugar beans	4.2	5.5	10	8
Wheat (2)	4.0	5.2	26	20
Wheat (1)	4.0	5.2	26	20
Onion	3.4	5.1	6	4

32. Maximum pumping discharge for each pumping station is shown below.

Station No.	Irrigable Area(ha)	Max. Water Demand (m^3/sec)	Pumping Discharge (m^3/min)	No. of Night Storage Dam
A	115	0.273	16.4	2
B	128	0.304	18.2	3
C	140	0.331	19.9	3
D	203	0.482	28.9	2
E	94	0.225	13.5	2
Total	680	1.615	96.9	12

[Rural Road Improvement]

33. Truck roads totaling 7,920 m in length at 5.0 m wide and secondary roads at 23,000 m long with 3.0 m widths are to be improved by the Project. The Whole of the work is to be gravel paving and the installation of pipe culverts.

[Domestic Water Supply]

34. Domestic water for farm households such as for the farmer's living use, livestock drinking water and miscellaneous farm use water is scheduled to be supplied together with the irrigation water through the irrigation facilities as to improve living conditions.

Item	Unit requirement(ℓ)	Size of faimily	Total (ℓ)
Family use	50/person/day	6 persons	300 per day
Livestock	50/head/day	5 heads	250 per day
Others	—	—	100 per day

FACILITY PLANNING

[Pumping Stations]

35. The Following 5 pumping stations are to be installed for water irrigation.

BLOCK	Irrigable Area(ha)	Discharge (㎥/min)	Pump Unit			
			Unit	Diameter (mm)	Head (m)	Generator (HP)
A	115	16.3	4	250	52	375
B	128	18.2	4	250	69	450
C	140	19.9	4	250	77	600
D	203	28.9	4	300	69	750
E	94	13.4	4	200	52	300
Total	680	96.7	20			

[Pipeline]

36. Pipeline Water heads at 4.5~6.2kg/·㎠ thin iron pipes were selected for the irrigation pipeline.

Block	Discharge	Length	Pipe Diameter
	(㎥/s)	(m)	(mm)
A	0.272~0.024	3,460	ϕ 500~ϕ 200
B	0.303~0.045	3,910	500~ 250
c	0.332~0.110	3,340	500~ 350
d	0.481~0.191	2,200	700~ 450
e	0.223~0.103	1,140	450~ 350

[Night storage Dam]

37. Night storage dams were installed to control the water discharge and the time lag between the pumping stations and each irrigation farm.

Block	Controlled Irrigation Area	One hour Dam Volume	Design Dam Volume	No. of Dams
	(ha)	(㎥)	(㎥)	(places)
A	10 ~ 105	85 ~ 893	110 ~ 1080	2
B	19 ~ 71	162 ~ 605	200 ~ 700	3
C	46 ~ 47	397 ~ 400	480	3
D	81 ~ 122	688 ~ 1044	830 ~ 1260	2
E	48 ~ 56	371 ~ 432	450 ~ 520	2

[Buildings]

38. For a smooth effective operation and maintenance, farmers training of modern agriculture the following buildings equiped in the Project Center were allocated Block C.

Buildings	Quantity	Number
Office Building	250 ㎡	2
Warehouse	300 ㎡	1
Workshop	210 ㎡	1
Garage	310 ㎡	3
Multipurpose Hall	190 ㎡	2
Staff quaters	60 ㎡	6

ORGANIZATION AND MANAGEMENT

[Executing Agency]

39. The Ministry of Energy, Water Resources and Development (MEWRD) which controls all surface water supplies will execute the intake pumping stations, water conveyance facilities and night storage dams. While the Agricultural, Technical and Extension Service (AGRITEX), UNDER THE Ministry of Lands, Agriculture, and Rural Resettlement, will execute in-field work and the construction of the project management office and marketing facilities.

Both the agencies have sufficient experience with the implementation of various irrigation development projects. They have their own provincial offices in Mutare, Manicaland which would handle the actual implementation with the assistance of engineering consultans and the hiring of general contractors.

[Financing]

40. Since the project cost is quite high implementation will be necessarily require funds from foreign goverments and/or international financing agencies in order to complete the construction on schedule. In this case, the foreign currency portion of the project cost will be financed by such foreign funds while the local currency portion will be provided by the goverment of Zimbabwe.

[Implementation Schedule]

41. The implementation of Phase-1 is for block-B and block-C including the project management office and marketing facilities attached to block-B and block-C. While Phase-2 is for block-A, block-D, block-E and marketing facilities of these blocks. Thus, the project size for each phase will be favorably appropriate for one time implementation.

[Operation and Maintenance]

42. AGRITEX shall be the key operation and maintenance body and responsible for all facilities and equipment including the pumping stations.

To carry out smooth and effcicient operation and maintenance work, the Nyakomba Project Management Office (NPMO) which undertakes actual activities shall be established under the AGRITEX. Six majon organizational functions to be included to the NPMO are considered below.

(1) Irrigation Manager: To manage overall activities and to coordinate with the AGRITEX District Office, Provincial Office and the Irrigation Management Committe (IMC).
(2) Pump Operation Section: To operate pumps and generators.
(3) Water Management Section: To undertake water distribution control, gate operations and monitoring the water management.
(4) Agricultural Extension Section: To undertake consultation and guidance of plot holders on various matters.
(5) Maintenance Section: To undertake repairs and maintenance of infrastructures, facilities, buildings and equipment.
(6) Farm Equipment Section: To Manage and operate farming equipment and marketing facilities for rent to plot holders.
(7) Administrative Section: To undertake general office routine work, collection of irrigation fees, etc.

COST ESTIMATE

[Project Cost]

43. The total project cost at current price (as of February 1990) amounts to 36.3 million Zimbabwe Dollars composed of 23.2 MZ$ for the foreign currency portion and 13.1 MZ$ for the local currency portion.

The annual operation and maintenance cost amounts to 578.6 thousand Zimbabwe Dollars.

SUMMARY OF PROJECT COST (Unit: 1000 Z$)

Block	Service Area (ha)	Project Cost F/C	Project Cost L/C	Project Cost Total	Cost per ha
Block A	115	4,172	2,228	6,400	55.6
Block B	128	4,477	2,406	6,883	53.7
Block C	140	6,529	3,774	10,303	73.6
Block D	203	4,983	2,802	7,785	38.3
Block E	94	3,054	1,901	4,955	52.7
total	680	23,215	13,111	36,326	53.4
		64%	36%	100%	

NOTE: Construction cost of the NPMO is included in Block C

PROJECT JUSTIFICATION

[Methodology]

44. The Project were justified by following three items namely economic, social and financial evaluation.

The economic evaluation judges the project viability in terms of direct contribution to the national economy. In this economic evaluation, Economic Internal Rate of Return (EIRR) method is employed.

The traditional economic evaluation judges the project viability by EIRR computed from "Efficient Price" which just measures national benefits through optimum allocation of scare resources. Under EIRR method, a development project for poverty is not promoted, when EIRR is lower than the oppotunity cost of capital. In recent years, in order to avoid such situation, the international funding agencies such as the World Bank have introduced the Social Internal Rate of Return method (SIRR) computed from "Social Price" which puts shadow weight on project benfits.

The following four analysis methods are employed to identify the financial viability of the Project;

(1) Financial Internal Rate of Return,
(2) Farm Budget Analysis,
(3) Government Budget Analysis, and
(4) Foregin Reserve Position Analysis.

[Major Parameter]

45. (1) Project life: 50 years
(2) Opportunity cost of capital: 2.80%
(3) Exchange rate: US$ 1.0=Z$ 2.304

[Economic Evaluationd]

46. EIRR of the Project is calculated at 5.50% which exceeds 2.80% of the oppotunity cost of capital by 2.70%.

[Social Evaluation]

47. SIRR of the Project, which takes the income disparity into account, is computed at 11.05%. This SIRR exceeds the opportunity cost of capital by 8.25%.

[Financial Evaluation]

48. FIRR of the Project is 4.25% which exceeds the opportunity cost of capital by 1.45%.

49. Farm economic surplus (disposal income) for the model household will increase by Z$ 1,344.6 per annum.

[Overall Evaluation]

50. The most important governmental policy is to improve the agricultural productivity and living standards of communal land farmers which occupy 55% of the National population.

The project, which is planned under this governmental policy, has not only economical and financial viabilities, but also has the model and pilot roles for future irrigation development projects on other Communal Land.

As mentioned above, the viability and significance of the Project was confirmed and the Zimbabwean Government strongly recommended the commencement of the construction works for the Project.

RECOMMENDATIONS

(1) THE NYAKOMBA IRRIGATION DEVELOPMENT PROJECT is technically and economically feasible. Furthermore, the Project will provide substantial and sustainable socio-economic benefits not only to the Project area but also in Zimbabwe as a whole. Thus, it is recommended that the Project be implemented as early as possible.

(2) The Project should be implemented in two phases. This would permit the quick obtainment of irrigation benefits and bring savings to the overall project cost, consequently farmers will be able to greatly benefit through double cropping.

(3) The executing agencies, the MEWRD and AGRITEX under MLARR recommend that the MEWRD be responsible for the construction work of pumping stations, pipelines, night storage dams and their incidental work.
AGRITEX is to be responsible for the construction work of irrigation canals, drainage canals, farm roads, land grading work and their incidental work.
AGRITEX also is to be responsible for all the pump station opreration and management work and all training services.
Consistent operation from the pumping station to the irrigation field is indispensable for the efficiency and productivity of the Project.

(4) For the efficient operation of the Project, various buildings are concentrated within the plot of Block C, which are called the Project Management Offices including office buildings, warehouses, workshops, garages, multi-purpose halls and staff quarters.

(5) Another measure, for the efficient operation of the project, is important to establish the farmers organization, to carry out the extension services, to utilize the farming machinery, etc..
AGRITEX has strongly requested to execute this measure for post construcion.

(6) Since a large portion of the project cost is required for its implementation, it will be necessary to obtain funds from foreign governments and/or international financing agencies in order to complete construction on schedule.

PREFACE
LOCATION MAP
SUMMARY
RECOMMENDATIONS
CONTENTS
LIST OF TABLE
LIST OF FIGURE
ABBREVIATIONS AND MEASURES

Page

CONTENTS

1. INTRODUCTION
1.1 Authority ——— 1
1.2 Project Background ——— 1
1.3 Objectives ——— 2
1.4 Study Team Activities ——— 2
1.4.1 Formation of the Study Team ——— 2
1.4.2 Study Team Activities ——— 3

2. ECONOMIC AND AGRICULTURAL BACKGROUND
2.1 National Economy ——— 6
2.1.1 Socio-Economy ——— 6
2.1.2 Social Condition ——— 6
2.2 First Five Year National Development Plan (1986-1990) — 7
2.3 Land Tenure System ——— 8
2.4 Agriculture ——— 9
2.4.1 Climate Fitures ——— 9
2.4.2 Agricultural Production ——— 10

3. THE PROJECT AREA
3.1 General Conditions ——— 13
3.2 Social Conditions ——— 15
3.2.1 Administration and Population ——— 15
3.2.2 Education ——— 16
3.2.3 Transportation and Communication ——— 17
3.2.4 Health Facilities ——— 18
3.2.5 Potable Water Supply ——— 18
3.2.6 Electrictity Supply ——— 18

3.3 Natural Condition ---- 21
3.3.1 Topography and Geology ---- 21
3.3.2 Meteorology and Hydrology ---- 23
3.3.3 Soil and Land Capability Classification ---- 30
3.4 Present Land Use and Agriculture ---- 47
3.4.1 Land Use ---- 47
3.4.2 Agriculture ---- 52
3.4.3 Farm Economy ---- 55
3.4.4 Agricultural Support Services ---- 56

4. THE PROJECT
4.1 Basic Concept of Development Plan ---- 65
4.2 Water Resouces Development Plan ---- 67
4.2.1 Meteorology and Hydrology Analisis ---- 67
4.2.2 Availability of Water Resources ---- 72
(Gairezi pump and Nyakomba dam)
4.3 Land Use Plan ---- 77
4.3.1 Ward Development Plan ---- 77
4.3.2 Land Use Plan ---- 78
4.3.3 Reallocation Plan ---- 80
4.4 Agricultural Development Plan ---- 100
4.4.1 Proposed Cropping Pattern ---- 100
4.4.2 Proposed Farming Practices ---- 103
4.4.3 Yield and Production ---- 103
4.4.4 Labor Force and Farm Mechanization ---- 103
4.4.5 Marketing and Price Prospects ---- 104
4.4.6 Farm Economy ---- 104
4.5 Land Consolidation Plan ---- 111
4.5.1 Farm Plot Plan ---- 111
4.5.2 Land Grading Plan ---- 112
4.5.3 Canal System for Irrigation and Drainage ---- 112
4.5.4 Farm Road System ---- 113
4.6 Irrigation and Drainage Plan ---- 116
4.6.1 Irrigation Water Requirement ---- 116
4.6.2 Field Irrigation Schedule ---- 118
4.6.3 Irrigation System Plan ---- 124
4.6.4 Drainage Plan ---- 127

4.7 Supplemental Component plan ——— 130
4.7.1 Rural Road Improvement ——— 130
4.7.2 Land Conservation Plan ——— 131
4.7.3 Domestic Water Supply ——— 131

5. FACILITY PLANNING
5.1 Pumping Station ——— 134
5.1.1 Pump Site ——— 134
5.1.2 Pumping Discharge ——— 134
5.1.3 Pump Plan ——— 135
5.1.4 Related Facilities Plan ——— 136
5.1.5 Pump House Plan ——— 137
5.1.6 Pump Suction Sump ——— 139
5.2 Head Race (Main Supply Line) ——— 139
5.2.1 Pipe Length and Pipe Diameter ——— 140
5.2.2 Pipe Material ——— 140
5.2.3 Hydraulic Calculations ——— 141
5.2.4 Related Facilities ——— 141
5.3 Night Storage Dam ——— 142
5.3.1 Location ——— 142
5.3.2 Dam Capacity ——— 142
5.3.3 Dam Structure ——— 143
5.4 Irrigation and Drainage Canal ——— 143
5.4.1 Irrigation Canal Plan ——— 143
5.4.2 Drainage Canal Plan ——— 145
5.5 Farm Roads Plan ——— 145
5.5.1 Route Plan ——— 145
5.5.2 Road Structure ——— 145
5.6 Nyakomba Project Management Office (NPMO) ——— 146
5.7 Marketing Facilities ——— 147

6. ORGANIZATION AND MANAGEMENT
6.1 Project Implementation ——— 154
6.1.1 Executing Agency ——— 154
6.1.2 Financing ——— 154
6.1.3 Construction Mode ——— 154
6.1.4 Consulting Service ——— 156

6.2 Implementation Schedule ——— 157
6.3 Organization for Operation and Maintenance ——— 157
6.3.1 Operation and Maintenance Body ——— 157
6.3.2 Operation and Maintenance Activities ——— 161

7. COST ESTIMATE
7.1 Project Cost Component ——— 163
7.2 Quantity of Project Works ——— 166
7.3 Project Cost ——— 166
7.3.1 Estimate Conditions ——— 166
7.3.2 Project Cost ——— 167
7.4 Operation and Maintenance Cost ——— 167
7.4.1 Cost Component ——— 167
7.4.2 Unit Rate for O/M ——— 169
7.4.3 Operation and Maintenance Cost ——— 170

8. PROJECT JUSTIFICATION
8.1 General Concept ——— 171
8.1.1 Objective ——— 171
8.1.2 Methodology ——— 172
8.1.3 Parameters ——— 174
8.2 Project Costs ——— 176
8.3 Project Benefits ——— 178
8.3.1 Definition of Benefits ——— 178
8.3.2 Beneficiaries ——— 178
8.3.3 Development of Benefit Accrual ——— 179
8.3.4 Agricultural Output Increase Benefit ——— 179
8.3.5 Road Benefit ——— 179
8.3.6 Domestic Water (Except Drinking Water) Benefit ——— 180
8.4 Economic Evaluation ——— 182
8.4.1 Economit Internal Rate of Return (EIRR) ——— 182
8.4.2 Sensitivity Analysis on EIRR ——— 182
8.5 Social Evaluation ——— 183
8.5.1 Social Internal Rate of Return (SIRR) ——— 183
8.5.2 Sensitivity Analysis on SIRR ——— 185
8.5.3 Intangible Benefit ——— 185

8.6 Financial Evaluation ——— 187
8.6.1 Financial Internal Rate of Return (FIRR) ——— 187
8.6.2 Farm Budget Analysis ——— 187
8.6.3 Government Budget Analysis ——— 190
8.6.4 Foregin Reserve Position Analysis ——— 190
8.7 Overall Evaluation ——— 191

ANNEX
1. Member List of JICA Team and AGRITEX

LIST OF TABLE

Table 2.3.1	CLIMATE OF ZIMBABWE (HARARE)
3.1.1	VILLAGE SUMMARY
3.2.1	POPULATION AND DENSITY, MANICALAND PROVINCE
3.2.2	POPULATION OF THE NYAKOMBA WARD
3.3.1	HYDROLOGICAL STATIONS
3.3.2	GAIREZI RIVER OBSERVATION
3.3.3	RESULT OF SOIL PROFILE SURVEY
3.3.4	RESULT OF SOIL PROFILE SURVEY
3.3.5	RESULT OF SOIL ANALYSIS
3.3.6	RECORD OF INTAKE RATE MEASUREMENT
3.3.7	RESULT OF MEASUREMENT OF WATER HOLDING CAPACITY AND THREE PHASE DISTRIBUTION OF SOIL SATURATION
3.3.8	USE OF LAND ACCORDING TO CAPABILITIES
3.3.9	LAND CAPABILITY CLASSIFICATION
3.3.10	LAND CAPABILITY OF CULTIVATED LAND
3.4.1	SUMMARY OF VILLAGES
3.4.2	LIVESTOCK BY VILLAGE
3.4.3	GRAZING SUMMARY VILLAGE
3.4.4	AREA PLANTED TO PRINCIPAL CROPS
3.4.5	CROP PRODUCTION AND AVERAGE YEILD
3.4.6	ONGOING CROPPING SYSTEM
3.4.7	ONGOING CROPPING CALENDER
3.4.8	CROP PRODUCTION PER YEAR BY VILLAGE
3.4.9	AVERAGE YEILD BY VILLAGE
3.4.10	AREA, INPUT AND KYIELD OF PRINCIPAL CROPS IN THE STUDY AREA AND IRRIGATED AREA (1988/1989)
3.4.11	SEED PRICE
3.4.12	PRICE OF FERTILIZERS AND CHEMICALS
3.4.13	PRICE OF MACHINERY AND EQUIPMENT
3.4.14	PRODUCER'S PRICE
3.4.15	AGRICULTURAL INPUT AND OUTPUT IN THE MODEL FARM

Table 3.4.16 NUMBER OF FAMILY AND FARM WORKER IN THE MODEL FARM
3.4.17 AFC LOAN DISBURSEMENT IN NYAKOMBA (1989/90)

4.2.1 ESTIMATED DAIRY RUNOFF PATERN AT NYAKOMBA DAM SITE
4.3.1 IRRIGATION AREA SCHEDULE
4.3.2 THE AVERAGE FAMILY COMPOSITION OF A TYPICAL FARMER
4.3.3 LABOUR AND DRAUGHT REQUIREMENTS
4.3.4 LABOUR AND DRAUGHT POWER REQUIREMENT IN PRESENT CONDITION
4.3.5 LABOUR REQUIREMENT IN PROJECT CONDITION
4.3.6 DRAUGHT POWER IN PROJECT CONDITION
4.3.7 ECONOMIC BALANCE OF MODEL HOUSEHOLDS
4.4.1 FARMING PRACTICE(1)
〃 (2)
〃 (3)
〃 (4)
4.4.2 PRESENT AND TARGET YIELDS
4.5.1 LAYOUT OF FARM PLOT BLOCK
4.6.1 IRRIGATION APPLICATION INTERVAL PER CROPS
4.6.2 FIELD IRRIGATION SUPPLY PER CROP
4.6.3 PEAK IRRIGATION SUPPLY DEMANDS OF PUMPING STATIONS
4.6.4 SUPPLY DEMANDS FOR DESIGNING SIZES OF PUMPS
4.6.5 ESTIMATED SUPPLIED DEMAND BY PUMP

5.1.1 THE DESIGN PUMP DISCHARGES
5.1.2 PUMP DIMENTSION
5.1.3 PUMP HEAD
5.1.4 PUMP POWER REQUIREMENTS
5.1.5 PUMP HOUSE DIMENSIONS
5.2.1 WATER SUPPLY LINE DEMENSIONS
5.2.2 HEAD LOSSES
5.3.1 NIGHT STORAGE DAM CAPACITIES
5.4.1 IRRIGATION CANAL DIMENSIONS
5.5.1 FARM ROAD DIMENSIONS
5.5.2 FARM ROAD PLAN DETAIL
5.6.1 PROJECT MANAGEMENT FACILITIES DIMENSIONS

Table 5.7.1 MARKETING FACILITIES DIMENSIONS

6.2.1 INVESTMENT SCHEDULE

7.3.1 SUMMARY OF PROJECT COST (AS OF FEB. 1990)

7.4.1 SUMMARY OF ANNUAL OPERATION AND MAINTENANCE COST (AS OF FEB 1990)

8.2.1 INVESTMENT COST

8.2.2 OPERATION AND MAINTENANCE COST

8.2.3 REPLACEMENT COST

8.3.1 DEVELOPMENT OF BENEFIT ACCRUAL IN GESTATION PERIOD

8.4.1 SENSITIVITY ANALYSIS OF EIRR

8.5.1 SENSITIVITY ANALYSIS OF SIRR

8.6.1 PHYSICAL PARAMETERS FOR THE FARM MODEL

LIST OF FIGURE

Figure	1.4.1	GENERAL SURVEY MAP
Figure	3.3.1	GEOLOGICAL MAP
	3.3.2	PROFILE OF GAIREZI RIVER
	3.3.3	SOIL TEXTURE MAP (SURFACE HORIZON)
	3.3.4	INTAKE RATE RECORD
	3.3.5	LAND CAPABILITY MAP
	3.4.1	LAND USE MAP
Figure	4.2.1	UNIT HYDROGRAPH AT NYAKOMBA DAM SITE
	4.3.1	CROPPING CALENDAR AND LABOUR INPUT
	4.3.2	PEAK LABOUR REQUIREMENT
	4.3.3	LABOUR REQUIREMENT OF MODEL FARMING FOR 1.0ha OF IRRIGATED LAND
	4.3.4	LABOUR REQUIREMENT OF MODEL FARMING FOR 1.5ha OF IRRIGATED LAND
	4.4.1	PROPOSED CROPPING SYSTEM
	4.5.1	ILLUSTRATIVE IRRIGATED LAND SIZE
	4.6.1	SCHEMATIC IRRIGATION SYSTEM NETWORKS
Figure	5.1.1	LAYOUT OF PUMP STATION (BLOCK A)
	5.1.2	LAYOUT OF GENERATOR HOUSE
	5.1.3	HEAD RACE IRRIGATION AND DRAINAGE NETWORK(1)
	5.1.4	HEAD RACE IRRIGATION AND DRAINAGE NETWORK(2)
	5.1.5	HEAD RACE IRRIGATION AND DRAINAGE NETWORK(3)
	5.1.6	TYPICAL SECTION (CANAL AND ROAD)
Figure	6.1.1	ORGANIZATION STRUCTURE FOR IMPLEMENTATION AND O/M
	6.2.1	OVERALL TIME SCHEDULE
Figure	7.1.1	PROJECT COST COMPONENT
	7.4.1	OPERATION AND MAINTENANCE COST COMPONENT

ABBREBIATIONS

MLARR	Ministry of Lands, Agriculture and Rural Resettlement
AGRITEX	Department of Agricultural Technical and Extendion Services
MEWRD	Ministry of Energy, Water Resources and Development
DMS	Department of Meteorological Services
ZESA	Zimbabwe Electricity Supply Authority
JICA	Japan International Cooperation Agency
FAO	Food and Agriculture Organization
SADCC	Southern African Development Programme
WADCO	Ward Developmet Committee
VIDCO	Village Development Committee
DDF	District Development Fund
GMB	Grain Marketing Board
CMB	Cotton Marketing Board
TMR	Tobacco Marketing Board
CSC	Cold Storage Commision
DMB	Dairy Marketing Board
CFU	Commercial Farmers Union
ZNFU	Zimbabwe National Farmers Union
NFAZ	National Farmers Assosiation of Zimbabwe
DR&SS	Department of Research and Specialist Services
NPMO	Nyakomba Project Management Office
UNDP	United Nations Development Programme
IBRD	International Bank for Reconstruction and Development
S/W	Scope of Works
F/S	Feasibility Study
GNP	Gross National Product
GDP	Gross Domestic Product
LSCF	Large Scale Commercial Farm
SSCF	Small Scale Commercial Farm
O&M	Operation and Maintenance
F/C	Foreign Carrency

L/C	Local Carrency
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
SIRR	Social Internal Rate of Return

MEASURES

mm	millimeter
cm	centimeter
m	meter
km	kilometer
cm^2, sq. cm	square centimeter
m^2, sq. m	square meter
km^2, sq. km	square kilometer
ha	hectare
m^3, cu. m	cubic meter
kg	kilogram
t, ton	metric ton
s, sec	second
min	minute
hr	hour
℃	degree centigrade
%	percentage
KW	kilowatt
MW	Megawatt
HP	horse power
PS	0.9864HP, 0.7355KW
EL	Elevation
MSL	Mean Sea Level
Z$	Zimbabwe dollar
US$	American dollar
¥	Japanese yen

1. INTRODUCTION

1. INTRODUCTION

1.1 Authority

This Report is prepared by the Japan International Cooperation Agency (JICA) in Accordance with the Scope of Work, which was agreed upon between the Government of Zimbabwe and the Government of Japan on 8 March 1989, for a Feasibility Study on the Nyakomba Irrigation Development Project.

This Report presents the results of the (project's) field surveys and feasibility study, and also contains the findings of the (Project area's) present conditions, the development concept and plan, proposed major project features, project benefits and costs as well as the economic justifications for the Project, as undertaken by the JICA Study Team and their counterparts nominated by the Government of Zimbabwe.

1.2 Project Background

The Nyakomba Irrigation Development Project is expected to act as a model and as a pilot project for Communal Lands integrated rural development.

In Zimbabwe there is a total of 164,119 ㎢ of Communal Lands which is equal to 42% of total national land. However, Communal Lands are generally located in marginal areas, and mainly located in Natural Farming Region 4 which is a semi-extensive farming area, and in Natural Farming Region 5 which is an extensive farming area. Therefore, the total areas of Natural Farming Regions 1, 2 and 3, which are intensive farming areas, only cover 43,466 ㎢ or 26% of the total Communal Lands, incidentally the percentage for Commercial Land is 51%.

The majority of Zimbabwe's population, about 55% or 4.8 million persons, live on Communal Lands. Population pressure, land degradation, the overall lack of access to annual production inputs, and diminished production means are the major Communal Land constraints.

To improve agricultural productivity and the livelihood of Communal Land inhabitants are the most important national economic improvements. Therefore, the Government will distribute 17.0% of Public Sector Investment Programme to the agricultural sector, which is next to the electricity and water sectors at

19.1%, of the 5-Year Plan.

On the other hand, the Manicaland Province, where the Nyakomba Irrigation Development Project is located, has the highest agricultural development potential compared with the other provinces. In the 5-Year Plan, the following improvements will be seen.

The main agricultural activities in the Manicaland Province are crop and cattle production. The produced crops are maize, sorghum, groundnuts, rice, sunflower, tea, coffee, cotton, tobacco, wheat, soyabeans, potatoes and a variety of horticultural products. There are well developed irrigation schemes in the Province which perennial rivers make possible. There is still the potential to develop additional irrigation schemes and this potential will be examined during the Plan period.

With this background, a Feasibility Study (F/S) has started from the 16 August 1989. The Phase I study was completed by the 24 December 1989 during the dry season. The Phase II study also started on 12 January 1990 and completed by the 9 July 1990 during the rainy season.

This Final Report for a F/S was prepared based on field surveys and office work from the Phase I and Phase II studies.

1.3 Objectives

The objectives of the studies were to formulate a development plan and to prepare the Feasibility Study Report on the Nyakomba Irrigation Development Project in the Manicaland Province, which will be justified according to technical feasibility, economic viability and socio-economic acceptability of agricultural production increase and improvement view points.

1.4 Study Team Activities

1.4.1 Formation of the Study Team

The Study Team is comprised of nine members for the Phase I and Phase II studies as follows.

Position	Name	Speciality	Phase I,	II
Team Leader	Y. Mochizuki	Rural Development Planning	◎	◎
Sub-Leader	J. Ishizaka	Irrigation and Drainage	◎	◎
	R. Sakanashi	Facilities Planning	◎	◎
	Y. Yoshida	Agriculture	◎	
	T. Ohmori	〃		◎
	A. Iwamoto	Hydrology and Meteorology	◎	
	M. Isomura	Land Use Planning		◎
	T. Ogawa	Economic Evaluation		◎
	S. Hosono	Design and Cost Estimation		◎

1.4.2 Study Team Activities

Surveys and studies were carried out broadly dividing Phase I and Phase II studies, and each Phase is comprised with field survey in Zimbabwe and home office work in Japan.

The Phase I study includes the following items;

[Field survey]

1) field soil surveys (30 sites) and the analysis of soil samples in the Zimbabwe University laboratory (44 samples),
2) general land use surveys of the Project area,
3) farm economic survey of 10 sellected families from 5 villages, the total number of families surveyed was 50,
4) surveys on farming systems, croping patterns, and crop yields,
5) surveys on socio-economy and farmer's organizations,
6) topo-survey of the Gairezi River cross sections and cross sections of the Nyakomba River proposed dam site,
7) instalation of 3 water gauge stations along the Gairezi River, water level and run-off measuring of the Gairezi River and the Nyakomba River,
8) site surveys for the 8 proposed pumping stations, and the Nyakomba dam site,
9) site surveys for proposed facilities, structures, irrigation

infrastructures, drainage and farming,

10) confirming and deciding on the hectarage and boundaries of the study area at 3,118 ha and the irrigable area at 756 ha (net 680 ha), and

11) to research construction materials and prices, and technical standards.

[Office work]

1) data analysis,

2) the delineation of the project area based on the analysis of the size of the development,

3) the deciding on a cropping pattern and farming methods plan,

4) a study on irrigation water intake and/or reservoir systems,

5) layout of irrigation and drainage systems, and

6) a study on the basic formulation concept for the development plan.

The Phase II study includes the following items;

[Field survey]

1) the decision on adoptable crops and cropping patterns,

2) the completion of laboratory soil analysis,

3) supplementary interview surveys on the farm economy and management of a 10 farmers,

4) detailed survey of land use in the project area,

5) farmer's organization functions and activities,

6) socio-economy, market prices, farm economy, etc.,

7) establishment of the basic conponents for the project center,

8) pumping station site surveys,

9) detailed surveys of construction materials and unit costs,

10) the existing conditions of contractors, machinery, requirement per work unit, inland transportation costs, etc..

[Office work]

1) a review of all results from previous field work and data analysis,

2) the completion of land use and reallocation plans,

3) the completion of the agricultural plan,

4) the completion of irrigation and drainage plans,

5) the formation of farm road and marketing facility plans,

6) the formation of major facility preliminary designs,

7) the formation of plans to support services and farmer's organizations,

8) benefit and cost estimation of the development plan,
9) the formation of the implementation plan and schedule,
10) the formation of the plan of operation and maintenance, and water management,
11) the evaluation of the development plan in the view of economic and financial analysis,
12) recommendations for the projects implementation, and
13) completion of the Final Report for the Feasibility Study.

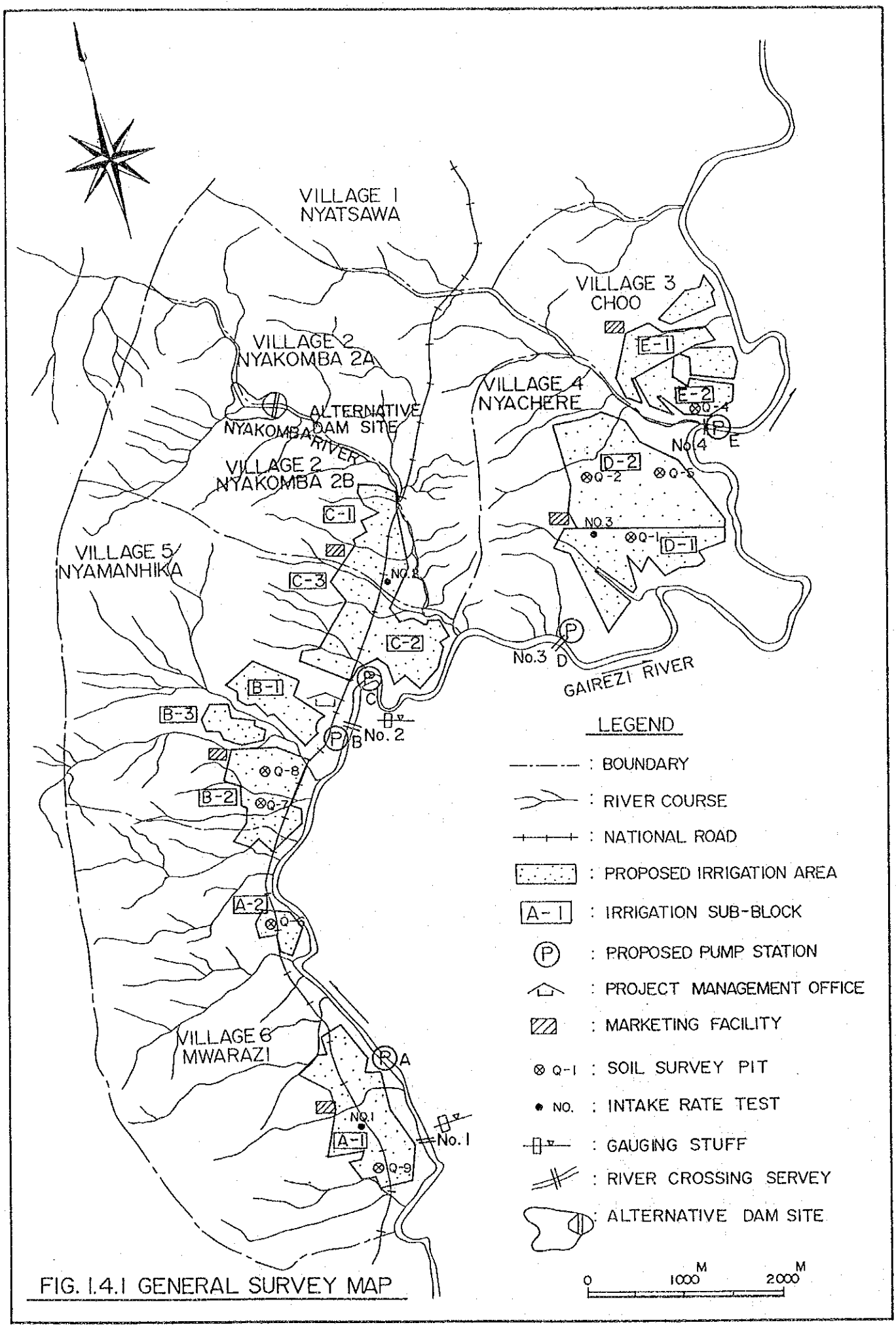

FIG. I.4.1 GENERAL SURVEY MAP

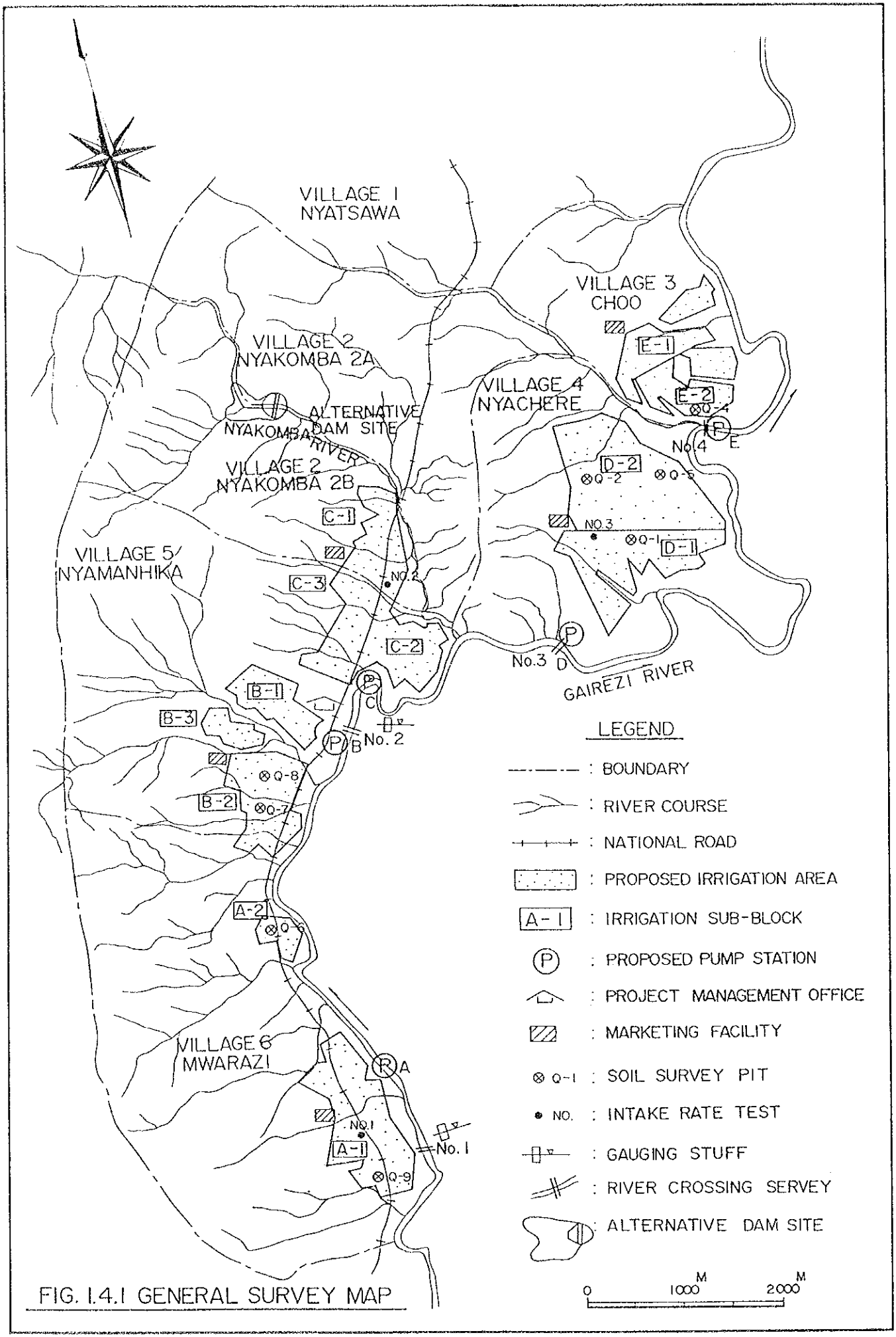

FIG. I.4.1 GENERAL SURVEY MAP

2. ECONOMIC AND AGRICULTURAL BACKGROUND

2. ECONOMIC AND AGRICULTURAL BACKGROUND

2.1 National Economy

2.1.1 Socio-Economy

The Republic of Zimbabwe achieved independence from the British in 1980 and it is now a part of the Commonwealth. Zimbabwe has 391 thousand sq. km of national land and the population stands at 8.64 million.

It is widely recognized that Zimbabwe has a stable economy compared with other countries in Africa. The Gross National Product (GNP) in 1987 was US$ 5,265 million, meaning US$ 590 per capita which in the third highest figure between 9 countries attending the Southern African Development Coodination Conference (SADCC). The Major Gross Domestic Product (GDP) sectoral shares are 27.5% in manufacturing, 13.7% in agriculture, 13.1% in distributive services, 6.9% in public administration, 6.7% in transportation, 5.8% in mining and quarrying, and 26.3% for others. Agriculture is still an important sector in the Zimbabwe national economy.

In the trading sector agriculture also has a very important role to play namely within the total amount of US$ 1,000 million in exports and also US$ 960 million in imports, food occupies 35.8% or US$ 358 million in exports and 7.0% or US$ 67 million in imports, respectively. Special attention is given to the figure of 35.8% in the exports, which is second to manufactured goods, against 7.0% of the imports. Trade with Japan, stood at US$ 85.5 million in exports and US$ 24.2 million in imports. It can, therefore, be said that the national economy of Zimbabwe is in a very sound position.

2.1.2 Social Condition

As mentioned above the independence of Zimbabwe in 1980, was about 20 years later than most other African countries. However, Zimbabwe achieved independence without a decline in the productivity of agriculture, manufacturing and other sectors of the economy.

In 1987 the population of Zimbabwe was 8.64 million. The Population density is 22 persons per sq. km with a relatively high population growth rate at 3.10%, and 23.6% of the total population is in urban areas. The breakdown of the

working population, excluding the Communal Land population, is 7.7% in primary industries, 26.5% in secondary industries and 65.8% in tertiary industries. Therefore the Zimbabwean economy can be called a commercialized system centering on mining and manufacturing.

The employment rate in Zimbabwe is rather low, according to the 1987 Statistical Year-book, the labour force participation rate in 1982 including communal farmers and excluding communal farmers was 63.5% and 50.3% respectively. This means that employment creation is a priority, especially on Communal Lands.

Education is an encouraging sector for the Government with the primary school figures jumping up remarkably from 2401 schools in 1979, prior to independence, to 4234 in 1985.

2.2 First Five Year National Development Plan (1986-1990)

First Five-Year National Development Plan 1986-1990 was formulated in April 1986, for which the second part was added in April 1988 as VOLUME Ⅱ.

This 5-Year Plan emphasizes the promotion of the following 6 items partiqularly.

(a) Transformation and control of the economy as well as economic expansion ;
(b) Land reform and efficient land utilization ;
(c) Raising the living standards of the entire population and, in particular, the peasant population ;
(d) Enlargement of employment opportunities and manpower development ;
(e) Development of science and technology ;
(f) Maintenance of a correct balance between the environment and development.

In the 5-year Plan, the following description on the agricultural sector can be found, "Agriculture, which is one of the three material production sectors, is placed at the center of the development strategy, especially as it relates to rural development. During the Plan period, therefore, Government will implement agricultural and rural development programmes and projects that are intended to increase agricultural productivity and output."

Promotion of agriculture in Zimbabwe is quite important for economic development, especially on Communal Lands.

2.3 Land Tenure System

Agricultural land in Zimbabwe may briefly be divided into two broad categories, Commercial Land which is permitted as personal title deeds on the one hand and, on the other hand Communal Land which is vested in the President. Commercial Land can be subdivided into Large Scale Commercial Land (LSCL) and Small Scale Commercial Land (SSCL). LSCL has been cultivated by white farmers who have the title deeds. SSCL has been developed by the yeoman class of successful farmers who were to be granted larger portions of land of between 30 and 300 acres in the newly created African Purchase Areas, and called the Small Scale Commercial Farmers. Communal Land, which was called Tribal Trust Land before Independence, cannot be given over to inhabitant private ownership. Therefore, inhabitants may occupy and use Communal Land for agricultural or residential purposes only, with the consent of the district council established for the areas concerned.

In Zimbabwe's, export trade agricultural products have occupied the top position. However, most exports are from of a small number Commercial Farms.

Zimbabwe is also the only country which had successful results in the agricultural sector after independence. The main factor for this success is the Zimbabwe government decided on a policy of reconciliation with white inhabitants after independence. Successful agriculture has been supported by 3,500 white Large Scale Commercial Farms and 8,500 black Small Scale Commercial Farms.

On the other hand, agricultural problems still exist especially in communal areas because of land degradation and the decline of productivity resulting from population pressure an increase in cattle and reduced tilling techniques such as the incorporation of manure, and the control of weeds, pests and disease. Therefore, the most important items for agriculture in Zimbabwe is to improve the contents of it's agriculture as well as to raise the living standards on Communal Lands.

Table 2.3.1 LAND CLASSIFICATION

Items	Commercial Land		Communal Land	National Land	TOTAL LAND
	Large Scale,	Small Scale			
Total Area, km²	156,304	15,630	164,119	54,706	390,759
〃 , %	40	4	42	14	100
Region 1-3, %	51	56	26	15	
Number of Farms	3,500	8,500	800,000		
Average Farm, Ha	4,466	184	21		

Note: 74% of all communal land is located in (Natural) Region 4 and 5.
75% of all small scale commercial land is located in Region 3 and 4.
51% of all large scale commercial land is located in Region 1 - 3.
Including 200,000 ha of urban areas.

2.4 Agriculture

2.4.1 Climate Features

The climate of Zimbabwe is divided into four seasons which are the hot season (Sept. - Nov.), the rainy season (Dec. - Feb.), the post rainy season (Mar. - Apr.) and the cold season (May - Aug.).

The hottest month is October, the average daily temperature is 21.3℃. Annual rainfall is 863 mm on average and this amount is concentrated in the rainy season, the total of out of the rainy season rainfall is less than 100 mm. In the post rainy season rainfall steadily decreases and temperatures drop. The cold season comes after mid May and lasts until about the middle of August, there is an occasional short period of drizzle and light rain mainly in the mountains of the eastern district. The weather is mainly fine with sunny days and cold nights. On calm nights ground frost in fairly widespread.

The climate of Zimbabwe (Harare) is shown in below.

Items	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annnal
Temperature	℃	20.0	19.8	19.4	18.7	15.9	13.6	13.6	15.6	19.0	21.3	20.8	20.4	18.2
Rainfall	mm	216	172	99	36	11	4	1	3	5	30	100	186	863
Humidity	%	77	79	72	67	61	59	51	47	45	46	61	72	61

2.4.2 Agricultural Production

Citing form the 5 year plan agriculture in Zimbabwe is as follows,

(1) Agriculture, which has been the backbone of the economy in the past, will remain the dominant sector in the economy over the 5-Year Plan period. This is borne out by the fact that over 70.0% of the population lives in rural areas and their main source of livelihood is farming. In addition, the growth of the economy is largely conditioned by the performance of the agricultural sector, which in addition to providing more than 90.0% of the food requirements and, accounts for 41.0% of total merchandise exports. Therefore, meaningful development must place the agricultural sector in the center of the development strategy.

(2) During the Plan period, agricultural output is expected to grow at 5.0% per year. This is well above the average rate of the projected population growth of 2.76%. This level of output will enable the country to increase its export of agricultural products by 6.0 to 7.0% annually and also to increase the processing of agricultural raw materials.

(3) It is projected that over the Plan period, employment in the sector will increase at an average annual rate of 2.2%. This increase will occur mainly in subsectors using labour-intensive production techniques such as horticulture.

(4) MAIZE; Maize output is expected to increase and stabilise at 3.5 million tonnes by 1990. Of the total maize output of 3.5 million tonnes, approximately 2.4 million tonnes will be produced by communal and resettled farmers, with the remainder produced by commercial farmers. While productivity in communal and resettlement areas will have risen by the end of the Plan period (1.75 tonnes/ha), it will still be far below that of commercial farms (4.75 tonnes/ha).

(5) WHEAT; Wheat output is expected to reach 275,000 tonnes by 1990. Wheat production declined to 99,000 tonnes in 1984, because of drought which caused water shortages for irrigation. In 1985 due to good rainfall, wheat production reached a level of 215,000 tonnes of which about 200,000 tonnes came from the large scale commercial sector and the remaining 15,000 tonnes from the small scale sector. It is estimated at that to attain self-sufficiency.

(6) COTTON; Cotton production is expected to increase to about 46,000 tonnes by 1990 on an enlarged area of about 275,000 ha. While the large-scale commercial sector is expected to maintain its prsent level of production and area planted of 170,000 tonnes and 75,000 ha. It is projected that communal farmers and small scale commercial farmers will increase output to about 230,000 tonnes on an increase area of 200,000 ha.

(7) TOBACCO; Zimbabwe's "golden leaf" tobacco, the country's number one earner of foreign currecy has good potential for futher expansion. The Export of tobacco accounts for one fifth of the country's merchandise export and generates 50.0% of Zimbabwean agricultural exports. Not only is the tobacco industry responsible for a large percentage of Zimbabwe's export earnings, but it also provides employment to 90,000 workers. Zimbabwe's tobacco production is based on promising world market forecasts, in which Zimbabwe stands firmly as the third largest exporter with a 15.4% share following the U.S.A. (22.3%) and Brazil (21.8%). Annual tabacco production is about 120,000 tonnes.

(8) TEA and COFFEE; Both are increasingly becoming important crops in the agricultural sector. In 1984, the combined export of these two crops amounted to Z$ 55 million or 3.5% of the total export. Over 90% of the coffee plantations and about 60% of the tea plantations are irrigated. Both industries are labour-intensive, providing employment for nearly 20,000 people.

(9) SOYA-BEAN and SUNFLOWER; Both are crops for further expansion. Soya-bean is produced mainly by large scale commercial farmers while sunflower is grown mainly in communal areas where it has a promising future because of its resistance to drought and its importance as a cash crop. The Government will encourage and support production of these two crops.

Zimbabwe has the potential for the expansion of many other agricultural produces such as sorghum, mhunga and rapoko which are drought resistant crops.

(10) HORTICULTURAL CROPS; Horticultural crops account to about 9.0% of the agricultural output. These include mostly fruit and vegetables. During the Plan period horticulture will be promoted. The strategy is intented both to widen employment opportunities throughout the year and to increase exports. Horticultural production will need back up services such as green houses, cooling rooms, quarantine and the supply of plant materials.

The development of horticulture will lead to the expansion of packaging, canning and other small scale industries which will also promote industrial decentralization and expand the material production industries of the economy. Horticultural crops such as kiwis, avocadoes, mangoes, paw-paws, granadillas mecadenian nuts, plums and almonds have great export potential.
Mulberry cultivation provides good scope for expansion.

(11) Agricultural diversification of this nature has a number of advantages such as improving the diet of the community, alleviation of transport problems associated with bulkly commodities, especially in exporting to distant lands, and the provision of full time agricultural employment as well as increasing the incomes of the people in communal areas. The Diversification of crops will also reduce the undue reliance on traditional crops.

(12) There has been insufficient emphasis on irrigation schemes. During the Plan period the Government will take measures to promote irrigated cultivation on communal land. These measures will also change the regulations that now govern the National Irrigation Funds in order to make funds more readily available to peasant farmers.

3. THE PROJECT AREA

3. THE PROJECT AREA

3.1 General Conditions

The study area in the Nyakomba ward belonged to the Saunyama communal land, Nyanga District, Manicaland Province, and is located about 200 kilometers north from Mutare which is the capital of the province.

The Nyakomba ward lies at about a 73-100 kilometres range from the Nyanga township that is the center of the Nyanga District on the Nyanga-Ruwangwe road via Troutbeck and the Nyamaropa Irrigation Project.

It shares boundaries with the Nyamaropa ward to the South, the Nyadowa ward to the West with mountain ridges. The Sabvure ward to the North and the Gairezi river that forms a national boundary with Mozambique to the East.

The main road runs from Nyanga to Ruwangwe through the Nyakomba Township and it can be approached from Nyanga and Mutare with paved all weather roads about 77 km and 177 km, also to Harare about 347 km connected with the national road at Rusape.

The Nyakomba ward is comprised of 6 villages as summarized below.

Table 3.1.1 Village summary

VILLAGE		AREA (in ha)						
No.	Name	Total	Arable	Irrigable	Grazing	Others	Population	House-holds
1.	Nyatsawe	1,169	367	(-)	771	31	831	129
2.	Nyakomba	729	186	(95)	518	23	638	108
3.	Choo	790	290	(110)	491	9	720	115
4.	Nyachere	885	402	(215)	472	11	807	140
5.	Nyamanhika	855	228	(155)	610	17	756	130
6.	Mwarazi	897	264	(105)	620	13	637	125
TOTAL(1~6)		5,323	1,737	(680)	3,482	104	4,390	747
〃	(2~6)	4,154	1,370	(680)	2,711	73	3,559	618

Note: Population increase ratio 3.1%. Population density 0.825 person per.km Arable land 0.396 ha/person. Data source: Ward development plan, Date July 1989.

The village road system is set up and each village is connected to the main road and public facilities. But almost all of the roads are still in poor conditions. There are no all weather roads and commuting with trafic is limited to the dry season except for the main road (Nyanga-Ruwangwe). Thus the improvement of farm roads in relation to the irrigation area should be taken into consideration in the irrigation project plan.

As to the marketing system, all grain and cotton are sold at the Nyamaropa Growth Center about 11 km away by the Marketing Boards which are under Government control.

Tabacco leaves are sold on the Harare Auction Floor. But the price of tabacco is not regulated. Horticultural products are sold locally or in the Nyanga township.

The other exisiting public facilities in the study area summarized as follows.

Facilities	Number
Pre-school	2
Primary school	2
Secondary school	1
Clinic	1
Dips	2
Hotel	2
General dealer shops	10
Restaurant	1
Counter butcher	1
Grinding mills	4
Blacksmith	1

There are no electrical services from the Zimbabwe Electricity Supply Authority (ZESA) at present. There is a plan by ZESA to bring power from Mutoko to Nyamaropa via Ruwangwe and Nyakomba, but the schedule is not yet set. No post office or telephone services are in the study area but are highly desirable.

3.2 Social Conditions

3.2.1 Administration and Population

(1) Administrative Division

A local government concerned with communal lands, is organized with four levels: village, ward, district and province. The Manicaland Province is divided into seven district councils, seven rural councils and the Mutare Municipality. The District council areas are basically communal land areas, while rural council areas are large and small scale commercial farming areas.

Communal land District council areas form the basis of local governments. A local government consists of two bodies, namely a deliberative body composed of elected councillors and an administrative body headed by the Chief Executive Officer who is at the same time, District Administrator. The District Administrators are appointed from the central government, Ministry of Local Government and Town Planning.

The Nyakomba Ward covered in the Project area is one of the five wards composed on the Sawnyama Communal Land which is located in the middle-east part of the Nyanga District Council. One councillor is elected from the Nyakomba Ward.

The Ward Development Committee (WADCO) is headed by the Councillor who acts as the chairman, and six Village Development Committees (VIDCO) are organized in the Nyakomba Ward to better administer the villages and the ward. These committees have been appointed by the council, and are managed by eight or nine committee members including one chairman, one secretary, one deputy secretary and one treasurer.

(2) Origin of the inhabitants

The original inhabitants were called the "Vanyama". From 1950 to 1959, on the land apportionment exercise several Manyika people were displaced from the Nyanga National Parks, Juliasdale and Sanyatwe areas to the East of Sawnyama and Nyamaropa communal areas. They intermarried with other tribes and became generally known as the "Manyika" people.

(3) Population - Density and Migration

The Project area covered by the Nyakomba Ward excluding the Natsawe Village has a land area of 41.54 sq.km. The Total population of the project area is 3,559 in 1989 and 3,605 in January 1990 with 618 households, the population increase during last one year is 1.35%. The Population density of the study area is 85.7 persons per sq.km in 1989, which shows a higher level than that in the Nyanga District Council Area. The Population density of the Nyanga District Council and Manicaland Province in the 1982 population census was 21.4 and 31.9 persons per sq.km respectively. Table 3.2.1 shows the population and the density of the Manicaland Province.

As shown in Table 3.2.2. About two thirds of the population is children under 15 years of age. A population pyramid is a broad base indicating a very young population.

This high proportion of children may be due to a combination of factors such as the prevalence of a high birth ratio level in the past and the migration of adults. About 400 people are working away from home or are out on military service or education purposes, according to information from the ward councillor in January 1990.

3.2.2 Education

Around 100 percent of the childlen under the age of 15 years living in the Nyakomba Ward attend primary school, according to the councillor.

According to the Manicaland 1982 census, 90% of the 10-14 years age group male and female attended school, and in the 15-19 age group however only 55 percent of the females as compared with 79 percent of the males attended school. Thus more girls than boys leave school after primary school.

There are three school levels in the project area, which are;

1) Pre-School,
   Two pre-schools are part of the Dandadzi and Chatindo primary schools.

2) Primary School,
   There are two primary schools, Dandadzi in the Mwarazi village and

Chatindo in the Nyakomba village, which are double-stream and three-stream, respectively.

3) Secondary School

The new Chatindo School in the Nyakomba village services the secondary schooling, providing up-to-"O"level certificate examinations.

3.2.3 Transportation and Communication

The gravel paved regional road called the Nyamaropa-Elmi Road, runs through the project area from Nouth to Sorth, which branches off from the all weathered national road named the Nyanga - Ruwangwe Road. The Nyamaropa - Elmi Road is the only access road to Nyanga. Two companies run 6 buses daily through this road, commuting to and from Mutare/Ruwangwe and Harare/Kazozo respectively, and one local trader owns a few large and small trucks dominantly transporting the agricultural inputs and outputs.

Two improvements for the main traffic roads related with the project area are presently planned by the Government as follows;

1) The Regina Coeli Road connecting from Regina coeli on the Nyanga-Ruwangwe Road to the Nymaropa town center which is a junction to the Nyamaropa-Elmi Road, is under construction with widenning and the paving of 8.7km, the paved Regina Coeli Road will be a short cut for Nyanga. The Ministry of Transport is in charge of this improvement work.

2) The District Development Fund (DDF) is now being used for the improvements of the Nyakomba-Nyangwaya Mazumbu Road and Bariri Road. These roads run through the Nyatsawe village and Choo village, the Bariri Road has been cut by the sharp Choo River gully.

Farm roads in the project area which connect to village and trafic roads and/or cultivated land, are narrow, being one or 2 meters wide which have not been maintained with their surfaces covered with deep cart tracks, only pedestrian or scotch cart passage is possible. The height of some farm roads is lower than adjacent cultivated land, they therefore become a drainage channel in the rainy season.

No telecommunication systems or postal services are in the study area. Residents must go to Tourbek about 50km from the project area to use public communication services.

3.2.4 Health Facilities

The Nyakomba clinic which is one kilometer from the township, services the community with basic out-patient attention as well as maternity services. If more care is needed patients are then refered to the Regina Coal Hospital or the Nyanga General Hospital which are run by three Certified Nurses.

3.2.5 Potable Water Supply

In the study area, there is only one shallow well and one small scale water supply system. The small scale water supply system serves potable water to two schools, townships and the clinic in Nyakomba. Almost inhabitants get their water from mountain streams in the rainy season and from the Gairezi of the Nyakomba River in the dry season for all purpose water such as drinking, domestic, bathing, cattle, etc.

3.2.6 Electricity supply

There are no electrical services in the study area. Only a Restaurant and a Hotel in the Nyakomba township have a private generator to service the canteen and for lodging.

Table 3.2.1 POPULATION AND DENSITY, MANICALAND PROVINCE

Area	Populatin	Area Km	Density
Buhera D.C.	168,520	5,364	31.4
Chitepo D.C.	92,035	1,512	60.9
Gazaland D.C.	140,130	3,285	42.7
Nyanga D.C.	69,260	3,231	21.4
Mabvazuva D.C.	55,539	1,211	45.9
Maungwe D.C.	148,609	3,017	49.3
Mutare D.C.	128,246	2,920	43.9
Total D.C.'s	802,339	20,540	39.1
Cashel R.C.	4,270	876	4.9
Chipinge R.C.	60,797	1,790	34.0
Inyanga R.C.	21,952	2,472	8.9
Makoni R.C.	38,339	3,051	12.6
Chimanimani R.C.	16,139	1,266	12.7
Tsungwesi R.C.	35,220	2,291	15.4
Mutare R.C	49,423	2,165	22.8
Total R.C.'s	226,140	13,911	16.1
Mutare Municipality	75,358	158	476.9
Manicaland Province	1,103,837	34,609	31.9
Zimbabwe	7,550,000	391,000	19.3

Source ; Manicaland Province, 1982 Population Census, Central Statistical office, Horare, March 1988.

Table 3.2.2 POPULATION OF THE NYAKOMBA WARD

	House-holds	Females	Males	Children below 10	Children over 10	Total	Average per H.H
(1989)							
1. Nyatsawe	129	189	149	261	232	831	6.44
2. Nyakomba	108	124	109	229	176	638	5.91
3. Choo	115	168	163	189	201	721	6.27
4. Nyachere	140	176	116	246	269	807	5.76
5. Nyamanhika	130	156	106	265	229	756	5.82
6. Mwarazi	125	138	121	168	210	637	5.10
Total	747	951	764	1,358	1,317	4,390	5.88
Total (2-6)	618	762	615	1,097	1,085	3,559	5.76
(1990 Jan)							
1. Nyatsawe	129	209	182	265	232	888	6.88
2. Nyakomba	108	130	79	201	242	652	6.04
3. Choo	115	132	134	191	265	722	6.28
4. Nyachere	140	164	122	246	269	801	5.72
5. Nyamanhika	130	172	150	194	264	780	6.50
6. Mwarazi	125	124	89	202	235	650	5.20
Total	747	931	756	1,299	1,507	4,493	6.01
Total (2-6)	618	722	574	1,034	1,275	3,605	5.83

Source: 1989; Ward Development Plan, July 1989
1990; Survey of EW in the Nyakomba Ward

3.3 Natural Condition

3.3.1 Topography and Geology

The topography of the ward is characterised by a major mountain range. There is Chitowa hill in the east part of the Nyakomba township and the Mazumba range that runs East to West. The low lying areas of the mountain skirts are characterised by fairly flat arable planes stretching in parallel with the Gairezi river.

The lowest altitude of the plan is around 800 metres and the highest of the mountain area is 1,350 metres. The arable lands in the area are mostly in the range of 800 metres to 850 metres and the above 850 m. The mountain slope is covered with savannah which is mostly steep and can easily be eroded with over grazing throughout the year. The Gairezi river runs at the eastern edge of the area from north to south and many small tributaries run from the mountain ridge towards the Gairezi. The run-off water on land is led by tributaries to the Gairezi, but most of the tributaries dry up in the drought season. There are several gully erosions caused by unsteady stream in the stream.

The surrounding of the study area is composed of a variety of granitic rocks, sediments and dolerites from the precambrian age. The base complex is comprised of granites together with numerous small ultramatic xenoliths and sedimentary material are uncomformably overlain by the Nyanga and the Gairezi facies sediments of the Umkondo group. All are extensively intruded by dolerite sills and dykes of various ages.

The low lying areas being arable lands are of alluvium and superficial deposits. The mountain range origin is varied and complex, but the area within the Umkondo group with chloritic and ferruginous schists is common to the south and well beded quarts schists and white orthquartzite are common to the Nyakomba river catchment. The north of the mountain range is basically of a ferruginous quarts and mica schist origin.

The grazing lands origin, distributed from the top of the mountain at 1,350 m to the foot of the mountain at 850 m, is varied and complex. There are quartz schist (qm) and ferruginous quartz - mica schist (fm) in the reaches of the Nyakomba river and also chlorite and ferruginous schist (cm) exist in the south

from the center of the study area. Other geological details are seen on fig. 3. 3.1

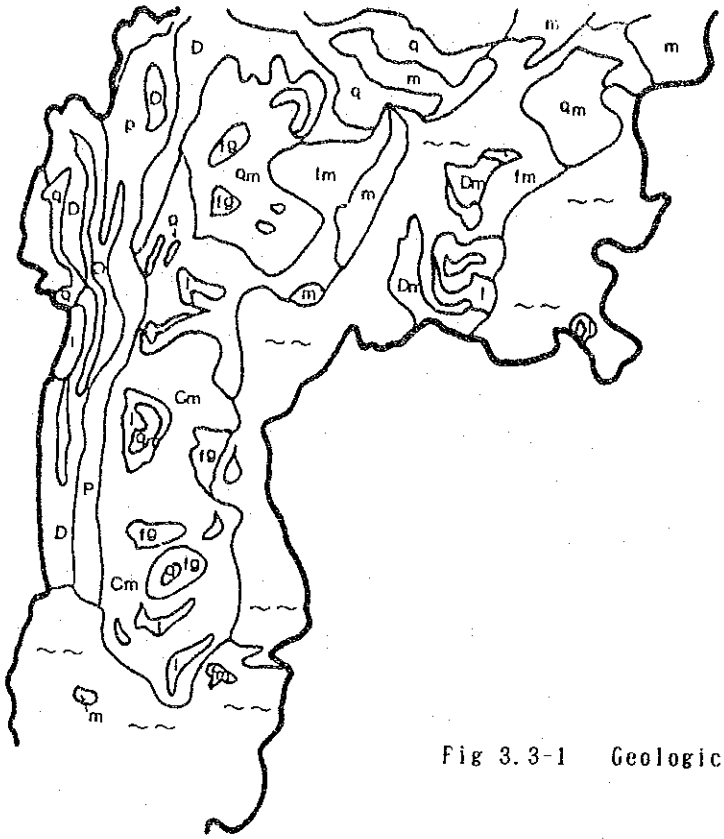

Fig 3.3-1 Geological Map

Explanation

Recent ··· ~~ Alluvium and colluvium

Precambrian

- Intrusion of Various Ages
  - D Dolerite dykes and sills of various ages
  - D_m Altered dolerite
- Umkondo Group
  - q_m Well-bedded quartz schist
  - C_m Chloritic and ferruginous schists
  - p Phyllitic argillite phyllite
  - f_g Ferruginous grits, quartzites, argillites, argillites
  - m Quartz-mica schist
  - l Subordinate crystalline limestone
  - f_m Ferruginous quartz-mica schist
  - q White orthoquartzite

3.3.2 Meteorology and Hydrology

(1) General

1. Meteorological Characteristics

Acording to Koppen's climatic classification, Zimbabwe is located in a tropical savanna climatic zone, of which the symbol is "AW", which has a per annum rainy season. For planning, however, the ammount of annual rainfall and its distribution are important factors.

Zimbabwe lies between 15.5° to 21.5° south latitude and on the equatorial side of the Tropic of Capricorn, but with its high altitude it shows a subtropical climate. Especially, in the eastern mountainous zone which has an altitude of 1,400 to 2,600 m, and in the central highlands which have an altitude of 1,200 to 1,800 m, mostly show around 20℃ as the annual mean temperature.
The eastern mountainous zone also has the highest annual rainfall, about 1200 to 2000 mm, in Zimbabwe. Almost all the plain areas in the country have a mean annual rainfall of 700 to 800 mm on average concentrated during October and March.

The Project area is located in the Nyakomba Ward, on the eastern part of the Manicaland Province, along the international boundary with Mozambique. The area has an altitude of 800 m to 850 m, the annual mean temperature is 23 ℃ and the annual mean rainfall is 956 mm.

2. Hydorological Characteristics

The rivers in Zimbabwe are classified into two broad water systems, namely the Zambezi system and the Save system, by the central high watershed areas. The rivers in the north, west flow into the Zambezi river and the rivers in the south-east into the Save river.

The Gairezi river, which is expected to be the main water source for this irrigation plan, flows down into the Project area from the Inyangani mountain which is the highest mountain in this country and lies on the eastern mountain ranges. The Gairezi flows down toward the north through steep mountain areas and it forms the international boundary with Mozambique, finally joining into

the Zambezi River.

(2) Outline of the Study

A meteorological survey was carried out for the study on cropping patterns and the analysis of river runoff. In the Project area, there are no meteorological stations, therefore, from the surrounding areas 3 meteorological stations Nyamaropa, Nyanga and Mutare were selected for study.

Meteorological data for the Project's planning in Nyakomba were converted from the above 3 stations data with conversion formulas.

A Hydrological survey was carried out for the acquisition of an irrigation water source. Considered water sources for the Project are the Gairezi River or the Nyakomba River. However there is no data available on these 2 rivers.

Therefore, hydrological data on the surrounding 4 rivers, such as the Tsanga, Marozi, Nyaruwaka and Pungwe were utilized with conversion methods.

(3) Existing Data Collection

1. Meteorological Data

1) Meteorological station and observed items

There are no meteorological stations in the study area. The nearest station is the Nyamaropa Irrigation Office about 20 km south of the Project area, and altitude of 840 m. This station records the daily rainfall.

The Nyanga Experimental station, at 45 km from the Project area and at an altitude of 1,878 m, has been observing temperature, rainfall, wind speed, relative humidity and evaporation.

The Mutare Meteorological Station is a national station. Its location is far from the Project area about 130 km. Therefore only data on sunshine hours is utilised as specific data.

Apart from the above data, evapotranspiration and solar radiation were collected as specific data. The whole of the data was collected from the Department of Meteorological Services, and some from each station directly.

2) Temperature Lapse Rate Analysis

In order to estimate the temperature in the Project area, a lapse rate analysis is applied, as follows.

$$Ts = Tn + 0.81\ (Hn - Hs) / 100 = Tn + 8.6$$

where, 0.81 ; coefficient by experiment
Ts ; estimated temperature of Nyakomba (℃)
Tn ; temperature of Nyanga (℃)
Hn ; elevation of Nyanga (1,878 m)
Hs ; elevation of Nyakomba (816 m)

The annual mean temperature of the Nyakomba area from 1940 to 1988, which was caluclated with the above formula, is 23.4℃.

2. Hydrological data

1) Hydrological stations

There are no hydrological stations in the Nyakomba river basin nor on the banks of the main stream of Gairezi river, although both are expected to be main water sources for the project's irrigation plan. Therefore, for project planning, hydrological data from the following 4 stations was unavoidably utilised. 3 of which are tributaries of the Gairezi river and one is in a neighbouring river basin.

Available hydro-data from the above 4 stations was collected from the Ministry of Energy and Water Resources Development. A list of the 4 stations (in brief) and data collected are shown below:

Table 3.3.1 Hydrological Stations

CODE	STATION	NAME of RIVER	AREA (km^2)	MAIN RIVER	ESTABLISED
F.6	Troutbeck Dam	Tsanga	17.9	Gairezi	Feb. 1958
FGP.77	Nyamaropa Weir	Marozi	109.0	Gairezi	Jan. 1969
FGP.C-7	Nyamaropa Canal	Marozi	109.0	Gairezi	Jan. 1969
FGP.78	Nyamaropa Weir	Nyaruwaka	77.7	Gairezi	Jan. 1969
FGP.C-8	Nyamaropa Canal	Nyaruwaka	77.7	Gairezi	Jan. 1969
F.14	Pungwe Causeway	Pungwe	85.5	Pungwe	Oct. 1970

2) Runoff Data

Daily runoff data from 1972/73 to 1987/88 was collected at the stations mentioned above. Some data is not available, but most of the data was utilised to analyse the runoff.

FGP. 77 along the Marozi river was selected as a typical station for runoff analysis because of its catchment area characteristics such as vegetation, mother rocks, topography and rainfall being similar to the catchment area of the Nyakomba River.

(4) Field Survey Findings

1. Water Level Observation of the Gairezi River

In order to investigate the water levels in the Gairezi River during the dry season, staff gauge sets were installed at two sites which were the candidate sites for pumping stations. The observed water level records in the Gairezi river are shown on Table 3.2.2, and Fig. 3.3.2. River factors on an observation line are shown below.

Table 3.3.2 Gairezi River Observation

STATION	DISTANCE	RIVER BED	WATER	RIVER SLOPE	WATER SLOPE	RECORDED MAX. LEV.	RECORDED MIN. LEV.
		809.50m	180.76m			816.70m	810.55m
Upper-stream							
	6,900m			1/800	1/830		
Staff Gauge,		801.00m	802.43m			810.95m	802.40m
Lower-stream							
	3,900m			1/3,900	1/2,930		
survey,		799.97m	801.10m			806.52m	800.75m
Cross-section							
	6,800m			1/1,100	1/1,150		
-do-		794.03m	794.77m			802.30m	794.47m

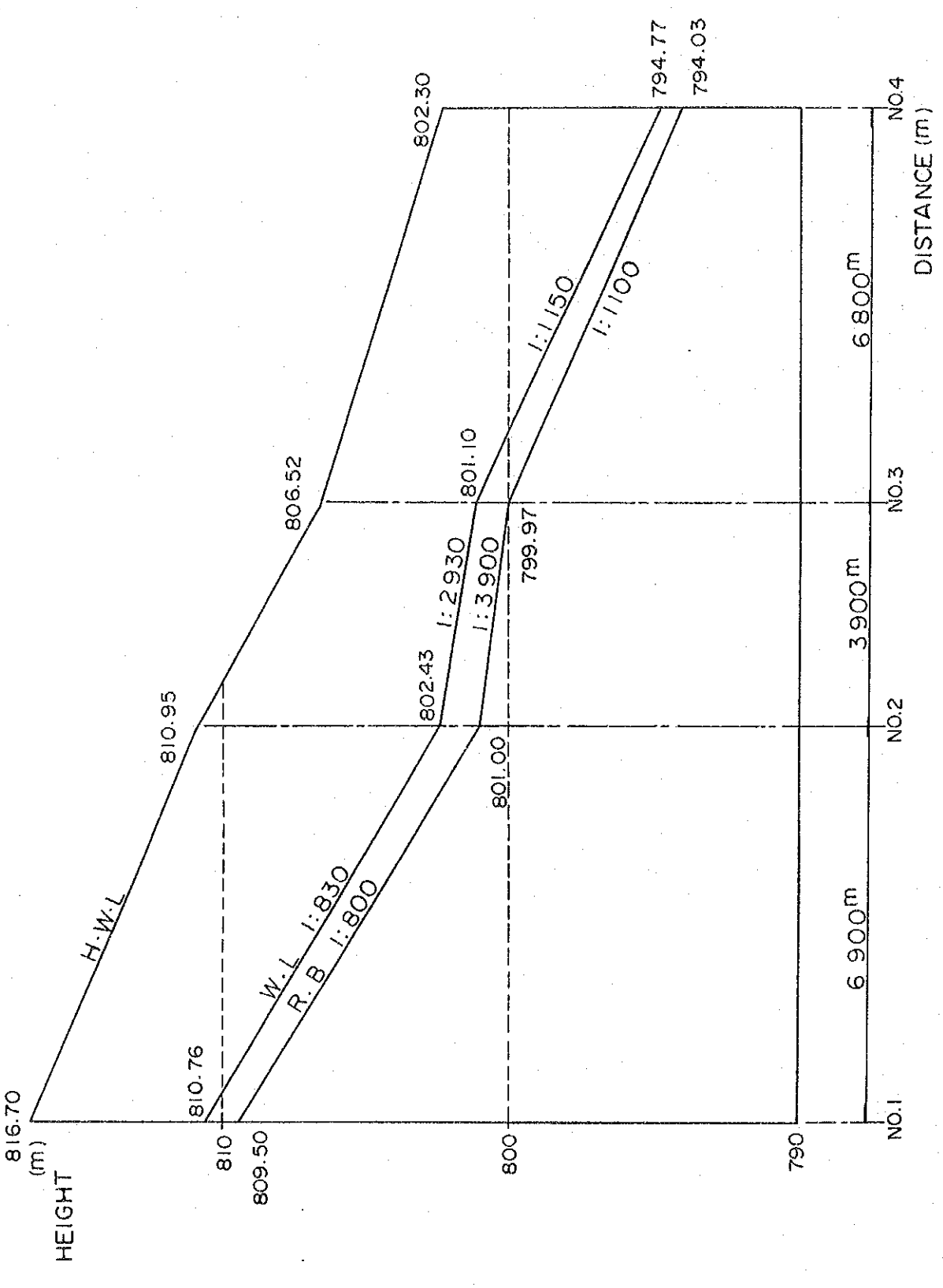

Fig. 3.3.2 PROFILE OF GAIREZI RIVER

2. Runoff Observation

During the survey period, water velocity was measured by a current flow meter at installed staff gauge points. The calculated runoff by velocity is shown below.

	DATE	RUNOFF(m^3/s)	DATE	RUNOFF(m^3/s)
Upper Stream Site	13/SEP, 1989	8.31	26/SEP, 1989	7.51
Lower Stream Site	18/SEP, 1989	8.37	26/SEP, 1989	7.82

3. Nyakomba River Runoff

Runoff measurements of the Nyakomba River were carried out at a point 100 m up stream from the Nyakomba Road bridge, using a triangle weir. To check the specific runoff (specific discharge), runoff of the Tsambanena river was also measured at 200 m up-stream from the junction of the Nyaruwaka river, using a triangle weir. These observations were carried out on 28 September 1989.

Runoff was calculated with the following formula.

$$Q = C \cdot h^{5/2} \qquad (3.2.1)$$

$$C = 1.354 + 0.004/h \cdot (0.14 + 0.2/\sqrt{D}) \cdot (h/B - 0.09)^2 \qquad (3.2.2)$$

where Q : Runoff in m^3/s
C : Coefficient of the Triangle Weir
h : Overflow Depth
B : Wier width
D : Height between the Weir's Edge and the Bottom

(1) Runoff of Nyakomba River

B = 70cm, D = 15cm, h = 12.9cm

$C = 1.354 + 0.004 / 0.129 \cdot (0.14 + 0.2 \sqrt{(0.15)} \cdot (0.129/0.7 - 0.09)^2$

$= 1.354 + 0.031 \times 0.656 \times 0.009 = 1.354$

$Q = 1.354 \times 0.129^{5/2} = 0.0081\ m^3/s$

(2) Runoff of Tsambanea River

B = 70cm, D = 15cm, h = 15.5cm