JAPAN INTERNATIONAL COOPERATION AGENCY

No. 2

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR MCHINJI GROUNDWATER DEVELOPMENT
IN
THE REPUBLIC OF MALAWI

APRIL, 1992

JAPAN ENGINEERING CONSULTANTS CO.,LTD.

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PREFACE

In response to a request of the Government of Republic of Malawi, the Government of Japan has decided to conduct a basic design study on the Project for Mchinji Groundwater Development and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Malawi a study team headed by Mr. Kazuhisa Matsuoka, Director of First Basic Design Study Division of Grant Aid Study and Design Department, JICA, from October 14 to November 18, 1991.

The team held discussions with the officials concerned of the Government of Malawi and conducted a field study at the Project Area. After the team returned to Japan, further studies were made, a draft report was prepared, and for the explanation and discussions of it, a mission headed by Mr. Yoshihide Nakai, Resident Representative, JICA Malawi Office, was sent to Malawi from February 14 to February 24, 1992. As a result, the present report has been completed.

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

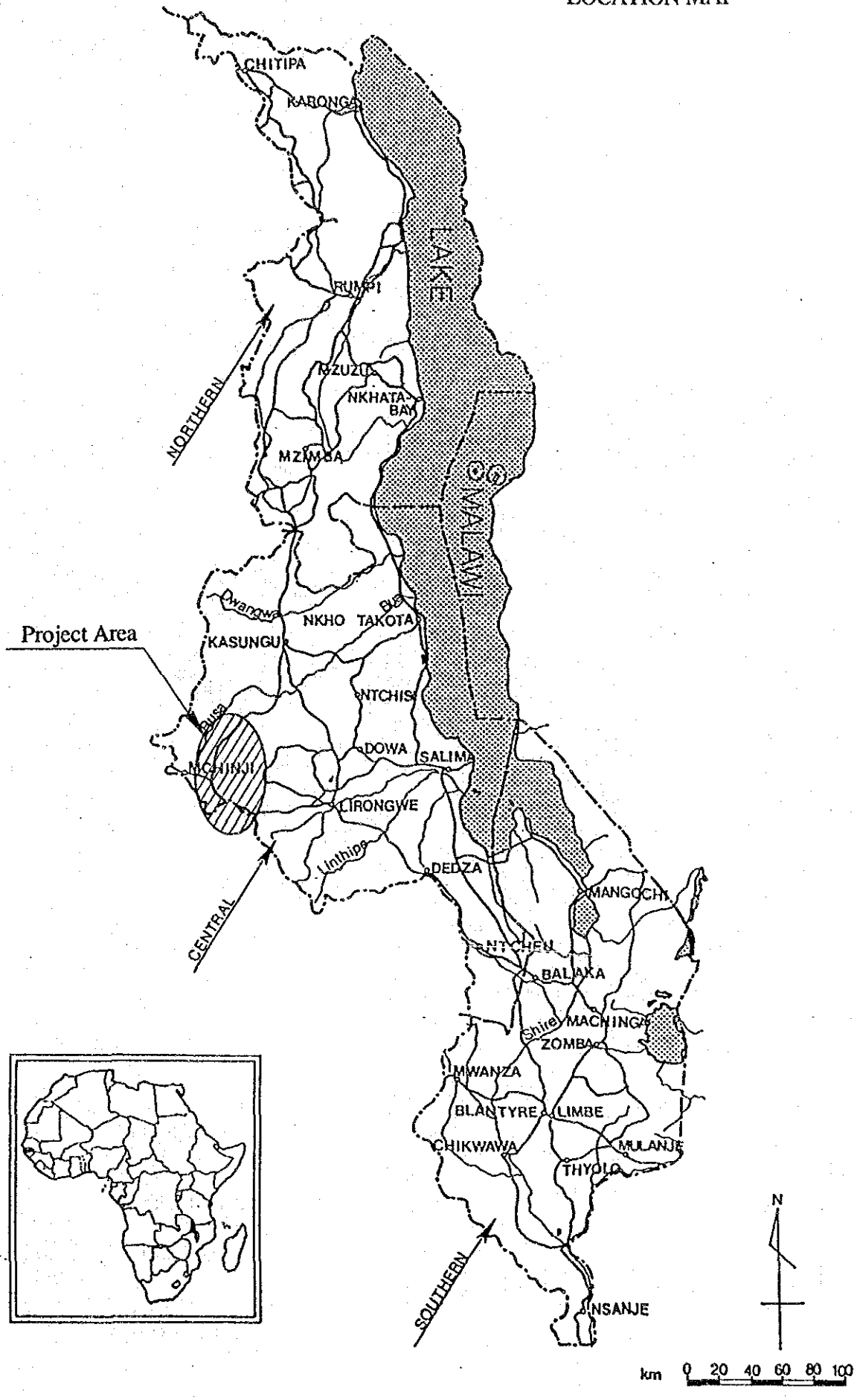
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Malawi for their close cooperation extended to the teams.

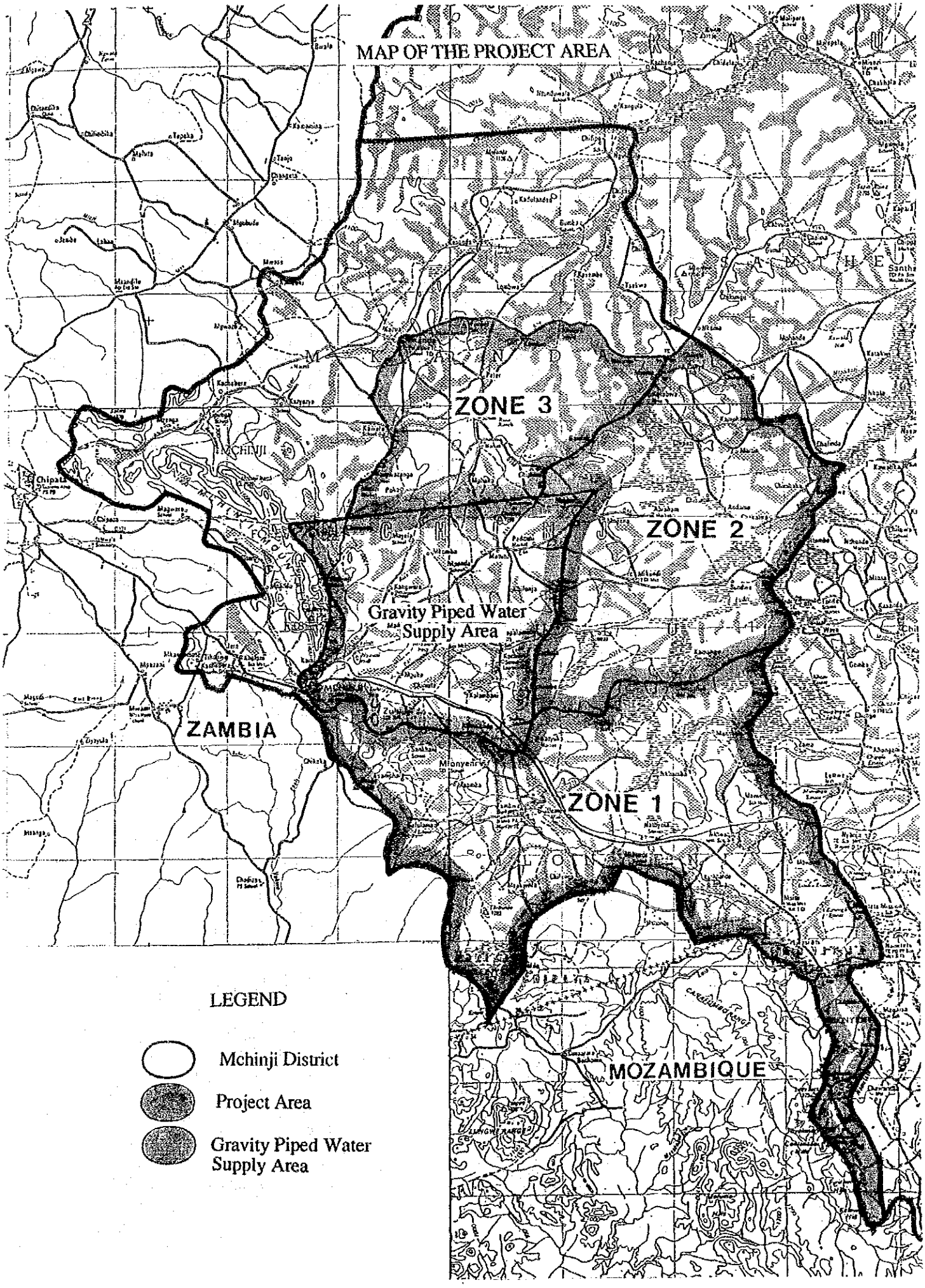
April, 1992

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

LOCATION MAP




MAP OF THE PROJECT AREA
ZONE 3
ZONE 2
ZONE 1
Gravity Piped Water Supply Area
ZAMBIA
MOZAMBIQUE
MCHINJI
LEGEND
Mchinji District
Project Area
Gravity Piped Water Supply Area

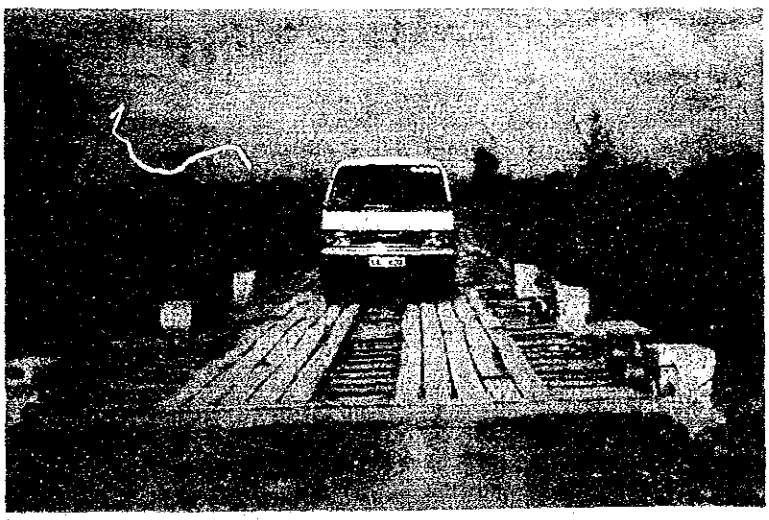
Existing borehole in the Project Area
(using Afridev handpump)

Dug well in the Project Area
(water is cloudy)

Tap for gravity piped water system adjacent to the Project Area

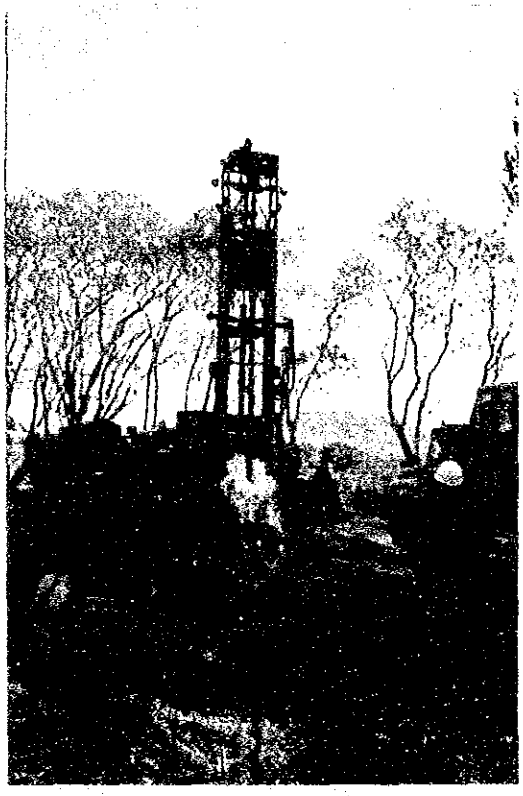
Electric prospecting

Bridge over dambo in the Project Area



Bridge and district road in the Project Area

Out-of-order percussion type drilling rig
(at Central Regional Office, Department of Water)



Drilling rig provided by Japan at work for IFAD Project
(in the Project Area)

Pump repair by VLOM system
(shallow well completed under UNICEF project at Ntchisi)

SUMMARY

Since independence from Britain in 1964, the Government of the Republic of Malawi has continuously emphasized the promotion of agriculture as one of its prime national policy objectives. Some 86% of the working population is currently engaged in agriculture and the agricultural sector accounts for 33% of the GDP (US$120 million in 1990). The Statement of Development Policies (1987-1996) calls for the achievement of economic growth exceeding the population growth rate and regards the development of agriculture, which plays an important role in both employment and export earnings, as the highest priority task.

With the belief that the provision of a stable supply of clean domestic water for rural inhabitants to improve their infrastructure is essential to achieve such agricultural development, the Government of Malawi has been nationally promoting a rural water supply development plan, of which the construction of boreholes and a gravity piped water supply system are the two pillars. The concrete target of this plan is to increase the water service population in rural areas to 5,860,000 (service ratio: 74%) by 1996 which is the target year of the Statement of Development Policies. As of 1991, the service population stands at 4,893,000 (service ratio: 65%) and, therefore, it is necessary to secure water supply sources for an additional 967,000 (gravity system for 639,000, boreholes for 250,000 and shallow wells for 78,000) in the next five years to meet the said target.

Water supply in rural areas in Malawi is the responsibility of the Department of Water of the Ministry of Works. There has been a general delay in the implementation of the water development plan, mainly because of financial constraints, and assistance from international organizations and donor countries has consequently been sought to implement the plan. The Department of Water is planning the construction of 1,000 boreholes in the next five years (1992-1996) to provide domestic water for an additional 250,000 people and assistance for the construction of 521 boreholes has so far been committed by the EEC and KfW. In addition, it is planned that 150 boreholes be constructed under small-scale groundwater development projects. The remaining 329 boreholes are still lacking concrete plans for financing. Against this background, the Government of Malawi made a request to the Government of Japan for the provision of grant aid for a groundwater development project (the Project) in Mchinji District, which is located in the mid-western part of Malawi, by providing the necessary machines, equipment and materials to construct 300 new boreholes in the District.

Following examination of the contents of the request, the Government of Japan decided to conduct the basic design study for the Project. According to the decision by the Government of Japan, the Japan International Cooperation Agency (JICA) sent the study team to Malawi for the period between October 14 and November 18, 1991. The study team held a series of

discussions and consultations with Malawi officials and conducted the field study. On its return to Japan, the study team examined and analyzed the collected data and compiled their findings in the draft report. JICA then sent a team to Malawi for the period between March 14 and March 24, 1992 to explain the contents of this draft report to the Malawi side.

The Project Area is the entire Mchinji District, excluding those areas receiving gravity piped water supply in the western part and estates in the northern part and covers an area of some 1,730km^2. Through consultations with the Malawi side, the following contents of the request were confirmed by both the Government of Malawi and the study team.

(1) Construction of 300 boreholes in the Project Area using two drilling rigs, one of which was provided by the Government of Japan in 1989 under its grant aid.

(2) Provision of one set of drilling machines, equipment, spare parts and materials required for the construction of the boreholes. It is preferable to use the Afridev Handpump in the Project, because the Government of Malawi has a policy to standardize on this type of pump for the smooth implementation of VLOM (Village Level Operation and Maintenance).

(3) Provision of on-the-job training (drilling and other techniques) to the Malawian counterpart staff during the construction period.

(4) Provision of technical training in Japan in regard to drilling techniques and hydrogeology.

Mchinji District has fertile land and its proximity to Lilongwe, the capital of Malawi and a large food consumption area, makes it an important area for agricultural development. Of the infrastructural services provided for the local inhabitants, the water service is particularly poor with a service ratio as low as 17% (total population in Project Area in 1987: 138,585). A large majority of the local inhabitants rely on unsanitary rivers or dug wells as domestic water supply sources. Many of these sources dry up in the dry season, compelling the inhabitants to travel long distances in the search for water which is particularly hard work. The provision of stable water supply sources is, therefore, a particularly pressing task. The hydrogeological survey results in the Project Area point to the sufficient existence of groundwater in a fissure zone composed of weathered bedrock.

The Groundwater Section of the Department of Water which will be responsible for the implementation of the Project has 551 staff members and has a national network of regional offices and maintenance offices. The Groundwater Section is mainly managed by 12 hydrogeologists and has ample experience of implementing groundwater development projects, having successfully completed many similar projects, including the North Kawinga Project

which was assisted by Japan. With the help of the World Bank and Denmark, etc., it has been promoting the VLOM system, a type of self-reliant scheme to encourage villagers to operate and maintain the boreholes in their villages, and adoption of the VLOM system is planned for the boreholes to be constructed under the Project. With regard to drilling machines, although the Department of Water has a number of drilling rigs, they are mainly percussion type rigs with poor work efficiency except for two rotary type rigs (also usable as an air-hammer). The drilling schedule, however, has been severely hampered by the general deterioration of the percussion type rigs.

After examination of the requested Project in the light of the above study findings, the following Project details have been prepared.

(1) Service Population

The service population (including those using existing boreholes) in the Project Area following the completion of the Project will be approximately 100,000 with a service ratio of some 50% (against an estimated population of 203,130 in 1996) to approach the national target service ratio of 74% in rural areas in 1996.

(2) Number of Boreholes to be Constructed

There is a total of 812 villages in the Project Area, of which 549 (68%) are small villages with a population of less than 200. While it is desirable for all the villages to enjoy a stable supply of domestic water, any project to ensure such a supply would be too large for financial commitment given the present low service ratio. For the immediate purposes, therefore, the population size is used as a criterion and the construction of new boreholes is in general restricted to those villages with a population of 200 or more. In the case of large villages, at least one borehole will be provided for every 400 inhabitants and the total number of new boreholes will be 300.

(3) Average Drilling Depth

Based on the field study results, the maximum borehole depth will be 75m with an average drilling depth of 50m.

(4) Construction Schedule

Taking into consideration the Project Area's climatic and geological conditions, performance records of similar projects in the past, expected work efficiency and expected rate of drilling failures, etc., the construction of 300 boreholes using two

drilling rigs will require three years. The number of boreholes to be constructed each year will be 80 in the first year and 110 in each of the second and third years.

(5) Borehole Type and Ancillary Facilities

The boreholes to be constructed under the Project will have a durable structure and a reinforced concrete cover to prevent water contamination. Ancillary facilities will include an apron, drainage channel and washing slab, etc.

(6) Machines, Equipment and Materials Plan

The successful completion of the Project on schedule will require certain machines, equipment and materials, including two rotary/air-hammer type drilling rigs. The Department of Water has only two such drilling rigs, both of which were provided by Japan and one of which is in constant use in the Southern Region. In addition to the remaining drilling rig, a drilling rig of the same type will consequently be newly provided by Japan for the Project together with other machines, equipment and materials required for the completion of 300 new boreholes using these two drilling rigs.

(7) Pumps

Afridev handpumps made in India will be used to assist the widespread adoption of the VLOM system which is being promoted by the Government of Malawi.

(8) Technical Cooperation

In view of the fact that engineers of the Department of Water, the organization responsible for Project implementation, lack sufficient work experience using the planned rotary/air-hammer type drilling rigs, they will undergo on-the-job training on drilling rig operation and maintenance to be conducted by the Japanese contractor during the three year construction period.

The provision of the following machines, equipment, materials and construction work will be required for the smooth and successful completion of the Project.

1)	Truck-mounted rotary/air-hammer type drilling rig (including high pressure compressor, tools and accessories)	1 set
2)	Truck-mounted pumping test equipment	1 set
3)	Electric prospecting equipment	1 set
4)	Cargo trucks	3
5)	Other vehicles	4

6)	Motorcycles	3
7)	Water tank	1
8)	Communication equipment	1 set
9)	Pumps	330
10)	Repair equipment	1 set
11)	Muddy water agent and blowing agent	for 300 boreholes
12)	Civil work equipment	1 set
13)	Local base facilities	1 set
14)	Spare parts for newly provided machines and equipment	1 set
15)	Spare parts and tools for previously provided machines and equipment	1 set
16)	Casings and screens (to be procured locally)	for 300 boreholes
17)	Construction work for 300 boreholes	1 set

The estimated Project cost to be borne by the Malawi side which mainly consists of the personnel cost is K320,000 (approximately ¥15,000,000).

The successful completion of the Project, which will provide boreholes in accordance with the village population size, will have the following positive effects.

(1) The target water supply rate of 27*l*/person/day will be secured for the service population of 107,440 (including those using existing boreholes) and the service ratio will approach the national target of 74%.

(2) The use of clean groundwater will greatly improve the prevention of waterborne diseases.

(3) Women and children will be freed from the daily hard, non-productive labour of water transportation (in consideration of WID issues).

(4) The use of the VLOM system which is the type of self-reliant scheme to operate the boreholes after their completion will assist improved awareness of health and environmental issues on the part of villagers as the VLOM has an integral package of health education.

(5) The transfer of drilling technology through on-the-job training during the construction period will strengthen the technical ability of the Department of Water vis-a-vis the future execution of groundwater development. Using the machines and equipment

provided for the Project, the construction of boreholes at a rate of some 50/year can be expected for at least the remaining seven year period of the drilling rig's normal life.

As discussed above, the Project relates to the BHN (Basic Human Needs) in that it will greatly contribute to improving the living standard of rural inhabitants and, therefore, the implementation of the Project by Japanese grant aid is deemed viable. The argument for Project implementation is also assisted by the fact that the Malawi side is well capable of implementing the Project with sufficient manpower and financial resources.

It is important that the necessary operation and maintenance cost be met for the effective utilization of the provided machines and equipment after the completion of the Project and, therefore, the Government of Malawi is strongly requested to continuously make proper budgetary appropriation to cover such cost.

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ABBREVIATIONS

AfDB	:	African Development Bank
AfDF	:	African Development Fund
BHN	:	Basic Human Needs
CSC	:	Christian Services Committee
DANIDA	:	Danish International Development Agency
DDC	:	District Development Committee
EEC	:	European Economic Community
EP & DD	:	Economic Planning and Development Department
JICA	:	Japan International Cooperation Agency
IDA	:	International Development Association
IFAD	:	International Fund for Agricultural Development
IMF	:	International Monetary Fund
KfW	:	Kreditanstalt für Wiederaufban
OPC	:	Office of the President and Cabinet
PVHO	:	Plant and Vehicle Hire Organization
SCAT	:	Swiss Centre for Appropriate Technology
SCF	:	Save the Children Fund (UK)
UNCDF	:	United Nations Capital Development Fund
UNCHS	:	United Nations Centre for Human Settlements
UNDP	:	United Nations Development Programme
UNICEF	:	United Nations Children's Fund
UNHCR	:	Office of the United Nations High Commissioner for Refugees
VLOM	:	Village Level Operation and Maintenance
WID	:	Women in Development

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

The Government of the Republic of Malawi believes the provision of a stable supply of clean domestic water is essential as one of the basic conditions for stable rural life and has introduced such targets as (i) the provision of a sufficient amount of domestic water (27*l*/person/day), (ii) a reduction of the water transportation time by means of reducing the transportation radius to less than 500m and (iii) a reduction of the waterborne disease occurrence rate through a stable supply of clean water in line with the objectives of the UN International Drinking Water Supply and Sanitation Decade (1981-1990). The two main pillars of the actual work are the construction of boreholes and the construction of gravity piped water supply facilities. The Statement of Development Policies (1987-1996) aims at increasing the water service population and the service population ratio in rural areas to 5,860,000 and 74% respectively by the target year of 1996.

As of 1991, 4,893,000 people are receiving the water service in rural areas, necessitating the development of new water sources to cater for an additional 967,000 people in the next five years to meet the above targets. The financial difficulties faced by the Government of Malawi, however, have forced delays in national development projects. It appears extremely difficult for the Government of Malawi to implement groundwater development without foreign aid and the Government of Malawi has accordingly requested international organizations as well as donor countries to provide the necessary cooperation. One such request was made to the Government of Japan in 1987 to assist the North Kawinga Groundwater Development Project. The subsequent grant aid provided by the Government of Japan was highly appreciated by the Government of Malawi. Under this background, the Government of Malawi made a further request to the Government of Japan to assist the Groundwater Development Project in Mchinji District.

After examination of the Malawi request, the Government of Japan decided to conduct the basic design study. According to the decision by the Government of Japan, the Japan International Cooperation Agency (JICA) sent the basic design study team headed by Kazuhisa Matsuoka, Director of First Basic Design Study Division of Grant Aid Study and Design Department, JICA to Malawi for the period between October 14 and November 18, 1991 to examine the viability of the Project as a grant aid project of the Government of Japan and to prepare the basic design in regard to the required and optimal size and contents of the Project.

The study team members discussed the contents of the request with officials of the Government of Malawi and conducted field study as well as data collecting on the hydrogeological conditions, water supply situation and borehole use and construction

conditions in the Project Area. Following a series of discussions with Malawi officials, the items basically agreed to were compiled as the Minutes of Discussions which were signed and exchanged by representatives of both parties at the Ministry of Works on October 24, 1991.

On its return to Japan, the study team members conducted the preparation of the basic design for borehole construction, selection of the required machines, equipment and materials, examination of the borehole construction work, estimate of the Project cost, preparation of the maintenance plan and examination of the Project's viability as a grant aid project of the Government of Japan, as a part of the domestic work based on the field study findings. The findings of the above work were then compiled in the draft report.

JICA then sent another study team headed by Mr. Yoshihide Nakai, Resident Representative of JICA Malawi Office to Malawi for the period between March 14 to 24, 1992 to explain the contents of the draft report. The final version of the basic design study report was then agreed by the study team members and Malawi officials and is now published here.

Member Lists of the Study Teams, Study Schedules, List of the Officials Concerned in Malawi and Minutes of Discussions, etc. are given in the Appendices of this report.

CHAPTER 2

BACKGROUND OF THE PROJECT

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2-1 Outline of the Republic of Malawi

2-1-1 General Descriptions

(1) Geography and Topography

Located between Lat. 9°30' and 17°10'S and Long. 33° and 36°E, Malawi is a landlocked country lying in the south-eastern part of Africa and to the west of Lake Malawi. It covers an area of 118,484km^2, of which more than 20% consists of lakes and marshes, Lake Malawi being the largest. Malawi's narrow strip of land stretches a distance of some 855km in the north-south direction along the East African Rift Valley and is bordered by Tanzania on the opposite side of Lake Malawi to the north, Zambia to the west and Mozambique to both the east and south. The capital was changed from Zomba to Lilongwe in 1975 and has been the centre of national development ever since.

Topographically, Malawi is largely composed of rift valley plains, rift valley escarpments, plateaus and isolated areas of highland, as shown in Fig. 2-1-1. It belongs to the southern part of the East African Rift Valley with rift valley plains running in a north-south direction at 400-600m above sea level which include Lake Malawi, the plains along the Shire River adjacent to Lake Malawi and the plains around Lake Chilwa.

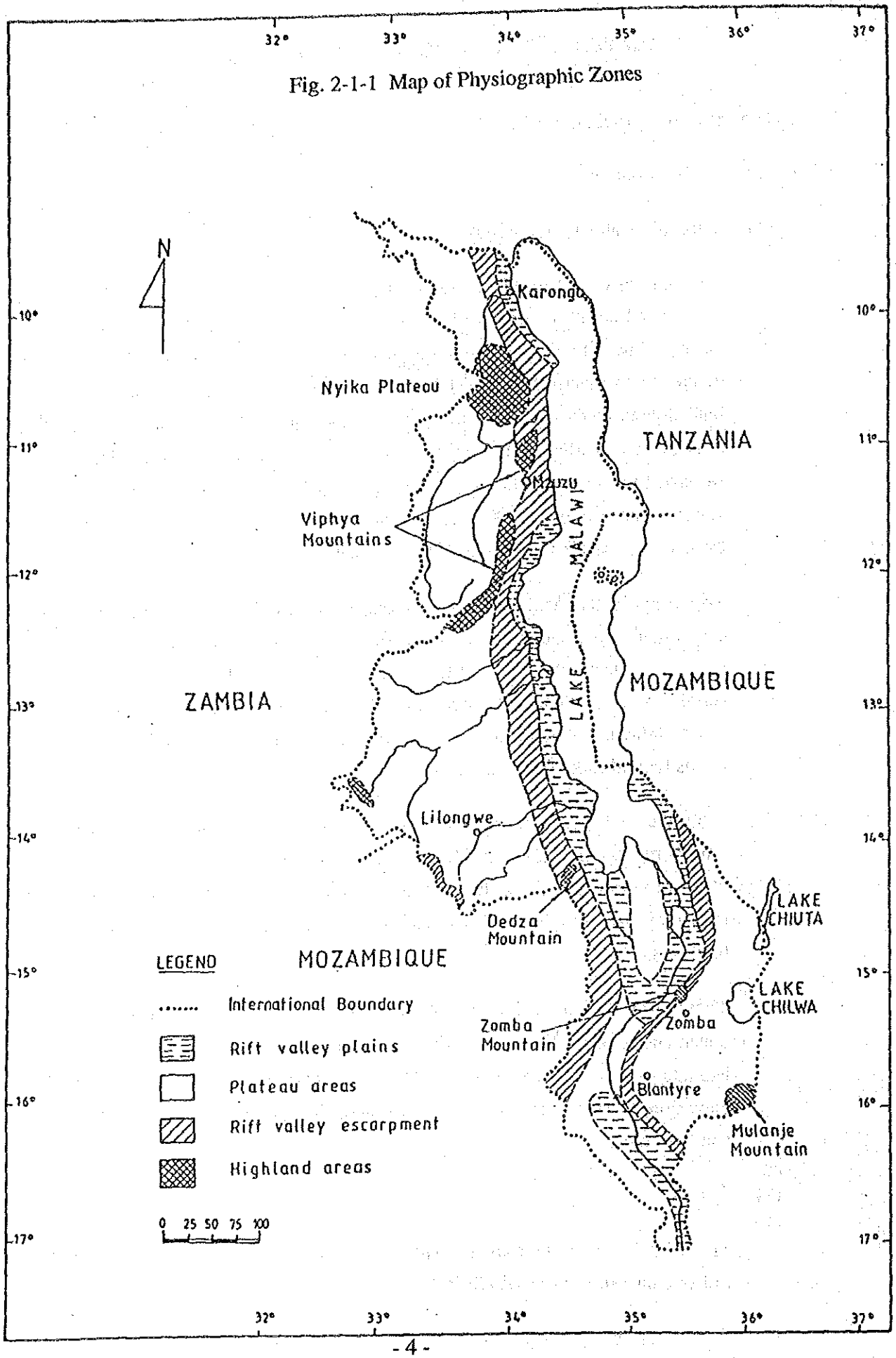
From the southern tip of Lake Malawi, the Shire River flows towards the south, joining the Zambezi River in Mozambique, and the Shire Valley extends for some 400km to the south along the Shire River. The plateau areas on both sides of the rift valley are 900-1,300m above sea level, occupying some 75% of Malawi's total land area.

There are scattered highland areas with elevations of around 2,400m, the most conspicuous being Nyika Plateau in the northern part of the country, the Viphya Mountains and Dedza Mountain in the central part and Zomba Mountain (highest elevation: 2,085m) and Mulanje Mountain (highest elevation: 3,000m) in the southern part.

(2) Climate

Malawi belongs to the tropical savanna zone and has a variable climate despite its rather small land area which is long and narrow stretching in the north-south

Fig. 2-1-1 Map of Physiographic Zones



direction with many undulations. It has alternative dry (April-November) and rainy (December-March) seasons and over 90% of the annual rainfall is recorded during the latter. The mean annual rainfall is 1,500-2,000mm along Lake Malawi in the northern part of the country, decreasing to less than 900mm in inland areas, while 800-900mm, 900-1,300mm and over 2,000mm are recorded for the southern plains, plateaus and mountains respectively. November is the warmest month and June and July are the coldest. The annual temperature fluctuation range is approximately 7-8°C. The mean annual temperature is 24-26°C for the plains, 19-22°C for the plateaus and 13-17°C for the mountains.

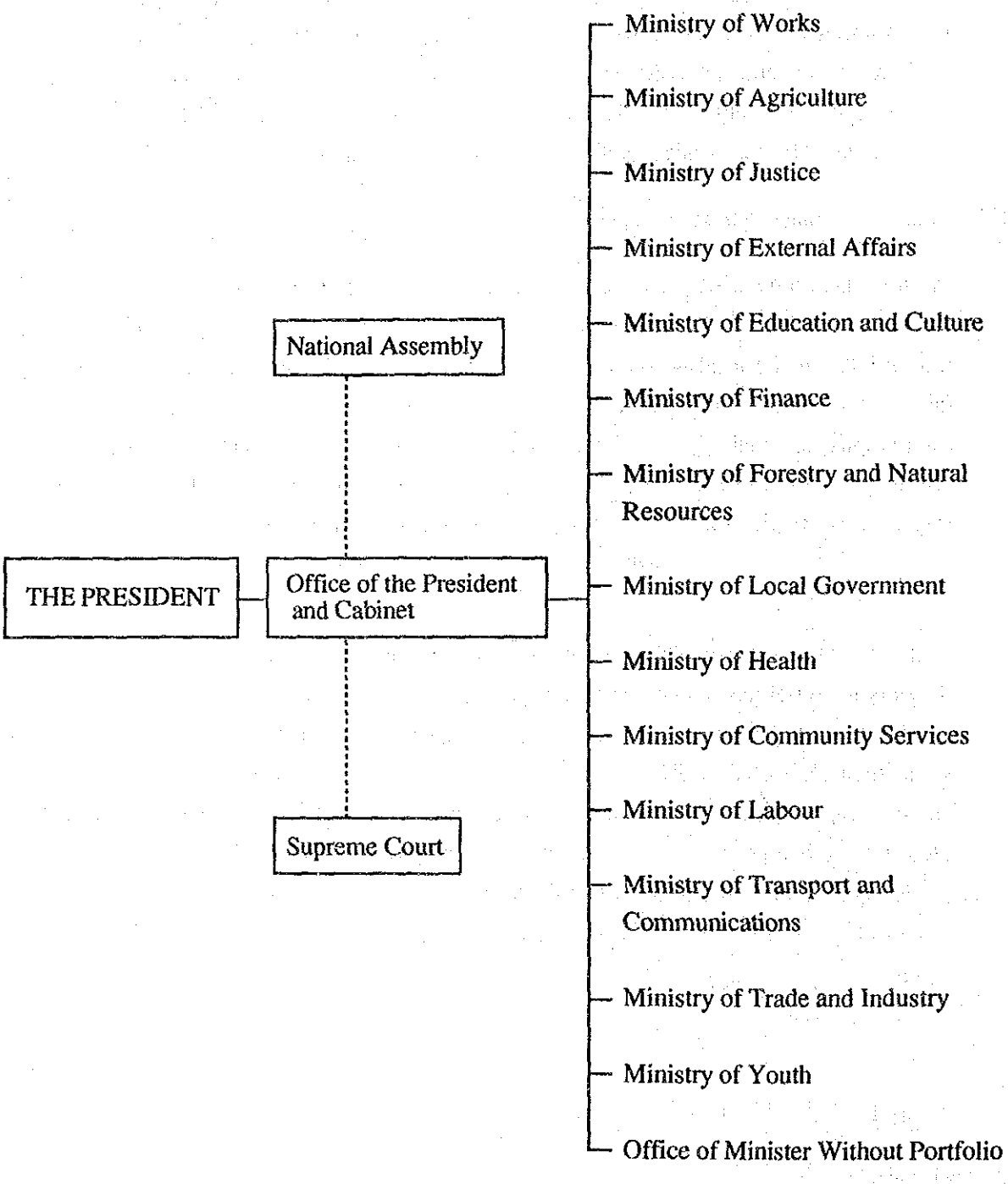
(3) Races, Languages and Religions

Malawi has many tribes, the largest being the Chewa tribe (almost half of the total population and living in the central and southern parts of Malawi), the Lomwe tribe (some 20% of the total population and living in the south-east) and the Ngoni tribe (some 10% of the total population and living in the north). Although each tribe has its own language, Chichewa is the national language while English is used as the official language. Christians and Muslims comprise some 35% and 12% of the population respectively and the remainder is considered to believe in the traditional animism.

(4) Political System

Malawi declared its independence on July 6, 1964 as a republic with a president with the only legal political party, the Malawi Congress Party, dominating the political scene. Dr. Hastings Kamuzu Banda was inaugurated as the first president in July, 1966 and subsequently elected to life-presidency in July, 1971. Several cabinet reshuffles have since occurred with the introduction or abolition of ministries. National unification efforts have been continuously implemented under President Banda's strong political leadership to ensure political stability. Fig. 2-1-2 shows the organization of the Government of Malawi as of November, 1991.

Fig. 2-1-2 Organization of Government of Malawi



2-1-2 Population

Since its independence in 1964, Malawi has conducted a national census on three occasions, i.e. in 1966, 1977 and in 1987 which is the latest census so far. A preliminary report has been published for the 1987 census prior to the publishing of a full report. According to this preliminary report, the population has been increasing since 1977 at an average annual rate of 3.7% as shown in Table 2-1-1.

In terms of regions, of Malawi's three regions, i.e. Northern, Central and Southern, the highest population concentration is found in the Southern Region due to historical and economic reasons. While the Southern Region accounts for some 50% of the total population, the Northern Region accounts for only 11%. The population densities of these regions in 1977 were 87 persons/km^2 for the Southern Region, 60 persons/km^2 for the Central Region and 24 persons/km^2 for the Northern Region which increased to 125 persons/km^2, 88 persons/km^2 and 34 persons/km^2 respectively in 1987.

The relocation of Malawi's capital from Zomba to Lilongwe in 1975 was a further attempt to redress the disproportionate distribution of the population in addition to new investment in agricultural development and the construction of a transport network in both the Central and Northern Regions. Despite such attempts, the 1977 and 1987 censuses found virtually no change in the relative population size of each region. The population inflow has meanwhile been accelerating somewhat but the urban population rate of 11% (1987) indicates a relatively slow urbanization process in Malawi compared to other developing countries.

Table 2-1-1 Population and Population Growth Rate in Malawi (1987)

Region	Sex			Growth Rate Against 1977 Population
	Total	Male	Female	
Northern	907,121	440,541	466,580	39.8% (3.4%)
Central	3,116,038	1,530,166	1,585,872	45.4% (3.8%)
Southern	3,959,448	1,909,393	2,050,055	43.7% (3.7%)
Total	7,982,607	3,880,100	4,102,507	43.9% (3.7%)

Note: Figures in brackets show the average annual growth rates.
Source: National Statistical Office

2-1-3 Economy

Malawi is a landlocked country located in the south-eastern part of the African continent with a high population density given its relatively small land area. It has no mining resources worthy of exploitation and its climate and land which are suitable for agriculture and its rich water resources represented by Lake Malawi are considered to be its national resources. Agriculture plays a predominant role in the national economy, accounting for 33% of the GDP and some 86% of the working population. Economic policies since independence have, therefore, mainly focused on the agricultural sector.

The country became a British protectorate in 1891 and, in the subsequent 50 years, economic development was conducted under British colonial policies. At the time of its independence in 1964, Malawi was the least developed of the three countries forming the Federation of Rhodesia and Nyasaland. After independence, however, Malawi made steady economic growth, recording an average annual GDP growth rate of 7% between 1964 and 1979. Malawi's favourable GDP growth which continued until the late 1970's slowed down in the 1980's, mainly because of the following reasons, and the average annual growth rate dropped to as low as 0.3% in the period between 1980 and 1983.

1) Sluggish international market prices of Malawi's main export crops.

2) Deterioration of trade conditions due to increased energy prices and FOB prices of petroleum products in 1979 and 1980, in turn caused by accelerated inflation in industrialized countries.

3) Closure of transportation routes to overseas markets and increase of transportation cost.

4) Conspicuous decline of new investment due to the completion of major infrastructure development projects.

The Government of Malawi introduced a structural adjustment programme, as shown in Table 2-1-2, in 1981 with the cooperation of the World Bank and the IMF as a fundamental policy initiative to solve the depression. The main pillars of this programme were as follows.

1) Fostering of the private sector.

2) Development with special emphasis on agriculture.

3) Finance measures (lower interest rate and reform of financial institution).

This structural adjustment of Malawi's economy bore fruit in that its real GDP growth rate recovered to an annual 3.5% for the period between 1983 and 1990 together with an improved international balance of payments and current balance of payments. In short, the structural adjustment programme was well implemented in Malawi except in one major field, i.e. the containment of spiralling inflation.

The per capita GNP in Malawi was 160 dollars in 1987 compared to 250 dollars in Zambia and 580 dollars in Zimbabwe.

Table 2-1-3 and Table 2-1-4 show the transition of the real GDP contribution by industries and the transition of the consumer price index respectively.

Table 2-1-2 List of Structural Adjustment Programmes

No.	Loan Title	Source	Amount	Period
1	First Structural Adjustment Loan	IDA	US$ 45 million	Aug. 1981 - Aug. 1982
2	Second Structural Adjustment Loan	IDA	US$ 55 million	Jan. 1984 - Dec.1984
3	Third Structural Adjustment Loan	IDA	US$ 114 million	Dec. 1985 - Sep. 1988
4	Industrial and Trade Policy Adjustment Credit	IDA	US$ 35 million	1988
		IDA	US$ 35 million	1989
		Japan, EEC, W. Germany, USAID	US$ 112 million	1989
5	Stabilization Programme	IMF	SDR 13.02 million	March 1988
6	Enhanced Structural Adjustment Facilities	IMF	SDR 56 million	July 1988

Table 2-1-3 Transition of Real GDP Contribution by Industries

(Unit: million Kwacha)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture	284.1	260.7	277.6	289.9	305.5	308.0	309.9	312.5	318.7	326.6	326.5
(Small-Scale)	231.2	210.6	215.9	223.8	240.9	242.0	244.5	242.4	243.6	244.0	235.7
(Large-Scale)	52.9	50.0	61.7	66.1	65.6	66.0	65.4	70.1	75.1	82.6	90.8
Manufacturing	89.0	92.0	91.7	98.2	100.6	103.8	106.1	107.1	110.6	120.0	133.5
Electricity and Water	14.1	14.4	14.6	15.8	16.1	16.4	17.3	18.7	19.1	20.7	23.1
Construction	41.3	35.9	36.1	33.0	29.6	37.2	31.2	31.1	38.7	41.5	43.8
Distribution	109.3	96.8	96.2	98.6	104.1	114.0	109.9	107.4	106.0	110.2	121.2
Transport and Communications	52.1	48.2	47.2	46.0	47.0	49.5	51.8	50.6	51.6	53.6	57.5
Financial and Professional Services	51.4	47.4	49.0	50.4	51.2	55.0	53.8	53.8	56.2	60.1	67.2
Ownership of Dwellings	32.3	31.7	32.8	33.8	34.6	36.3	36.6	37.3	38.6	40.5	41.7
Private Social and Community Services	29.1	30.5	31.0	33.1	34.7	35.2	37.7	38.4	39.8	41.1	42.5
Producers of Government Services	79.0	83.3	87.9	92.2	101.7	108.2	118.0	134.5	141.6	143.1	145.0
Unallocated Financial Charges	-20.7	-19.1	-19.7	-20.3	-20.6	-22.2	-21.7	-21.7	-22.6	-22.6	-22.6
GDP (at Factor Cost)	761.0	721.8	744.2	770.7	805.5	841.4	850.6	869.7	898.3	934.8	979.4

Source: Economic Report, 1985, 1986, 1987, 1989 and 1990

Table 2-1-4 Transition of Consumer Price Index (1980=100)

(Mid-Term Average)

	1986	1987	1988	1989	1990
Consumer Price Index	199.5	252.9	332.2	384.4	428.5
Rate of Increase (%)	14.8	26.8	31.4	15.7	11.5

Source: Monthly Statistical Bulletin, July, 1991

2-1-4 Trade Balance

Malawi has the typical trade structure of a developing country where mainly such agricultural products as tobacco, tea and sugar and the processed products of these primary products are exported while industrial products are imported. Agricultural products account for 90% of the total export earnings. The three main export items of

tobacco, tea and sugar account for 75%, 12% and 8% respectively of the total agricultural product exports.

The trade balance of Malawi showed a chronic deficit between independence and 1984 when the rapid export increase put the balance into the black for the first time. The balance went back into the red in subsequent years and remains there today.

The trade figures for the period between 1985 and 1990 show an average annual growth rate of 23% for exports and 25% for imports, indicating the faster growth of the latter.

Table 2-1-5 and Table 2-1-6 show the export and import trends of the main items while Table 2-1-7 shows the overall trade balance. Britain is still the main importer of Malawi products, accounting for some 21% of Malawi's total export earnings, followed by the US and Japan with approximately 13% each. With regard to imports, South Africa is the main supplier of goods to Malawi, accounting for some 37% of the total import value, followed by Britain (17%), Japan (6%) and West Germany (also 6%).

Table 2-1-5 Export Trends of Main Agricultural Products

(Unit: million Kwacha)

	1986	1987	1988	1989	1990
Tobacco	244.4	373.7	474.9	458.3	769.6
Tea	65.8	61.0	79.5	101.2	127.4
Sugar	39.9	63.5	73.2	65.3	76.9
Coffee	22.5	20.4	24.6	17.0	28.2
Groundnuts	15.5	13.2	22.0	1.0	-
Pulses	9.1	25.6	8.2	6.2	5.7
Cotton	2.1	0.8	-	16.6	10.9
Rice	1.1	-	6.2	4.2	4.0

Source: Monthly Statistical Bulletin, July, 1991

Table 2-1-6 Import Trends by Commodities

(Unit: million Kwacha)

	1985	1986	1987	1988	1989
Consumer Goods	62.0	64.8	68.7	100.3	155.2
Plant, Machinery and Equipment	70.4	66.5	123.6	167.0	208.0
Transport Means	62.8	71.0	60.4	132.9	199.6
Materials for Building and Construction	29.8	26.1	31.1	66.7	79.2
Basic and Auxiliary Materials for Industry	178.3	158.8	247.1	425.0	524.1
Parts, Tools and Miscellaneous Appliances	16.3	17.9	20.9	34.0	43.5
Commodities for Intermediate and Final Consumption, Others	73.0	72.8	102.1	154.2	189.2
Total	492.6	477.9	653.9	1,080.1	1,398.8

Source: Economic Report, 1989 and 1990

Table 2-1-7 Trade Trends of Malawi

(Unit: million Kwacha)

	1985	1986	1987	1988	1989	1990
Exports (Re-exports)	422.0 (11.2)	462.2 (13.2)	615.1 (12.6)	751.7 (9.7)	741.7 (11.5)	1,123.1 (25.2)
Imports	506.2	478.0	653.9	1,080.2	1,389.8	1,587.4
Balance	-84.2	-15.8	-38.8	-328.5	-657.1	-464.3
Import/Export Ratio	1.20	1.03	1.06	1.44	1.89	1.41

Source: Monthly Statistical Bulletin, July, 1991

2-1-5 Industries

(1) Agriculture

The agricultural sector plays a crucial role in the economy of Malawi. In 1990, 33% of the GDP came from agriculture while agricultural products and their processed products accounted for more than 90% of the total exports. Moreover, some 90% of the working population is still engaged in this sector.

Agriculture in Malawi is largely classified into small-scale independent farming and estate farming. Estate farming presupposes land lease while independent farming is conducted on public land. In terms of agricultural production and marketing activities, government assistance primarily focuses on independent farmers who are the majority of the population.

As the small-scale independent farming sector largely consists of self-sufficient farmers, no concrete figures to show the growth trend of this sector are available. However, it is estimated that the sector achieved real average annual growth of some 3% in the second half of the 1980's.

The small-scale independent farming sector accounts for 75-80% of the total agricultural output, producing not only maize (Malawi's main crop), pulses, groundnuts and rice but also such cash crops as tobacco and cotton. The sector also contributes to the national economy through the supply of raw materials to domestic industries and the export of surplus products.

Estate farming comprises the production of such international commodities as flue-cured tobacco, barley tobacco, tea and sugar. This sector accounts for 23% of the total agricultural output and more than two-thirds of the total export earnings.

Table 2-1-8 and Table 2-1-9 show the recent output figures for small-scale independent farming and estate farming respectively.

Table 2-1-8 Output of Main Agricultural Products by Small-Scale Independent Farming in 1990

(Unit: thousand tons)

Maize	Tobacco	Groundnuts	Cotton	Rice
1,569.4	18,320.5	30.9	42.8	57.9
Pulses	Cassava	Millet	Sorghum	Sweet Potatoes
68.5	167.8	7.8	18.6	177.0

Source: Agricultural Department, Ministry of Agriculture

Table 2-1-9 Output of Main Agricultural Products by Estate Farming

(Unit: thousand tons)

	1986	1987	1988	1989	1990
Tobacco	51.2	61.3	66.3	81.0	85.8
Tea	39.0	31.9	35.2	39.0	39.1
Sugar	155.8	167.7	170.0	157.2	189.3

Source: Economic Report, 1989 and 1990

(2) Industry and Mining

As Malawi lacks mineral resources, industry can be summarized as an agricultural product processing industry, mainly producing export commodities, intermediate goods for import substitution and consumer goods. The most important are the food/beverage, textile/leather and tobacco/tea industries.

At present, the Government of Malawi is stressing on the fostering of private companies to vitalize the economy. The new industries being encouraged include bicycle assembly, industrial coal, handweaving, leather tanning and cassava starch.

Table 2-1-10 shows the transition of the industrial output index in the last six years.

Table 2-1-10 Transition of Industrial Output Index (1984=100)

	Weight	1985	1986	1987	1988	1989	1990
Total	100.0	103.2	105.3	100.8	106.6	115.8	131.8
For Domestic Use	63.0	104.5	110.0	101.3	107.5	120.1	133.8
Consumer Goods	45.0	106.3	110.3	109.5	111.5	122.8	137.0
Food/Beverages/Tobacco	13.0	111.8	111.3	115.2	127.6	152.1	162.5
Clothing/Footwear/Textiles	9.0	75.4	91.5	89.9	64.2	66.4	76.8
Others	23.0	115.3	117.0	114.0	120.5	128.3	146.0
Intermediate Goods	18.0	99.9	109.3	80.8	98.0	113.3	126.0
For Export	23.0	100.4	89.7	87.6	95.2	95.1	117.8
Electricity and Water	14.0	102.3	109.7	119.9	121.7	130.8	145.5

Source: Monthly Statistical Bulletin, July, 1991

(3) Working Population

There is no detailed account of the employment situation in Malawi. In general, it appears safe to assume that more than 90% of Malawi's labour force are absorbed by the self-sustaining sector of the national economy and that the remaining some 10% are waged workers in the modern industrial sector.

As shown in Table 2-1-11, some 46% of the employed workers in the primary industries, i.e. agriculture, forestry and fisheries, and as many as 32% work in the tertiary industries, i.e. retail trade, transport, finance and community services, etc. The employment ratios of the public sector and the private sector have little changed in recent years and stand at around 80% and 20% respectively.

Table 2-1-11 Number of Employed by Industrial Sectors

(Unit: thousand persons)

	1985	1986	1987	1988	1989	(%)
Agriculture, Forestry and Fisheries	190.7	185.1	179.9	197.8	199.8	45.8
Mining and Quarrying	0.3	0.3	0.3	0.3	0.3	-
Manufacturing	59.9	68.0	49.6	53.7	57.3	13.1
Electricity and Water	4.5	4.7	5.5	5.2	5.6	1.3
Building and Construction	23.1	28.8	30.7	32.4	33.1	7.6
Retail Trade, Hotels and Restaurants	38.8	38.5	34.4	35.0	30.6	7.0
Transport, Storage and Communications	23.9	26.3	24.6	25.2	26.9	6.2
Finance, Insurance and Business Services	12.7	13.0	12.8	12.8	12.8	2.9
Community, Social and Personal Services	57.0	63.1	69.6	66.7	70.1	16.1
Total	410.7	427.8	407.4	429.1	436.5	100.0
Public Sector Employment	328.6	343.5	316.4	342.2	348.3	79.8
Private Sector Employment	82.1	84.3	91.0	86.9	88.2	20.2

Source: Economic Report, 1989 and 1990

2-1-6 Trends of Foreign Assistance

Malawi suffers from a chronic revenue shortage and foreign assistance is essential to achieve the goals of various programmes and projects, including those stipulated in the Statement of Development Policies. In view of this necessity to secure foreign assistance, the Government of Malawi has been trying to coordinate with international and national aid organizations to maximize the benefits of the use of limited funds by selecting proposals on the basis of appropriate criteria and priority order.

As Table 2-1-12 shows, economic cooperation by Donor Aid Classified (DAC) Countries to Malawi from 1986 to 1990 was headed by Britain, Japan and West Germany at 11%, 10% and 10% respectively. Among international organizations, the World Bank was prominent with 27% of the total amount. While the ratios of grant element and loans are 50:50 for the total amount, grant element is predominant for bilateral assistance (85%) while loans are the mainstream (72%) for financial assistance from international organizations.

Table 2-1-13 indicates that economic assistance from DAC countries and international organizations to Malawi in the last five years has strongly focused on finance/trade, agriculture, transport and industry/mining sectors.

Table 2-1-12 Economic Assistance to Malawi by DAC Countries and International Organizations (1986-1990)

(Net Disbursement, Unit: million dollars)

		Bilateral										International Organizations						Total
		U.K.	Japan	West Germany	U.S.	Canada	Nether-lands	France	Denmark	Others	Sub-Total	World Bank	EEC	AfDB/ AfDF	UNDP	Others	Sub-Total	
1986	Grant	16.4	6.9	11.7	13.1	6.2	3.8	1.5	3.3	3.4	66.3						19.5	85.8
	TC*	(9.2)	(3.2)	(0.3)	(3.2)	(2.3)	(1.8)	-	(0.5)	(0.2)	(20.7)						(7.9)	(28.6)
	Loan	-	10.4	-	-	-	-	4.4	1.3	0.4	16.5						101.7	118.2
	Total	16.4	17.3	11.7	13.3	6.2	3.8	5.9	4.6	3.8	82.8	88.6	16.4	6.2	4.3	5.7	121.2	204.0
1987	Grant	31.7	17.8	34.1	16.7	7.7	5.9	0.8	1.5	3.8	120.0						24.2	144.2
	TC*	(13.1)	(4.8)	(5.8)	(5.9)	(3.4)	(2.1)	-	(0.5)	(0.2)	(35.8)						(10.0)	(45.8)
	Loan	-	33.5	-	-	-	-	2.7	1.6	0.2	38.0						73.6	111.6
	Total	31.7	51.3	34.1	16.7	7.7	5.9	3.5	3.1	4.0	158.0	52.0	21.5	11.5	5.1	7.7	97.8	255.8
1988	Grant	41.0	11.9	19.7	44.1	5.7	8.5	-	4.7	7.7	143.3						47.9	191.2
	TC*	(15.0)	(5.6)	(6.9)	(11.8)	-	(2.5)	-	(1.1)	(1.1)	(44.0)						(17.0)	(61.0)
	Loan	-	27.0	-	-	-	-	2.2	-	-	29.2						104.3	133.5
	Total	41.0	38.9	19.7	44.1	5.7	8.5	2.2	4.7	7.7	172.5	81.6	39.8	11.7	10.8	8.3	152.2	324.7
1989	Grant	23.2	13.2	33.8	33.0	10.3	6.1	3.4	6.1	9.0	138.1						47.7	185.8
	TC*	(12.8)	(4.6)	(4.0)	(9.4)	(3.6)	(1.9)	(2.4)	(0.6)	(1.3)	(40.6)						(16.2)	(56.8)
	Loan	-	11.8	-	-	-	-	7.9	-	-	19.7						93.4	113.1
	Total	23.2	25.0	33.8	33.0	10.3	6.1	11.3	6.1	9.0	157.8	81.4	39.6	4.1	12.2	3.8	141.1	298.9
1990	Grant	43.4	15.9	42.2	22.2	10.9	7.2	0.5	4.1	6.7	153.1						52.5	205.6
	TC*	(13.5)	(5.0)	(9.5)	(6.7)	(4.6)	(2.5)	(0.5)	(0.6)	(1.2)	(45.1)						(21.1)	(66.3)
	Loan	-	-	-	-	-	-	4.2	-	-	4.2						125.1	129.3
	Total	43.4	15.9	42.2	22.2	10.9	7.2	4.7	4.1	6.7	157.3	103.3	33.6	16.9	13.6	10.2	177.5	334.9
1986/ 1990 Total	Grant	155.7	65.7	141.5	129.1	40.8	31.5	6.2	19.7	30.6	620.8						191.8	812.6
	TC*	(63.6)	(24.2)	(26.5)	(37.0)	(13.9)	(10.8)	(2.9)	(3.3)	(4.0)	(86.2)						(72.3)	(258.5)
	Loan	-	82.7	-	-	-	-	21.4	2.9	0.6	107.6						498.1	605.7
	Total	155.7	148.4	141.5	129.1	40.8	31.5	27.6	22.6	31.2	728.4	406.9	150.9	50.4	46.0	35.7	689.9	1,418.3

*TC: Technical Cooperation

Source: Department of Economic Planning and Development

Table 2-1-13 Sector-by-Sector Assistance to Malawi by DAC Countries and International Organizations

(Net Disbursement, Unit: million dollars)

Sector / Year	Agricul-ture	Industry & Mining	Energy	Finance & Trade	Posts & Telecom.	Transport	Education	Health	Water & Sanitat.	Housing	Other Services	Planning & Admin.	Total
1986	21.0	7.1	3.3	90.1	9.2	27.5	21.6	5.5	1.9	1.6	1.2	14.1	204.1
1987	34.6	27.6	4.4	86.8	3.9	33.5	21.8	8.3	12.3	2.8	2.0	17.8	255.8
1988	51.8	74.9	4.1	41.6	28.2	37.8	26.0	15.3	10.8	3.5	6.5	24.2	324.7
1989	63.1	57.0	3.7	30.5	13.1	35.3	26.2	14.6	14.6	7.9	5.1	20.9	292.0
1990	63.1	38.4	16.4	56.7	1.6	73.6	30.8	17.7	9.5	6.1	3.0	24.8	341.7
Total	233.6	205.0	31.9	305.7	56.0	207.7	126.4	61.4	49.1	21.9	17.8	101.8	1,418.3

Source: Department of Economic Planning and Development

2-2 Outline of Water Supply Sector

2-2-1 Administrative Organization for Water Supply

(1) Water Supply Administration

Water supply in Malawi is totally administered by the Department of Water of the Ministry of Works. In the case of the two large urban centres, i.e. Blantyre and Lilongwe, each centres has a Water Board which is an affiliated organization of the Department of Water and which acts as a kind of public corporation to operate the water supply services in accordance with government policy. The water supply in other centres and rural areas is directly controlled by the Department of Water. Fig. 2-2-1 and Fig. 2-2-2 show the organization of the Ministry of Works and the Department of Water respectively.

Fig. 2-2-1 Organization of Ministry of Works

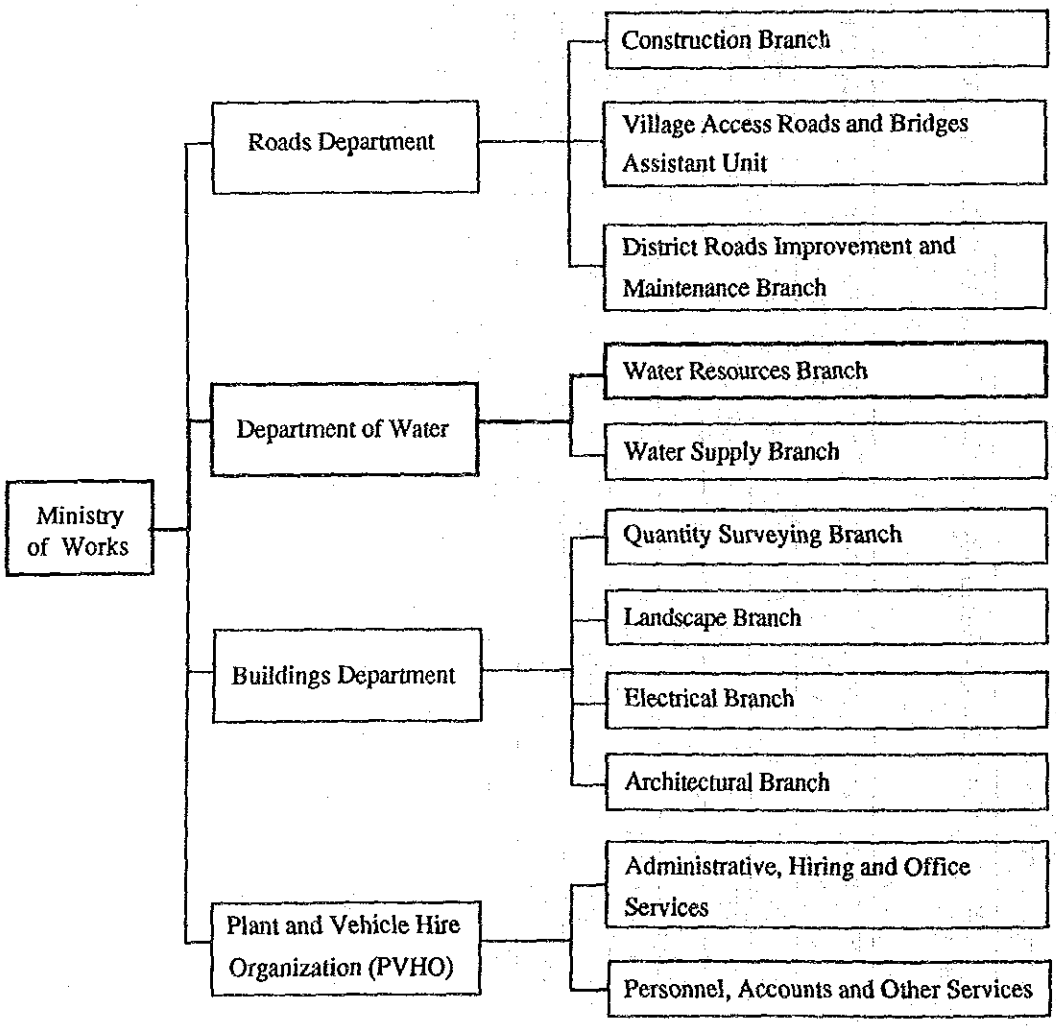
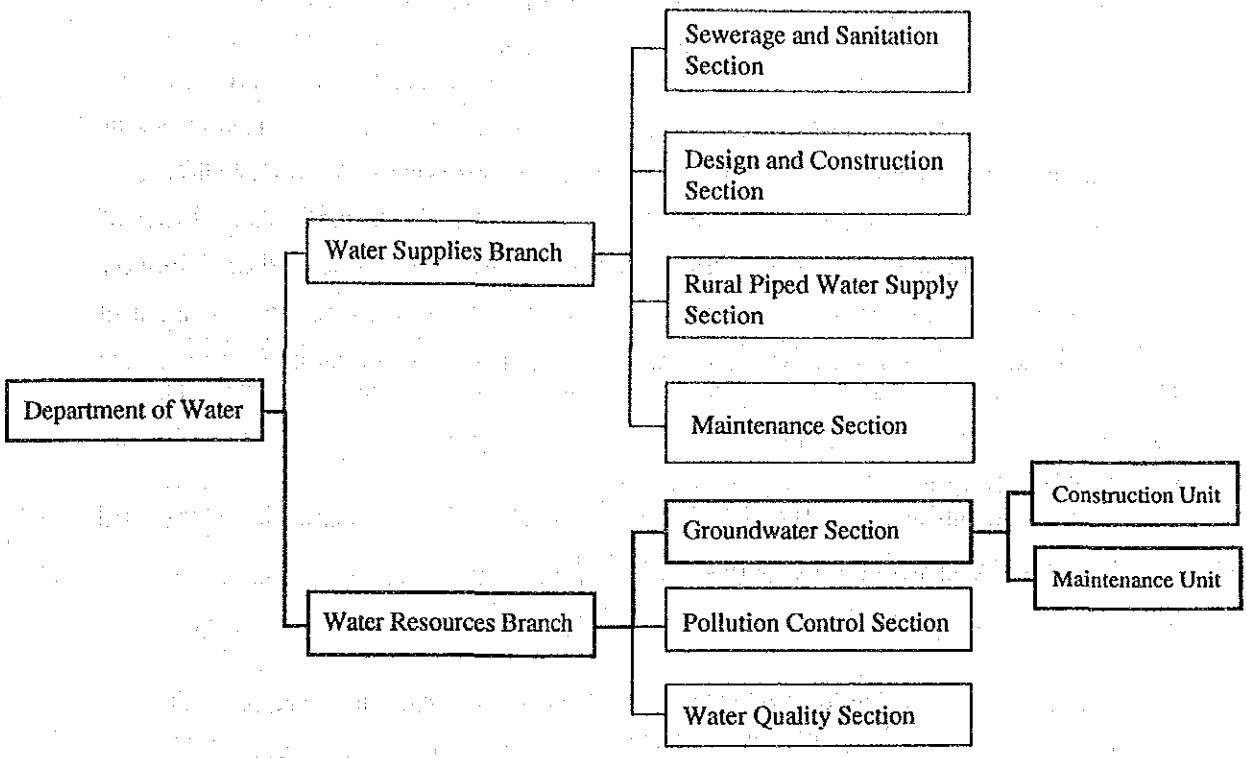


Fig. 2-2-2 Organization of Department of Water



The work assignment at the Department of Water is shown below. The Groundwater Section of the Water Resources Branch will be responsible for the implementation of the Project.

- Water supply in urban centres other than Blantyre and Lilongwe ..... Water Supplies Branch: Design and Construction Section, Maintenance Section
- Water supply in rural areas
  - gravity piped water supply ..... Water Supplies Branch: Rural Piped Water Supply Section
  - boreholes and shallow wells ..... Water Resources Branch: Groundwater Section

When integrated groundwater development such as this Project is envisaged in a rural area, the original project is prepared by the Department of Water in consultation with interested bodies, including the Ministry of Health, Ministry of Agriculture, local communities and the National Planning Agency. The project contents are then examined by the Economic Planning and Development Department (EP & DD) of the Office of the President and Cabinet (OPC) with

coordination by the Ministry of Finance. The project is adopted as a national project upon receipt of approval from the EP & DD.

In the early days, water supply in rural areas was under the jurisdiction of the Geological Department of the Ministry of Agriculture and Natural Resources as well as the Ministry of Community Development and Social Welfare. In 1979, all related works were integrated to the Department of Lands, Valuation and Water of the latter ministry. Since 1984, however, the Department of Water of the Ministry of Works (Ministry of Works and Supplies for the period between 1984 and 1988) has been acting as the competent authority for the water supply service.

(2) Budgets

The past budgets of the Ministry of Works, Department of Water and Groundwater Section are given in Table 2-2-1.

Table 2-2-1 Past Budgets of Ministry of Works, Department of Water and Groundwater Section

(Unit: Kwacha)

Organization	Year / Budget	1987/88	1988/89	1989/90	1990/91	1991/92
Ministry of Works	Revenue Budget	32,403,505	35,420,869	46,001,558	50,493,480	53,174,590
	Development Budget	62,925,498	56,815,372	77,365,140	93,496,021	127,364,638
	Treasury Funds	85,996,789	92,766,277	42,232,573	51,884,380	57,329,233
	Total	181,325,792	185,002,518	165,599,271	195,873,890	237,868,461
Department of Water	Revenue Budget	1,505,885	1,439,149	7,850,375	8,533,740	9,642,859
	Development Budget	20,289,604	42,589,112	29,549,565	18,360,296	27,000,011
	Treasury Funds	11,660,871	11,527,557	10,852,530	15,781,688	16,931,079
	Total	33,456,360	55,555,818	48,252,470	42,675,724	53,573,949
Groundwater Section	Revenue Budget	-	-	2,761,808	3,224,457	2,220,954
	Development Budget	2,197,472	2,605,095	3,366,876	1,538,514	3,167,500
	Treasury Funds	7,329,561	6,677,304	4,824,205	7,172,768	7,506,009
	Total	9,527,033	9,282,399	10,952,889	11,935,739	12,894,463

Sources: 1) Department of Water
2) Approved Estimates of Expenditure on Development Account for Financial Year 1991/92
3) Approved Estimates of Expenditure on Revenue Account for Financial Year 1991/92

The revenue budget covers general expenses, including the personnel cost, operation and maintenance cost of offices, materials and equipment and others, and is allocated from the central government budget. The revenue budget allocated

from the central government budget for the Groundwater Section was first accounted for in the 1989 financial year and includes the maintenance cost of boreholes and shallow wells throughout the country.

The development budget covers the cost of implementing development projects and is mostly provided by donor countries and international organizations. A relatively small amount is also allocated from the central government budget to cover the part of the development project cost to be met by the Malawi side.

The treasury funds are the costs of work commissioned from other government agencies, associations and private companies, etc. In the case of the Groundwater Section, the maintenance cost of boreholes and shallow wells was paid by those (local inhabitants) requesting the repair via the District Development Committee (DDC) until the 1988 financial year. Local inhabitants have been relieved from the payment of this cost, however, since the 1989 financial year as the maintenance (repair) cost of boreholes and shallow wells is included in the revenue budget.

The largest budget source for the Groundwater Section is treasury funds at some 55%, followed by the development budget at 25% and the revenue budget for maintenance at 20%.

(3) Legal Framework for Groundwater Development

The Water Resources Act, which addresses issues relating to water resources, stipulates water rights in regard to surface flow water but fails to mention groundwater development. In general, groundwater development is only feasible when the Department of Water approves such development after first examining the likely results from the viewpoint of water resources conservation.

There are no specific regulations regarding the quality of domestic water but proposed Malawi standard are listed by the National Water Resources Master Plan (1986, UNDP and Department of Water). Refer to the Water Quality Analysis Results in the Appendix for further details on water quality. The proposed Malawi standard only provide target values for the physical and chemical aspects and similar values for the biological aspect, including permissible levels of coliform and other bacteria, are not listed.

With regard to the operation and maintenance of water supply facilities using groundwater, the Village Level Operation and Maintenance (VLOM) movement which assumes the active participation of the benefiting inhabitants is being promoted in association with integrated groundwater development projects (the

VLOM is described in detail in 2-2-2(5), 4-2-2 and Chapter 6). This movement has yet to be promoted nationally and the time is not ripe for its enforcement by the introduction of a relevant act.

2-2-2 Current Conditions of Groundwater Development

(1) Scope of Work of Groundwater Section

The main areas of work of the Groundwater Section, the main body for groundwater development, are described below.

1) Compilement of hydrogeological data.

2) Preparation, implementation and management of groundwater development projects.

3) Construction of water supply facilities using groundwater.

4) Maintenance of boreholes and shallow wells.

(2) Organization of Groundwater Section

At present, the Groundwater Section is composed of the Headquarters and the Central, Northern and Southern Regional Offices and is mainly run by the 12 hydrogeologists assigned to these offices (see Fig. 2-2-3).

Each Regional Office has a Construction Unit and a Maintenance Unit. The work of the former is mainly the construction of boreholes and shallow wells and is further divided into the Drilling Sub-Unit, Data Sub-Unit, Pumping Test Sub-Unit, Survey Sub-Unit and Shallow Well Sub-Unit. The Maintenance Unit is responsible for the continuous running of completed boreholes and shallow wells through the proper maintenance/repair of boreholes and shallow wells/pumps and is further divided into the Stores Sub-Unit, Pump Assembly Sub-Unit and branch offices.

Table 2-2-2 and Table 2-2-3 show the personnel composition of the Groundwater Section and the scope of work of each sub-unit respectively.

(3) Available Machines and Equipment

The Groundwater Section currently has 14 drilling rigs, i.e. 11 percussion-type machines and three rotary-type rigs. A total of 14 drilling teams operate in the Drilling Sub-Unit. Most of the drilling rigs were made in the 1970's or early

1980's and, therefore, show signs of serious deterioration. As six are beyond repair, only eight (six percussion-type and two rotary-type) are currently operable (see Table 2-2-4).

Of the six percussion-type rigs in use, two are small, have a poor work performance and are mainly used for rehabilitation work, including the cleaning of boreholes. The other percussion-type rigs are approaching the end of their lives and frequently break down. Moreover, the work performance of these rigs vis-a-vis hard bedrock is very poor. In general, a drilling rig has a 10 year life expectancy but some of the rigs owned by the Department of Water have been in use for as long as 20 years. Such long usage indicates the high standard of machine and equipment maintenance as well as a strong commitment and ability on the part of members of the Water Department to fulfil their work responsibilities.

The rotary-type rigs were originally provided in 1989 by Japan for the North Kawinga Groundwater Project and play a key role in the drilling in places with intimidating bedrock conditions and in responding to emergency situations and are essential for the Department of Water to perform its duties.

Given the above situation, the Department of Water hopes to replace the percussion-type rigs with rotary-type rigs (together with technical training) to improve the work efficiency in the immediate future.

Fig. 2-2-3 Organization of Groundwater Section

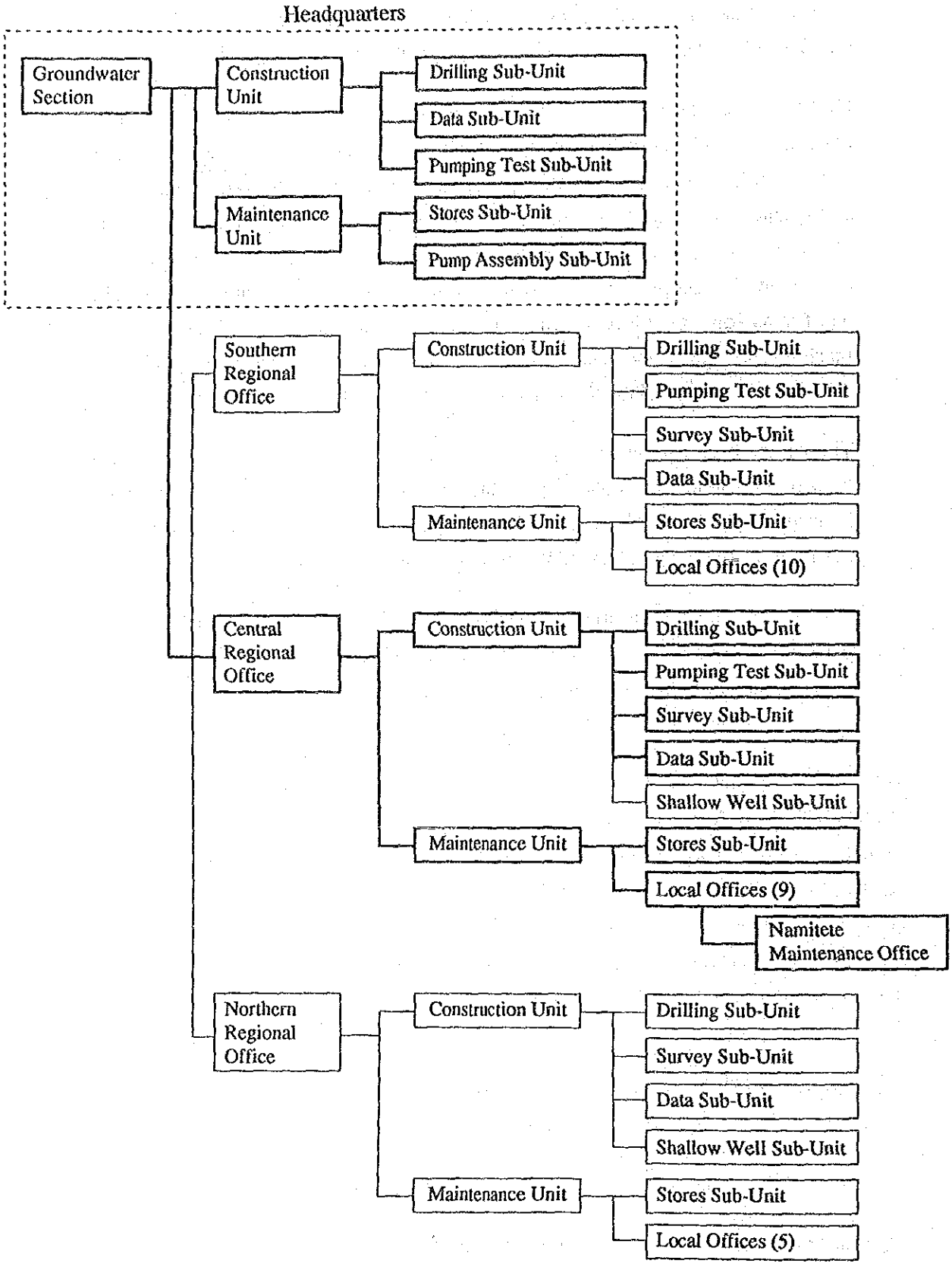


Table 2-2-2 Staff Distribution of Groundwater Section

Unit		Job Title	Head-quarters	North Regional Office	Central Regional Office	South Regional Office	Total
Administration		Principal Hydrogeologist	**1				1
		Senior Hydrogeologist				2	2
		Hydrogeologist	**4	1	**2	2	9
		Mechanical Engineer (PO)*	**1				1
		Technical Officer (TO)		1	1	1	3
Construction Unit	Drilling Sub-Unit	Chief Driller (CTO)	**1				1
		Senior Driller (STO)	**1			**1	2
		Driller (TO)		**1	**2		3
		Operator		2	11**(4)	1	14
		Labourer		10	55	6	71
	Data Sub-Unit	Clerk	**5	1	**1	2	9
	Survey Sub-Unit	Senior Technical Assistant				1	1
		Technical Assistant		2	**3	2	7
		Operator		8	**8	8	24
	Pumping Test Sub-Unit	Senior Technical Assistant	**1				1
		Technical Assistant			**2		2
		Operator			**7	2	9
	Shallow Well Sub-Unit	Senior Technical Assistant			1		1
		Operator		10	45		55
Maintenance Unit	Maintenance Sub-Unit	Mechanical Engineer	**1				1
		Senior Technical Officer	**1				1
		Technical Officer		1		1	2
		Senior Technical Assistant			**1	2	3
		Technical Assistant		2	5	3	10
		Operator		20	63 **(6)	70	153
	Stores Sub-Unit	Senior Stores Officer	**1				1
		Clerk	**1	1	**1	2	5
	Pump Assembly Sub-Unit	CTO/PO	**(1)				(1)
Accounts		Chief Executive Officer	1				1
		Senior Executive Officer	1	1		1	3
		Executive Officer	1		1		2
		Clerk	19	4	4	3	30
Others		Typist	2	1	3	2	8
		Watchman	1	1	2	2	6
		Driver	2	8	10	15	35
		Labourer		6	12	56	74
Total			45	81	240	185	551

Notes: 1) * denotes pump technicians.
2) ** expected to participate in the Project in question.

Table 2-2-3 Work Assignment Within Groundwater Section

Unit		Assigned Work	Level Attained and Remaining Tasks
Construction Unit	Drilling Sub-Unit	Borehole construction and borehole rehabilitation except pump repair.	Most rigs owned are the percussion-type and sufficient expertise is observed for this type of rig. However, training is deemed necessary for the use of two rotary/air hammer-type rigs provided by Japan (see 4-3-3).
	Data Sub-Unit	Recording and storage of borehole drilling data, various test data and maintenance data.	While computers were introduced some time ago to store all data, input work has not yet been completed, delaying full usage of computerized data.
	Pumping Test Sub-Unit	Implementation of pumping tests at completed boreholes to determine hydraulic values of aquifers and economically proper discharge.	It is necessary to view test data from a wider perspective and to use data more efficiently.
	Survey Sub-Unit	Implementation of physical prospecting (mainly electric prospecting) to select borehole sites.	Operating equipment does not pose any problem. However, work should be conducted in line with hydrogeological interpretation provided by hydrogeologists.
	Shallow Well Sub-Unit	Construction of shallow wells and provision of technical guidance and supervision if local inhabitants participate in construction work.	These sub-units only exist in the Central and Northern Regional Offices and have proved useful in shallow well construction work along Lake Malawi.
Maintenance Unit	Maintenance Sub-Unit	General maintenance work, including repair of pumps at existing boreholes and shallow wells.	The diversity of the pumps in use have necessitated the services of this sub-unit. With the introduction of Afridev handpumps, pump maintenance will be increasingly placed in the hands-off benefiting inhabitants (see Chapter 6).
	Stores Sub-Unit	Mainly inventory control of pump parts.	
	Pump Assembly Sub-Unit	Procurement of pumps and spare parts.	

Table 2-2-4 List of Borehole Drilling Rigs Owned by Groundwater Section

No.	Name of Drilling Rig	Rig No.	Owned by *	Year of Manufacture	Type	Max. Drilling Depth	Present Work Efficiency	Conditions as of October, 1991
1	Ruston Bucyrus 22RK (U.K.)	MG 2221	CR	1967	Percussion Trailer Type	100m	45m/week	out of order (beyond repair)
2	- do -	MG 2401	CR	1971	- do -	- do -	- do -	- do -
3	- do -	MG 2405	CR	1971	- do -	- do -	- do -	in use
4	- do -	MG 2406	CR	1971	- do -	- do -	- do -	out of order (beyond repair)
5	- do -	MG 2408	CR	1971	- do -	- do -	- do -	in use
6	- do -	MG 6941	CR	1975	- do -	- do -	- do -	out of order (beyond repair)
7	- do -	MG 538E	NR	1981	Truck-Mounted Percussion Type	- do -	- do -	in use
8	AXBE 450/120 (Sweden)	MG 652F	CR	1983	Percussion Trailer Type	50m	45m/1.5 weeks	- do -
9	- do -	MG 653F	NR	1983	- do -	- do -	- do -	out of order (beyond repair)
10	DANGO 200 (U.K.)	MG 365E	SR	1981	- do -	- do -	- do -	in use
11	Ruston Bucyrus 22RK (U.K.)	MG 3101	CR	1985	- do -	100m	45m/week	- do -
12	HYDREQ (U.K.)	MG 543D	CR	1979	Truck-Mounted Rotary Type	400m	100m/2-3 days	out of order (insufficient compression pressure, lack of spare parts)
13	KOKEN FSW-7T-S22 (Japan)	MG 177L	SR	1989	- do -	200m	- do -	in use
14	- do -	MG 178L	CR	1989	- do -	- do -	- do -	in use (planned use for Project)

Source: Department of Water

* NR: Northern Regional Office
CR: Central Regional Office
SR: Southern Regional Office

[Current Conditions of Machines and Equipment for Borehole Constuction Provided by Japan]

The two sets of machines and equipment for borehole construction which were provided by Japan in 1989 for the North Kawinga Groundwater Project are currently allocated to the Central Regional Office and Southern Regional Office and their current conditions are shown in Table 2-2-5.

1) Machines and Equipment for Borehole Construction

Although the drilling rigs and truck-mounted test pumping equipment have minor problems, such as oil leakage in the hydraulic system, wear and tear of wires and a shortage of spare parts, both can be used for the Project with the replenishment of spare parts and some repair work. In the case of the truck fleet, one truck mounted with a 5 ton crane is beyond repair due to an accident but the other vehicles only require minor repairs. The current average mileage of the fleet is some 60,000km. The current average mileage of the station wagons and pick-up trucks is around 100,000km and will exceed 150,000km at the time of the commencement of the Project. Taking into consideration the severe driving conditions of the unpaved roads, it will be necessary to procure new vehicles for the Project.

2) Scheduled Work

The machines and equipment allocated to the Central Regional Office is scheduled to be in use until March, 1992 for the IFAD-related project but there is no fixed schedule beyond this date. The machines and equipment allocated to the Southern Regional Office will be continuously used for some time for the UNHCR project mainly dealing with refugees from Mozambique.

3) Possible Problems

Those drillers undergoing training for the North Kawinga Groundwater Project have mastered general drilling techniques. However, their technical skills are inadequate to deal with drilling requirements posed by diverse geological conditions, accidents and simple repair needs. The inadequate technical level of the Malawi technicians is partly responsible for the oil leakage from the drilling rigs and wire cuts. Aware of this shortcoming, the Department of Water intends to improve the technical level of its staff by means of retraining those with previous training experience under the North Kawinga Groundwater Project for the new Project.

(4) Borehole Construction Performance

In principle, borehole construction work is directly conducted by the Department of Water. The poor work efficiency of the drilling rigs described above, however, means that some drilling work is commissioned to three domestic drilling companies. As these companies tend to be overbooked, they find it difficult to complete the commissioned work in accordance with the planned schedule.

The number of boreholes directly constructed by the Department of Water since 1983 are shown below.

1985/86	150
1986/87	102
1987/88	120
1988/89	123
1989/90	134
1990/91	98 (7 sites were completed by the drilling rigs provided by Japan)

The annual number of boreholes completed upto 1989/90 was around 120-150 but the performance worsened in 1990/91 due to numerous breakdowns in 1990.

Table 2-2-5 Current Conditions of Machines and Equipment Provided by Japan for North Kawinga Groundwater Project and Its Planned Future Use

(as of October, 1991)

	Machines and Equipment Allocated to Central Regional Office (MG 178L)	Machines and Equipment Allocated to Southern Regional Office (MG 177L)
Work Performance in Past 12 Months	Drilling at 13 sites. Main Beneficiaries: • Ministry of Agriculture • Malawi Army • CCAM[1]	Drilling at 28 sites. Main Beneficiary: • UNHCR Other Work: • Prevention of mud flow and floods at Phalombe
Work Schedule for Immediate Future	Drilling at 41 sites in Dowa District for Ministry of Agriculture project funded by IFAD (until March, 1992).	• Drilling at 4 sites (2 each at Chang'ambika and Mwaza) • Drilling at 2 sites at Phalombe for SCF[2] project • Drilling for UNHCR project (maximum 60 sites/year, expected to last several years)
Machines and Equipment Conditions	(Drilling Rig and Test Pumping Equipment) Minor problems such as oil leakage, worn or cut wires and shortage of spare parts exist but do not pose any serious obstacle to drilling work. The replenishment of spare parts and some repair work will be required for their use for the Project. Present mileage: 5,648-19,735km (Trucks) One truck with a 5 ton crane which had an accident is in the repair shop of the PVHO and the site work is conducted by a substitute truck. There is no definite repair completion date due to the extensive damage. Other problems include oil leakage from the crane. Present mileage: 64,394km (Station Wagons and Pick-Up Trucks) Present mileage: 85,966-95,063km. Their use until 1993 will increase the mileage reading to over 150,000km, necessitating their replacement by new vehicles.	(Drilling Rig and Test Pumping Equipment) As left. Present mileage: 7,623-13,740km (Trucks) Main problems are worn crane wire and loosened bolts which fasten the chassis and leaf springs. Present mileage: 42,806-57,057km (Station Wagons and Pick-Up Trucks) Present mileage: 72,806-160,864km

Notes: 1) CCAM: Women Development Organization in Malawi
2) SCF : Save the Children Fund

(5) Operation and Maintenance System

Maintenance of the wells are normally conducted by the Maintenance Offices (Local Office) which are generally located on one in each district basis. Each office has one borehole maintenance coordinator (TA), six operators and one driver. In the case of a pump breakdown, the person responsible for well maintenance (local inhabitant) sends a postcard explaining the state of the breakdown to the Headquarters of the Department of Water which subsequently issues a repair instruction to the relevant Maintenance Office via the Regional Office. On receipt of such an instruction, an operator is dispatched from the Maintenance Office to conduct the repair free of charge. In the case of a integrated groundwater development project, operation and maintenance are conducted under the village level operation and maintenance (VLOM) system which will also be adopted for the Project.

[VLOM System]

The Government of Malawi is trying to encourage the use of the VLOM system as a viable borehole operation and maintenance system at village level. The key element in this government drive is the use of easy-to-maintain Afridev handpump. The VLOM system consists of two components, i.e ① daily maintenance of boreholes by villagers and ② efforts to form a borehole operation and maintenance organization and to deal with social, economic and technical problems relating to borehole operation. The VLOM system is regarded as a general back-up system for borehole operation and maintenance at village level (see Chapter 6 for details).

At present, the VLOM system has been adopted to operate and maintain boreholes developed by the ① Dowa West, ② Lilongwe North East, ③ Livulezi and ④ Karonga projects.

The District Development Committee (DDC) is currently trying to organize an operation and maintenance system for the North Kawinga Project and the Department of Water is preparing to secure the necessary budgetary appropriation to implement the VLOM system from the next financial year.

[Afridev Handpump]

1) Development History and Characteristics of Afridev Handpump (Fig. 2-2-4)

Development of the Afridev handpump, an improved version of the locally manufactured Maldev pump, commenced in 1981 in order to (1) provide villagers with an easy-to-maintain pump and (2) create a handpump for borehole use which could be manufactured by a developing country. The first breakthrough was made in early 1982 when the conventional metal bearing was replaced by a plastic bearing.

The Afridev handpump development site was moved to Kenya in 1983 where the UNDP and World Bank conducted a series of trial manufacture and demonstration tests of the pump head, cylinder, rod and rising main, etc. until 1986 with the overall objectives of creating a tough, easy-to-maintain handpump with a simple structure. The UNDP and World Bank published the standard specifications on the Afridev handpump (Swiss Centre for Appropriate Technology (SCAT) Specifications) in 1989 to streamline the production processes of the Afridev handpump in developing countries.

Local production of the Afridev handpump by a developing country requires quality approval by the UNDP-World Bank Regional Water and Sanitation Group (located in Nairobi and New Delhi) prior to the commencement of production. At present, Kenya and India have an appropriate production system.

Adoption of the Afridev handpump is essential for the successful implementation of the VLOM system in view of the following advantages.

a) Use of minimum level technology and easy maintenance by villagers with simple tools.

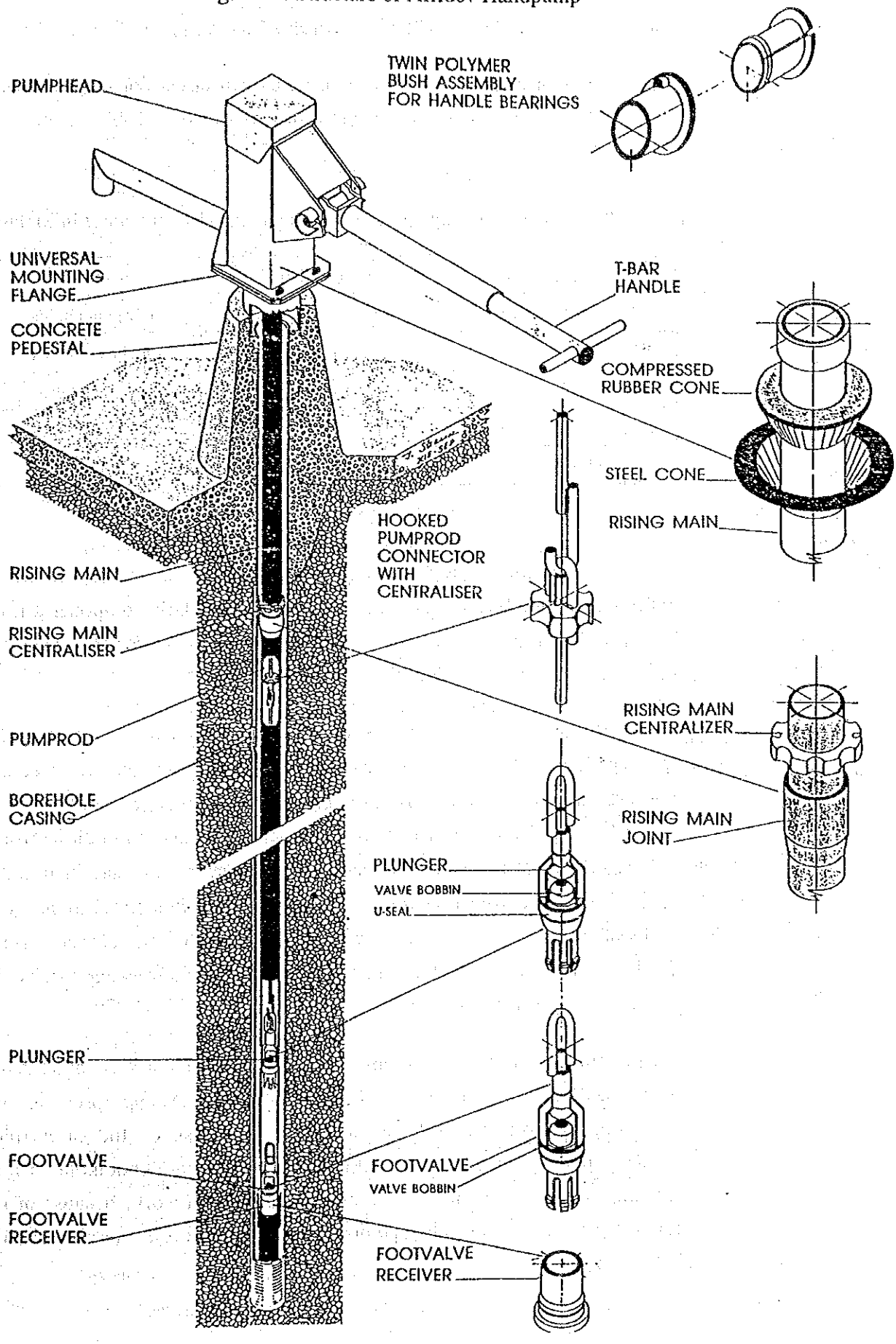
b) Low operation cost (such conventional pumps as the Indian Mark II and Crimax, etc. require a crane-mounted truck to move the pump head and the vehicle and fuel costs account for most of the operation cost).

c) Durability and reliability.

d) Low price.

e) Good manufacturing prospects in a developing country (in view of adequate supply of spare parts).

Fig. 2-2-4 Structure of Afridev Handpump



2) Current Manufacturing Conditions of Afridev Handpump in Malawi

There is currently only one manufacturer of the Afridev handpump in Malawi and the production output of this manufacturer is shown in Table 2-2-6.

Table 2-2-6 Production Output of Afridev Handpump Manufacturer in Malawi

Production Output	Delivered to	Remarks
250 (1988~Present)	drilling companies	only pump heads
30 (1990)	drilling companies	only pump heads
120 (1990~1991)	PVHO	only pump heads
50 (1989)	Department of Water	only pump heads
30 (1991)	churches	full sets

This manufacturer has so far produced 480 Afridev handpumps, of which 450 are just pump heads. Plastic bearings and down-hole components must be imported in the form of finished products or raw materials, causing a substantial delay in handpump delivery.

Although the company commenced production based on the standard specifications in 1991, the mass-production stage has not yet been reached. The product quality is not uniform and quality approval has not yet been granted by the UNDP-World Bank Regional Water and Sanitation Group. The eagerness of the company to achieve improved in-house production can be observed at its trial mould manufacture for such rubber components as cones and centralizers. The self-reliant manufacture of the full set Afridev handpump may well be achieved in the near future if strong support by the government is forthcoming.

For the purpose of the Project, however, it is impossible to envisage the use of Afridev handpumps manufactured in Malawi and it is appropriate to plan their import from either India or Kenya. The use of Indian Afridev handpumps is planned for the EEC-assisted Salima-Nkhotakota Project (dealing with 202 boreholes, including rehabilitation work) because of the reliable performance of Indian pumps in the Karonga Project (assisted by the DANIDA).

2-2-3 Current Domestic Water Supply Situation

(1) Water Supply Rate

The water supply rate in Malawi is based on the type of service area and the Department of Water has set the per capita rate per day as follows.

Large Urban Centres	•Blantyre	135*l*
	•Lilongwe	140*l*
Other Urban Centres		55*l*
Rural Areas (gravity piped water supply)		36*l*
Rural Areas (boreholes and shallow wells)		27*l*

(2) Water Supply Sources

The sources of water supply are surface water, lake water and groundwater. Water supply in urban centres is largely surface water. In rural areas, domestic water is provided by either the gravity piped water supply system using surface water or the borehole or shallow well system using groundwater.

Water supply using surface water usually involves the use of a dam from which the water is distributed through pipes. In general, most surface water is classified as being soft and does not cause any quality problems. Nevertheless, when a small river is the water source, the supplied water may have a relatively high inclusion of foreign matter. The development of water source areas by means of adopting forest conservation and other measures is, therefore, in progress in these areas.

Aquifers containing groundwater are mostly found in either weathered bedrock or alluvium. Groundwater extracted from parts of the alluvium along the Shire River presents some problems due to the relatively high levels of dissolved iron and sulphide, etc. In the case of groundwater, it is generally extracted from either a borehole or shallow well using a handpump and no special water purification measures are employed.

(3) Current Conditions and Problems of Water Supply Facilities

In urban areas, particularly in such large urban centres as Blantyre and Lilongwe, the water service ratio is almost 100% and water supply plans are being implemented with the construction of new dams and other facilities.

In rural areas, water supply using the gravity piped system is employed in 56 areas (over two million service population).

In the case of water supply using groundwater, 8,000 boreholes with handpumps and 3,000 shallow wells are said to exist, serving approximately 2.5 million people. However, some 30-50% of these are currently out of order due to structural faults and deterioration of the boreholes and shallow wells and the breakdown of handpumps. The UNDP and IDA are now financing projects to rehabilitate these boreholes and shallow wells on a nationwide scale (see 2-3-3 for details). The widespread breakdown of boreholes and shallow wells forces many rural inhabitants to use unsanitary water from dug wells or rivers. In addition, they are compelled to travel long distances in the dry season to fetch water from far off sources, thus spending much time in non-productive labour with the spread of waterborn diseases possibly resulting.

The low water supply ratio in rural areas described above is the result of financial constraints on both the construction of new boreholes and shallow wells and their maintenance.

(4) Water Service Population

The current water supply situation in Malawi's urban and rural areas is shown in Table 2-2-7.

Table 2-2-7 Current Water Supply Situation (1991)

Area		Service Population		Service Ratio (%)	Total[1] Population
Urban	Blantyre	395,000	882,000	74	1,190,000
	Lilongwe	232,000			
	Other Urban Centres	255,000			
Rural	Borehole[2]	2,000,000	4,893,000	65	7,560,000
	Shallow Well[2]	750,000			
	Gravity Piped Water Supply	2,143,000			
Total		5,775,000		66	8,750,000

Source: Five Year Plan (1992~1996)
Notes: 1) Estimated based on population growth rate used in 1987 census.
2) The real service population is much lower as 30-50% of boreholes and shallow wells are out of order.

2-3 Outline of Related Plans

2-3-1 National Development Plans

Malawi's Statement of Development Policies (1987-1996) announced in 1987 proclaims such targets as the eradication of poverty and ignorance, extermination of epidemics, narrowing of the income gap and improved welfare, etc. by means of achieving rapid and continuous economic growth. In addition, the Statement of Development Policies stipulates the following policy objectives to achieve these targets.

(1) Promotion of agriculture which generates 37% of Malawi's GDP and is the most important sector in terms of employment and foreign currency earnings.

(2) Further exploitation of the country's natural resources, including forests, minerals, fisheries and tourism potential.

(3) Consolidation of the infrastructure, including roads, communications network, electricity supply and water supply, etc.

(4) Provision of increased assistance for small commercial and industrial enterprises.

(5) Expansion of educational facilities and fostering of capable teaching staff.

(6) Improvement and expansion of the medical service network.

The above targets are in line with those under the Structural Adjustment Programme jointly implemented by the Government of Malawi and the World Bank. The Programme intends to improve Malawi's annual GDP growth rate from 0.5% in 1987 to 4.5-4.8% in 1990-1994 through international and bilateral financial assistance.

As the projects concerning the national development are all funded by donor countries and/or international organizations, there is no concrete forecast for the future development cost. The trend of the development budget up until 1990 is described in 2-1-6.

The provision of a stable water supply for rural inhabitants is stressed as a precondition for the improved infrastructure, in turn resulting in accelerated agricultural development and better health and hygiene as such a stable water supply will eradicate the chronic water shortage problem, contribute to the stabilisation and improvement of rural life, facilitate the settlement of villagers, liberate the rural population from non-productive labour and improve health and hygiene conditions.

The National Development Five Year Plan (1992-1996) lists 20 strategic targets in the water resources sector, of which the main targets are listed below.

(1) Promotion of water resources development by maintaining close communication between related ministries and agencies following a comprehensive water resources management plan, in turn prepared using well compiled data on water resources, including groundwater.

(2) Water quality monitoring to prepare water pollution prevention measures.

(3) With regard to the construction of rural water supply facilities, development and introduction of appropriate technologies and systems to consolidate such public facilities as communal taps and wells, etc. in proper coordination with other rural development projects covering agricultural and other sectors.

(4) Establishment of an operation and maintenance system most appropriate for rural water supply facilities. VLOM with the participation of rural inhabitants has been selected (see Chapter 6).

(5) Establishment of a proper inventory control system for materials, machines, equipment and spare parts required for the construction and maintenance of rural water supply facilities.

(6) Improvement of the technical expertise of technicians through training.

(7) Consolidation of local organizations of the Department of Water.

2-3-2 Regional Development Plans

Mchinji District is considered to be one of the most fertile areas in Malawi and its proximity to Lilongwe, the capital and a large food consumption area, makes agricultural development in Mchinji District an important task. Under this background, Mchinji District was selected as the model district for comprehensive regional development and Mchinji District Physical Development Plan was jointly prepared by the Office of the President, UNDP and United Nations Centre for Human Settlements (UNCHS) in 1987 with the following objectives.

(1) Establishment of a framework for the coordination and implementation of social and economic development programmes and projects.

(2) Promotion of balanced economic growth, maintaining ideal distribution of production activities and population.