No. 3

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR GUINEA-WORM ERADICATION AND RURAL POTABLE WATER SCHEME IN THE FEDERAL REPUBLIC OF NIGERIA

JULY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

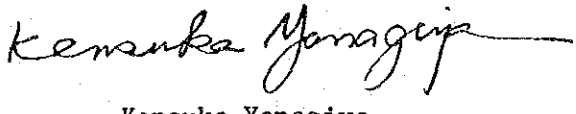
In response to the request of the Government of the Federal Republic of Nigeria, the Government of Japan decided to conduct a basic design study on the Project for Guinea-Worm Eradication and Rural Potable Water Scheme and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Nigeria a study team headed by Mr. Masao Tsujioka, Deputy Head, First Basic Design Study Division, Grant Aid Planning and Survey Department, JICA, from March 1 to April 9, 1988.

The team had discussions on the Project with the officials concerned of the Government of the Federal Republic of Nigeria and conducted a field survey in the Project area. After the team returned to Japan, further studies were made. As a result, the present report has been prepared.

I hope that this report will serve for the development of the Project and for the stabilization and upgrade of people's lives through the improvement of rural water supply situation in the Federal Republic of Nigeria and will consequently contribute to the promotion of friendly relations between our two countries.

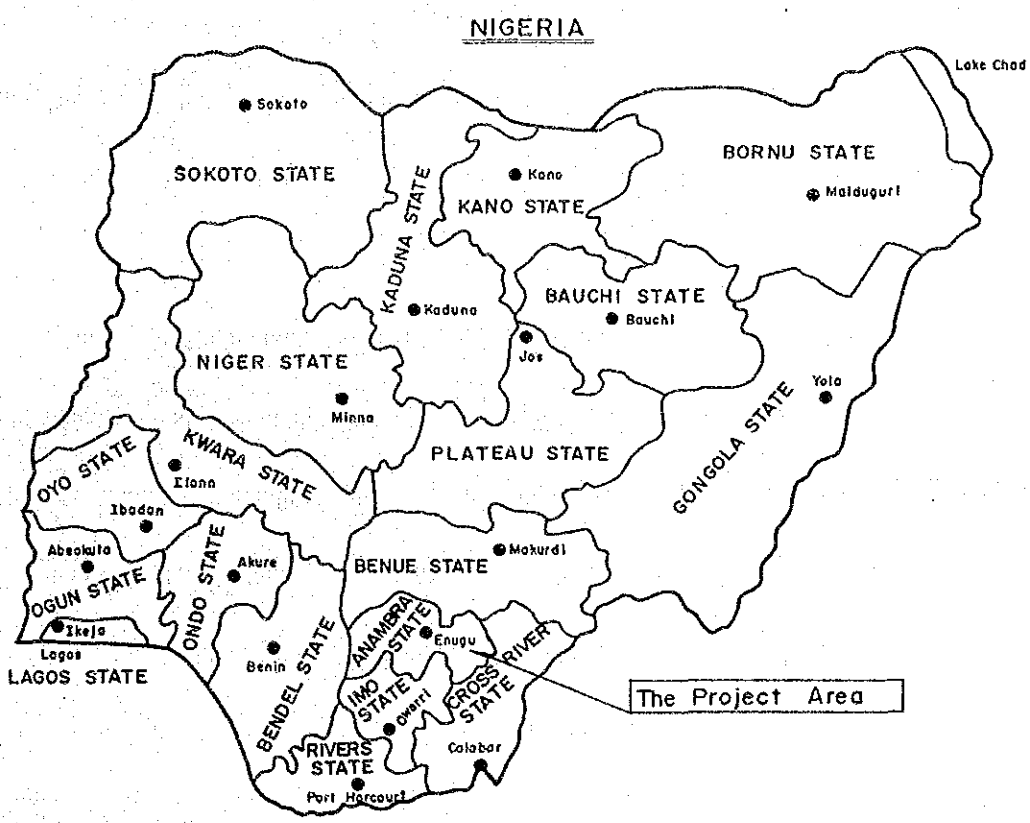
I wish to express my deep appreciation to the officials concerned of the Government of the Federal Republic of Nigeria for their close cooperation extended to the team.

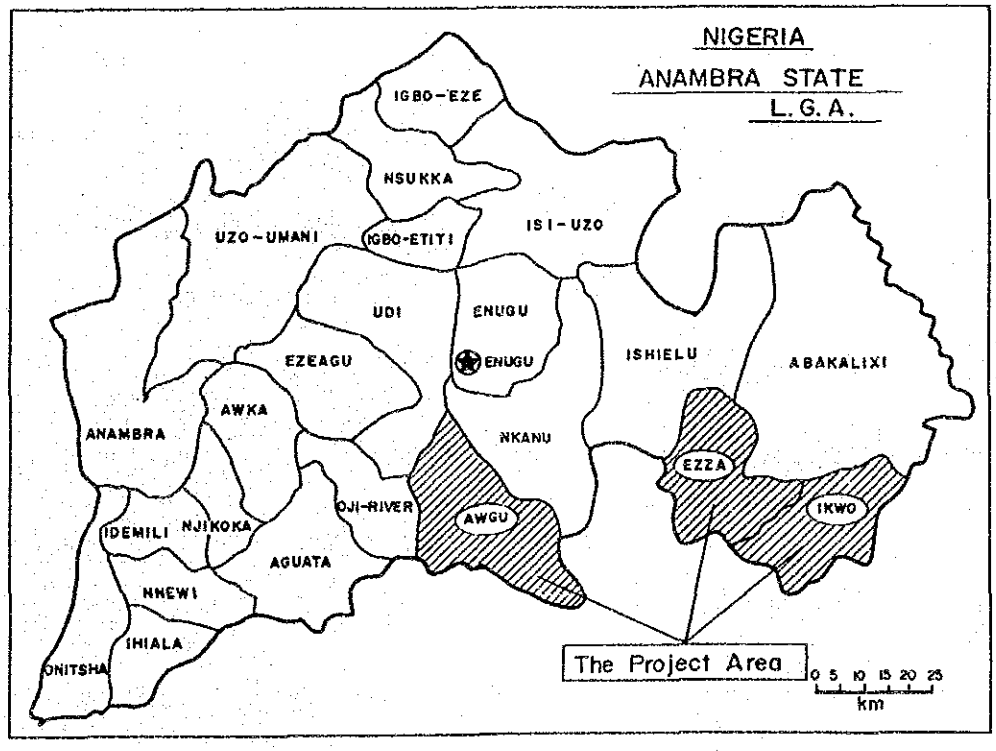
July, 1988



Kensuke Yanagiya
President
Japan International Cooperation Agency

LOCATION MAP



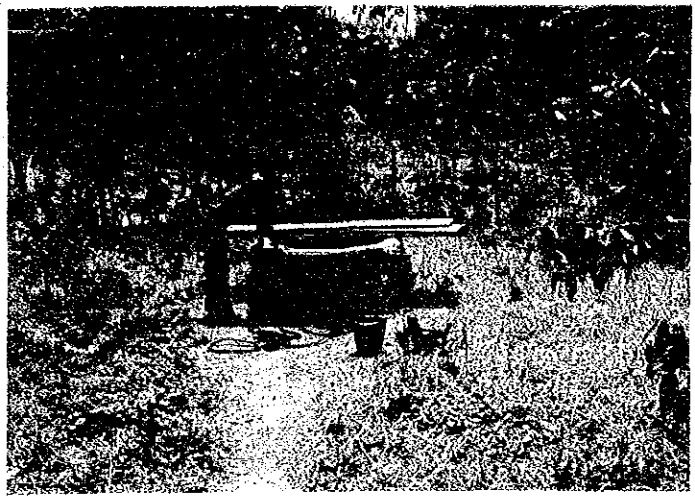


従来の水源
ミジンコの生息している溜池

Traditional water source
Pond where the cyclops inhabit

ギニア・ウォーム症
足より出て来るギニア・ウォーム

Dracunculiasis (Guinea worm disease)
G—Worm pierces the skin of the lower leg.



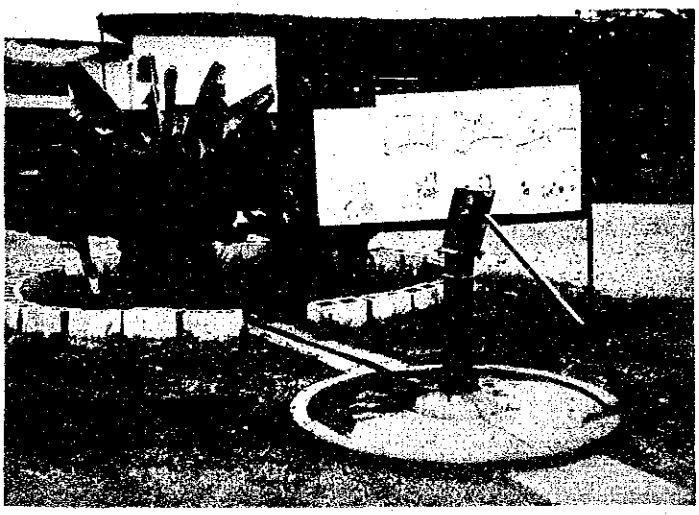
従来の水源
安全な水を得るための手掘り井戸

Traditional water source
Dug well to get safe water

新しい水源
タスク・フォースの建設した井戸

New water source
Handpump borehole
constructed by Task Force

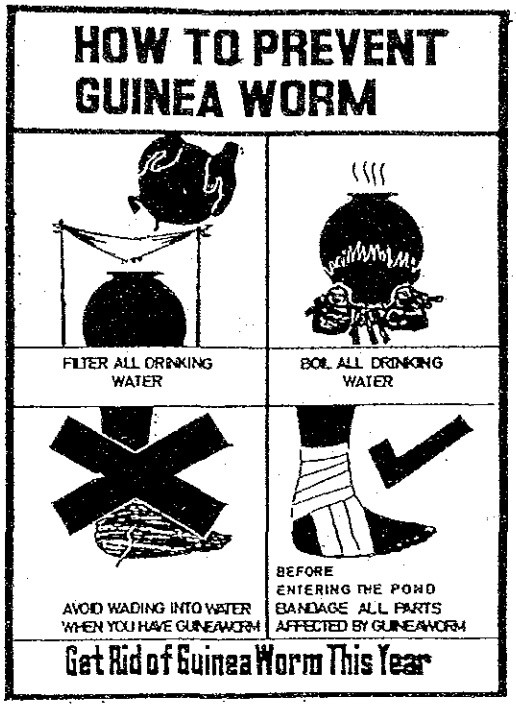
水質調査風景
Water quality test

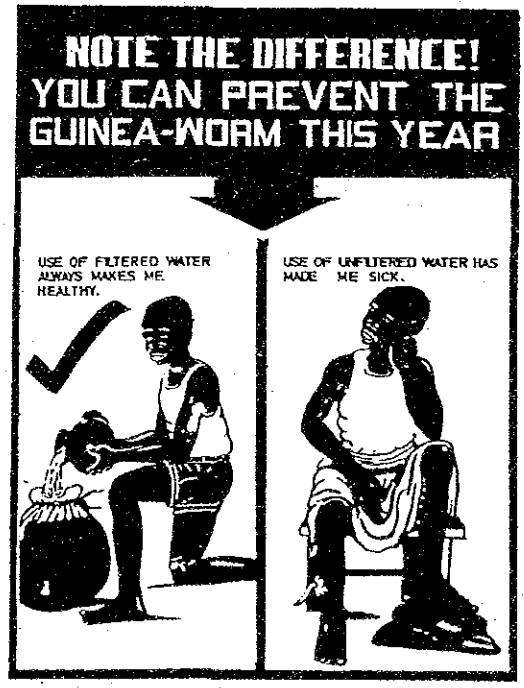


ユニセフ援助（ワトサン計画）の井戸
Handpump borehole
constructed in the WATSAN Project

ギニア・ウォーム対策啓蒙活動のポスター

POSTERS FOR G-WORM ERADICATION EDUCATIONAL ACTIVITIES





アナンブラ州保健省

Ministry of health, Anambra State

BASIC DESIGN STUDY REPORT
ON THE PROJECT FOR
GUINEA-WORM ERADICATION AND
RURAL POTABLE WATER SCHEME
IN THE FEDERAL REPUBLIC OF NIGERIA

CONTENTS

ATTACHED DOCUMENTS
(APPENDICES)

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND SYMBOLS

DFRRI	:	Directorate of Foods, Roads and Rural Infrastructure
G-W	:	Guinea worm
PVC	:	Polyvinyl chloride
WATSAN	:	Water and Sanitation Programme
UNICEF	:	United Nations Children's Fund
GDP	:	Gross Domestic Product
UNDP	:	United Nations Development Program
OPEC	:	Organization of Petroleum Exporting Countries
WHO	:	World Health Organization
LGA	:	Local Government Area
US$	:	US Dollars
ϕ	:	Diameter (caliber) of pipe
lit/sec	:	Water amount per second, unit: litre
lit/min	:	Water amount per minute, unit: litre
m^3/day	:	Water amount per day, unit: cubic metre
lit/min/m	:	Specific capacity of yield, unit: litre per minute per metre
pH	:	Index of Hydrogen Ion
Ω -m	:	Specific Resistivity
UNIT	:	Unit of water quality in WHO standard
μ S/cm	:	Unit of electrical conductivity, unit: Micro Siemens per centimetre

SUMMARY

The Federal Republic of Nigeria (hereinafter referred to as Nigeria) is an agricultural country as well as an oil producer and is a member of OPEC. It has a population of over one hundred million, which is equivalent to one-fourth of the total population of Africa. After independence, Nigeria suffered from the continuous fall in oil prices caused by the world recession in the 1980's ,which resulted in an insufficient foreign currency reserve; thus, seriously affecting the economy of the country. The Government of Nigeria has been carrying out a policy of national economic revival in its 4th National Development Plan (1981-1985) which was followed by the Structural Adjustment Programme (1985-).

In the Programme, the water supply improvement project for national health and hygiene is one of the top priorities. The two main objectives of the water supply improvement project of the National Development Plan are: (1) to install a communal water tap within 200m of all households in the urban areas, and (2) to considerably shorten the time required for securing potable water in the rural areas. The supply of safe water to rural areas also aims at the eradication of Guinea-worm disease which is caused by the shortage of safe drinking water in the country.

It is estimated that over 2.5 million people are infected by Guinea-worm disease in Nigeria. The Guinea-worm is a nematode parasite that infects human beings. The larvae parasitize cyclops (water fleas) inhabiting stagnant water such as pond water, enter the human body when such water is drunk, grow into imagoes (mature worms) in about one year, and come out of the human body by piercing mainly the skin of the lower legs. The infected person feels intolerable pain when the worm comes out of his body. Especially in the Abakaliki zone, over 300,000 cases are reported per year, meaning that about 60 percent of the population is infected, if potentially infected cases are also included.

Since Guinea-worm disease is caused by drinking unsafe water from ponds, etc., it can be completely eradicated if safe potable water can be secured for the people, according to the UNICEF-aided projects in Kuwara State which supply underground water for drinking.

In order to eradicate Guinea-worm disease, the Ministry of Health of Anambra State has been carrying out: (1) hygiene education for the rural dwellers, (2) medical treatment of infected people, (3) chemical treatment of water sources, (4) use of rainwater for drinking purposes, and (5) water supply improvement through constructing boreholes. However, due to the lack of manpower and insufficient budget, the establishment of borehole water supply facilities, i.e., the fundamental solution to secure potable water, has not yet reached a satisfactory level.

To improve the health condition of rural people and the national water supply situation, the Government of Nigeria has requested grant aid from the Government of Japan for constructing 150 boreholes in the Abakaliki zone of Anambra State, and procurement of the equipment and materials required for this construction, together with the formulation of a rural water supply programme to be assisted by UNICEF.

The Government of Japan, after examining the request, decided to conduct a Basic Design Study on the Project, and JICA sent a Basic Design Study Team to Nigeria from March 1 to April 9, 1988.

The objectives of the study were to analyze the background and feasibility of the plan, and to conduct the necessary field surveys to determine the optimal scope of the Project.

The Study Team conducted field surveys in Lagos (the national capital), Enugu (the state capital) and communities in the Abakaliki zone, and held a series of discussions with the authorities concerned of the Government of the Federal Republic of Nigeria.

The Study Team has concluded that 150 boreholes with handpumps and the supply of equipment and materials for their construction are urgently required for securing safe drinking water from groundwater sources to relieve the three Local Government Areas (i.e. Ikwo, Ezza and Awgu) located in Abakaliki zone from serious infection of Guinea-worm disease.

Also, it has been judged that the transfer of knowledge related to planning, design, site selection, drilling and construction supervision of boreholes to the Nigerian staff will also be indispensable in this Project.

The outline of the Project, and the major equipment and materials to be supplied for the Project are as follows;

Outline of the Project

Objective LGA	Number of Communities	Population	Boreholes	Benefited population
IKWO	15	154,000	57	28,500
EZZA	22	247,000	74	37,000
AWGU	7	129,000	19	9,500
Total	44	530,000	150	75,000

Major Equipment and Materials

Items	No. of Units
1) Drilling rigs with a high pressure compressor and accessories	2
2) Supporting vehicles	12
3) Supporting equipment	2

4) Borehole cleaning and water lifting test equipment	2
5) Agent	1
6) Casings and screens	1
7) Handpumps	173
8) Electrical prospecting apparatus	1
9) Water quality analysis kit	2
10) Workshop tools	1
11) Spare parts	1

If the Project is executed under Japanese grant-aid, the undertakings/responsibilities of the two Governments will be as follows:

The Undertakings of the Government of Japan:

- Construction of 150 boreholes equipped with handpumps.
- Supply of equipment and materials required for the construction of the above boreholes.
- Selection of borehole sites.
- Design and supervision for procurement and construction.
- Transfer of technical knowledge during the construction.

The Undertakings of the Government of Nigeria:

- Deployment of Nigerian personnel and budgetary arrangements for implementation of the Project.

° Efficient operation and maintenance of the granted equipment and water supply facilities to be constructed.

In addition to the grant aid to be provided by the Government of Japan, the Government of Nigeria shall make budgetary arrangements amounting to 430 thousand Naira (13.6 million Yen) for construction, and 750 thousand Naira (23.7 million Yen) for operation and maintenance for a period of ten (10) years after the completion of the borehole construction.

The Project will be commenced after the Exchange of Notes between the two Governments is concluded.

The Project is scheduled to be completed in 28 months, including all the necessary steps such as the conclusion of a consultant agreement, detailed design, tendering, conclusion of contracts for procurement and construction, procurement and transport of equipment and materials, and the construction of 150 handpump equipped boreholes.

The Project will be implemented by the Ministry of Health, Anambra State. After the completion of the Project, the benefited local people, under the guidance of the WATSAN Project Office and Anambra State Water Corporation, will conduct daily operation and maintenance of the constructed water supply facilities.

By providing potable water, this Project will directly contribute the eradication of Guinea-worm disease and decrease the incidence of other diseases carried by drinking water, and thus improve and maintain the health and hygiene of the people.

As for the social benefits, the Project will help reduce the time and labor required for securing safe drinking water since water source facilities are provided close to the communities. The time and labor saved could be used for domestic chores and agricultural production activities.

Besides such direct benefits, knowledge related to the construction, operation and maintenance of water supply facilities will be transferred to the Nigerian staff through the implementation of the Project, and will enable them to conduct the construction of similar facilities in the future.

From the above facts, it is concluded that grant-aid cooperation for the Project is justifiable from both the technical and financial points of view.

The following would be recommended to the Government of Nigeria as a result of the Basic Design Study for the Project:

The beneficiaries of this Project would not include the entire population in the Project Area since the Project is implemented preferentially in the most urgent areas. It is, therefore, essential to continue similar construction work to supply potable water to all the remaining people so as to eradicate Guinea-worm disease in the area.

Provision of an appropriate staff and budget is necessary for the effective utilization of the granted drilling rigs and associated equipment.

In order to carry out the operation and maintenance of the water supply facilities to be constructed under the Project, it is also important to build up closer cooperation with the UNICEF-assisted WATSAN project office which will be established in Anambra State.

CHAPTER 1. INTRODUCTION

In Anambra State of the Federal Republic of Nigeria, the water supply situation in the rural areas needs to be consolidated, although the urban areas are relatively well equipped with water supply facilities.

In particular, in the Abakaliki zone situated in the eastern part of Anambra State, the water supply service level is very low, with only about three percent of the service supplied by water taps.

The sources of drinking water are mainly the stagnant water of artificial ponds or stream water.

The water from these sources is poor in quality and causes a high occurrence of water-borne diseases, which recorded the high incidence rate of 35 percent in the 1985 census.

More than three hundred thousand people, mostly children and farmers, suffer from dracunculiasis yearly, which fact seriously influences the agriculture-dependent economy of the region.

In order to improve these conditions, the Government of Nigeria planned the Guinea-worm Eradication and Rural Potable Water Scheme (so-called borehole project) and requested grant-aid from the Government of Japan to urgently construct 150 boreholes at 44 communities in 3 Local Government Areas in Abakaliki zone, including the supply of two sets of drilling rigs and the supporting vehicles required for carrying out the scheme.

After examining the request made by the Government of the Federal Republic of Nigeria, the Government of Japan decided to conduct a Basic Design Study on this Project, and has entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched the Study Team led by Mr. Masao Tsujioka, Deputy Head, First Basic Design Study Division, Grant-Aid Planning and Survey Department, JICA, to Nigeria to conduct the study from 1 March to 9 April, 1988.

The Study Team held a series of discussions and conducted field inspections and exchanged views with the authorities concerned of the Governments of Anambra State and the Federal Republic of Nigeria.

The matters basically agreed upon in the discussions between the Study Team and the Nigerian authorities are recorded in the Minutes of Meetings signed on 11 March, 1988 by both representatives.

CHAPTER 2. BACKGROUND OF THE PROJECT

2-1. General Conditions in Nigeria

The Federal Republic of Nigeria gained its independence from the Great Britain in 1960. The continued military coup d'état and Biafuran war influenced by the tribal confrontation broke out after independence, and the country had not experienced any form of political stability for a long time.

Since the present Babangida Military Government was established in 1985, the government has been stabilized and is setting economic reconstruction of the country as the main theme.

The country is situated between 3 - 15 degree east longitude, and 4 - 14 degrees north latitude. It stretches for 1,300 km and 1,100 km in east-west and north-south direction, respectively. It covers an area of 924 thousand square kilometers and is one-seventh of that of West Africa.

It has a population of 100 million or one-fourth of that of Africa and is one of the largest countries in the African continent.

Nigeria adopted federalism and consists of 19 states at present; all states had its own government.

It is one of the biggest oil producing countries with a production of 1460 thousand barrels per day in 1986 and has achieved high economic growth in the '70s. It reached the peak of economic growth in 1979 and 1980 and after that, the actual rate of growth in DGP turned into minus because of world-wide economic recession, oil glut, shortage of foreign currency due to reduced exporting activities, financial difficulties and shortage of development fund, etc.

The dullness of oil business (sharing more than 15 percent of GDP) was severe but no substitute was found for export commodities. The share of oil income became larger and reached 97.1 percent in 1985.

Reflecting such financial situation, the international trade balance turned into red and rescheduling of budget has been requested.

The government expedites international cooperation by adopting a nonalignment policy.

England, France and Japan contribute largely to bilateral cooperation with Nigeria. Japan became one of the most largest furnishing countries providing 17.8 Million US dollars in net disbursement of 31.2 Million US dollars of actual ODA given to Nigeria in 1983.

The amount of multi-lateral aid was 18.4 Million US dollars, and UNDP became one of the largest furnishing organizations in the same year.

The member list of the study team, itinerary of field survey, the list of organizations and persons contacted, a copy of the Minutes of Meetings and the list of reference documents collected, etc., are herein attached as Appendices.

Based on the said survey, the study team had carried out, since their return to Japan, the examination of effectiveness of the Project, basic design of water supply facilities, selection of equipment and materials required for implementation of the Project, the preliminary estimate of project cost, planning of operation and maintenance of the facilities and so forth.

This report describes the most effective plan for the implementation of the Project.

2-2. Summary of National Development Plan

Although the Fourth National Development Plan (1981-1985) has ended in 1985, the principle has been continued still now under the name of "the Structural Adjustment Programme (SAP)".

Most of the aims of the Third Development Plan remain valid in the Fourth Plan period, and they are the following:

1) Greater self reliance by achieving optimum utilization of human and material resources;

2) Development of technology;

3) Increase productivity and reduction in the level of under employment;

4) Reduction in rural-urban migration;

5) The promotion of a new national orientation conductive to greater discipline, be attitude to work and cleaner environment.

The important targets of policy in each sector are -.

1) to reach 7% in actual economic growth;

2) to make efforts to establish self-support system on food, putting agriculture in the most important sector;

3) to promote domestic manufacturing industry for reduction of the dependence on the petroleum sector;

4) to strengthen the economic infrastructure, particularly power, water supply and tele-communications which are at present bottlenecks to performance of almost all sectors of economy.

The GDP is about 65.5 billion Naira in 1985. The agricultural sector and petroleum sector occupy 26% and 19% of the GDP, respectively. In this connection, the agricultural and petroleum sectors occupy 17% and 24%, respectively, of GDP (51.6 billion Naira) in 1981. The above-mentioned result shows that there has been a remarkable growth agricultural productivity.

2-3. Water Supply Situation in Nigeria

2-3-1. Present Situation

The situation of water supply in Nigeria is very much different between urban and rural areas. Because the rural water supply condition is quite inferior to that in urban area reflecting less political and financial investment in the rural water supply works compared with such investment in the urban water supply works. The principle of water supply policy of this country is to reduce the incidence rate of all diseases by repleting water supply facilities and to raise the living standard of village people. However, it is a fact that the national finance could not cover the consolidation of water supply facilities.

Concerning water source in the village, surface water, dug well water and piped water are used by 63%, 26% and 8% of the households, respectively. Boreholes are used by only 3% of the households. However, in urban area 58% of the household are supplied with treated water and 11% with untreated water conveyed through pipelines. The share of surface water and dug well water are 9% and 17%, respectively. Borehole is used by 5% of the household. (see Table 2-1)

If towns with more than ten thousand people are called urban area, 1983 towns could be so counted. The populations of urban and rural areas are at the ratio of 80 and 20, respectively, in accordance with the guidelines of the Fourth national Development Plan.

The service coverage in Nigeria is estimated below by adopting the above-mentioned figures. People who drink safe water from boreholes and pipe in rural areas is about 11% of the rural population or 2.2% of the total population.

Table 2-1. Service Coverage in Nigeria

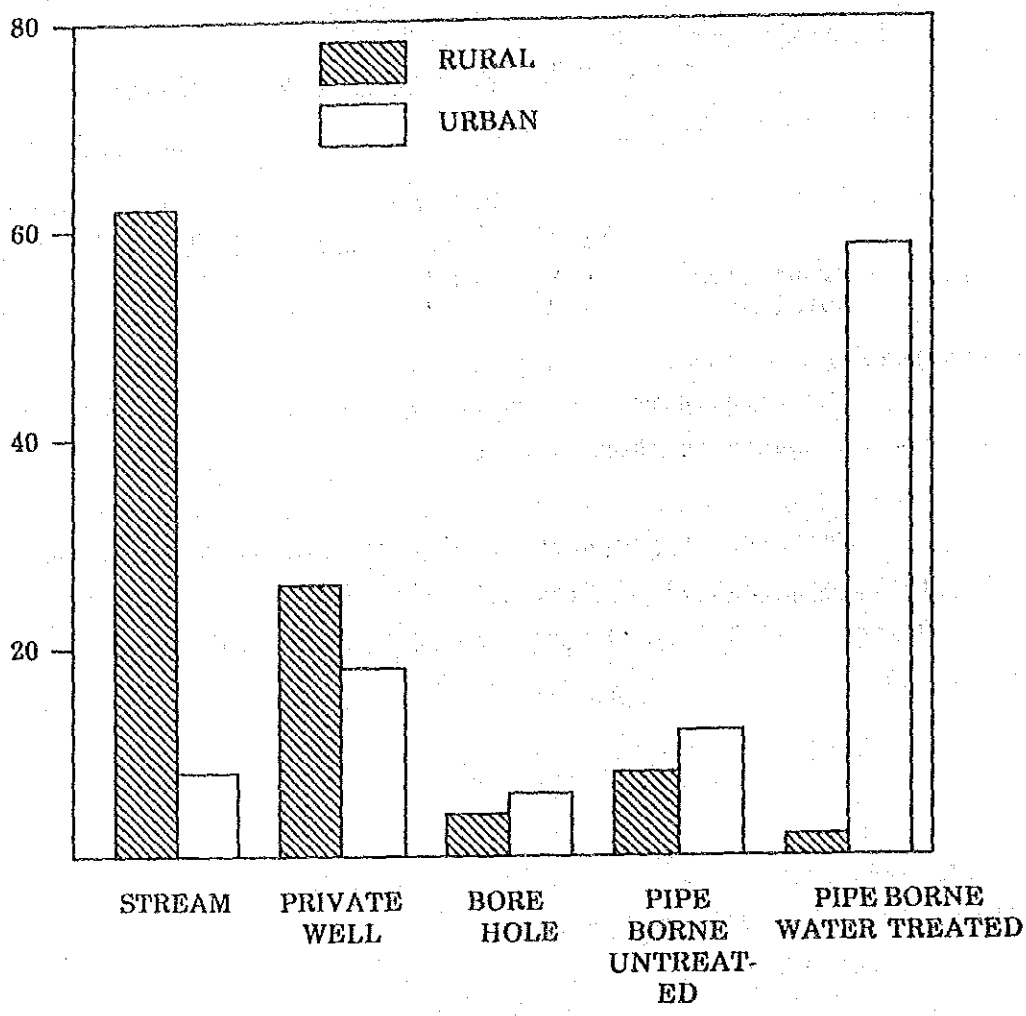
(% to the whole Nigeria)

	Stream	Private Well	Borehole	Pipe Born Water	
				Treated	Untreated
Urban Area	6.9	13.4	4.2	46.3	9.2
Rural Area	12.7	5.1	0.6	1.3	0.3

The water supply situation in the respective capitals of all the 19 states is shown in Fig. 2-4.

The rate of propagation of water supply to the household is 66% in Lagos (Capital of Nigeria), 50% in Enugu (Capital of Anambra State), and 38% in the average for all Federal and state capitals.

FIG. 2-1 SOURCE OF WATER SUPPLY BY SECTOR, NIGERIA, 1983/84



Source : Report of General Household Survey, April 1983-March1984 Federal Government

Table 2-2 PERCENTAGE DISTRIBUTION OF HOUSEHOLDS BY SOURCES OF WATER SUPPLY BY STATE, URBAN NIGERIA, 1983/84

States	Stream	Private Well	Bore Hole	Pipe Borne		Total
				Treated	Untreated	
Anambra						
Urban area	69.7	19.9	–	10.4	–	100
Rural area	11.4	–	–	88.6	–	100
All Nigeria						
Urban area	63.3	25.6	3.0	6.4	1.7	100
Rural area	8.6	16.8	5.2	57.9	11.5	100

(Federal Government : Department of Statistics)

Table 2 - 3 SUMMARY OF ALLOCATION FOR THE WATER SUPPLY SECTOR

The 4th N. D. P. (1981 - 85)

States	State Government Allocation	Local Government Allocation	Total
Lgos	453.790	0.040	453.830
Oyo	164.871	2.582	167.453
Ondo	139.090	1.830	140.920
Ogun	102.631	1.637	104.268
Bendel	260.585	30.000	290.585
Rivers	71.700	8.800	80.500
Imo	120.000	21.000	141.000
Anambra	126.728	52.000	178.728
Cross River	102.300	33.500	135.800
Benue	60.000	10.007	70.007
Kwara	104.000	5.105	109.105
Niger	94.700	14.340	109.040
Sokoto	105.800	–	105.800
Kaduna	217.850	10.090	227.940
Kano	180.000	14.455	194.455
Bauchi	123.231	20.000	143.231
Plateau	143.160	48.330	191.490
Borno	150.000	28.523	178.523
Gongola	84.590	9.580	94.170
Total	2,805.026	311.819	3,116.845

(Federal, Department of Statistics : the 4th N. D. P. Text)

Table 2-4 WATER SUPPLY IN STATE CAPITALS

(% to Households)

States	Capital	In-house or In-compound Water Supply	Sewerage Dispasal		Power
			Pit Latrine	Flush Toilet	
Lgos	Lgos Metropolis	66.0	30.0	30.0	94.0
Oyo	Ibadan	33.4	66.9	25.2	56.1
Ondo	Akure	23.8	57.1	1.6	37.7
Ogun	Abeokuta	25.3	25.4	9.3	47.4
Bendel	Benin City	24.9	95.0	4.0	59.3
Rivers	Port Harcourt	73.0	0.4	18.6	79.0
Imo	Owerri	63.3	3.1	3.6	70.8
Anambra	Enugu	49.9	5.6	26.4	68.7
Cross River	Calabar	11.3	51.6	3.5	26.2
Benue	Makurdi	21.9	18.2	–	23.1
Kwara	Ilorin	30.7	33.4	10.3	28.4
Niger	Minna	44.8	89.0	1.2	30.5
Sokoto	Sokoto	25.4	95.1	0.6	14.2
Kaduna	Kaduna	73.0	77.7	14.1	53.3
Kano	Kano	26.1	76.9	1.3	69.3
Bauchi	Bauchi	5.0	–	5.0	25.0
Plateau	Jos	73.0	48.8	4.8	61.8
Borno	Maiduguri	14.0	–	–	–
Gongola	Yola (Jimeta)	38.9	–	–	–

(Federal, Department Statistics : The 4th N. D. P. Text)

2-3-2. Water Supply Plan in Nigeria

The main objectives of water supply sector during the Fourth National Development Plan period are two fundamental policies, as follows:

* In the urban centers, no house will be located more than 200 meters apart from the water tap.
* In the rural areas, the time spent in fetching water will be drastically reduced.

In order to achieve these targets, the government will pursue the following policies:-

(1) The institutions already established in the form of State Water Boards will be strengthened, and in some cases reorganized and provided with adequate staff and funds to implement and commission more water projects. In order to improve the finances of the Water Boards, a vigorous cost recovery policy based on reasonable user charges will be pursued.

(2) Additional sources of raw water will be identified and exploited through the activities of the River Basin Authorities and State Water Boards. This will be done by damming rivers and streams sinking boreholes and in coastal regions by desalination of sea water.

(3) The School for the training of Assistant Works Superintendent in Kaduna will be expanded to train more of the much needed manpower in the water supply sector.

(4) An educational campaign will be mounted, especially in the rural areas, to underscore the value of boiling water in order to improve its quality for drinking purposes as well as to encourage hygienic water storage practices.

(5) Hydrological investigations will be intensified in order to collect adequate data for further expansion of water resources in the country.

(6) To ensure a consistent quality of water supply, the various State Water Boards will be encouraged to set up water quality control laboratories to monitor the quality of water supplied to consumers.

The Federal Government has two concrete ideas to cope with the National Water Supply Plan, as follows:

1. Development of groundwater by the Federal Department of Water Resources. i.e., to drill 1,500 boreholes throughout the country by investing 104 million Naira.

2. Construction of five reservoirs in each State by the State River Basin Development Authority with a budget of 35 million Naira.

These policies are to be materialized by the efforts of the respective State Governments for the development of rural areas.

The target of the State Government is to construct new water supply facilities and to extend the existing facilities in urban areas. Concerning consolidation of rural water supply, the target is to increase the supply of safe potable water. In addition to borehole drilling, earth-fill dams are to be constructed to supply piped water to the villagers.

In accordance with the text of the Fourth National Development Plan, the allocation of investment is as below. The total investment during five years is 3.1 billion Naira and the allocated investment to the Anambra State is 178 million Naira (35 million Naira per year). However, most of this investment is made for the arrangement of urban water supply facilities, as shown in Table 2-3.

The point at issue in this sector is the pending problem of arrangement of water supply facilities and still drinking of infested water by people.

Improvement of water supply situation by borehole construction was one of the aims of the Third National Development Plan (1976-1980) and good result was obtained as first step, to some extent, in Anambra, Bauch, Borno, Benue and Rivers states. Dam construction, arrangement of filtration plant and distribution network were aimed for urban area, and the result reached 30 percent of the target. Investment of 581.5 million Naira was made for the water supply works. A budget of about six times that of the precedent Third NDP is allocated for water supply works in the Fourth National Development Plan. However, the budget is still not enough to reach the goal.

In order to solve the problem in the water supply sector, the following measures are required in addition to the financial difficulties.

- establishment of collection method for suitable water charge.
- elevation of management ability of the engineer in charge of operation and maintenance of existing facilities.

2-4. Water Supply Situation in the Anambra State

2-4-1. General Situation

Of the total population (i.e., 7.1 million in 1987) in the State, about 75% live in the rural areas. People who have been supplied with the potable water through the water supply facilities are estimated at about 2.1 million (30%) in the State. Only 0.8 million of the 5.3 million villagers are supplied with safe potable water through boreholes and pipeline. The remaining 4.5 million people drink water poor in quality and quantity.

The Anambra State Water Corporation has performed mainly the improvement and expansion of urban water supply system. The objective areas are concentrated in the western region from Enugu city and along the national highway.

The water supply facilities have now been arranged by the Water Corporation in 17 Local Government Areas in the State to cover 3.2 million people. (see Table 2-5)

However, the actual beneficiaries are about 2.1 million, estimated from the amount of water supplied. The most of the water sources are stream water and groundwater. The groundwater source forms 22 percent of the sources.

The Water Corporation puts water supply with individual taps in large cities such as Enugu and Onitsha. However, no water supply facilities have been established in 6 LGA among a total of 23 LGA in the state. The objective areas of this Project are Ikwo, Ezza and Awgu LGAs, and these three LGA are included in the six LGAs as mentioned above.

Villagers living in the rural areas where no facilities are provided obtain potable water from streams, ponds and dug-wells.

Table 2－5 Situation of Existing Water Supply Facilities in Anambra State

(Water Corporation)

LGA	Population	Project Name	Service Amount (M^3/d)		Number of planned Beneficiary	Actually covered Beneficiary	coverage rate (%)
			Per day	Per person			
ABAKALIKI	422	Greater Abakaliki	11,294	52	218	376	89
AGUATA	452	Uga Regional	526	2	223	18	4
AWKA	388	Imo·Awka Regional	3,074	28	110	102	26
NJIKOKA	455	Agulu · Aguinyi	570	8	74	19	—
〃		Nimo ·Enugu·Ukwu	1,172	6	209	39	13
ANAMBRA	360	Awkuzu	470	11	43	16	4
ENUGU	511	5 Projects	76,407	89	860	588	115
UDI	195	7 Projects	2,361	21	112	77	39
EZEAGU	199	3 Projects	608	10	61	20	10
OJI-RIVER	111	3 Projects	1,147	17	69	38	34
IHIALA	248	Ihiala	466	7	68	16	6
NNEWI	329	Nnewi Urban	1,262	15	84	42	27
〃		Ozubulu	840	15	56	28	—
IDEMILI	197	6 Projects	2,119	16	129	71	36
NSUKKA	316	Nsukka Urban	3,814	40	96	127	41
〃		3 Projects	667	7	95	22	—
IGBO-ETITI	216	3 Projects	1,167	8	141	40	19

L G A	Population	Project Name	Service Amount (M^3/d)		Number of planned Beneficiary	Actually covered Beneficiary	coverage rate (%)
			Per day	Per person			
IGBO-EZE	286	11 Projects	1,695	20	84	55	19
ONITSHA	586	Onitsha City	13,207	29	454	440	75
ISI-UZO	253	Obollo· Afor	251	12	21	8	3
ASSHIELU	347	–	–	–	–	–	0
AWGU	310	–	–	–	–	–	0
EZZA	252	–	–	–	–	–	0
IKWO	159	–	–	–	–	–	0
NLAN	281	–	–	–	–	–	0
UZO-UWANI	214	–	–	–	–	–	0
Total	7,086		123,117	38	3,207	2,142	30

Note) Population : in 1987
Actually covered Beneficiary : 30 lit / day·capita in every LGA
130lit / day·capita in Enugu only (Planned amount by Water Corporation)
Coverage rate : Rate of actually covered Beneficiary to all population in LGA
Population : Unit 1000 persons

The water in these ponds is almost not suitable for drinking purpose because of high impurity and contamination with bacteria and parasites. In Abakaliki, Ikwo, Ezza and Ishiel LGAs there are many ponds and reservoirs in which the cyclops species (hosts of Guinea-worm larvae) inhabit. These areas are the highly polluted zone in Nigeria.

2-4-2. Guinea-Worms

(1) Guinea Worm Disease (DRACUNCULIASIS)

The following conditions prevailingly observed in Nigeria suggest that the country has been suffering from considerably high rate of occurrence of Guinea-worm disease.

a) In areas where good quality potable water is not available,

b) In areas where the inhabitants are not highly conscious of Guinea-worm prevention, and

c) In areas where there has been a delayed in measures taken to tackle the Guinea-worm issue.

The patients suffering from Guinea-worm are not common in the urban areas. But in the rural areas, it is found at a rate of about 2.5 million patient per year. And most of all are farmers and children. The occurrence of Guinea-worm disease by regions in Nigeria is shown in Figure 2-2. From the figure, the Project Area, Anambra state, is one of the highly polluted areas.

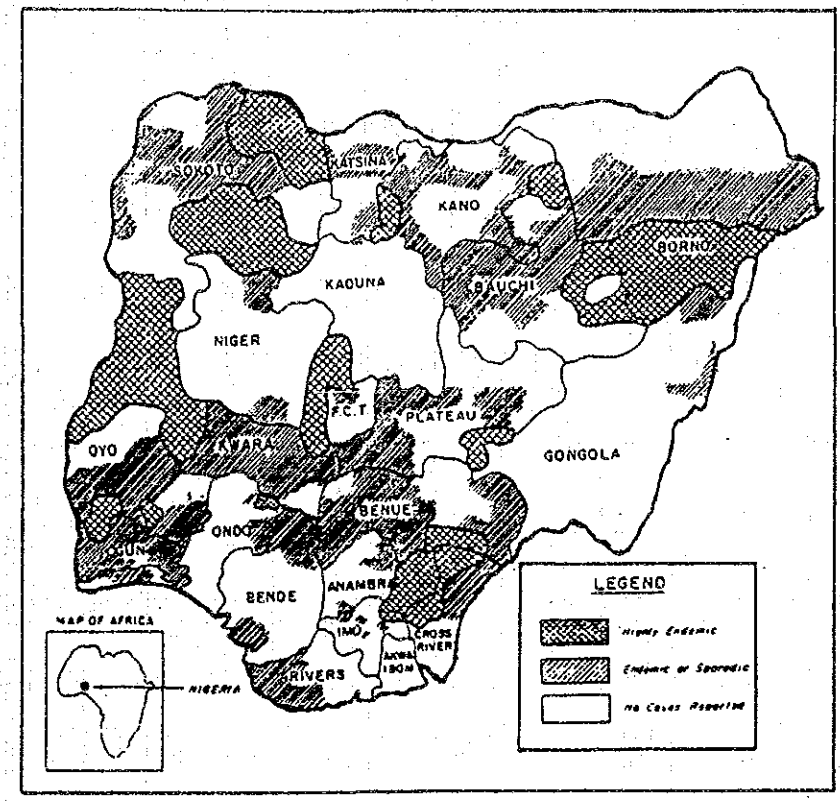
The Guinea-worm infection is summarized as follows:

i) The mature female worm pierces the skin causing an ulcer.

ii) When the ulcer is in contact with water, larvae are discharged into the water.

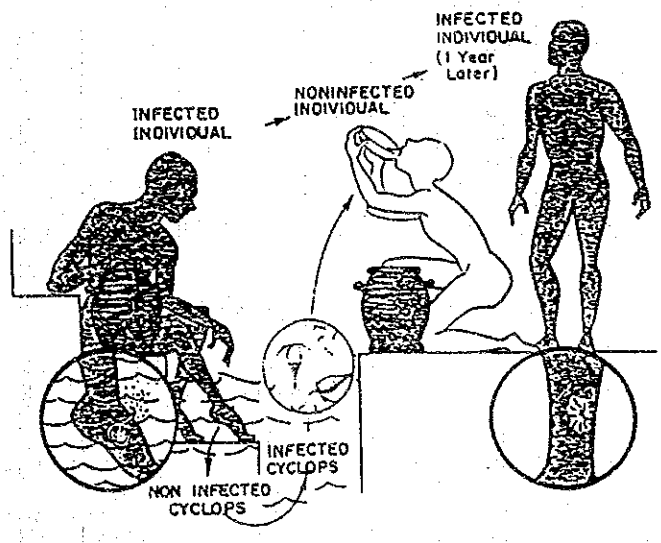
iii) The larvae infect Cyclops, a small crustacean.

FIG. 2-2 MAP OF NIGERIA SHOWING THE DISTRIBUTION OF DRACUNCULIASIS (GUINEA WORM DISEASE) BY STATE



(UNICEF, 1987)

FIG. 2-3 Life Cycle of Guinea Worm



- The mature female worm pierces the skin of the lower leg causing an ulcer
- When the ulcer is in contact with water, larvae are discharged into the water
- The larvae infect Cyclops, a small crustacean.
- The water, contaminated with the infected Cyclops, is consumed.
- The ingested larvae mature in humans in one year.

- Guinea worm disease is transmitted entirely by drinking water.
- The contaminated water is typically from open surface sources such as stagnant ponds or "step wells."

Table 2-6 OCCURRENCE OF WATER BORN DISEASES IN ANAMBRA STATE

(Ministry of Health Anambra State)

Zone	Guinea-Worm Disease (DRACUNCULIASIS)			Schistosomiases			Malaria			Dysentery			Intestinal parasites			Cholera		
	1985	1986	1987	1985	1986	1987	1985	1986	1987	1985	1986	1987	1985	1986	1987	1985	1986	1987
ABAKALIKI*1)	380,000	220,000	116,000	2,000	1,780	960	5,000	10,000	3,141	1,001	950	1,000	1,400	1,001	504	50	35	10
AWKA	-	-	-	964	1,032	916	4,800	9,000	3,000	650	700	540	1,070	850	400	-	2	3
ONITSHA	-	-	-	4	2	-	5,600	11,196	3,500	570	750	600	930	720	440	10	7	5
NSUKKA	*2) 1,300	*2) 904	*2) 759	10	8	2	4,000	8,000	3,100	1,050	700	500	1,014	860	410	-	7	5
ENUGU	*3) 6,300 (5)	*3) 4,926 (4)	*3) 2,142 (2)	13	7	4	5,300	11,000	3,600	550	761	450	1,050	740	450	40	1,000	7

*1) ABAKALIKI Zone consists of 4LGAs (ABAKALIKI, IKWO, EZZA and ISHIELU)

*2) Asper G-W patients, Number in ISI-UZO LGA only

*3) Asper G-W patients, Number in AWGU LGA only Population at endemic area in AWGU LGA 177,697 in 1985, 120,638 in 1986, 123,654 in 1987

iv) The water, contaminated with the infected Cyclops, is consumed.

v) The ingested larvae mature in humans in one year.

vi) The cycle is repeated from i)

The Guinea-worm disease is transmitted entirely by drinking water.

(2) Guinea-Worm Disease in Project Area

Patients suffering from Guinea-worm disease in the Abahaliki zone including Ikwo and Ezza of the Project Area has been reducing in number since 1985. (Ref. to Table 2-6). And this seems to have resulted from effective anti-Guinea-worm campaign advocated by the Ministry of Health, Anambra State. More precise number of patients suffering from Guinea-worm disease is available through the survey in seven communities of Awgu LGA in the Project Area. The breakdown of the relevant number of the patients is shown as follows:

The total number of patients was 15,081 comprising of 2,500 who gathered for dosing with medicine conducted by the Ministry of Health in February through march, 1988 and 12,581 patients who have not come for the dosing. The aforesaid total number accounts for about 12 percent of the approximate total population of 127,000 of the seven communities.

The number of patient in 1987, obtained from the Ministry of Health is about 116,000 in Abakaliki zone, which accounts for about 10 percent to the population. Consequently, the aforesaid figures of 12 percent for Awgu LGA are deemed reasonable.

The number of patients diagnosed as Guinea-worm case is the number of those people who feel pain when the worms have come out of human bodies piercing the skin after growth for 10-11 months in the human body.

However, the worm lies hidden in the human body for about 10 months without giving pains to those people.

Therefore, they are not counted as the number of patients. Those latent cases are seemed to be about 5-6 times of the patients who feel pains.

If such latent cases are added to the painful patients, the data prepared by the Ministry of Health is regarded as justifiable showing that about 60 percent of the population in Abakaliki zone are the patients.

(3) Countermeasures for Guinea-worm Eradication

The Ministry of Health of Anambra State has formed the following four groups to provide education and development to the local inhabitants:

1) Health Education Group

The group, consisting of five Public Health Assistants, renders services in Public Relation with advertising posters and information cars, so as to let the local people know about the fear of Guinea-worm and the necessity of filtering and boiling water before drinking.

2) Water Treatment Group

The group, consisting of three entomostralogist and several other health officials, applies Abate to kill cyclops once every four to six weeks.

3) Patients Treatment Group

The group, headed by doctors, make roving visits to the health centers throughout the areas and doses Zentel and Ambilhar to the Guinea-worm patients to remove worms from their bodies.

4) Parasitology Group

The group, consisting of four parasitologists, checks the water samples taken from the ponds to examine for the presence of cyclops before and after applying the cyclops killers.

The aforesaid movements are the countermeasures taken for the purpose of health and sanitation. And in the Anambra state, on the other hand, the Ministry of Health has been promoting, with enthusiasm, an effective campaign to establish fundamental countermeasures through wells construction, under close cooperation of UNICEF, so as to ensure stable supply of safe potable water:

1) Concrete rain water collecting tanks are being provided at public facilities such as schools, hospitals, etc.

2) Borehole drillings and installation of hand pumps are now under way.

The above two programmes are promoted by Task Force provided under DFRRI's budget.

Furthermore, over 300 boreholes are planned and to be constructed under the UNICEF's aids as Rural Water and Sanitation Project (WATSAN).

The Task Force was tentatively established organization under direct control of the governor and it constructed, 111 numbers of boreholes in the urgently required places in the Anambra state.

(4) Chemicals

a) Medicines to be Guinea-worm Patients

One of the medicines for Guinea-worm disease is Zentel (Albendazola). Zentel mitigates pain caused by mature female guinea worms when come out of human body and accelerates this movement. Guinea-worms, which take about two weeks to come out of human bodies, can be smoothly removed in only four to five days by dosing of Zentel. The medicine, when dosed to patients make the painful time shorter. Each tablet of Zentel weights about 200 mg and the patients can take two tables in a dose. The tablets are efficacious only for one dosing.

b) Chemicals Used to Kill Cyclops, the Middle-Hosts

The cyclops killer is a chemical with the commercial name of Abate. Medically, the tables contain Temephos, which is a carefully handled medical material, though it is considered harmless to human. Temephos is used world-wide for infectious diseases caused by cyclops. It is efficacious enough to kill cyclops by applying only 1g for 1 m^3 of water. The comercialized liquid Abate has 50 percent density and therefore. 2g is required to kill the cyclops in 1 m^3 of water.

The problem when applying this chemical is the correct estimation of input amount. In other words, water amount of a pond should be calculated as precisely as possible. Regularly repeating the application of this chemical is quite essential for ponds and standing water since water amount in these places are changeable due to rainfall, spring, and the various use of water. Currently, chemical application has been made once in four weeks.

c) Filters for Filtration

Filtration of drinking water is more effective than chemical application. Filtration eliminates cyclops (the middle host of Guinea-worm) from water. Cyclops size ranges from 0.5 mm to 2.00 mm, and thickly woven gauze or cotton cloth can be used to eliminate cyclops. The Ministry of Health is campaigning on the employment of filtration of drinking water.

Actually, UNICEF has been making endeavours to supply the country with filter materials instead of chemicals.

The Ministry of Health supplied the medicines/chemicals and other materials into Awgu LGA in quantity as follows in May 1987.

i)	Zentel Tablets	Tablets for 2,500 dosings
ii)	Cotton Cloth	8 rolls
iii)	Gauze	3 rolls
iv)	Dettol	1 gallon
v)	Ambilhar	70 cartons (20 x 500 mg)

2-4-3. Water Supply Programme in Anambra State

To improve water supply situation in the Anambra State, the Federal and State Governments have planned and implemented the following water supply programme. However, the Water Corporation has not been able to fulfill the function till now.

1) National Borehole Project

The scope of the project is to drill 32 boreholes in all Nigeria and to install motor-driven pumps, elevated tanks and 10 pieces of communal water taps on the respective boreholes.

The plan was made by the Water Resources Department of the Federal Government, and was executed by the State Government and the Water Corporation. The project was commenced in 1982, and 3 boreholes were allotted to the Anambra State.

No borehole has been completed yet. The project is not considered as the rural water work by spot supply in view of the scale of facilities.

2) Water Supply Scheme by the Anambra State Water Corporation (ASWC)

The ASWC has planned to consolidate water supply facilities at 51 places in the Anambra State. The scheme contains rehabilitation of existing old facilities, construction of new facilities and expansion of existing rural water supply facilities, etc. The scheme was commenced in 1986 and the

works have been completed for 6 places. The remaining works have been suspended due to insufficiency of state finance, low ability of constructor and aggravation of foreign exchange, etc.

Construction of new facilities are scheduled in the central parts of Ezza and Ikwo LGAs, where are included in the objective areas in the JICA assisted Guinea-worm Eradication and Potable Water Scheme. However, establishment of the new water supply facilities will not be materialized because of the above-mentioned reasons.

3) Rural Water Supply Plan by the Task Force

The task force project was to construct hand pump equipped boreholes in 250 communities in the Anambra State under the financial aid of DFRRI of the Federal Government. The project started in February 1986 and ended in October 1986.

They drilled 118 boreholes, of which 111 holes were reported to be succeeded wells.

However, the result was not satisfactory since the works had been carried out under the leadership of the military, without sufficient previous investigation and work supervision, emphasizing only its urgency and percentage of success.

These hand pump equipped boreholes were constructed at public institutions such as health centers, schools and markets, etc. The construction cost was 30 thousand Naira per borehole, including the installation of hand pump.

4) Water Supply Programme by the World Bank

This is a great-sphere urban water supply arrangement programme in Onitsha city financed by the budget of the State Government and foreign loan. The work is carried out by the Anambra State Water Corporation.

The construction period is divided into two phases, Phase I (1979 - 1990) and Phase II (after 1990).

The water source is a combined use of stream flow and groundwater aiming the security of potable water for 585.9 thousand people (projected population for 1990) in Onitsha city and surrounding villages.

The project expenditures for Phase I and II are 38.3 million and 20.6 million Naira, respectively.

5) Water Supply Programme by UNICEF

The UNICEF assisted WATSAN Programme is scheduled to be commenced in 1988 in the Anambra State of which the detail is described in Chapter 3. Prior to the commencement of this programme in the Anambra State, UNICEF inaugurated "the WATSAN Programme in Nigeria" in 1982 and has already carried out the works in four states (Imo, Gongola, Kwara and Cross-river) with capital investment of 21.1 million US$ and running expenses of 15.9 million US$.

The partial charge born by the Nigerian Government was 9.5 million US$, or equivalent to about 60% of the running expenses.

2-4-4. Administrative Organization of Water Supply Works

The major organizations of water supply works are the Ministry of Health and the Water Corporation belonging to the Ministry of Lands, Public Works and Transport.

The respective roles taken by the these organizations are mentioned below.

1) Water Corporation of Ministry of Lands, Public Works and Transports

To execute the followings for the development, supply, O & M of public, domestic and industrial water.

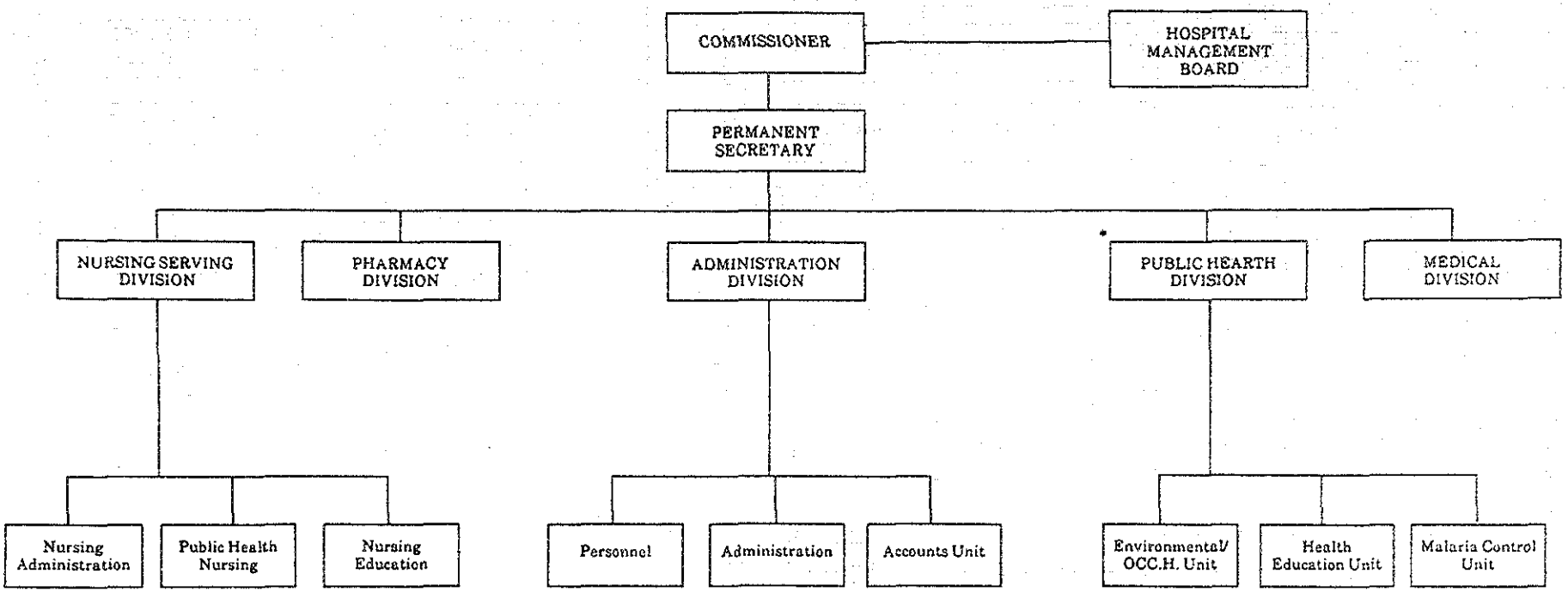
- Development of water sources
- Construction and O & M of urban and rural water supply facilities
- Security of water quality in the water sources

2) Ministry of Health

- Measures against epidemic and water borne diseases
- Improvement of hygienical environment
- Treatment of water source to eradicate Guinea-Worm disease

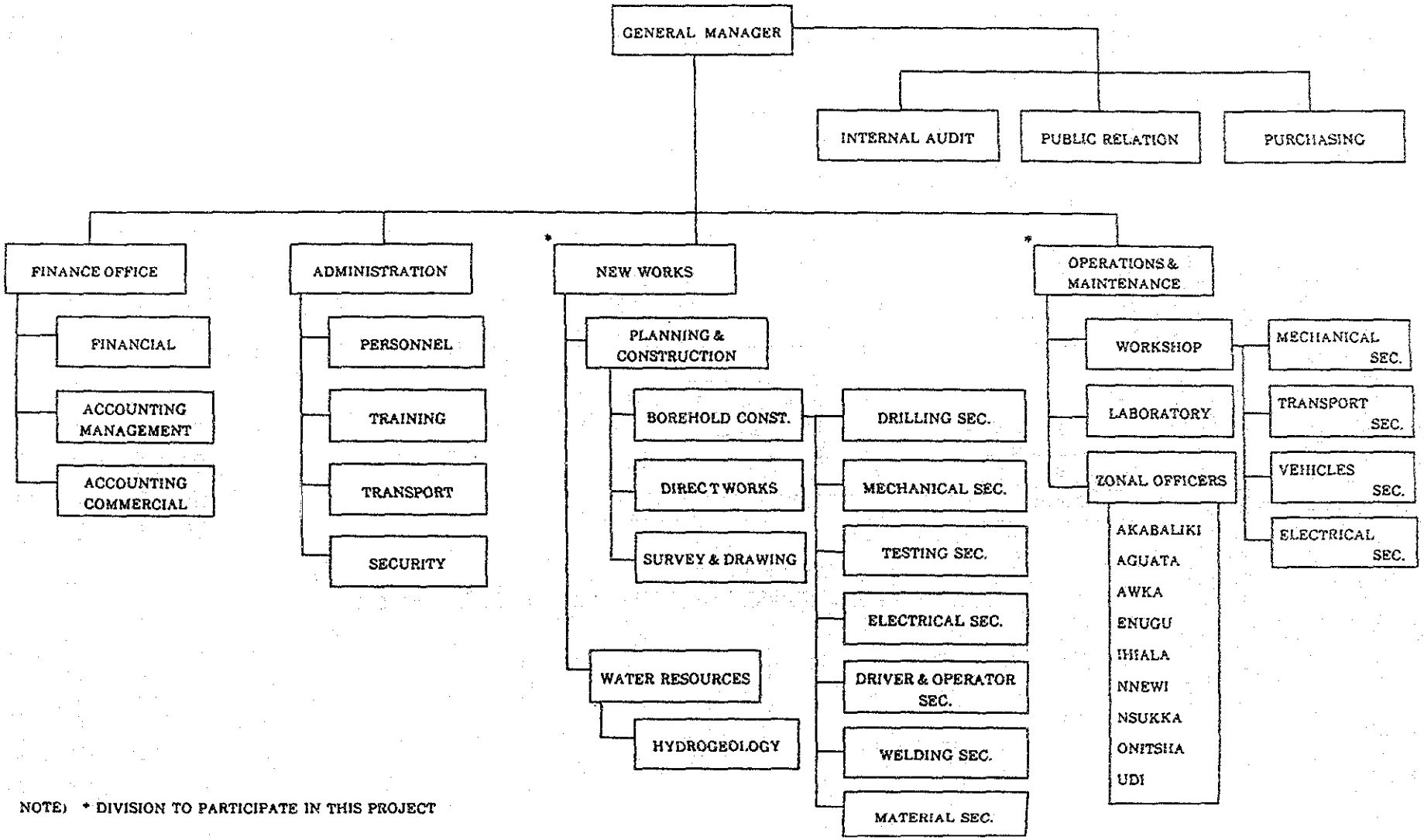
The organograms of the Anambra State Water Corporation and Ministry Health are shown in Figure 2-5 and Figure 2-4.

FIG. 2-4 MINISTRY OF HEALTH ORGANOGRAM, ANAMBRA STATE



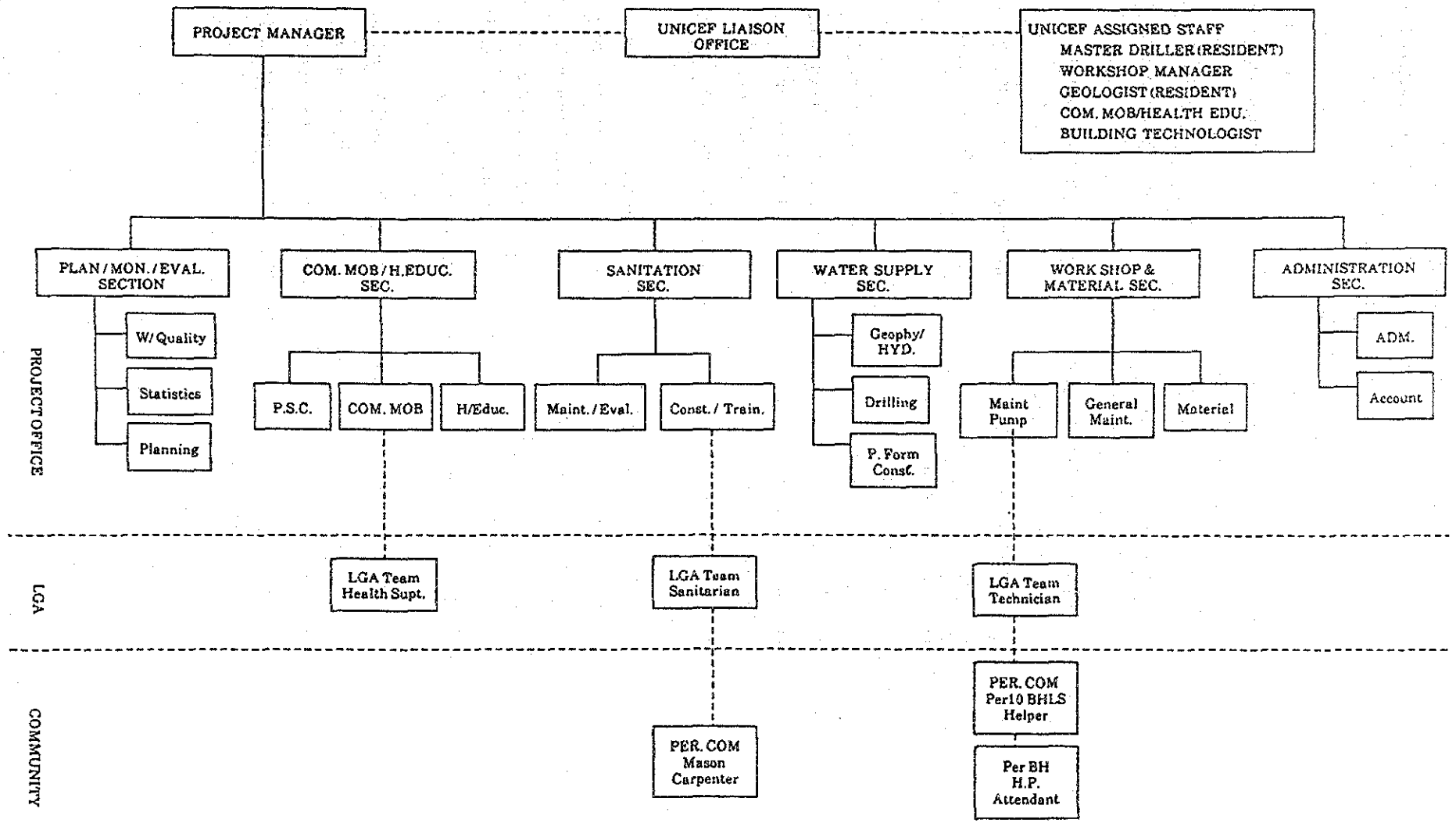
Note) * DIVISION TO PARTICIPATE IN THIS PROJECT

FIG. 2-5 ANAMBRA STATE WATER CORPORATION ORGANISATIONAL STRUCTURE



NOTE) * DIVISION TO PARTICIPATE IN THIS PROJECT

FIG 2-6 ANAMBRA STATE WATSAN PROJECT ORGANOGRAM



CHAPTER 3. GENERAL DESCRIPTION OF PROJECT AREA

3-1. Natural Environment

3-1-1. Location and Topography

The Federal Republic of Nigeria faces the Guinea Bay in the south, and shares the borders with the Peoples Republic of Benin, the Republic of Niger, and the United Republic of Cameroon. It is located in a range from 3° to 15° of east longitude and from 1° to 14° of north latitude with maximum length of 1,300 km in E-W and 1,100 km in N-S. The area is about 924,000 km^2, almost two and a half times that of Japan.

The topography of the country can be characterized by two specific features; the three highland topography areas formed by the Niger River originating in the Guinea Highland and the Benue River running out of Cameroon, and the flat lowland topography areas developed along the above two rivers and the coastal areas along the Guinea Bay.

In details, the three high-topographic mountainous areas form the northern central, the east/northeastern highlands, and the western plateau. The flat lowland topography areas form the Sokoto plain, lowland areas along the large rivers, Chad Basin, and the deltaic coastal flat land formed by large rivers.

The vegetation of the country can be roughly classified as tropical rain forest in the coastal area, the savanna in the central area, and the grassland area in the north. The proposed Project Area is located along the boundary of the tropical rain forest area and the savanna area.

Enugu, the state capital of Anambra, is about 600 km far from Logos, the national capital. It takes about six hours by car and one hour by air to get there. Abakariki, the objective areas, is located about 100 km to the east of Enugu and it takes about one hour by car from Enugu.

The elevation of Anambra ranges from the areas below 100 m extending along the Niger River and around the Cross River to hilly land at about 500 m, running north to south in the central part of the state. In Abakariki, the objective area is low and flat land eroded by many small rivers and streams. The major rivers such as the Niger, Anambra, and Cross, etc. flowing through the area, are run dry in every dry season. The Abakariki area lies in the Cross River Basin.

Anambra has an area of about 17,675 km^2, and the objective area covers about 1,927 km^2, which accounts for 10.9 percent of the total area of Anambra State.

3-1-2. Population

Anambra has an estimate of about 7.085 million in 1987 and the population density is about 400.8 persons/km^2. All these figures could not be obtained from statistical assumption as there has been no demographic census since 1963. The population increasing rate is estimated at three percent per annum. (Anambra State, Statistic Division, 1986)

Anambra State is administratively divided into 23 local government administration areas (LGA). The demographic information on population for each LGA and the population density are shown in Appendix-6, and those of the project area are in Appendix-7, respectively.

The aforesaid demographic information shows that the population of the whole Project Area is 719,000 with a population density of 374.6 persons/km^2.

From these figures, the Project Area is one of the medium scale LGAs in the State. Among villages in the Area, Udoma of Awgu LGA has the largest population of 36,945, while Amaura of Ezza has the smallest of 2,186, and the average per village is about 12,400 persons.

About 98.5 percent of the population in Awgu, and 92.4 percent in Ezza as well as Ikwo are engaged in agriculture in the villages dotted in the LGAs.

Most of the people have not obtained the safe water as described in the Chapter 2.

3-1-3. Geology

The Project area, located at the southeast of Enugu, consists of three LGAs, Awgu, Ikwo and Ezza, and hilly land at an elevation of about 1,000m running from north to south in the eastern part of Awgu. At the southeastern end of Ikwo, the Cross river runs southwards and develops a flat alluvial plain.

The Project Area extends low and flat in a range of elevation from 100 m to 250 m between the hilly land at the eastern part and the Cross river flowing the southeastern part of the State.

The geology of the Project Area is shown in Table 3-1 Stratigraphy and Figure 3-1 (1) and (2) Geological Maps.

The characteristic features of the Project Area are mudstone in the Cretaceous (shales and silty stones) and basin structure with the axis running from northeast to southwest.

The mudstone consist of five geological groups. The Asu River Group is distributed in the most parts of Ezza and Ikwo and in the extreme southern part of Awgu. This group, consisting of shales and siltstones, contains no sand stones and shows low specific resistivity when measured by electrical prospecting.

The Eze-Aku Shale Group develops in small strip in the extreme southern part of the Ezza and Ikwo LGAs, and the Awgu LGA with extremely small layer of sand stone sandwitched in between.

The Awgu Ndeaboh Shale Group is mainly observed in the central part of Awgu LGA with thick alternate layer of sand stones, where abundant groundwater has been found in some places.

This layer is the source of the domestic water supplied by the Water Corporation in Ogugu community. However, there is not thick sandstone layer and therefore shows very low specific resistivity in the most part of the objective area except for Ogugu community area.

The lower coal layers and the Asata Nkporo Shale Groups exist in the hilly land extending to the east of Awgu where abundant surface runoff water is found, and therefore the area is not included in the objective areas of the groundwater development. Along the Cross river, there develops the alluvium composed of softly compacted clay, silt and sand and the physical prospecting conducted reveals that the maximum thickness of this alluvium reaches about seven meters.

Table 3-1. Stratigraphy

Age	Formation	Mark	Lithology
Quarternary	Alluvium	a 1	Clay, Silt, Sand
	Lower Coal Measure	6	Shale, Siltstone, Coal
	Asata, Nkporo Shale Group	5	Shale, Sandstone, Siltstone
Cretaceous	Awgu, Ndeabch Shale Group	4	Shale, Sandstone
	Eze.Aku Shale Group	3	Shale, Sandstone, Silt
	Asu River Group	2	Shale, Silt Stone

3-1-4. Meteorology

Nigeria can be classified into the following four climatic areas distributed parallel to the equator:

a) Semi-equatorial climate - prevailing in the deltaic areas, 130 km - 160 km inland from the Ivory Coast with an annual rainfall of over 2,000 mm and a relative humidity of 60% to 80%.

b) Climate in the hinterland of the tropical climate zone - prevailing in the area extending with about 240 km wide in the central part of the country with an annual rainfall in a range from 1,000 mm to 1,500 mm, and a relative humidity of 50% - 80% and four months of dry season.

c) Tropical climate - prevailing in the northern part of the country with an annual rainfall in a range from 500 mm to 1,000 mm, a relative humidity of 20% - 40% in January and 60% - 70% in July, and a dry season lasting from April to August.

d) Highland climate - prevailing in the highlands of Josu, Ayudawau and Ogbudo with an annual rainfall in a range from 1,000 mm to 1,400 mm.

The Project Area belongs to the climate classification b): Climate in the hinterland of the tropical climate area.

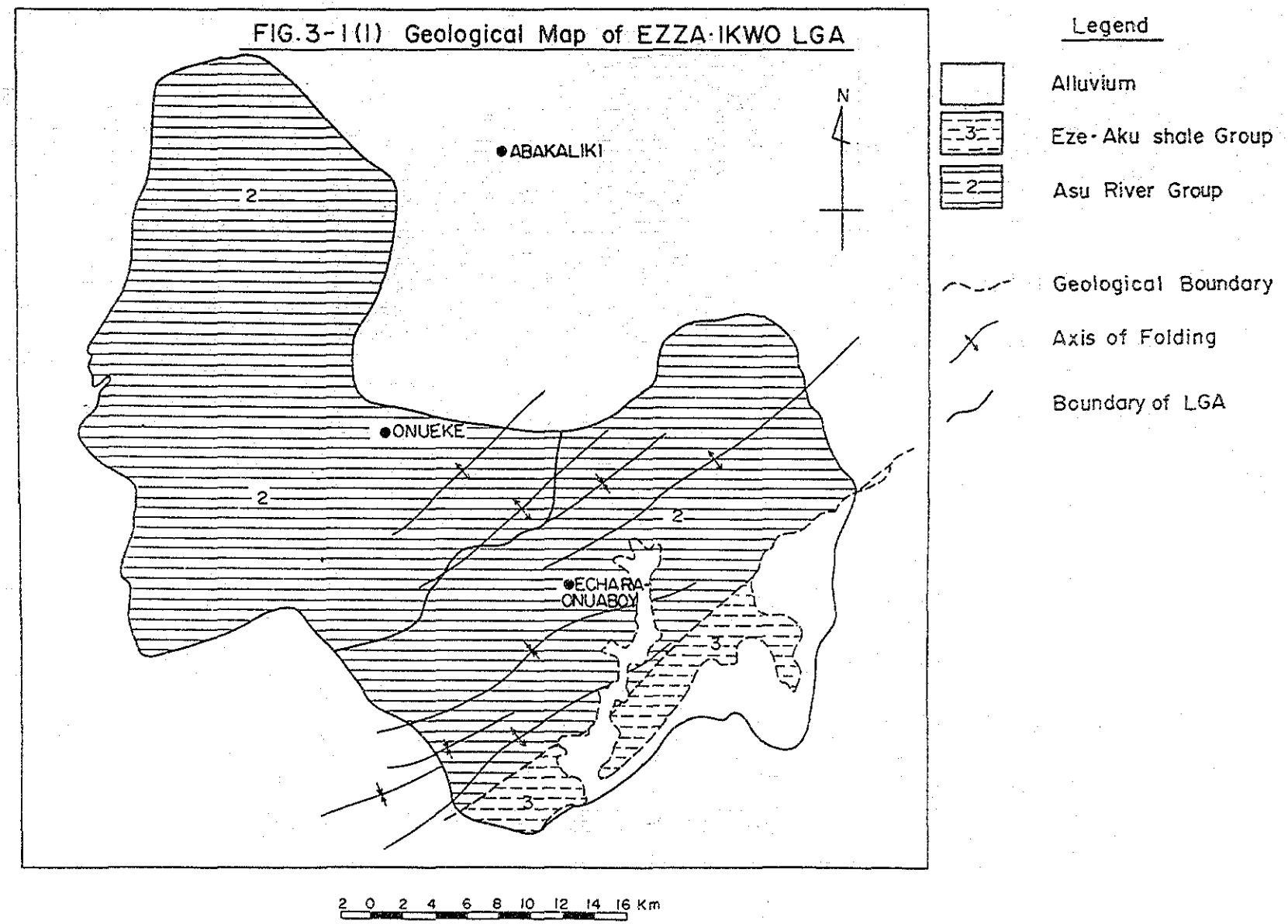


FIG.3-1(1) Geological Map of EZZA-IKWO LGA
N
ABAKALIKI
ONUEKE
ECHARA-ONUABOY
2
3
Legend
Alluvium
Eze-Aku shale Group
Asu River Group
Geological Boundary
Axis of Folding
Boundary of LGA
2 0 2 4 6 8 10 12 14 16 Km

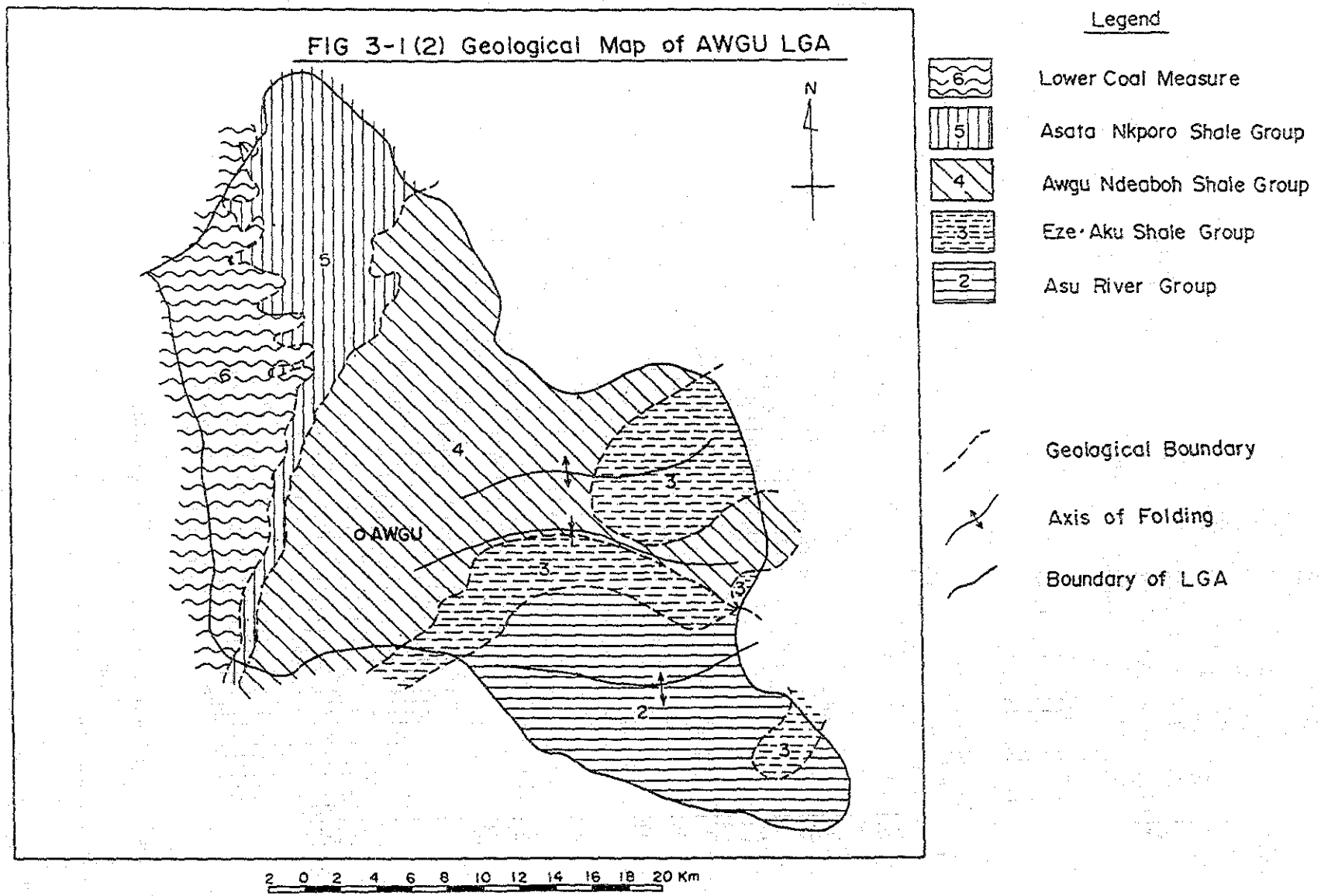
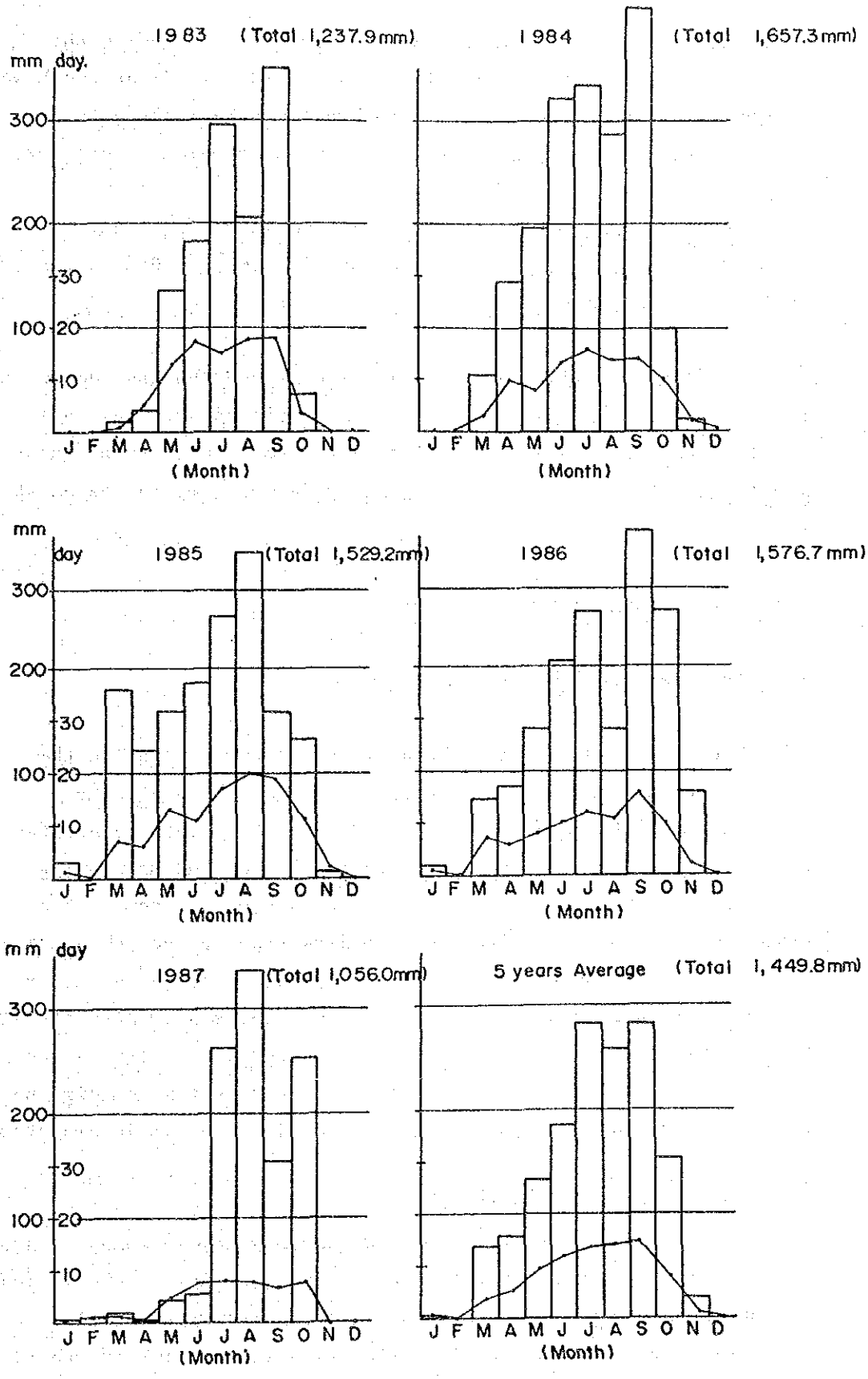


FIG 3-1(2) Geological Map of AWGU LGA
N
AWGU
Legend
Lower Coal Measure
Asata Nkporo Shale Group
Awgu Ndeaboh Shale Group
Eze-Aku Shale Group
Asu River Group
Geological Boundary
Axis of Folding
Boundary of LGA
2 0 2 4 6 8 10 12 14 16 18 20 Km

Fig. 3-2 RAIN & RAINY DAYS IN LOWER ANAMBRA (1983-1987)



Source : from the record at Lower Anambra Irrigation Project

The rainfall data in the Project Area is referred to the observation data recorded for five years (1982- 1987) at the Lower Anambra Irrigation Project near the Project Area. The data are shown in Appendix - 8, and the histogram is shown in Figure 3-2.

The above data shows that the maximum annual rainfall is 1,857.3 mm recorded in 1984, while the minimum is 1,056 mm recorded in 1987.

The mean annual rainfall is 1,449.8 mm and the dry season lasts for five months from November to March, while the wet season lasts for the remaining seven months from April to October with a mean monthly rainfall of 194.5 mm, and rainy days per month reachs about 12.7 days in average.

3-1-5. Hydrology and Groundwater

(1) Surface Runoff Water

The surface water distributed in the surveyed area is the Eastern Aboine, and Asu River systems, all of which are the tributaries of the Cross river. In Ezza and Ikwo, there are two rivers of the Eastern Aboine and Aboine flowing and meandering southwards. These rivers present a herring-bone system with a number of medium/small rivers and streams flowing into them. The main streams, although reduce remarkably in discharge in the dry seasons, are perennial rivers. The other rivers are intermittent rivers which dry up in the dry season. Under these circumstances, inhabitants who do not have any other means to get water dig the river bed in the dry season hoping to obtain very little amount of water.

In Awgu LGA, the Asu River flows southwards, in meanders and turns to east after running through the Project Area. And it joins the Aboine River. The Asu River is a perennial river similar to the other two rivers, although its tributaries are all intermittent rivers.

(2) Hydro-geology

Hydro-geology of Ezza, Awgu and Ikwo LGAs can be classified into four groups as illustrated in Figure 3-3.

1) Hilly land - consisting of coal layer and alternations of sandstone and shale blessed with abundant surface water, and is excluded from current groundwater survey.

2) Alternations of sandstone and shale - consisting of alternations of sandstone and shale particularly with considerably thick sandstone layers serving as promising aquifer to retain groundwater and is excluded from the current groundwater survey.

3) Shale layers - consisting of shale layers with the presence of thin lens-shape sandstone. The potential groundwater originated from weathered surface layers or cracks is taken up for development objectives.

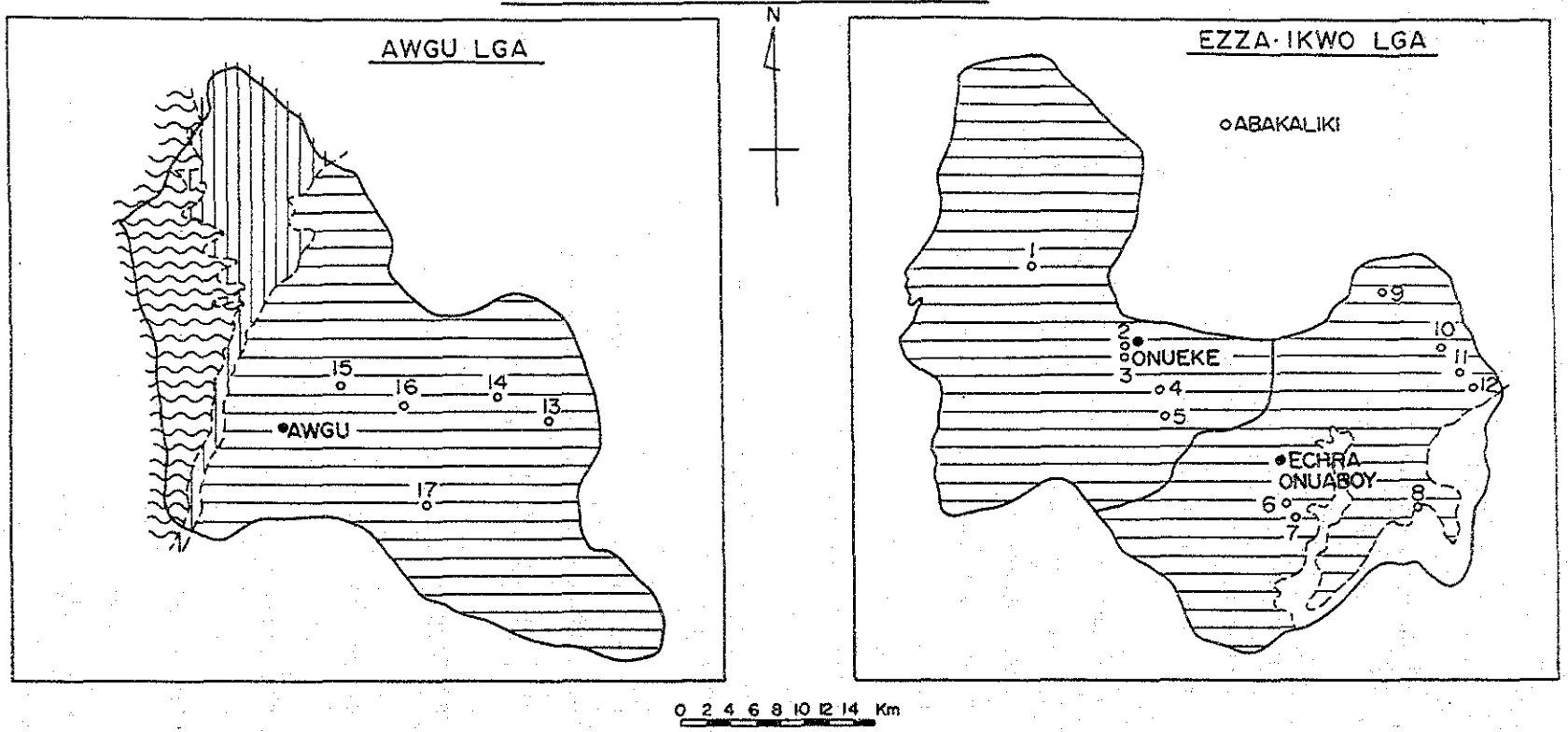
4) Alluvium - distributed mainly in the basin of the Cross river and consists of clayey soils, sand and gravel, but is not promising as aquifer due to rather thin layers.

(3) Electric Prospecting

The survey team has carried out the electric prospecting to grasp the specific features of the expected aquifer in the Project Area according to the following specifications.

Method of Prospecting:		Vertical prospecting with Wenner's 4-pales method
Survey Points	:	17 points
Survey Depth	:	130 m
Location of Points	:	Ref. to Table 3-2 & Figure 3-3.
Analysis	:	By Sundberg's standard curve.

FIG. 3-3 Hydrogeological Map



The test points were decided near the existing boreholes taking the geological structure into consideration.

Table 3-2. Location of Electric Prospecting

No.	LGA	Community	Location	Geology
E-1	Ezza	Ogboji	T-Ship/Existing Borehole	Shale
E-2	"	Amuzu	Central SCH	"
E-3	"	Amuzu	Community SCH	"
E-4	"	Amegu	Central SCH	"
E-5	"	Amegu	Community SCH	"
E-6	Ikwo	Amadu Igbudu	T-Ship/Existing Borehole	"
E-7	"	Amudu Igbudu	Community SCH	"
E-8	"	Odomobo	Central SCH	Alluvium/Shale
E-9	"	Echilike	T - Ship/Existing Borehole	Shale
E-10	"	Enyibichiri	Central SCH/Existing Borehole	"
E-11	"	Echara Inyimagu	Community SCH	"
E-12	"	Ofenakpa	Community SCH	"
E-13	Awgu	Ezinesi Uduma	Community SCH	"
E-14	"	Uduma	Central School	"
E-15	"	Emudo	Community SCH	"
E-16	"	Mdubowo	Secondary SCH	"
E-17	"	Ndeboh	Central SCH	"

The following matters have been resulted from the electric prospecting carried out by the survey team.

The cretacene silt stone and shale found in the objective area are hard and well-compacted deposit, and are so impervious that they do not retain the potential water in thin pores.

And consequently, water is found only in the case that there would exist cracks or weathering portion developed in the layers.

Since the crack developing in silty stone or shale would possibly show a higher value of specific resistivity than that of tightly compacted hard rocks without cracks, electric prospecting would detect the presence of an aquifer. This is also true for the weathered rocks, but specific resistivity is low when water in the aquifer contains chlorine.

The results of the prospecting are shown in $\rho - a$ curve in Appendix-9.

The specific resistivity of the respective survey points shows comparatively low values, reflecting the characteristic features of the local geography. In details, at 13 points except for E1-3 and 10, the value about 30 Ω-m at the zone deeper than 10m.

Based on the analysis of the data the stratigraphy of the Project Area are grouped as follows:

a) The cracks available as aquifer can be found comparatively deep. E 1, 2, 3, 10.

b) At the subsurface, saturated aquifer can be found. E 4, 5, 6.

c) Shallow to deep area, generally showing low specific resistivity due to chlorine in the water confined. E 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

The areas specified as the above (a) are Ezza LGA and the northern part of Ikwo LGA. Low specific resistivity points are corresponded to the geology of the Project Area as follows:

1st Groups: Specific Resistivity 980 - 2,750 Ω-m
Thickness 1.0 to 3.9 m
Dry sandy soil

2nd Group: Specific Resistivity 123 - 930 Ω-m
Thickness 1.6 to 8.3 m
Uncompacted layers or rocks and saturated with groundwater infiltrated through weathered surface layers.

3rd Group: Specific Resistivity 23 - 930 Ω-m
Thickness 9.8 m to 34.8 m
Comparatively well compacted shale.

4th Group: Specific Resistivity 50 - 174 Ω-m
Thickness found deeper than 12.5 to 44.0 m
Well-developed cracked shale with expectation of groundwater.

The layers specified as (b) are distributed from the southern tip of Ezza LGA to the central part of Ikwo LGA, and the following matters are revealed by study in corresponding to the geology.

1st Group: Specific Resistivity 380 - 3,300 Ω-m
Thickness 0.8 to 1.3 m
Consisting of dry sandy soils

2nd Group: Specific Resistivity 130 - 660 Ω-m
Thickness 1.0 m to 4.7 m
Prematuredly compacted layers saturated by groundwater.

3rd Group: Specific Resistivity 35 - 73 Ω-m
Thickness 4.7 to 38.0 m
Heavily weathered shale layers saturated by groundwater infiltrated from the surface.

4th Group: Specific Resistivity 14 - 16 Ω-m
Thickness 8.0 m - 44.0 m and deeper
Impervious layers consisting of well-compacted shale

The layers specified as (c) are distributed in the southern part of Ikwo LGA and Awgu LGA. And the results of the corresponding study with the related geology are shown as follows.

1st Group: Specific Resistivity 120 - 1,250 Ω-m
Thickness 0 m to 1.1 m
Consisting of dry soils with some parts saturated by groundwater

2nd Group: Specific Resistivity 50 - 290 Ω-m
Thickness 0 m to 2.8 m
Prematuredly compacted or weathered shale layers saturated by surface runoff water

3rd Group: Specific Resistivity 4 to 20 Ω-m
Thickness 0 m to 3.8 and deeper
Saturated weathered layers with well-developed cracks in the deeper portions saturated with water highly concentrated by chlorine; particularly, at E-13,17 in Awgu, the specific resistance shows as low as 7 - 10 Ω-m. These seems to be due to water quality with high turbidity and high contents of Fe, Mn, Cu, etc. which is discussed later.

The results of the above analysis can be summarized as follows:

* In Ezza, cracks that developed to considerably deep portions are widely distributed, and these cracks have high potential to provide favourable aquifers.

* In northern Ikwo, the weathered parts up to 40 m deep from the surface are judged to serve as favorable aquifers, but in the southern part, the chlorine concentration is expected high in view of the values of specific resistivity.

* In Awgu, although the surface weathered layers is a possible aquifers, the chlorine concentration is rather high as a whole.

(4) Data of Existing Boreholes

a) Data/Information Prepared by the Task Force

The task forces have carried out 17 borehole drilling in the Project Area as a part of the Task Force Programme for Borehole Drillings for 25 communities in Anambra State. All of these 17 boreholes have been drilled through shale layers, and Table 3-3 presents the data of their depths and water tables by each LGA.

Table 3-3. Average of Borehole data by LGA (Task Force)

Group	No. of Wells	Well Depth (m)	Water Table (m)
Ezza	7	38.2	6.1
Ikwo	9	39.6	9.8
Awgu	1	45.7	7.0
Average	17	39.4	8.1

The maximum and minimum depths of the wells drilled are 37.5 m and 45.7 m, respectively. And most of the wells are in the range of 36.6 m to 45.7 m in depth (120 ft - 150 ft). This series of borehole drillings can be judged to have been carried out to exploit the groundwater, expected in the weathered surface layers and in the cracks in their sublayers.

The data of yields of the wells at drilling by Task Force are not available, but the field investigation by Survey Team has revealed that only three boreholes are available for pumping up among 15 boreholes (including those in Abakaliki LGA). (Ref. to Table 3-4)

The other wells are poor in their yields or have pumping facilities problem. Such poor yields have resulted from insufficiency in prior survey and inadequate design of wells, which caused pumping inability in the dry season as the water level falls below pump cylinder. Since some are yielding wells and others not in the same geological conditions, poor yielding is not always a result of absence of aquifers. Some wells are left broken because O & M works are put in the hands of beneficiaries without patrol and routine work by governmental organization.

b) Data of Ohazola LGA in Imo State (UNICEF)

Under the UNICEF assisted WATSAN Programme, 53 boreholes have been drilled in the Ohazola LGA, Imo State adjacent to the Project. Since the WATSAN Programme has exploited the groundwater in the shale layers at the similar geological stratigraphy, the information on the WATSAN is helpful to the Project. The test results of the boreholes are summarized in Table 3-5.

Table 3-4. Present Condition of Existing Boreholes

Location LGA/Community	Possibility of Pumping	Operational Status	Operation Hours	Pumping (q't)(lit/min) /Stroke (min)	Reasons of Inabilities of Pumping
Abakaliki					
Optomo	yes	yes	6 - 12 15 - 19	21/60	
Edda	yes	yes	24	Extremely little	Poor aquifer Poor water quality
Chukucha	no	no	-	-	Trouble with pump
(Task Force)	no	no	-	-	"
Eze	yes	yes	24	Extremely little	Low water table due to poor yield
Ikuwo					
Echiariki	yes	yes	24	Extremely little	"
Enibichir	yes	yes	6 - 10 14 - 18	10.5/100	
Echara.Inimagu	yes	yes	24/2 days	Extremely little	Poor yield
Ibdou	yes	yes	6 - 18	2.6/100	
Amadou.Ekdou	yes	yes	24	Extremely little	Poor yield
Amon	no	no	-	-	Trouble with pump
Ezza					
Umezeoka	no	no	-	-	Trouble with pump
Oboji	no	no	-	-	"
Awgu					
Adba	no	no	-	-	Trouble with Pump
Neuwe	yes	yes	24	Extremely little	Poor yield

Table 3-5. Average Values of Boreholes Data under WATSAN Programme

Well Depth (m)	Water Table (m)	Drawdown of Water Table (m)	Pumping (lit/s)	Specific Yield (lit/s/m)
27.4	4.4	4.5	1.202	0.424

The well depth is measured at 20 m at minimum and 44 m at maximum, excepting for unsuccessful boreholes, and most of the boreholes are in a range from 25 m to 35 m in depth. The groundwater table is comparatively shallow, in a range from 0.5 to 13.8 m.

In other words, the objective aquifers are found in the surface weathered zones or subsurface shale cracking zones in Ohazola LGA.

The UNICEF Team has employed the horizontal electric prospecting to determine the drilling positions, and when the specific resistivity at a prospected depth (AB/2) is found to fall in a certain range, an expected yield can be obtained therefrom.

It is reported that unsuccessful boreholes (dry hole) were only four (4) out of 53 drilled holes or the percentage of success was 92.4% and yield was about 1.2 lit/s on an average.

For example, in Ohazola, a yield over 1.0 lit/sec is obtained when AB / 2= 80 m shows a specific resistivity in a range from 86 to 304 Ω-m. Two boreholes have given lower yields than 1.0 lit/sec in the said series of drillings. And the specific resistivity for these two boreholes are in a range from 16.0 to 21.1 Ω-m.

And when drilling is made for the points having 10Ω-m and below, the yield is poor to unsuccessful. Furthermore, drilling has not been carried out for points indicating the specific resistivity over 304 Ω-m.

For references, conversion of the value at the depth of 80 m (obtained by Wenner Method) to the UNICEF method with AB/2= 80 can indicated that most of the prospecting points have the specific resistivity in a range between 10 and 300Ω-m, except for E-1, 11, 15 and 16.

As learnt from the above, it is expected that the further detail survey and analysis on the available data will result in drillings with satisfactory yield.

(5) Water Quality of Existing Wells

a) Water Quality Test Conducted by UNICEF in Ohazola LGA, Imo State

The report is made on the water quality of the groundwater exploited in the UNICEF Programme in Ohazola LGA, Imo State (Ref. to J.O. Ademiluyi. Nigeria Water and Sanitation Association, 2nd Annual Symposium/Conference).

The results are tabulated below. the table shows that 50 to 72 percent of the water samples taken from the boreholes drilled through the similar shale structure contain more minerals such as Fe, Cu, Mn as well as turbidity and pH compared with the standards given by WHO.

Table 3-6. Result of Water Quality Test in Ohazola LGA, Imo State

Items	pH	Fe	Mn	Cu	Cr	NO3	F	Cl	Mg	Ca	SO4	Turbidity
Number of Test Sample	13	13	6	11	6	3	11	2	9	2	3	12
Number of Samples exceeding the WHO's allowable value	7	8	4	8	0	0	0	0	1	1	0	7
Percentage(%)	53.8	61.5	66.7	72.7	0	0	0	0	11.1	50.0	0	58.3

b) Result of Water Quality Test Conducted by Water Corporation

Table 3-7 shows the result of water quality test conducted by the Water Corporation in Abakaliki LGA.

Abakaliki has the similar geological shale structures as the Project Area, and the result of water quality test shows that color degree, mineral contents, hardness, evaporation residues, etc. are more than the WHO Standards.

Table 3-7. Water Quality of Existing Well(Abakaliki LGA)

Item		Ishiele	Ezze Inyamagu	Igbeagu	Igbeagu	WHO Standard Allowable	WHO Standard Limit
Color	(unit)	5	50	5	5	5	50
pH		7.8	6.8	7.8	7.1	7-8.5	6.5-9.2
Turbidity	(unit)	10	-	92	7	5	25
T. Hardness	(ppm)	132	237	128	85	100	500
SiO_2	(ppm)	20	40	30	20	-	250
Cl	(ppm)	19.85	0.24	17.2	14.18	200	600
Fe	(ppm)	1.49	-	1.7	1.35	0.1	1.0
SO_4	(ppm)	4.5	-	29	21.2	200	400
Alkalinity	(ppm)	486	558.5	548	450	-	-
T.R.E.	(ppm)	528	-	721	553	500	1,000
S.Solid	(ppm)	-	-	377.2	240.5	-	-
EC	(μS/cm)	-	-	550	500	-	-

Note: T. Hardness ... Total Hardness
T.K.E. ..... Total Residue on Evaporation
S. Solid ..... Suspended Solid

As learnt from the test results in Ohazola LGA and Abakaliki LGA, it is anxious that the water to be exploited in the Project Area will exceed the WHO standards in turbidity, pH, total hardness, Fe, Mn and Cu contents.

The pH values in Abakaliki do not exceed the WHO standards but almost half of the tested water in Ohazola LGA, Imo State, exceed the standards. The UNICEF report mentions that the water with exceeding pH values to the acid side has caused hand pumps malfunction due to corrosion with riser pipes by acid, and consequently, anti-corrosive materials like stainless steel should be used for pipes.

High Fe content in water causes many rusts on pipe surface, occurrence of ferreous bacterias, defection in taste, and colorization of clothes washed. A careful attention should be paid to avoid cloggings on the delivery pipes of the hand pumps, although little adversely effects are given to human body.

Mn is expected to give similar effects to Fe, when contained in water, Cu contained in water, is toxic to fish and aquatic weeds, but little affects adversely to human body although water taste poor.

The turbidity, according to the UNICEF Report, is assumed to result from small shale particles to have dissolved out by heavy geological movement in the past. These wells, which are comparatively shallow in depth, will contain a considerable amount of water infiltrated from the ground surface. The countermeasures for such surface water infiltration should be taken by pouring cement grout around upper parts of holes and also a careful attention should be paid to the grading of filter materials to be employed to prevent small soil particles from following in.

2) Result of Germ Test by Survey Team

The Survey Team has carried out the germ tests for source water of the proposed objective area, and the results are shown in Table 3-8.

The test found that there were groups of color bacillus in the water sample taken from the boreholes in Echialiki and Enibichirialiki. Since such source water pollution is considered to come from inflow of surface water, it is quits essential to pour the cement grout to the upper walls of the wells.

d) Possibility of Mineralization of Water by Zinc

The report by DFRRI on the Water Supply Programme for 250 communities in Anambra State indicate that there are zinc and lead ores distributed in the Eze-Aku shale layers and the groundwater relating to such layers may be mineralized by zinc or lead in the conditions of the geological inclination to southeast and presence of pervious layers like sandstones.

The allowable limit set by WHO is 0.1 ppm for lead and 5.0 ppm for zinc. If water contains these minerals exceeding the above limit, continued use of this water as potable water will given an adverse effect to human body. Therefore, the in-situ water quality test to be conducted when the boreholes will be drilled shall include lead and zinc contents as check items.

e) *Summary of Water Quality Problems*

° Anti-corrosive materials shall be used for the riser pipes.

- The water in the Area contains Fe so much that the riser pipes of pumps may be clogged and maintenance services should be rendered considering this point.
- Careful attention shall be paid to the gradation curve of filter materials to prevent the fine particles in the soils from flowing in.
- It is necessary to provide the cement grout at the upper walls of the wells prevent surface water from flowing into and contaminate borehole.
- In some parts, the groundwater contains such minerals as lead and Zinc and when the in-situ water quality tests at drilling sites find excessive amount of lead or Zinc to the allowable limit, the boreholes shall be judged unsuitable and the holes shall be made backfill completely.

Table 3-8. Results of Germ Test for Source Water for Domestic Water Supply

LGAs/ Communities	Kind of[1/] Water Sources	Water Temperature (°C)	pH	Common Germ (1m/1it)		Color Bacillus (1m/1it)
Ikwo				Sample		
Echaliki	Borehole	31	7.6	No.1	4	0
Enibichialiki	"	32	7.0	No.2	80	20
Ndiaechaar*1	Pond	32	5.6	No.3	>100	80
Igbudu	Borehole	28	6.8	No.4	0	0
Awgu						
Amata.Mubo		29	5.6	No.5	100	10
Okpanku		28	6.6	No.6	100	150
Mpu (301it/min)	spring	27	6.4	No.7	80	20
Udoma (2001it/min)	spring	29	5.4	No.10	34	40
Ezza						
Amoura		28	6.4	No.8	>100	30
Inyere		36	6.2	No.9	>100	40
Abakaliki						
Oktemo	Borehole	28	7.0		-	-
Edda	Borehole		7.6		-	-

*1 ... Water is not used as potable water

(6) Summary of Hydro-geology

- The development objectives are the potential groundwater found in cracks in the deeper layers in the northern parts of the area as well as in the shallow weathered layers in the southern parts. Geology of the both parts is shale.

- When drilling points are decided, plural numbers of electric prospecting should be carried out for one point to give prudent judgement. Judging from the experience of the current survey, the electric prospecting should be conducted by horizontal prospecting method which is deemed effective as the UNICEF Team employed.

- The generally low values measured in the specific resistance are due to the water quality. The dissolved materials as lead and zinc are toxic to human body and Fe, Cu and extraordinary pH give adverse effects to pumping facilities, and therefore, necessary countermeasures should be taken prudently.

3-2. Socio-Economic Environment

(1) Transportation, Communication and Electrification

The transportation available between Lagos, the national capital, and Enugu, the state capital, is by air and land. For the air route, the daily flights are operated, while, for the land route, the well-paved highway links the two cities and it takes about six hours to trip by car.

The commercial port most closest to Enugu is Port-Harcourt, although about 250 km apart from Enugu and about 3-hours car ride for the trip.

The main roads around Enugu are well-paved, but other roads than the above unpaved and even four-wheel driving vehicles hardly access to the proposed objective areas in the wet season. And in most cases, the bridges with these branch roads are broken or unpassable with large vehicles.

The in-city telephone communication is available, but long-distance calls are often unsuccessful. The international calls from Enugu are almost impossible and telex is only the way available for communicating with outside areas of the city and foreign countries.

The Project Area has not been electrified yet, whereas the urban areas like Enugu city and Abakaliki town are already provided with electricity.

(2) Education

There are 2,074 elementary schools and 453 junior high schools in Anambra State and the farmer has about 757,000 pupils and the latter 195,000 pupils, respectively.

Besides the above, there are 153 Mission Schools with 21,000 pupils in total (1984 - 85, Statistic Division, Ministry of Finance and Economic Planning, Enugu). In the Project Area, there are 211 elementary schools and 39 junior high schools, having about 55,000 pupils and 9,500 pupils, respectively. (Ref. to the above data).

(3) Major Local Products

About 95 percent of the total number of households in Awgu LGA and about 92.4 percent of that in Ezza and Ikwo LGA's are farming households, (Ref. to above data) and the major products in the region are Yam and Cassava. In addition to the above, paddy and maize are grown. Cassava is grown throughout the year as perennial crop.

Sheep and chickens are raised by about 60 percent of farming households, although not so many in number. There are no major products but farm products.

3-3. Present Water Supply

(1) Ikwo LGA

The estimated population in Ikwo was 154,000 in 1986. There are no water supply systems provided in the area but only nine (9) boreholes drilled by Task Force but only two or three boreholes are available in the dry season. And yet, a restriction is set on the use of these boreholes by only 12 hours a day. And the water amount to be supplied by these pumps are in a range from 2.6 lit/min to 10.5 lit/min as the figures confirmed by the Survey Team.

When it is assumed that these boreholes can be operated for consecutive 12 hours, one well can supply water with 500 persons on an average on the assumption of the per capita consumption by 10 lit/head.

If three boreholes can be operated, the water can be supplied for 1,500 persons in prudent side, but the remaining 152,500 persons cannot be blessed with stable safety water supply.

As learnt from the above, the water supply by boreholes can cover only one percent or so in the dry season.

In the wet season, however, the groundwater table rises to enable the boreholes operative by pumps for water supply, except for those boreholes with pumps in trouble.

When eight boreholes are operative in the wet season, the beneficiary population rate rises to 2.5 percent with 4,000 persons supplied.

Those people who are not dependent upon the boreholes in their water supply, have actually to use the stangnant water in the artificial ponds in communities or stream water. There are

a variety of sizes in these artificial ponds with diameter from 200 m to 10 m.

These ponds are dug by villagers themselves to store water in the dry season. The water, which is stagnant in the ponds, provide habitats for cyclops, the middle hosts of Guinea-worm larvae. The local inhabitants use usually such stored water as daily domestic water but sometimes use as potable water unavoidably. And therefore, they are exposed to Guinea-worm larvae by drinking such water.

The surface water, rarely polluted by Guinea-worm larvae, cannot be fully used in the dry season, and they become stagnant water with considerably high turbidity in this season.

Most of the local people, however, use the surface runoff water as potable water.

(2) Ezza LGA

The estimated population of this LGA was 247,000 in 1986. There are no water supply systems except for three boreholes drilled by Task Farces. Two of the pumps were inspected by the Survey Team and found broken and unusable.

The local people have used the streams, ponds and artesian wells as water sources. In this area, the Abenyi River flows with considerably abundant discharge. People of the communities four to six kilometers apart from the water sources have been carrying their potable water on foot or by bicycle.

Around Onwke where the community hall is located, many of the artesian wells are less than 10 m deep. But only the rich men can afford to dig these wells because the construction cost is as high as 200 Nira. Consequently, other inhabitants share the water from

the wells. Water from these artesian wells supply muddy water but not polluted. However the water is unhealthy for drinking and not enough amount, to use this method for water supply scheme to eradicate Guinea-worm disease.

(3) Awgu LGA

The estimated population of the area was 300,000 in 1986. The Project includes seven communities in the southern half of this LGA with a total population of 129,000.

In one part of the objective area, there was a water supply system having groundwater source constructed before the civil war (1967 - 1970), but these facilities were destroyed beyond repair during the civil war.

There exists only one borehole drilled by Task Force, which can yield only a very little in the dry season. The local people are forced to seek the water from sources such as springs, artesian wells, or purchase from water tank rollies. There are two springs confirmed, which supply water with local people of about 43,000, of Udoma and Mpu communities.

These two springs, however, are located four to six kilometers away from the center of the communities. There are some artesian wells which can supply water even in the dry season, although their depth are in a range from 6 m to 7 m in general. But the construction cost of the wells is too expensive, more than 200 Nira, and only one well per 10 to 16 households is available.

The inhabitants in communities where springs or artesian wells are unavailable, have to buy water transported from Enugu city or Imo State. This water is sold at 1 Nira 50 Kobo per 1.0 Eng.gal.

Commonly, one family needs about 25.0 Eng.gal. per day (abt. 113 lit.), and the expenditure for water purchase is not so small.

The demographic and areal information of three objective LGAs are shown in Table 3-9.

Table 3-9. General Information of Objective Area (1986)

LGA	Land Area (km^2)	Population(1,000 persons) Total	Objective Area	GW Pollution Area	No. of Wells Reg'red	Exist. Boreholes	No. of GW Patients*4 (1,000 per's)	No. of Hospital*2
Ikwo	382	159	159	140	57	9	16 *1	11
Ezza	763	252	252	195	74	3	25 *1	4
Awgu	776	310	129	47	19	6	15	27
Total	1,921	721	540	382	150	18	56	42
Abakaliki *3	4,796	1,179	-	-	-	29	116	51
Anambra St.	17,675	7,085	-	-	-	111	118	859

*1 ... The figures are obtained by proportional distribution with coefficient of patient numbers (116,000) to Abakaliki population (1,180,000).

*2 ... Total of hospitals, clinics, material centers and health center (as of 1985).

*3 ... Abakaliki zone consists of 4 areas of Abakaliki, Ikwo, Ezza, & Ishiel LGAs.

*4 ... Incidence rate in polluted areas is deemed about 60%, but the Table show about 10% to total population of LGA.

3-4. Water Supply Programme by UNICEF

The UNICEF assisted WATSAN Programme was commenced in the Imo state in 1982 and continued its execution in 4 states (i.e. Imo, Gongola, Kwara, and Crossriver and Niger States). This programme is scheduled to start at Abakaliki, Ishielu and Ishi-uzo 3 LGA's in the Anambra State in 1988.

The outline of WATSAN Programme in the Anambra State is as follows:

1)	Name of Project	:	Anambra State Rural Water and Sanitation Project
2)	Financed by	:	Anambra State Government, the Directorate FMOH and UNICEF
3)	Executed by	:	Anambra State Government with assistance from UNICEF
4)	Duration of UNICEF's Assistance	:	From 1988 to 1990 (inclusive)
5)	Objectives of the Project	:	

5.1. General

a) Improve health and reduce the incidence of infant mortality and morbidity due to water-borne (especially Guinea-worm) and excreta-related diseases.

b) Promote behavioral changes with respect to water use, personal hygiene and efficient disposal of waste.

c) Generally improve the standard of living and generate a higher productivity in remote rural areas by reducing drudgery and water born diseases.

d) Mobilize communities and train artisans at village level for subsequent proliferation of adequate excreta disposal technology as well as financial and operational maintenance of water supply schemes.

5.2. Specific

a) Build state institutional capacity to provide potable water to rural areas, through a minimum handpump equipped borehole production rate of 50/rig/year, and application of other low cost technologies such as spring development and rain water catchment.

b) Develop and sustain "Village Level Operation and Maintenance" (VLOM) of the water points through the training of one Village Based Worker (VBW) per water point, and promoting the privatization of water point maintenance at village level.

c) Propagate Ventilated Improved Pit (VIP) latrine construction technology at village level, by constructing at least 200 demonstration compartments per year at market places, schools and clinics, and simultaneously provide "on the job training" of artisans.

d) Improve attitudes towards environmental sanitation and excreta disposal through community mobilization, health education and communication techniques. The effectiveness of this component will be indirectly measured by the reduction of faecal coliform counts in household water samples.

e) Eradicate water borne diseases, especially Guinea Worm Disease, which can be achieved by improving the water supply and health education in affected areas.

f) Develop a data base for the systematic development of water resources in the future.

The partial charges of the project are as follows:

UNICEF Undertakes to:

* Import and pay for the Anambra State Government 20 vehicles (4WD).

* Provide US$100,000 for the period 1989 to 1990 inclusive to procure 120 handpumps per year and accessories, as well as locally unavailable spare parts for light and heavy vehicles, and drilling equipment.

* Provide Support Personnel, as agreed in each annual Plan of Operation, to assist in Project implementation and training.
* Pay wages and salaries to UNICEF staff.

Anambra State Undertakes to:

* Agree to locate the Project in a highly visible position to enable it to mobilize resources and personnel from other sectors.

* Appoint a Project Manager who must be a competent and experienced government official and understands the government system thoroughly, and above all, has free access to Commissioners, Permanent Secretaries, Chief Executives and Directors.

* Provide a minimum of 1.5 million Naira (two rig operations plus the other specific objectives) for the Project's 1988 recurrent expenditure and in subsequent years until 1990, a budget corresponding to the level of activities.

* Provide a Project Base cum workshop as per design submitted to the State by UNICEF, and assign to the Project the underlisted equipment.

  - Workshop equipment and tools
  - 2 drilling rigs with accessories
  - 1 test pump unit
  - Geophysical equipment

The organogram of UNICEF assisted WATSAN Project is shown in FIG. 2-6.

CHAPTER 4. THE PROJECT

4-1. Objectives of the Project

The Project aims to supply safe water to people of Anambra State who have no adequate water supply facilities at present, to stabilize and upgrate their living standard, and to contribute to the national economic development of Nigeria.

The improvement of the existing water supply conditions in this state will eradicate the diseases presently caused by the poor quality of potable water, specially the Guinea worm disease which has marked a high incidence rate of farmers and children, and furthermore, it will increase the agricultural production, the major industry of this state.

The Project is outlined as follows;

(1) To construct 150 boreholes equipped with handpumps in the three Local Government Areas of Ikwo, Ezza and Awgu suffering from the highest incidence rate of Guinea worm disease in Anambra State for supply of potable water. The number of boreholes for each local government area is tabulated below;

LGA	Number of Communities	Population ('000 persons)	Number of boreholes	Incidence Rate (%)
Ikwo	15	154	57	68
Ezza	22	247	74	60
Awgu	7	129	19	62
Total	44	530	150	63

(2) To provide the equipment and materials for construction of the above-mentioned boreholes.

(3) To undertake on-the-job training of Nigerian personnels so that they will continue the construction of water supply facilities after the termination of Japanese cooperation by using the above equipment and materials.