

No. 01

BASIC DESIGN STUDY REPORT  
ON  
THE WATER SUPPLY PROJECT  
FOR  
MIDDLE TO LARGE SCALE VILLAGES  
IN  
THE NORTHWESTERN AREA  
OF  
THE FEDERAL REPUBLIC OF NIGERIA

JANUARY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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## PREFACE

In response to a request of the Government of the Federal Republic of Nigeria, the Government of Japan decided to conduct the Basic Design Study on the Water Supply Project for Middle to Large Scale Villages in the Northwestern Area of the Federal Republic of Nigeria, and entrusted the study to the Japan International Cooperation Agency (JICA).

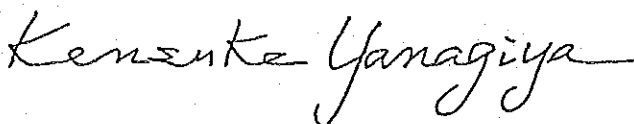
JICA sent to Nigeria a study team headed by Mr. Satoru Abe, Official, Grant Aid Division, Ministry of Foreign Affairs, from September 8 to October 7, 1991.

The Team held discussions with the officials concerned of the Government of the Federal Republic of Nigeria, and conducted a field study in the study area. After the Team returned to Japan, further studies were made and the present report was prepared.

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

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

January 1992



Kensuke Yanagiya  
President

Japan International Cooperation Agency

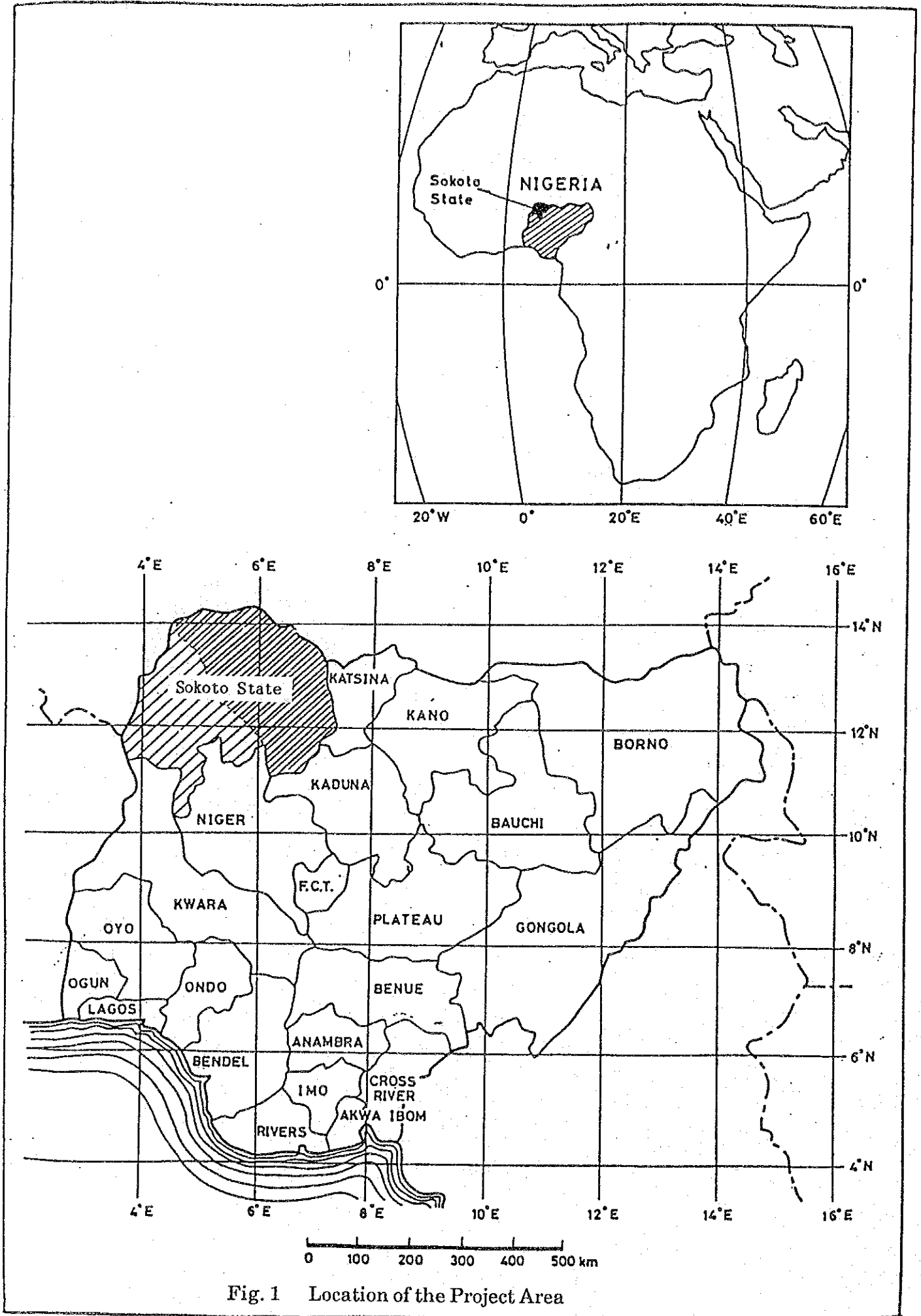


Fig. 1 Location of the Project Area



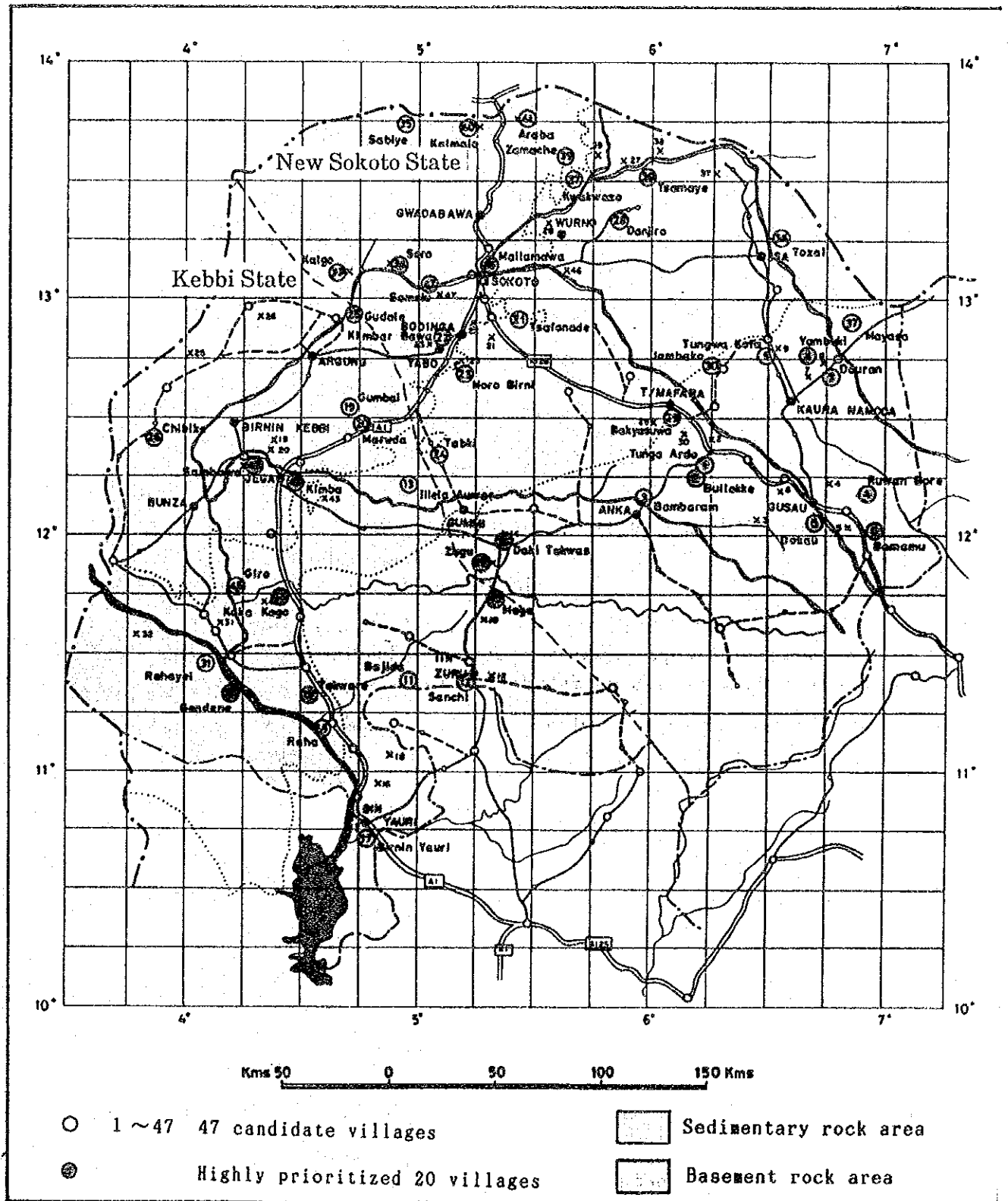


Fig. 2 Location of the Prioritized Villages

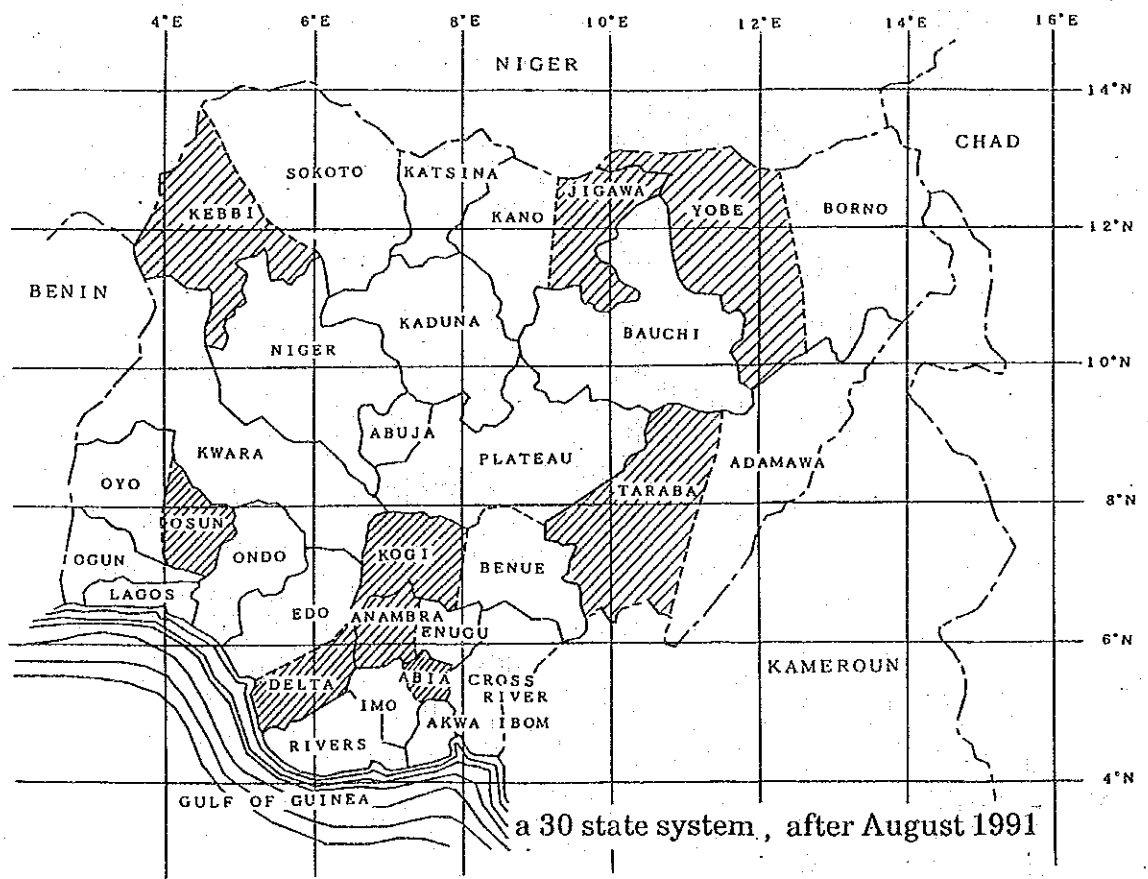
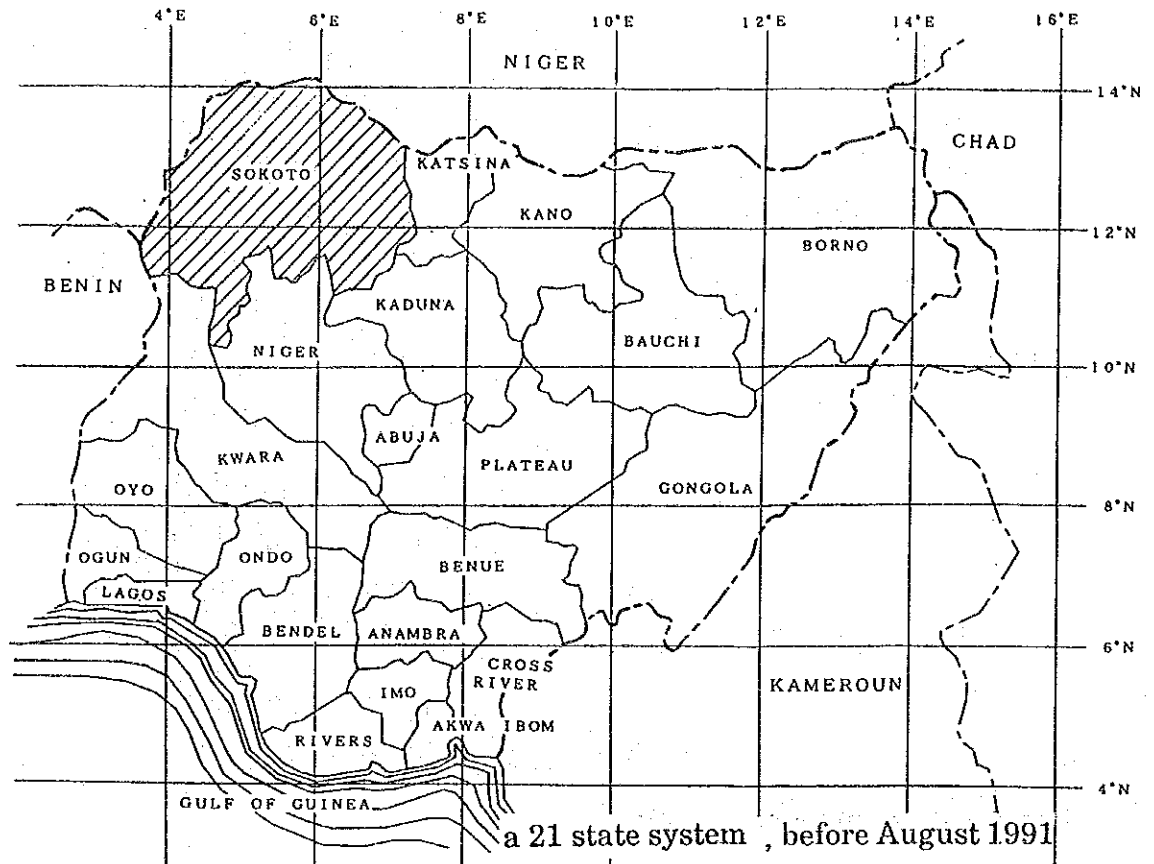


Fig. 3 State Boundary Map of Nigeria

## ABBREVIATION AND SYMBOLS

FMWR	:	Federal Ministry of Water Resources
FDWR	:	Federal Department of Water Resources
FDHH	:	Federal Department of Hydrology and Hydrogeology
FDWSQC	:	Federal Department of Water Supply and Quality Control
SMWHWR	:	State Ministry of Works, Housing and Water Resources
RBDA	:	River Basin Development Authority
SSWB	:	Sokoto State Water Board
KSWB	:	Kebbi State Water Board
SMANR	:	State Ministry of Agriculture and Natural Resources
SMACI	:	State Ministry of Agriculture, Commerce and Industry
SADP	:	Sokoto Agricultural Development Project
SARDA	:	Sokoto Agriculture and Rural Development Authority
LGA	:	Local Government Authority
DFRRI	:	Directorate for Food, Roads and Rural Infrastructure
WHO	:	World Health Organization
FMOH	:	Federal Ministry of Health
SMOH	:	State Ministry of Health
AFRC	:	Armed Forces Ruling Council
SAP	:	Structural Adjustment Programme
FGT	:	Federal Government Territory
GDP	:	Gross Domestic Product
l/c/d	:	liter per capita per day
l/min	:	liter per minute
5m BGS	:	5 meters below ground surface
5m AGS	:	5 meters above ground surface
φ 8"	:	8 inches in diameter



## SUMMARY

The Federal Republic of Nigeria (hereafter referred to as Nigeria) is the leading oil producing country in Africa producing 1,300,000 barrels of oil daily. The economy of the country is mainly dependent on oil production, and as a consequence was badly affected by the sluggish trend in the worldwide demand for oil in the 1980's which led to the sharp reduction of oil prices.

Nigeria was once one of the world's leading exporter of agricultural products, and accordingly, the Nigerian Government decided to restore its agricultural production potential in order to restore its failing economy. The economic restoration policy, with agricultural development as its main concern, was then formulated. The improvement of the standard of living in the rural area, which makes up 2/3 of the country's population, was given emphasis, and the securement of stable and sanitary drinking water became a matter of great importance.

In accordance with the above policy, the Federal Ministry of Agriculture, Rural and Water Resources Development formulated the groundwater development plan in 1987. The objective of the plan was to supply water to the middle to large scale villages in the northern part of Nigeria situated in the dry savannah zone where water resources are scarce. The Ministry then requested cooperation from the Japanese Government for the implementation of the project.

In accordance with this request, JICA carried out the "Study on Groundwater Development in Northern Nigeria" between April 1988 and June 1990. The study results revealed that the groundwater potential even in the so called difficult area is about 140m<sup>3</sup>/day km<sup>2</sup>. Furthermore, a water supply plan for 47 candidate villages was formulated and 20 highly prioritized villages were selected.

In December 1990, the Nigerian Government requested grant aid from the Japanese Government for the implementation of the groundwater development project in the 20 prioritized villages. In response to this, the Japanese Government implemented the Basic Design Study through the JICA.

The basic design Study Team conducted the field survey work from September 8, 1991 to October 7 of the same year. The Team conferred with the State Water Board, the Nigerian executing agency, concerning the details of the request, and concurrently conducted supplementary field survey work. However, as a result of the implementation of the Nigerian State Increase Policy (from a 21 state system to a 30 state system), the objective area, Sokoto State, along with the other States, was divided into 2 in August 27, directly before the Team's departure for Nigeria.

Further, the rationalization of the State Administration by integrating every State Ministry into 6 Ministries was also announced. In accordance with the State Division, the 20 villages named in the request were divided between the new Sokoto and Kebbi States, with 12 of the villages distributed in the new Sokoto State and 8 in the new Kebbi State. Based on the matters conferred with the Nigerian authorities concerned, it was confirmed that the Nigerian Government's prioritization of the 20 villages has not been altered. In addition, the details of the request for groundwater development and water facility construction in the 20 prioritized villages have been confirmed. However, it was decided that the implementation of the project in the 8 villages in the new Kebbi State should be put off for a little while longer until the organization of the executing body is confirmed. Therefore, the basic design study for the 12 villages in the new Sokoto State was finalized.

The water supply system of the new Sokoto State in the urban and rural areas are comparatively good. However, that of the majority of middle to large scale villages, supposedly the main supporters of the agricultural industry, is remarkably way behind. The implementation of this project, therefore, is a matter of urgency to the State Government.

Given the above conditions, the results of the basic design study are as shown below.

Item	Project
Project area	New Sokoto State (65,000km <sup>2</sup> ) 12 villages of high priority
Target Year	1992 - 1993
Target population	58,000 (New Sokoto State)
Construction of water supply system	<ul style="list-style-type: none"> <li>- Rural type facilities for 7 villages</li> <li>- Semi-urban type facilities for 2 villages</li> <li>- Combination of rural and semi-urban type facilities for 3 villages</li> </ul>
Equipment	<p>Vehicles and Tools for Maintenance and Management Use</p> <ul style="list-style-type: none"> <li>- 2 station wagons fully equipped with repair tools,</li> <li>- 1 well service machine</li> <li>- 1 set of tool and spare parts</li> </ul>

The project cost shared by the Nigerian side for the implementation of the above is 1,960,000 Naira.

This project is mainly executed by the Sokoto State Water Board which is under the jurisdiction of the Ministry of Works, Housing and Water Resources, Sokoto State. The Sokoto State Water Board also receives technical advise and guidance from the Water Supply and Quality Control Department of the Federal Ministry of Water Resources.

The departments of the State Water Board mainly in charge during the construction period is the Hydrology and Borehole Department, established through the merging of the former Rural Water Supply Department and Borehole Department, and the area offices concerned. After the construction period, the Building and Repair Department and the related area offices shall take over the management of the system. The General Manager of the State Water Board shall be generally responsible for the entire execution period of the project, including the operation and maintenance of the system.

The operation and maintenance system shall be conducted through the collaboration of the State Water Board and the Water Association organized in each village.

Each village shall organize a Water Association of their own, select an operator to conduct the daily operations, secure the funds required by the State Water Board, train the operators, and carry out the operation and maintenance of the system (patrol services including repair, preservation, inspection and fuel provision). The State Water Board's past achievements on the operation and maintenance of urban water supply systems confirmed a holding of capable and sufficient number of personnel, an aspect which makes the implementation of the operation possible. In addition, the operation and maintenance cost of the constructed materials which was estimated to be approximately 180,000 Naira in the 12 villages, an amount equivalent to approximately 0.2% of the State Water Board's recent average budget, proved the capability of the State Water Board in acquiring the required funds.

It can be concluded, therefore, that even under the current system, the State Water Board is adequately capable of carrying out the operation and maintenance of the constructed water supply systems.

The implementation of this project is estimated to take a period of 12 months, as the procurement and delivery of materials and equipment will take



approximately 5 months and the construction of wells and water supply facilities will take approximately 9 months.

The implementation of the project is expected to improve the health condition of the residents, save up much time allotted for water intake, increase agricultural production, and promote cultural activation, education, etc. In addition, it can result to the reduction of water purchasing costs and the activation of the area. Furthermore, it is also expected to improve the women's social status, especially housewives who will be participating in the water supply system management activities.

The Northern States of Nigeria, including the project area, are vastly made up of basement rocks, and according to previous results, the implementation of a large groundwater development is difficult in this area. In addition, similar to the project area, the water supply condition in the middle to large scale villages in the northern States is remarkably behind. The implementation of this project, therefore, will give impact to other Northern States due to similar geological and climatic conditions.

According to the aforementioned, the implementation of the groundwater development project under Japan's Grant Aid Program is considered highly relevant.

One of the prerequisites for the implementation of this project is the reconsideration of the current charge system. At present, the administrative organization takes full responsibility of the rural water supply system, from its execution up to its operation and maintenance. Due to heavy recurrent costs, therefore, new developments can not be implemented. However, if the beneficiaries share the burden of the recurrent cost, it is believed that the conditions of the rural water supply system is destined to improve. We are proposing, therefore, for the enlistment of the active participation of the residents in the operation and maintenance of the system and facilities, and the reinforcement of the partial sharing of costs.



## TABLE OF CONTENTS

	<u>Page</u>
PREFACE	
LOCATION MAP OF THE PROJECT AREA	
LOCATION MAP OF THE PROJECT SITES	
STATE BOUNDARY MAP OF NIGERIA	
ABBREVIATION AND SYMBOLS	
SUMMARY	
CHAPTER 1. INTRODUCTION .....	1
CHAPTER 2. BACKGROUND OF THE PROJECT .....	5
2-1 Overview of Water Supply Sector .....	5
2-1-1 Water Supply Conditions .....	5
2-1-2 Policy and Basic Plan .....	6
2-1-3 Present Situation of Water Supply Works .....	10
2-2 Outline of Related Projects .....	11
2-3 Outline of the Request .....	12
2-4 Outline of the Project Area .....	14
2-4-1 Location and Socio-Economic Condition .....	14
2-4-2 Natural Condition .....	16
2-4-3 Outline of Water Supply Sector .....	26
CHAPTER 3. OUTLINE OF THE PROJECT .....	33
3-1 Objective .....	33
3-2 The Study and Examination on the Request .....	34
3-2-1 Justification and Necessity .....	34
3-2-2 Execution, Operation and Maintenance .....	35
3-2-3 The Relation between Similar Projects and Foreign Assisted Projects .....	39

3-2-4	Study of Requested Facilities, Equipment and Materials .....	39
3-2-5	Necessity of Technical Cooperation .....	47
3-3	Project Description .....	48
3-3-1	Executing Agency and Operational Structure .....	48
3-3-2	Plan of Operation .....	49
3-3-3	Location and Condition of the Project Sites .....	50
3-3-4	Outline of Facilities and Equipment .....	51
3-3-5	Operation and Maintenance Plan .....	51
3-4	Technical Cooperation .....	57
CHAPTER 4.	BASIC DESIGN .....	58
4-1	Design Policy .....	58
4-2	Design Criteria .....	59
4-2-1	Water Supply Amount and Service Population .....	59
4-2-2	Type Selection of Water Supply System .....	60
4-2-3	Other Design Conditions .....	61
4-3	Basic Plan .....	63
4-3-1	Outline of Water Supply Facility Plan .....	63
4-3-2	Water Supply Facility Plan .....	64
4-3-3	Equipment Plan of Equipment .....	76
4-3-4	Basic Design Drawings .....	77
4-4	Implementation Plan .....	104
4-4-1	Implementation Policy and Personnel Required .....	104
4-4-2	Construction Condition and Points to Pay Attention .....	109
4-4-3	Construction Supervisory Plan .....	111

4-4-4	Procurement Plan .....	113
4-4-5	Implementation Schedule .....	116
4-4-6	Scope of Work .....	121
4-4-7	Project Cost Estimation .....	122
CHAPTER 5. PROJECT EVALUATION , CONCLUSION AND RECOMMENDATION .....		124
5-1	Project Effects and Conclusion .....	124
5-2	Recommendation .....	125

## List of tables

Table - 1	Administrative Division of Project Area .....	16
Table - 2	Water Supply System Construction Achievements of the (Old) Sokoto State Water Board .....	27
Table - 3	Budget Allocation to Sokoto State Water Board (including foreign assistance) .....	37
Table - 4	Requested Facility type and Classification by Geology and Administrative Area .....	40
Table - 5	Study Results of the Type and Scale of Facilities (for the 12 villages in Sokoto State) .....	45
Table - 6	Study Results of the Type and Scale of Facilities (for the 8 villages in Kebbi State) .....	45
Table - 7	Comparison Table of Request/ Basic Design .....	46
Table - 8	Target Water Supply Amount Guidline .....	59
Table - 9	Outline of the Water Supply Facility Plan (for the 12 villages in Sokoto State) .....	64
Table - 10	Outline of the Water Supply Facility Plan for the 12 Villages in Sokoto State .....	65
Table - 11	Number of Casing/ Screen Materials .....	74
Table - 12	Quantity of Pump Facilities .....	75
Table - 13	Quantity of Distribution Pipes .....	75
Table - 14	Project Personnel Distribution Plan .....	108
Table - 15	Procurement of Facilities, Materials and Equipment .....	115
Table - 16	Work Flow Chart .....	117
Table - 17	Well Construction Work Schedule .....	120

## List of Figures

Fig. 1	Location of the Project Area	
Fig. 2	Location of the Prioritized Villages	
Fig. 3	State Boundaty Map of Nigeria	
Fig. 4	Meteorological observatory and raimfall distribution .....	23
Fig. 5	Geological plane of the project area .....	24
Fig. 6	Geological diagram of the project area .....	25
Fig. 7	Organization Chart of New Sokoto State Water Board ....	31
Fig. 8	Organization Chart of Kebbi State Water Board .....	32
Fig. 9-1	Standard Design of the Well (Hand pump) .....	72
Fig. 9-2	Standard Design of the Well (motorized pump) .....	73
Fig. 10	Standard water supply facility (1) Hand pump pase structure .....	78
Fig. 11-1	Standard Water Supply facility (2)-① 32 m <sup>3</sup> , Elevated Reservoir tank Structure .....	79
Fig. 11-2-1	Standard Water Supply facility (2)-② 3 m high, Elevated tank tower Structure .....	80
Fig. 11-2-2	Standard Water Supply facility (2)-③ 5 m high, Elevated tank tower Structure .....	81
Fig. 11-2-3	Standard Water Supply facility (2)-④ 7 m high, Elevated tank tower Structure .....	82
Fig. 11-3	Standard Water Supply facility (3) Commural faucet base Structure .....	83
Fig. 11-4	Standard Water Supply facility (4) Joints, standard cross-section of excavation and others ...	84
Fig. 11-5	Standard Water Supply facility (5) Generator house Structure .....	85
Fig. 12-1-1	Water facility arrangement graph No. 1 Tunga Ardo .....	87

Fig. 12-2-1	Water facility arrangement graph No. 2 Bullake .....	88
Fig. 12-3-1	Water facility arrangement graph No. 4 Ruwan Bore .....	89
Fig. 12-3-2	Water supply facility vertical graph No. 4 Ruwan Bore .....	90
Fig. 12-4-1	Water facility arrangement graph No. 5 Dokau .....	91
Fig. 12-4-2	Water supply facility vertical graph No. 5 Dokau .....	92
Fig. 12-5-1	Water facility arrangement graph No. 6 Bamamu .....	93
Fig. 12-6-1	Water facility arrangement graph No. 7 Dauran .....	94
Fig. 12-6-2	Water supply facility vertical graph No. 7 Dauran .....	95
Fig. 12-7-1	Water facility arrangement graph No. 8 Yambuki .....	96
Fig. 12-7-2	Water supply facility vertical graph No. 8 Yambuki .....	97
Fig. 12-8-1	Water facility arrangement graph No. 14 Daki Takwas .....	98
Fig. 12-9-1	Water facility arrangement graph No. 15 Zugu .....	99
Fig. 12-9-2	Water supply facility vertical graph No. 15 Zugu .....	100
Fig. 12-10-1	Water facility arrangement graph No. 34 Soro .....	101
Fig. 12-11-1	Water facility arrangement graph No. 46 Mallamawa .....	102
Fig. 12-12-1	Water facility arrangement graph No. 47 Samalu .....	103



## APPENDIX

1.	Minutes of Discussions .....	A - 1
2.	Interview members list of Basic Design Survey Team .....	A - 16
3.	Formation of Basic Design Survey Team .....	A - 18
4.	Calendar of Basic Design Survey Team .....	A - 20
5.	Basic Design of Water Supply Facilities for the 8 villages in Kebbi State .....	A - 22
	5 - 1 Water Supply Facility Plan .....	A - 23
	5 - 2 Water Supply Facility Plan by Village .....	A - 28
6.	Appended figures and tables	
Appended table -1	Outline of the water supply facility design for the 8 villages in Kebbi state .....	A - 24
Appended table-2	Outline of the water supply facility plan for the 8 villages in Kebbi state .....	A - 25
Appended table-3	Quantity of wells .....	A - 26
Appended table-4	Quantity of elevated reservoir tanks, towers and generator houses .....	A - 26
Appended table-5	Quantity of pump facilities .....	A - 27
Appended table-6	Quantity of distribution pipes .....	A - 27
Appended Fig. 1-1	Water supply facility arrangement graph No.10 Maga .....	A - 29
Appended Fig. 1-2	Water supply facility vertical graph No.10 Maga .....	A - 30
Appended Fig. 2-1	Water supply facility arrangement graph No.18 Takware .....	A - 31
Appended Fig. 2-2	Water supply facility vertical graph No.18 Takware .....	A - 32
Appended Fig. 3-1	Water supply facility arrangement graph No.25 Gudale .....	A - 33
Appended Fig. 3-2	Water supply facility vertical graph No.25 Gudale .....	A - 34
Appended Fig. 4-1	Water supply facility arrangement graph No.26 Chibike .....	A - 35

Appended Fig. 4-2	Water supply facility vertical graph No.26 Chibike .....	A - 36
Appended Fig. 5-1	Water supply facility arrangement graph No.32 Gendene .....	A - 37
Appended Fig. 5-2	Water supply facility vertical graph No.32 Gendene .....	A - 38
Appended Fig. 6-1	Water supply facility arrangement graph No.42 Sambawa .....	A - 39
Appended Fig. 6-2	Water supply facility vertical graph No.42 Sambawa .....	A - 40
Appended Fig. 7-1	Water supply facility arrangement graph No.43 Kimba .....	A - 41
Appended Fig. 7-2	Water supply facility vertical graph No.43 Kimba .....	A - 42
Appended Fig. 8-1	Water supply facility arrangement graph No.44 Kuka Kogo .....	A - 43
Appended Fig. 8-2	Water supply facility vertical graph No.44 Kuka Kogo .....	A - 44

## **CHAPTER 1. INTRODUCTION**



## CHAPTER 1 INTRODUCTION

The Federal Republic of Nigeria (referred to hereafter as Nigeria), before its declaration of independence from the British Empire in 1960, became an oil producing country in 1957. It started exporting crude oil in 1958 and became the leading oil producing country in the African Continent. Although 70 to 80% of the national finance income depends on oil, the country is essentially an agricultural country and two-thirds of the population are into agriculture. In the first half of the 1960's, the GDP rate of agriculture was 60% and agricultural products covered 70% of the export industry. In the latter half of the 1960's, however, the economic trend shifted from agriculture to oil due to the rapid increase in oil production.

The first oil shock in 1973 brought the country huge foreign currency holdings and worldwide acknowledgement as a country that would likely attain remarkable economic growth. The economy started to weaken in the 1980's, however, when the oil export industry showed a sluggish trend which consequently led to the inevitable sharp reduction of oil prices in 1983, an occurrence which delivered a heavy blow to the nation's economy.

Agriculture was once the nation's basic industry, but it had been given light consideration since 1979 as the economy shifted its focus to oil production. As a consequence, the country lost its full potential in agricultural production.

In order to cope with the above-mentioned situation, the Structural Adjustment Program (SAP) was formulated in 1986 as an economic restoration policy. Aside from this, the Fifth Five-Year Development Plan (1987-1991) was also formulated. This development plan aims to improve the nation's standard of living by establishing economic independence. To re-establish national economy, development shall not be limited only to the oil industry, but shall also encompass the agricultural industry, the steel industry, gas industry, mining industry, the manufacturing industry, and the industry of communication and transport. High priority is particularly attributed to the establishment of self-sufficiency in food production through agricultural development, expansion of the export industry and the improvement of the citizen's standard of living.

Moreover, the National Economy Restoration Plan implemented in 1988 emphasized agricultural expansion to gain self-sufficiency in food production and seriously considered the improvement of the standard of living of the many farmers residing in the rural area.

The northern states of Nigeria, including the new Sokoto and Kebbi states (the details of the division of Sokoto State shall be given later), the objective areas of the Water Supply Project in the Northwestern Area, are situated in the savannah dry zone. Although the implementation of a large agricultural development is difficult in this area, each State aims to gradually establish a self-supply system by improving the farmers' standard of living. It is, therefore, important to immediately ensure the stable and hygienic supply of the residents' domestic water by developing groundwater in this area where most of the rivers are dried up in the long dry season.

Under these circumstances, the Nigerian Government requested technical assistance from the Japanese Government in 1987 for the implementation of groundwater development and the water supply project using groundwater as its source in the (former) Sokoto and Niger States of the northwestern area.

In answer to the above request, the Japanese Government dispatched the Contact Mission in November 1987 and the Scope of Work (S/W) Mission in February 1988. A Conference was held and mutual agreement was reached by both governments on the development study in the former Sokoto State.

The project study commenced in March 1988. The groundwater development potential of the entire (former) Sokoto State area (approximately 100,000km<sup>2</sup>) was evaluated and the water supply project for the 47 middle to large villages within the state was formulated. The results of the study are summarized in the final report which was completed in June 1990.

Based on the results of the study, the Nigerian Government selected 20 villages that are urgently in need of groundwater development and which shall profit highly from the project. Then in December 1990, it appealed to the Japanese Government for grant aid for the implementation of the project.

After studying the request, the Japanese Government decided to conduct the basic design study of the project. Based on the Government's implementation policy, the Japan International Cooperation Agency (JICA) dispatched the basic design Study Team, headed by Mr. Satoru Abe of the Ministry of Foreign Affairs Economic Cooperation Bureau Grant Aid Section, to Nigeria from the 8th of September 1991 up to the 7th of October 1991.

In August 27, 1991, the commemoration day of the President's 6th year of reign and directly before the Study Team's departure, President Babangida publicly announced the change of the 21 State system to the 30 State system. Accordingly, Sokoto State, the objective area, was then divided into the new Sokoto State in the northeastern half, and the new Kebbi State in the southwestern half. The following day, the new governors of the 9 newly established States and the policy to rationalize the state administration by restricting the administrative organization of all 30 States to 6 Ministries were officially announced.

In the former administration, the Sokoto State Water Board, which is under the jurisdiction of the Sokoto State Ministry of Public Works and Transport, was responsible for the execution of the water supply project. As a result of the aforementioned division of States and the re-organization of the State Ministries, the respective Ministry of Works, Housing, and Water Resources of the new Sokoto and Kebbi States became directly in charge of the water supply projects.

The new Sokoto State Water Board and the Kebbi State Water Board became the executing agencies, and 12 and 8 of the 20 selected villages belong to Sokoto State and Kebbi State, respectively.

The Study Team visited Nigeria when the country was in the midst of administrative reformation work and the distribution of the State Water Board personnel and facilities between 2 States. Despite the fact that the high ranking personnel were selected and facility distribution policies were settled in the new Kebbi State, both the Water Board and Ministry were then nonexistent. As a result, the Study Team was obliged to confer the details of the request with the authorities of the new Sokoto State, while it conducted the field survey (supplementary study, namely leveling, electric prospecting, study of the construction conditions, etc.) required for facility design.

The Study Team, based on the results of the development study and the supplementary field survey, designed the water supply facilities for the 20 selected villages situated in the 2 States and calculated the construction cost after arriving in Japan. However, the study concerning the economic feasibility of the grant aid, facility construction and operation and maintenance plan, granting of materials for the facilities, and the calculation of the project cost estimate stated in this report only indicated that of the new Sokoto State (12 selected villages).

Although the consignment of the Water Board, which is under the jurisdiction of the Ministry of Works, Housing and Water Resources, as the executing agency in Kebbi State was confirmed, its actual state was nonexistent. Therefore, the progress of the formation of the Water Board's structure and its preparedness should be observed closely before another study is to be carried out.

The facility design data relevant to Kebbi State and the data obtained from the field survey are shown in the Appendix.

The composition of the Study Team, detailed study schedule, the minutes of discussion, interviewer's list, and the list of collected data are also shown in the Appendix.

This basic design study was originally entitled as the "Basic Design Study of the Water Supply Project in Sokoto State". It was, however, changed after the field study to the "Water Supply Project for Middle to Large Scale Villages in the Northwestern Area of the Federal Republic of Nigeria" to avoid the confusing conditions prevailing between the old and the New Sokoto State at that time.



## **CHAPTER 2. BACK GROUND OF THE PROJECT**



## CHAPTER 2 BACKGROUND OF THE PROJECT

### 2-1 Overview of Water Supply Sector

#### 2-1-1 Water Supply Conditions

The propagation rate of the water supply system in Nigeria's urban areas is over 90% (72% for pipe water supply facilities, 6% for hand pump wells and 17% for dug-wells). By contrast, the propagation rate in rural areas (covering more than 80% of the Nigerian population) is only 40% (9% for pipe water supply facilities, 6% for hand pump wells and 25% for dug-wells). The rest of the inhabitants are using river water or standing water. Conclusively, only 60% of the country's population are provided with water supply facilities.

The use of dug-wells usually involve problems like domestic drainage contamination and depletion during the dry season. Hence, the propagation rate of stable and safe water supply facilities nationwide is estimated to be less than 50%, and less than 30% in rural areas.

The 4th National Development Plan points out the following problems concerning low water supply conditions :

- Insufficient water supply facilities and insanitary water.
- The rural areas are not completely provided with the required water supply facilities.
- The Water Supply Sector's lack of funds due to inadequate budget distribution.
- Lack of ability to execute the charge system which shall increase the plant investment.
- Improper maintenance of water supply facilities due to shortage of staff.

The guideline of the First Rolling Plan (1990-1992) indicates the following causal factors behind the problems of the water supply sector :

- Difficulty in securement of funds collected from beneficiaries due to a disordered organization and management system.

- Inadequate maintenance of existing water supply facilities due to shortage of technical experts and materials.
- Restriction in the amount of water resources to be supplied due to insufficient water supply and distribution networks, particularly in southern Nigeria where water resources are abundant.
- The organizations responsible for the water supply works, namely the State Water Board and the local government, and the State Ministry of Health which is supposed to be responsible for health and water resources are not in league with each other.

The Water Supply Sector is beset by the above mentioned problems. The conditions were even worsened by the implementation of the Structural Adjustment Program (SAP), the economic reformation policy, in 1986. The implementation brought about the devaluation of the currency which led to the decrease in the budget for the import of materials required in the construction and operation and maintenance of facilities. Due to this condition, the launching of new enterprises and the immediate solution of the shortage of materials for the operation and maintenance of facilities became difficult. Moreover, it particularly caused the remarkable delay of the water supply project in the rural area.

#### 2-1-2 Policy and Basic Plan

The related water supply improvement projects of Nigeria, in the Federal Government level, are executed by the following organizations.

- Organizations under the jurisdiction of the Federal Ministry of Water Resources (FMWR) :
  - a). The Federal Department of Hydrology and Hydrogeology (FDHH)
  - b). The Federal Department of Water Supply and Quality Control (FDWSQC)
  - c). The River Basin Development Authority (RBDA)
- Organization under the jurisdiction of the State Ministry of Agriculture :

a). The Directorate for Food, Roads and Rural Infrastructure (DRRRI)

In the Local Government level, the executing organizations are as follows.

- The State Water Board (SWB) of the State Ministry of Water Resources is the main executing organization;
- The State Ministry of Health (SMOH);
- The State Agriculture and Development Authority (SARDA) administered by the State Ministry of Agriculture.

The water supply related policies included in the 4th Five Year National Development Plan are as follows.

- 1) The reinforcement of the State Water Board personnel and financial standing through the thorough collection of water charges.
- 2) The development of new water resources by the River Basin Development Authority (RBDA) and the State Water Board (SWB). Water resources can be secured by the use of dams for storage, use of boreholes, and by the desalination of sea water.
- 3) The training of the technical staff for water supply works.
- 4) The setting up of campaigns for the importance of boiling drinking water in rural areas to guarantee a safe water quality.
- 5) The completion of the Hydrology and Hydrogeological Study for the securement of new water resources.
- 6) The installation of a water quality laboratory in the State Water Board for water quality control.

The objective of the above mentioned plan is to ensure a stable and sanitary drinking water supply. To achieve this objective, the following strategies were formulated and indicated in the 1st Rolling Plan (1990-1992).

- 1) Decentralization of responsibilities to fully enable the person in charge of the daily water supply and maintenance of the facilities to demonstrate discretion.
- 2) Training of staff needed for the short and long term operation and maintenance of facilities.
- 3) Promotion of local manufacturing industries, establishment of enterprises and the encouragement of the production of chemical products and materials for water supply and distribution.
- 4) Enforcement of the institutional authority of the Federal Ministry of Water Resources to encourage cooperation and coordination among the water supply sector staff and to accelerate the standardization of their technique, including those within the service level and the environment preservation standards.
- 5) Introduction of a proper system for the collection of charges from the beneficiaries to secure funds which shall cover the essential operation and maintenance cost.
- 6) Publicize the importance of sanitary drinking water to promote the residents' health and environmental sanitation through the media and the activities of the local organization.
- 7) Implementation of various research studies and to make the results of these known to each State Water Board in order to improve the quality and quantity of water supply.
- 8) The increasement of the amount of community water supply by the Federal Government through DFFRI.

Similar to the above, the 1st Rolling Plan (1900-1992) shall not only reinforce the maintenance and management of the existing facilities, but shall also emphasize the following :

- Technological Cooperation in the implementation of the proj
- Involvement of the residents ;
- Fund collection introducing the charge system ;
- Minimization of the use of foreign currency ;
- Training of technical staff engaged in water supply works.

### 2-1-3 Present Situation of the Water Supply Works

The budget allocated for the water supply sector in the First Rolling Plan had to be changed due to the increase in the number of States in 1991. The 3 year budget indicated in the plan in the beginning of 1990 exceeded 2,580 million naira, approximately 2.4% of the total budget for all sectors (104,510 million naira) (see list below).

Federal Government and 21 States	Total budget for water supply sector (1990 - 1992) (1 million naira)
Federal Government	18.235
Akwa Ibom	64.600
Anambra (Enugu, Anambra)	85.930
Bauchi	86.860
Bendel (Edo, Delta)	142.690
Benue (Kogi, Benue)	14.152
Borno (Yobe, Borno)	267.078
Cross River	40.000
Gongola (Taraba, Adamawa)	66.452
Imo (Abia, Imo)	92.000
Kaduna	82.355
Kano (Jigawa, Kano)	150.000
Katsina	139.630
Kwara	66.363
Lagos	250.000
Niger	125.500
Ogun	91.285
Ondo	75.200
Oyo (Oyo, Osun)	148.450
Plateau	21.400
Rivers	246.075
Sokoto (Kebbi, Sokoto)	309.489
<b>Total</b>	<b>2,583.744</b>



The water related administrations of Nigeria are generally governed by the Federal Ministry of Water Resources. In terms of water supply works, the Federal Department of Water Supply and Quality Control (FPWSQC) plays a leading part among the 8 departments in the FMWR. On the other hand, the Federal Department of Hydrology and Hydrogeology (FDHH) administers water resource developments, and in accordance with the water resource conditions in each State, participates in the river water use and groundwater development and extends technological advice to the related organizations of the States.

The execution of the water supply works, however, is mainly the responsibility of the Water Board of each State under the jurisdiction of the Federal Ministry of Water Resources. Water Supply Works for special purposes, however, are usually executed by the following organizations aside from the State Water Board.

- Water supply works to counter-act water born diseases

The State Ministry of Health participates in the works. This particular project was conducted through Japan's Grant Aid Program in the Anambra State (1989) and Niger State (1991) as a countermeasure against Guinea Worm diseases.

- Water supply works to improve the standard of living in rural villages

The State Ministry of Agriculture is the main executing body. Through the subsidy of the World Bank, more than 6,000 wells (hand pump wells) have been drilled in 1984 in various northern States including Sokoto, Kano and Bauchi. The project still continues at present.

## 2-2 Outline of Related Projects

The Federal Ministry of Agriculture, Rural Water Resources Development conducted a borehole project nationwide from the latter half of the 1970's up to the start of the 1980's. In this project, 80 deep wells were drilled in the old Sokoto State, and approximately 40 of these were installed with motor pumps. These

facilities are utilized by large villages. These facilities were transferred to Sokoto State in 1984, and the State Water Board maintains and manages them.

The Federal Ministry of Water Resources formulated the water supply project for groundwater development in the northern part of Nigeria where surface water resources are poor. The groundwater development study in northern Nigeria was implemented from 1988 to 1990 through the technical assistance of Japan. Aside from the Ministry of Water Resources, the Sokoto State Water Board as well as the Sokoto Rima River Basin Development Authorities participate as the counterparts of JICA.

Recently, the Federal Ministry of Water Resources, with the aim to accelerate the development of water supply, irrigation, hydropower plant and other related projects, formulated the nationwide water resources development plan in 1991. It is now requesting assistance from the Japanese Government for the formulation of the Master Plan.

### 2-3 Outline of the Request

The 4th Five-Year Plan (started in 1984 and was discontinued) and the 1st Rolling Plan (1990-1992) of the Nigerian Government state that the implementation of the drinking water supply must be given utmost importance as it shall satisfy the most basic human need. It is particularly important to immediately proceed with the water supply project in the rural areas, to elevate the standard of living in this area and consequently restore the agricultural industry, the main policy of the Government to restore the economy.

Given these conditions, the Federal Ministry of Agriculture and Rural Water Resources Development of Nigeria (later divided into the Federal Ministry of Agriculture and Rural Development and the Federal Ministry of Water Resources) formulated "the northern area groundwater development plan" which includes water supply works for middle to large scale villages. The Ministry,

then, requested the Japanese Government for cooperation in 1987 for the implementation of the plan.

The northern part of Nigeria is situated in the dry savannah zone with very little rain. More than half of the area is a basement rock area, a difficult area for groundwater development. These topographic conditions proved the importance of a thorough study prior to the implementation of the project. In view of this condition, the Japanese Government answered the request of the Nigerian Government by conducting the development study.

The development study covered the former Sokoto State (new Sokoto and Kebbi States, covering approximately 101 thousand km<sup>2</sup>) out of the states mentioned in the request, Sokoto and Niger States (covering approximately 175,000km<sup>2</sup>). The final report of the development study was completed in June 1990. Based on the results of the development study, the Nigerian Government once again appealed to the Japanese Government in December 1990 for grant aid for the implementation of the project in the 20 highly prioritized villages among the 47 middle to large scale villages.

The details of the request concern the construction of water supply facilities in the following 20 villages.

Area I (12 villages)

Tunga Ardo  
Bullake  
Ruwan Bore  
Dokau  
Bamamu  
Dauran  
Yambuki  
Daki Takwas  
Zugu  
Soro  
Mallamawa  
Samalu

Area II (8 villages)

Maga  
Takware  
Gudale  
Chibike  
Gendene  
Sambawa  
Kimba  
Kuka Kogo

## 2-4 Outline of the Project Area

### 2-4-1 Location and Socio-Economic Environment

The project area is located in the northwestern part of Nigeria. It is the former Sokoto State which is now divided into the Kebbi State and the new Sokoto State. It is partly bordered by the Democratic Republic of Benin to the southwest area and by Niger for most part of the western area and the entire northern area. To the east, it is bordered by the Katsina State (separated from Kaduna in 1987), and to the south, by the 3 States Kaduna, Niger and Kwara.

The area measures approximately 100,000 km<sup>2</sup> and ranks as the third biggest Nigerian State after the former Borno State (divided into Yobe and Borno States in 1991) and the former Gongola State (divided into Taraba and Adamawa States).

As of 1990, the population of the area is estimated at 9.05 million, and more than 80 % of the populace are engaged in farming (the agricultural population of Nigeria is 58% of the country's population).

Sokoto State is located in the dry savannah zone where the dry season is long. The agricultural activities in the area are limited to the rainy season, which is from May to October, except in the irrigation area along the Sokoto River. During harvest time, however, it produces approximately 1,900,000 tons of grain, 50,000 tons of cotton, etc. Cattle raising is also prosperous in the area, and the Fulani family is always on the move in search of new pastures. Approximately 750 thousand cattle, sheep and goats are also raised in the area.

Next to agriculture, the Government largely supports the commercial and industrial section. It re-established the State Investment Board and conducted enlightenment campaigns through seminars and workshops. However, the interest of the investors are directed to marketing and service industries, and the manufacturing industry is only limited to the manual production of textile, furs and general merchandise.

The former Sokoto State was administered by 5 Administrative Divisions composed of 219 local government authorities and 83 districts. In August of 1991, a decree to increase the number of States was officially announced, and as shown in Table 1, Sokoto was divided into 2 States with 18 local government authorities and 80 districts.

There are 4 large tribes in the area, and among these, Hausa (83%) and Fulani (12%) are overwhelmingly large that together they constitute 95% of the population. Islam is the main religion in both tribes (the Christian population is only less than 5%). The ratio between the Muslims and the Christians in the northern area is 9:1 or 95:5. In the southern States, however, the Christian population dominates the Muslims with a ratio of 6:4 or 7:3.

Christians living among the Muslim populace are usually alienated. But villages composed only of Muslims are well coordinated with a village chief as the central figure.

The head of the Muslims is called a Sultan. The Sultan is elected from the Emirs of 5 States, and the Sultan's Palace is established in the elected Emir's State. At present, the Palace is in Sokoto. The Sultan is vested with vast authority that even the President of Nigeria must pay him a courtesy call before starting his visit to the Northern States.

Table - 1 Administrative Division of Project Area

State	Administrative Division	Local Government Authority	District
Kebbi	Argungu	Augungu	8
	Gwandu	Bagudo	6
		Birnin-Kebbi	2
		Bunza	5
		Jega	2
	Yauri	Yauri	6
	Zuru	Zuru	6
Sokoto	Sokoto	Anka	3
		Bodinga	6
		Gusau	4
		Gwadabawa	2
		Isa	2
		Kaura-Namoda	3
		Silame	3
		Sokoto	7
		Talata-Mafara	4
		Wurno	5
Yabo	6		

## 2-4-2 Natural Conditions

### (1) Meteorology

The meteorology of the former Sokoto State, now divided into Sokoto and Kebbi States, is characterized by the rainy season from May to September and the dry season from October to April. The largest monthly mean precipitation is in August, indicating 240 mm in Gusau. There are no precipitation from November to February, but few in October, March and April.

The mean precipitation in Sokoto City is 632 mm. From the latter half of the 1970's up to the 1980's, however, the amount of precipitation has taken a downward trend. In 1987, the amount of precipitation was the lowest ever in the 1980's at 325 mm.

As shown in Fig.4, the rainfall distribution decreases northwards from Sokoto to the Nigerian Border indicating less than 600 mm/year. On the way south, however, it gradually increases at the southern line connecting Bunza and Talata-Mafara at more than 900 mm/year.

In Sokoto State, the daily mean maximum and minimum temperature by year are 34.8° C and 21.2° C, respectively. Temperature is highest in April at 40.1° C, and lowest in August at 30.5° C. The temperature in Sokoto State does not vary greatly, but Sokoto city and its outskirts are the hottest area in the State.

## (2) River Hydrology

The rivers flowing in the project area are the prominent African Niger River and its tributaries namely the Rima River, Sokoto River and Zamfara River. The Niger river flows eastward from the neighboring Niger Republic to Nigeria. It passes through the southwestern part of the Kebbi State off to the Niger State. The length of the river's course in Sokoto State is approximately 150 km.

Rima River originates from the basement rock area of the northeast mountains of new Sokoto State. It takes the north-northwest direction off to Sabon Birni and then flows southwest to Wamako. It is joined somewhere in between by the Sokoto River which also flows to the northwest direction of the basement rock area. Rima River joins the Zamfara river near Bunza and as it moves south, it joins the Niger River near the border of the Kwara State.(see Fig. 2 in the first page).

The basin area of Rima River at the Wamako point is approximately 57,000 km<sup>2</sup>. It has an annual flow of approximately 1,700 million m<sup>3</sup>. The basin area of Sokoto River at the Gitandoka point is approximately 12,000km<sup>2</sup>. It has an annual flow of 730 million m<sup>3</sup> (both estimates were based from the 1965~1966 records). Furthermore, the measured flow of the Zamfara River in Jega during

the study showed a very high value of 284 m<sup>3</sup>/sec (September 1988), and a very low value of 0.95 m<sup>3</sup>/sec (October 1988).

The rivers flowing into the Sokoto and Rima Rivers are the intermittent rivers in the basement rock area. The downstream and midstream of the Sokoto and Rima rivers are the perennial rivers in the sedimentary area.

The annual run-off ratio of Gitandoka, located downstream of the Sokoto River, and Wamako, located in the middlestream of Rima River, amounts to 4~7%. The remaining percentage either permeates the ground or is evapotranspired.

The discharge observation in the Rima River was carried out from November 1988 to March 1989. The results showed the following correlation between the water balance of the river bed and the groundwater of the catchment area.

i) During the rainy season (June to August), the total flow of Gitandoka and Sabon Birni, located upstream of the Rima River, is larger than the flow of Wamako downstream. The amount of flow lost is assumed to cause influent seepage in the alluvium along the river. However, as the dry season approaches, the flow of Wamako exceeds the flow upstream due to groundwater oozing out from the Kalambaina limestone aquifer.

ii) The flow of Wamako and Argung ranges from 10~200 m<sup>3</sup>/sec from May to September, with the upstream flow of Wamako exceeding that of Argung. But during the dry season, where both flows range from 1.0~10 m<sup>3</sup>/sec, the conditions are reversed due to groundwater oozing out from the upper aquifer of the Gwandu formation and the alluvium.

iii) The downstream flow of Argung and Bunza increases during the dry season. Since there are no inflowing rivers, the increase may be largely attributed to groundwater oozing out from the aquifer of the Gwandu Formation and the alluvium.



iv) The flow of the Zamfara River in Jega in the dry season (1~13 m<sup>3</sup>/sec) is maintained by the groundwater oozing out from the outcrops of the Gundumi Formation and the Rima Formation in the basin.

### (3) Geology

The geological structure of the project area is shown in fig. 5 (geological plane), and Fig. 6 (geological cross section). The area is largely divided into two : the basement rock area in the southeastern part, and the sedimentary area in the north-northwestern part of the project area.

The basement rock area consists of the plutonic and metamorphic rocks of the pre-cretaceous period. The sedimentary rock area consists of layers formed during the cretaceous period to the tertiary period. The layers in the sedimentary area are formed in an ascending order starting with the Gundumi Formation directly covering the basement rock , followed by the Ilo Formation, the Rima Formation (all three formations belong to the cretaceous system), the Sokoto Formation, Gwandu formation (both belong to the tertiary system), and finally, the Quarternary Formation at the uppermost.

The basement rock area covers approximately 42% of the entire project area, 49% of the new Sokoto State and approximately 28% of the Kebbi State.

### (4) Hydrogeology

The geology of the basement rock area and the sedimentary area are hydrogeologically different.

Granite, gneiss, crystalline schist and quartzites of plutonic and metamorphic rocks constitute the basement rock area, and the fresh rocks of this area are extremely hard. Groundwater can be found in rocks loosened by weathering, in altered parts of coarse grain rocks, cracks of gently altered rocks and in contact fractures of plutonic and intrusive rocks.

Groundwater generally resides in the basin-shaped depression of fresh rocks caused by deep weathering, except in areas specifically structured with faults, fracture lineaments and intrusive rocks.

The basement rock area is considered as a difficult area for groundwater development. It would be difficult to produce groundwater, therefore, unless the wells are constructed in the areas mentioned above.

The mean specific capacity of the existing boreholes is generally low at less than 10 m<sup>3</sup>/day/m.

The hydrogeological structure of the sedimentary area, on the other hand, shows that large number of aquifers forming a monocline structure are arranged in the southeast to northwest direction. The hydrogeological overview of the layers described in (3) is given below.

a. Gundumi Formation

The Gundumi formation consists of sand, gravel and clay, the origin of lacustrine deposits. As it is the bottom layer of the Sokoto sedimentary basin, it overlies the basement rocks. The zonal distribution of this formation covers 14% of the entire area, from the northeast to the southwest direction. Unconfined groundwater which is recharged by rain water and river water seepage can be found in the northeastern formation, while confined groundwater can be found in the southwestern formation because it is overlaid by another layer. The mean specific capacity of the existing boreholes is 57 m<sup>3</sup>/day/m. This value indicates that the formation holds good aquifers.

b. Ilo Formation

The Ilo Formation is distributed in the southwestern part of the area and inter-fingers with the Gundumi Formation. It is overlaid by the Rima Formation. The characteristics of the aquifer in this formation are similar to those of the Gundumi Formation.

c. Rima Formation

The Rima Formation is made up of marine deposits caused by marine transgression. It is divided into 3 formations, the lowest being the Taloka Formation, followed by the Dukamaje and the Wurno formations. Aquifers can be found in the sandy areas of the Taloka and Wurno Formations. The Dukamaje Formation is an aquiclude as it is mainly composed of shale.

The aquifer of this Formation shows a low specific capacity of 3~20 m<sup>3</sup>/day/m in the northern part of Sokoto City, but a favorable specific capacity of 23~63 m<sup>3</sup>/day/m in the southern area. The groundwater level in both areas, however, is deep and of bad quality.

d. Sokoto Formation

The Sokoto Formation occupies 3% of the project area and is made up of 2 formations, the Dange (lower) and the Kalambaina (upper) Formations. The Dange Formation is an aquiclude which consists mainly of marine clay deposits. The Kalambaina Formation consists of clay limestone and marls, and forms the aquifer of unconfined groundwater. Many springs, lakes and marshes can be found along the hill that is made up of the Kalambaina Formation.

e. Gwandu Formation

The Gwandu Formation are tertiary deposits occupying 22% of the project area (the former Sokoto State) from the northeast to the southwest direction. It is subdivided into 3 layers : the upper, middle and basal layers. Unconfined groundwater can be found in the aquifer of the upper sandy layer, while confined groundwater can be found in the aquifer of the basal layer. The middle layer is an aquiclude. The aquifers of the Gwandu formation are in favorable conditions indicating a specific capacity of 50~100 m<sup>3</sup>/day/m, or more in some areas.

f. Quarternary Formation

The Quarternary Formation consisting of unconsolidated sediments of sand, gravel and clay is distributed in the alluvial lowland (Fadama) of the Sokoto and Rima Rivers. The unconfined groundwater in the aquifer of this formation are utilized through shallow wells.

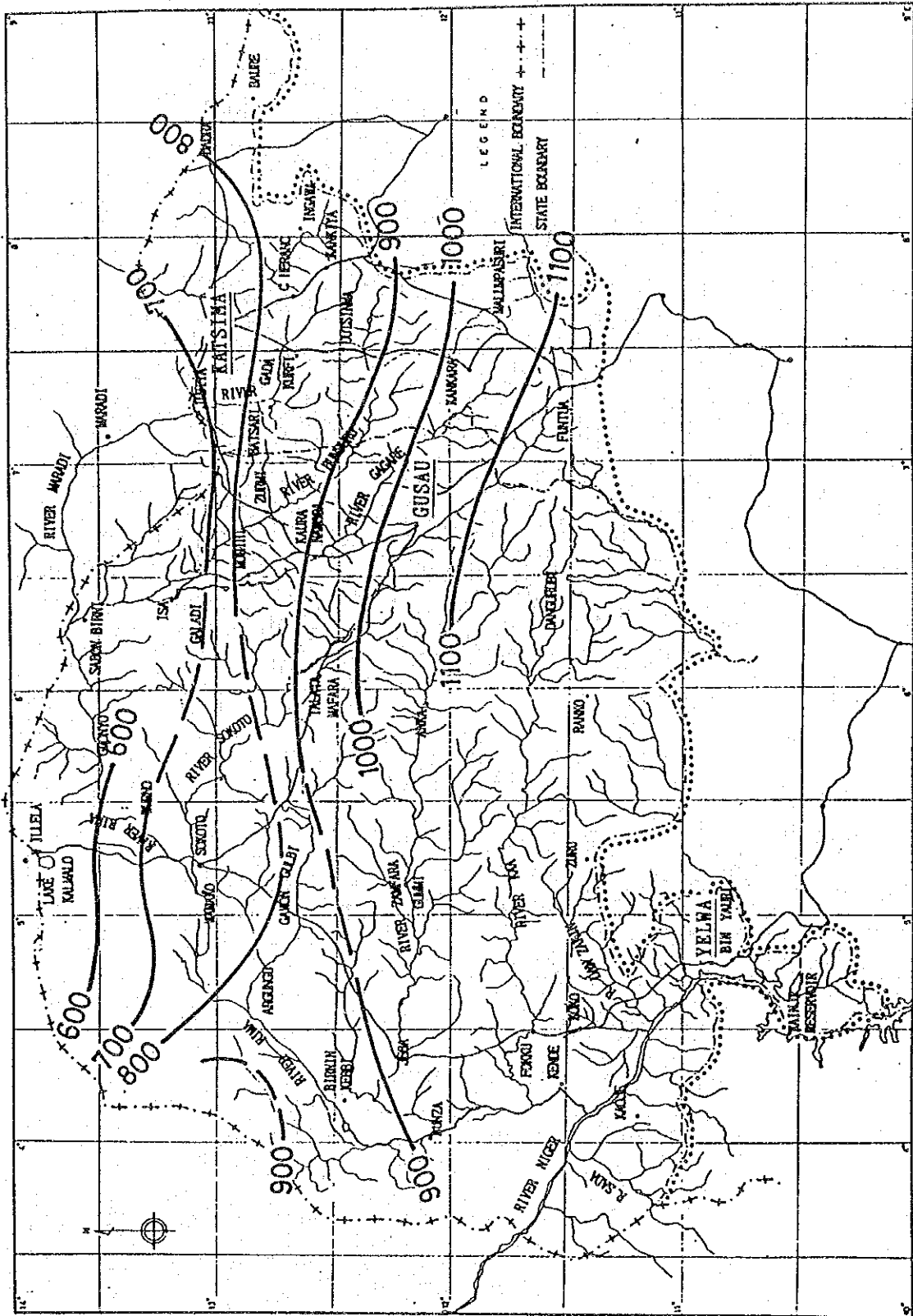


Fig. 4 Meteorological observatory and rainfall distribution (mm/year)

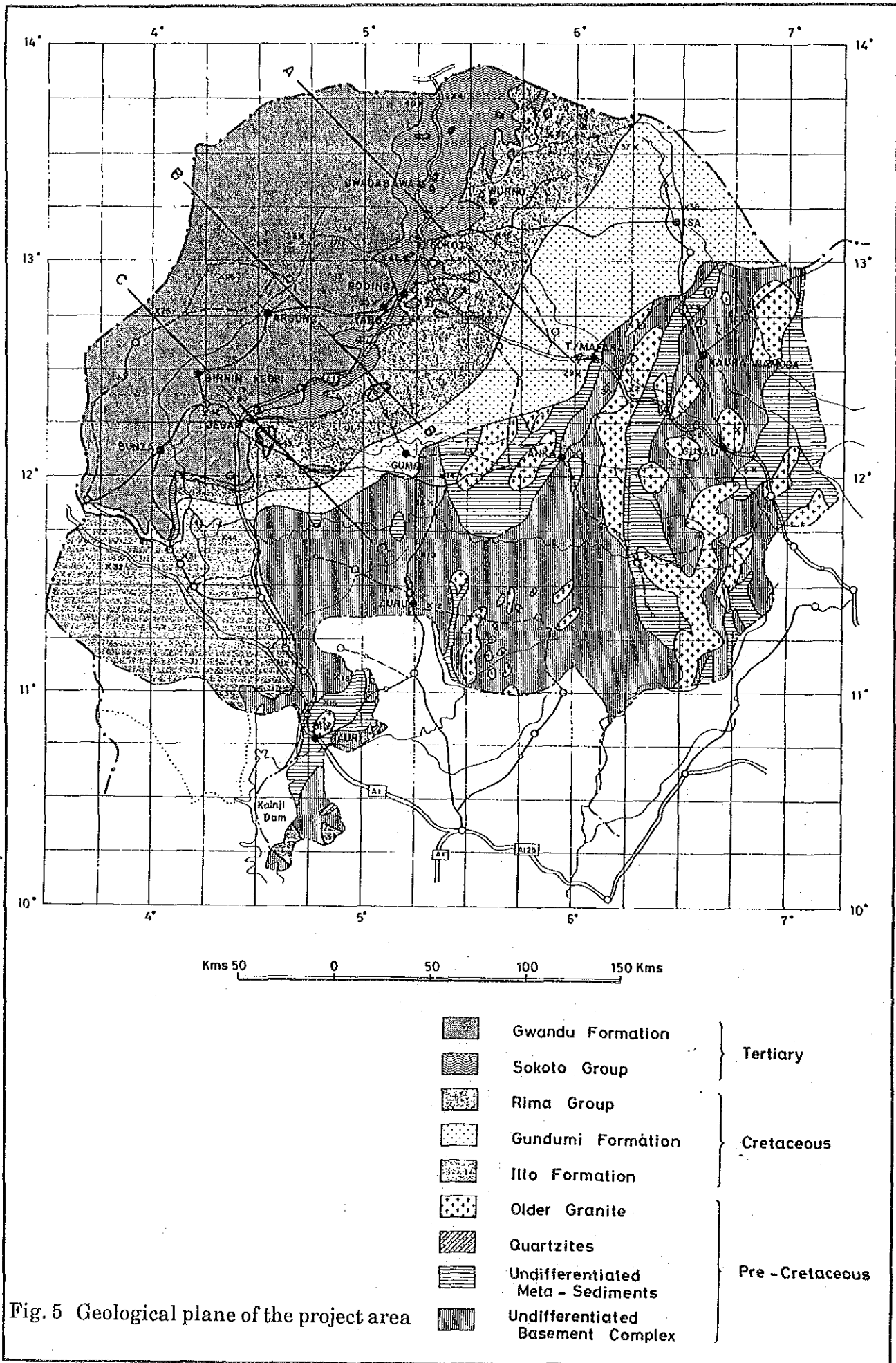


Fig. 5 Geological plane of the project area

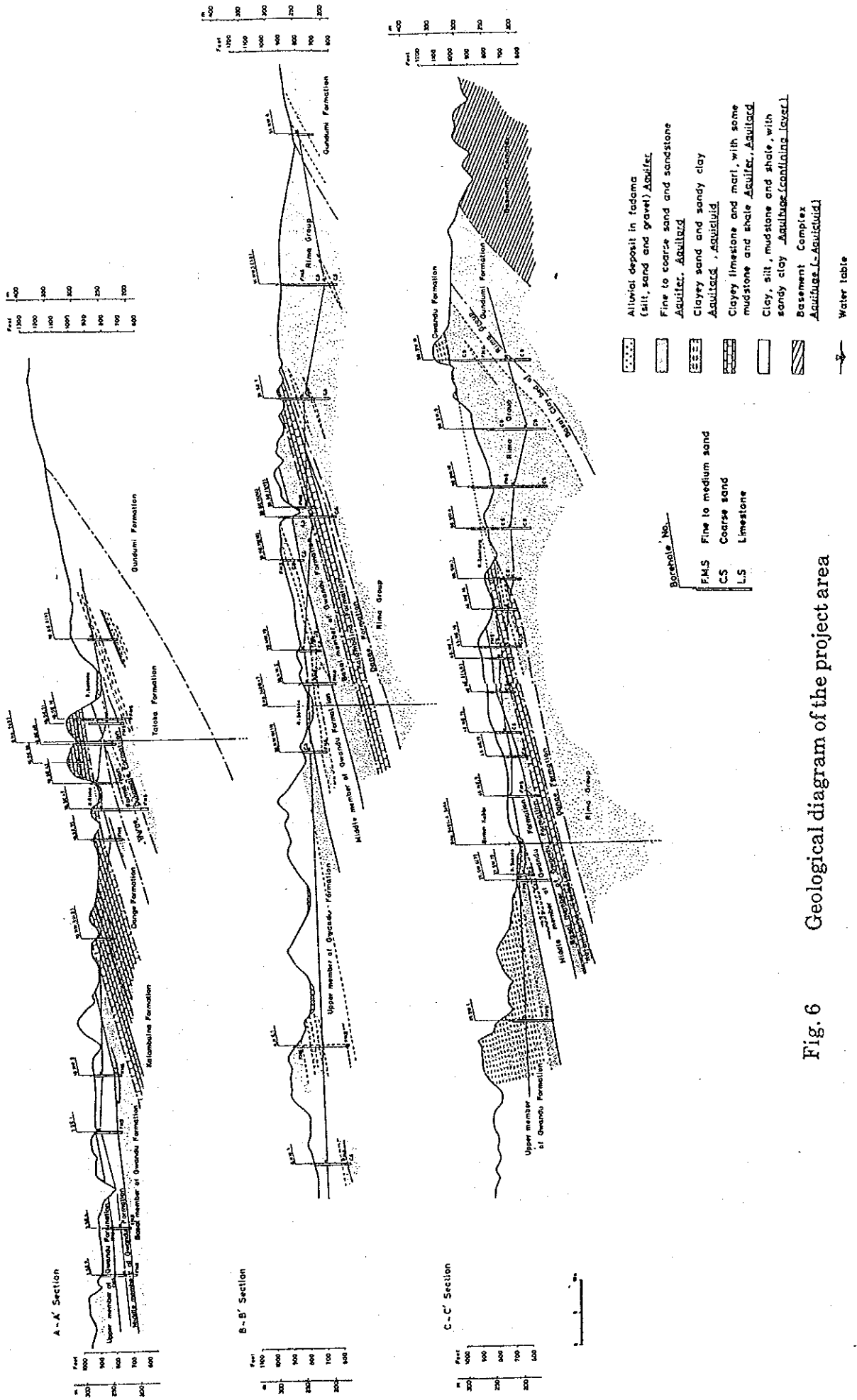


Fig. 6 Geological diagram of the project area

### 2-4-3 Outline of the Water Supply Sector

#### (1) Urban Water Supply

The urban water supply in the project area are being operated in the 19 cities and towns listed below. The maintenance of the facilities is performed by the Water Board and the water charge per family is 5 naira a month.

(city / town)	(water source)
Sokoto	Rima River, borehole
Gusau	Sokoto River, borehole
Kaura Namoda	borehole
Talata Mafara	Sokoto River, borehole
Anka	borehole
Shinkafi	borehole
Gummi	Zamfara River, borehole
Tambuwal	borehole
Yabo	borehole
Gwadabawa	borehole
Birnin Kebbi	Rima River, borehole
Argungu	Rima River, borehole
Yauri	Niger River
Zuru	borehole
Jega	Zamfara River, borehole
Kamba	borehole
Koko	borehole
Ngaski	Niger River
Mafta	borehole

The Sokoto State Water Board was reorganized in 1984, and its urban water supply activities are indicated in Table 2.



**Table 2 Water Supply System Construction Achievements  
of the (old) Sokoto State Water Board**

Project Name	Project Cost (Million Naira)	Year	Outline of the Project
Emergency W/Supply treatment plant, Sokoto	3.3	1983 ' 1984	Treatment 27,000 m <sup>3</sup> /day
Sokoto W/Supply expansion project	89.7	1985 ' 1988	Raw water pump station, Transmission line, 105,000 m <sup>3</sup> /day treatment, 3 reservoir tanks, treated water pump station etc.
Talata mafara W/Supply expansion project	12.3	1987 ' 1989	Water intake facilities water transmission station, treatment of 2.300 m <sup>3</sup> /day, concrete water tank, 0.5 MGD treatment plant, 500 mm-300 mm pipelines
Argungu W/Supply project	8.1	1988 ' 1989	500 mm ductile iron pipeline, 0.5 MGD treatment plant, 500 mm raw water pipeline, intake, access road, 100 m <sup>3</sup> elevated steel tank
Mahuta W/Supply project	1.7	1988 ' 1989	Water intake, facilities pumping generator house, water tank, 100,000 MGD treatment plant
Gusau W/Supply Expansion project	269.0	1986 '	Dam construction, 10MGD treatment plant, 3 concrete tanks (total 1,600 m <sup>3</sup> ), Pre-sedimentation tanks etc.
Ngaski W/Supply project	4.3	1988 ' 1989	Water intake facilities, raw water canal, 454 m <sup>3</sup> /day treatment plant, Transmission pipe connected to tank etc.
Auka W/Supply project	0.7	1987 ' 1988	2 boreholes, pumping system transmission pipe connected to tank
Chafa W/Supply project	5.3	1986 ' 1988	Extension of 250 mm ductile iron pipe from Gusan (42 Km), Distribution system to 3 major towns
B/Kebbi and Yauri Intake rehabilitation project	1.4	1989 ' 1991	Rehabilitation of intake facilities
Isa and Bagudo W/Supply project	3.2	1989 '	Upgrading to urban type supply system

## (2) Semi-Urban Water Supply

The former Sokoto State had 150 semi-urban water supply facilities which provided groundwater to middle to large scale villages with more than 1000 population. Through the gravity method, groundwater stored in elevated reservoir tanks is conveyed to several communal faucets.

The existing facilities which were constructed by the Federal Government before 1983 were transferred to the State Water Board in 1984, and the maintenance of these facilities was entrusted to the State Water Board. More than half of these transferred facilities were dysfunctional or abandoned, and with the Federal Government's 1,000,000 naira grant in 1985, 30 were rehabilitated. Until now, 100 of the facilities are provided with routine inspection, repair services, overhaul and replacement services.

New projects were not conducted since 1984, and as a consequence, there are now more than 100 villages, including those with abandoned facilities, in need of semi-urban water supply facilities.

In comparison, the semi-urban water supply is remarkably way behind that of the rural area.

## (3) Rural Water Supply

The rural water supply facilities constructed by the public sector in the project area are generally borehole facilities with hand pumps. These water supply facilities (1, sometimes 2 per village) are constructed in villages with less than 1,000 population (most of the villages hold a population of 500 to 600).

The construction of these facilities was the result of the country's reconsideration of the importance of the agricultural industry in the 1980's. The construction of facilities was carried out by the State Ministry of Agriculture and Natural Resources as a part of the Sokoto Agricultural Development Plan (SADP) in order to improve the rural infrastructural conditions. SADP was handed over to the Sokoto Agriculture and Rural Development Authority (SARDA) which was

established in 1985. SARDA has been responsible ever since for the rural water supply work.

The former Sokoto State had approximately 4,900 small villages. Boreholes with hand pumps were constructed in less than 150 villages during the onset of SADP in 1982. The residents of the remaining 4,750 villages collect their domestic water from hand dug wells, surface water and standing water.

In 1983, through the aid of the World Bank, the borehole plan for the rural areas commenced and approximately 4000 wells were constructed by 1990. The plan's rate of achievement was favorable at approximately 80%. The maintenance of the facilities are being conducted favorably by the cooperation of SARDA and the residents' autonomous body.

#### (4) Organizations for Public Water Supply

The water supply system in the project area consists of the three types : the urban water supply system, semi-urban water supply system and rural water supply system. According to the State Regulation, the State Water Board is responsible for the entire water supply work, which ranges from construction to maintenance.

Since the onset of the SADP, however, the rural water supply system was entrusted to SARDA which is under the Ministry of Agriculture and Natural Resources, leaving the State Water Board only responsible for the urban and semi-urban water supply systems.

However, it is highly possible that all water supply projects shall be integrated again in the Water Board as a result of the division of States and the rationalization of the administrative organization. The State Water Administrative Organization is shown in Figures 7 and 8.

The total number of staff in the former Sokoto State Water Board was 2,222 (112 in the headquarters, 293 in the water depot and 1,817 in 9 area offices). In accordance with the State Division Policy which took effect in September 1991, the former Sokoto State Water Board staff was divided between the new Sokoto

State and the Kebbi State. Five area offices were established in Kebbi State, and 4 in new Sokoto State. However, the new Sokoto State now has 7 area offices by the further addition of 3 area offices and aims to provide excellent services.

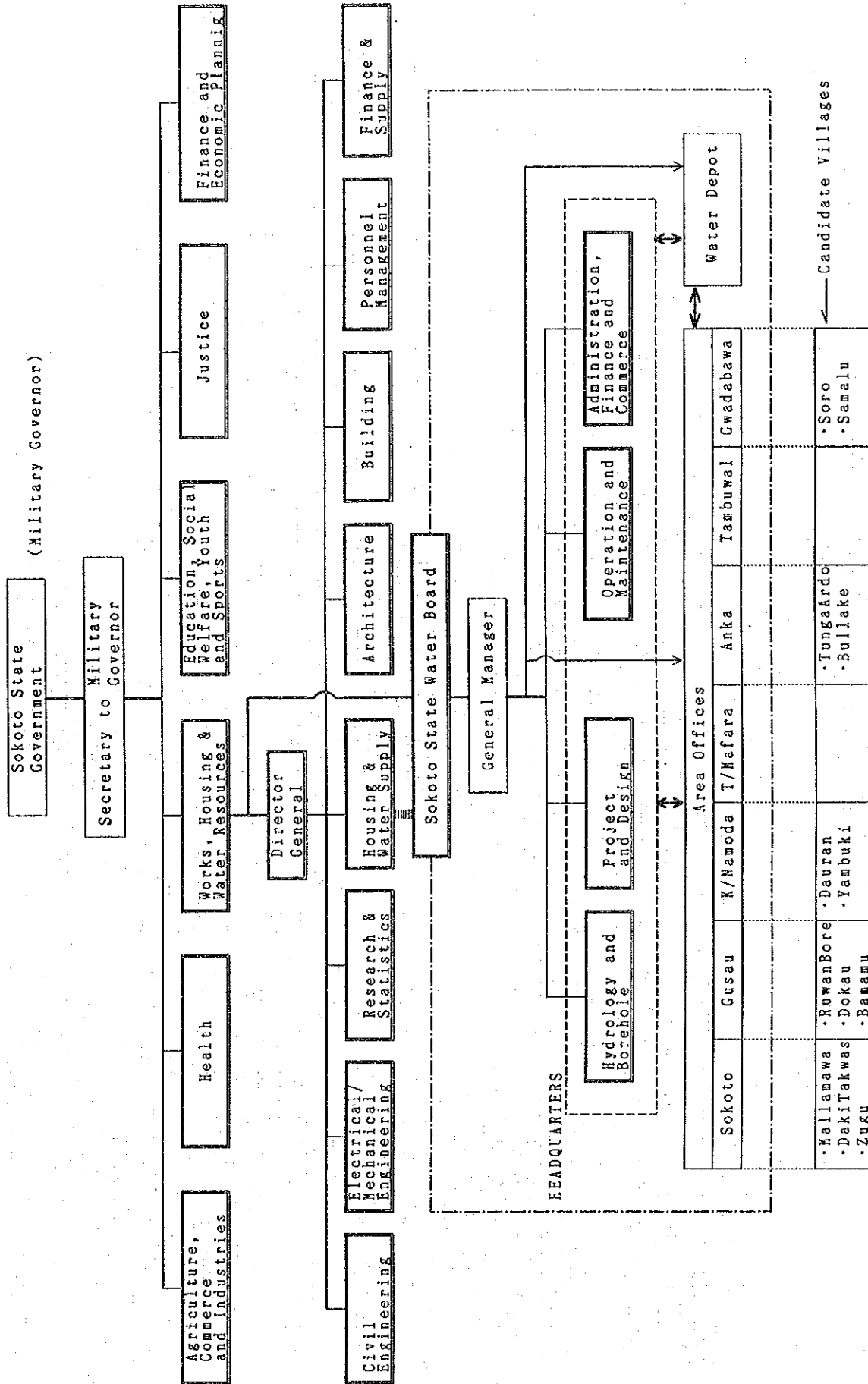


Fig. 7 Organization Chart of New Sokoto State Water Board

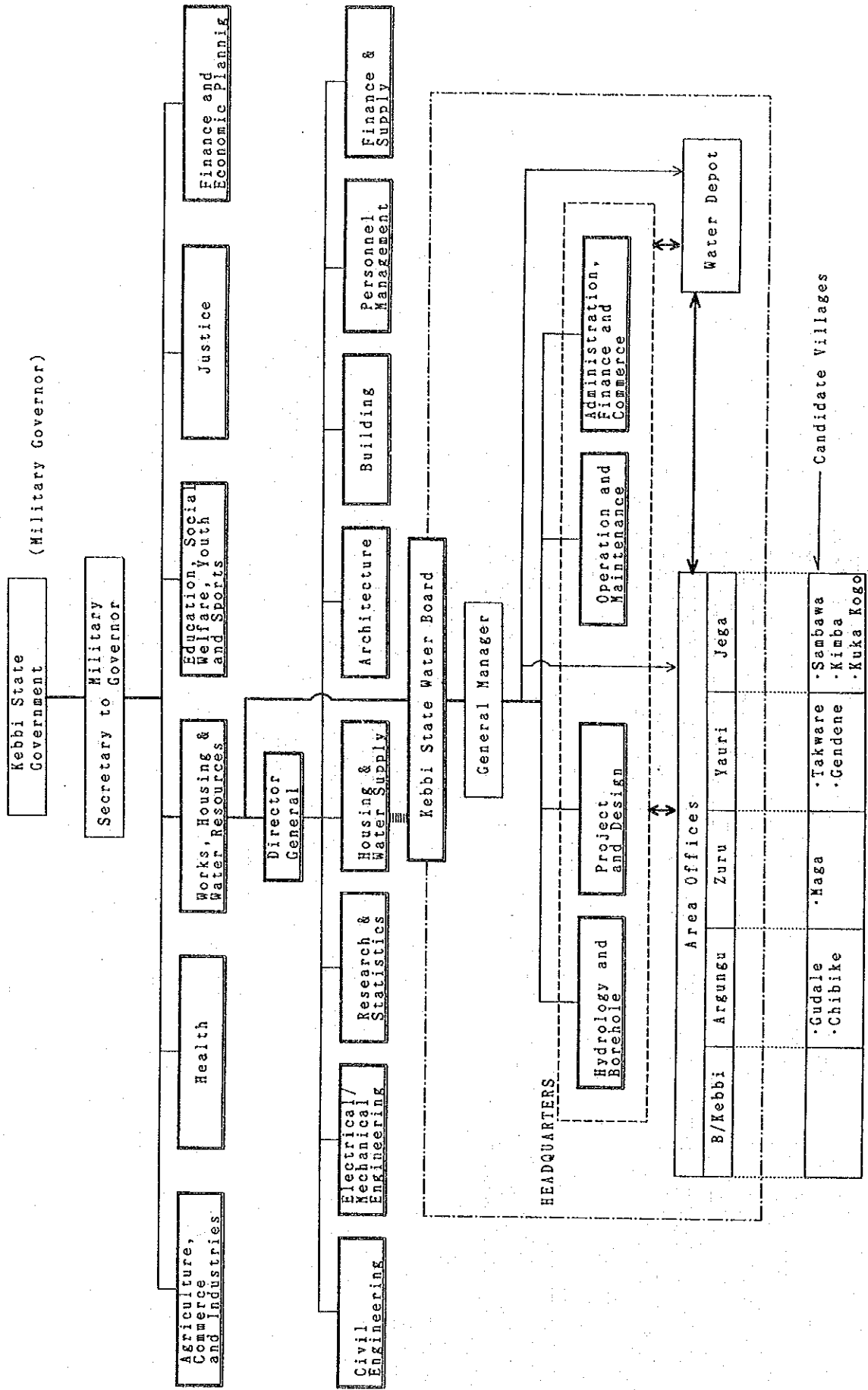


Fig. 8 Organization Chart of Kebbi State Water Board

## CHAPTER 3. OUTLINE OF THE PROJECT





## CHAPTER 3 OUTLINE OF THE PROJECT

### 3-1 Objective

This project is intended to ensure a stable supply of potable drinking water and to elevate the standard of living in northwest Nigeria which is located within the dry savannah zone. It is particularly intended for the middle to large scale villages with a population ranging between 1,000 and 30,000 and water supply conditions which are remarkably way behind that of the rural and urban areas, because no further developments were undertaken since 1984 owing to the fall of the Nigerian Economy.

The standard of living in the state has not improved and has remained low because the domestic water supply of the semi-urban areas, supposedly the biggest supporter of the agricultural economy, is very poor. To cope with this condition, the Nigerian Government established the water supply project through groundwater development. The achievement of this objective is, therefore, of great urgency.

## 3-2 The Study and Examination on the Request

### 3-2-1 Justification and Necessity

The 4th National Development Plan and the 1st Rolling Plan of the Nigerian Government state that the water supply works must be immediately improved as it shall basically satisfy human needs and help promote Agricultural Development, the Government's most important policy.

As it is located in the dry savannah zone, Northern Nigeria has very little rain, few perennial rivers, and compared to the southern area, limited water resources, It is, therefore, necessary to develop groundwater to ensure a stable water resource. Accordingly, the Nigerian Government formulated the groundwater development project for the dry northern area and requested technical cooperation from the Japanese Government for the execution of the study prior to the implementation of the project.

The results of the study clearly indicate that the groundwater potential in the northwestern part of the area is high enough to ensure drinking water supply. During the study, 20 of the 47 villages without public water supply facilities were highly prioritized and selected for groundwater development based on the following criteria.

- a. A comparatively large population and very stringent water demand.
- b. Impeded agricultural activities due to many prevalent water born diseases, contagious diseases and guinea worm diseases caused by insanitary water intake.
- c. An extremely high demand for water supply facilities, willing participation and competence in the administration and maintenance of facilities.
- d. Favorable access conditions, especially in respect to construction and maintenance.

The Nigerian Government requested grant aid from the Japanese Government for the execution of the project. The beneficiary population (total population of the 20 villages) is about 119,000, only 1.3% of the total population of the water supply project area which is 9,050,000, and 1/4 of the 450,000 population of the 50 semi urbanized villages without public water supply facilities.

As previously stated, the project area is located in the dry savannah zone with few rainfall and a short rainy season. Nearly half of the entire area is a basement

rock area, a very difficult area for groundwater development. Therefore, the implementation of the water supply project through groundwater development in the densely populated middle to large scale villages shall be very risky. In spite of the above conditions, however, the study results clearly indicate a potential groundwater production of approximately 140 m<sup>3</sup>/km<sup>2</sup> daily.

The project was formulated based on the results of a carefully conducted study which only left few technical problems unsolved. Furthermore, this project shall be very effective in various northern Nigerian States too, due to similar climatic and geological conditions.

Lack of finances for recurrent costs pointed out in the 4th Five-Year Plan and the 1st Rolling Plan is a serious problem in Nigeria as well as in the project area. To reduce the financial burden of the Nigerian Government, a study, proposed by the Study Team, concerning the enlistment of the residents' active participation in the operation of the facilities and the partial sharing of the maintenance fees is being conducted.

The urban water supply charge system was first implemented in the Sokoto State. At present, the said State is preparing a new water supply management method for semi-urban areas.

It can be concluded, therefore, that the new management methods adopted in this project shall greatly influence similar projects in and out of the State.

### **3-2-2 Execution, Operation and Maintenance**

The Study Team visited Nigeria at a time when the Federal Government was making the reformation plan of the State administration as a preparation for the change to civilian administration in 1992.

As a consequence, the Study Team was only able to confirm the future trends of the new ministry in charge of the water supply sector and the Water Board, the agency which executes water supply project works of the new Sokoto State. Since that of Kebbi State was not confirmed, the Study Team proceeded with a plan only for the new Sokoto State.

Generally, the Water Board is in charge of the management and execution of the urban water supply, semi-urban water supply for middle to large scale villages, and rural water supply (boreholes with hand pumps). However, due to rapid population increase in the urban areas, it has been busy improving the water supply system in the said area that it neglected its responsibilities toward the semi-urban and rural areas.

Among the semi-urban facilities transferred from the Federal Government, only 50 are being continually maintained.

The rural water supply system in small villages shall be entrusted to SARDA because the Water Board is short of funds. However, the rural water supply projects are being subsidized by the World Bank and are, therefore, conducted on a contractual basis. Furthermore, SARDA has no well drilling equipment and usually asks the Water Board for the re-drilling of non-functioning wells.

From these circumstances, the Water Board, aside from being mainly involved with the water supply projects in the urban areas, started in 1990 to allocate its budget to the water supply projects in rural areas, decided to better the rehabilitation works and to implement new projects.

The 3-year (1990-1992) budget allocated to the State Water Board, which was mentioned in the 1st Rolling Plan, is shown in Table 3.

The operation and maintenance of the water supply facilities in the past were performed by the cooperation of the Water Board's headquarters, the water depot and the area offices. The Water Board headquarters is involved with hydrology, borehole, planning and design, operation and maintenance, and administration, finance and commerce. The water depot is in charge of the building, repair and storage works (workmen's room and workshop, storehouse for machine parts).

Professionals shall be stationed in the headquarters and workshop to take charge of the water source development, planning and design of water supply facilities, supervision of construction work and maintenance work (mechanics and electricians). In accordance with the nature of the work, experts shall be employed and sent to the area offices. All in all, there are more than 2,200 personnel.

**Table 3 Budget Allocation to Sokoto State Water Board  
(including foreign assistance)**

1990 - 1992

Type Classification		Project Name	Budget (Million Naira)			
			90-92 Total	1990	1991	1992
Urban water supply	New Construction	Gusau 10 MGD water treatment plant, Gusau water barrage	110.0	110.0		
		Argung 0.5 MGD treatment plant	10.0	5.0	5.0	
		Talata mafara 0.5 MGD treatment plant, Elevated tank provision	10.0	5.0	5.0	
		B/Kebbi raw water intake, Improvement of distribution system	9.0	9.0		
		Construction of additional boreholes and 45m <sup>3</sup> tank in Isa and Bagudo	2.0	2.0		
		Sokoto phase II (Balla weir, and expansion of distribution system)	24.0	10.0	14.0	
		Investigation for Kaura Namoda dam construction	25.0	10.0	14.0	
		Expansion of Gusau supply system	12.5	9.5	3.0	
		Ngaski water treatment plant, pipeline	2.0	2.0		
		Expansion of Jega, Tambuwal, Koko, Gummi, Kamba and Yabo supply system	16.0	9.0	7.0	
		Upgrading to Urban type system in Wurno, Zurmi, Riban and Bunza	15.0		8.0	7.0
	Mahuta water treatment plant	0.5	0.5			
	Rehabilita-tion	Rehabilitation of Zuru pumping system,	19.0		6.0	13.0
		Renovation of Yauri raw water intake weir expansion of treatment plant	0.5	0.5		
Replacement of borehole pumps		4.5	0.5	2.0	2.0	
Rural water supply	Semi-Urban Type	Borehole construction in 6 Basement rock area villages	5.0	5.0		
		Elevated tank installation				
		Upgrading from rural to semi-urban type in ten villages	12.0		7.0	5.0
		Upgrading from rural to semi-urban type in ten villages				
		Motor pump installation in 6 villages	9.0		4.0	5.0
		Replacement of borehole pumps	2.0		1.0	1.0
Hydro-meteorological station, Equipment and materials for operation and maintenance, service vehicles, and spare parts			16.489	0.980	7.325	8.184
Total			989.489	173.98	81.325	34.184

Upon the division of the Water Board in September of 1991, technical experts were evenly distributed between the new Sokoto State and Kebbi State, and the retrenchment of unnecessary staff was reasonably conducted.

The system of operation of the constructed facilities shall be carried out through the collaboration of the Water Association organized in each village and the State Water Board. The Water Association shall be made up of a leader, an operator, a public relations staff, guardsman, etc. The association shall perform the daily facility operation work. According to the present State Regulations, the State Water Board shall shoulder all facility maintenance and management expenses. The State Water Board shall, therefore, secure the required maintenance and management fund, train the operators and maintain the facilities (repair, preservation, inspection). It (area offices) shall conduct routine patrol services along with fuel provision, too.

A study on the competence and the financial status of the State Water Board was carried out to confirm the feasibility of this operation system. The study confirmed that the State Water Board is competent and has sufficient number of personnel based on the results of the maintenance and management of the urban water supply facilities. As for its financial status, the study results show that it is sufficiently capable of securing the estimated facility maintenance and management budget for the 12 villages (180,000 Naira (¥ 2,340,000)), an amount which is only 0.17% of its 3 year (1990-1992) budget of 103.163 million Naira. Furthermore, the Minister of the State Ministry in charge and the General Manager of the State Water Board were found to be actively willing to maintain and manage the facilities. The Water Board's experience with the maintenance and management of the pilot facilities in Horo Birni shall be a great help, too.

Based on the above, it is judged, therefor, that the maintenance and management of the constructed facilities through the cooperation of the State Water Board and the village residents is possible.

With regard to the operation of the district water supply work which was pointed out as a problem in the 1st Rolling Plan due to worries concerning the management of the budget for recurrent costs, the basic design Study Team proposed the reconsideration of the current customary law (residents, except for those in urban areas, shall be exempt from charges), and the possible implementation of a system which would call on the participation of the residents

in the operation and maintenance of facilities and partial payment of maintenance fees.

The residents' sharing of the recurrent cost is also one of the Federal Government's policy, and with the willingness and capability of the residents of the 20 selected villages, this policy is considered to be very feasible and therefore, requires serious study in the Sokoto and Kebbi States.

### **3-2-3 The Relation between Similar Projects and Foreign Assisted Projects**

Several big projects in urban areas have been conducted with international assistance. Some of these projects are the expansion of the Sokoto Water Supply assisted by the World Bank, the expansion of the Gusau Water Supply assisted by Germany, and the construction of the Birnin Kebbi Water Supply Facilities assisted by the Development Bank of Africa.

On the other hand, to improve the foundation of the rural area, a borehole plan for the securement of drinking water supply is being conducted since 1984 (small villages of less than 1000 population). As for semi-urban areas (medium to large scale villages), however, the national borehole plan (deep well drilling and installation of motor pump facilities) conducted in early 1980 with the assistance of the World Bank was the last water supply project conducted in the area.

The drinking water supply securement plan, which shall be subsidized by Japan's Grant Aid Program, shall be the Water Board's first foreign assisted water supply project in semi-urban areas.

### **3-2-4 Study of Requested Facilities, Equipment and Materials**

The Federal Ministry of Water Resources of Nigeria requested the construction of a water supply system in the 20 villages selected among the 47 middle and large scale villages in Northern Nigeria, and the materials and equipment for operation and maintenance.

The water supply facilities requested by the Nigerian Government for the 10 villages in the basement rock area are semi-urban facilities for 6 villages and boreholes and handpumps for 4 villages. For the 10 villages in the sedimentary area, the Government requested that all facilities should be semi-urban in type. See Table 4 for the classification of areas by State Division.

Table - 4 Requested Facility type and Classification by Geology and Administrative Area

Type of facility	Name of Village	Geology	State
Rural type system  Plural number of H/P facility	Tunga Ardo	Basement Rock Area	Sokoto State
	Bullake		
	Bamamu		
	Daki Takwas		
Semi-Urban type facilities  • Borehole with motor pump  • Elevated re- servoir tank  • Pipeline  • Communal faucets	Ruwan Bore		
	Dokau		
	Dauran		
	Yambuki		
	Zugu		
	Soro		
	Mallamawa		
	Samalu		
	Takware	Sedimentary Rock Area	Kebbi State
	Gudale		
	Chibike		
	Gendene		
Sambawa			
Kimba			
Kuka Kogo			
Haga	Basement Rock Area		



However, upon the reviewal of the results of the development study and the basic design study, the facilities that were considered appropriate are different from those requested, (see Table 5 (new Sokoto State) and Table 6 (Kebbi State)).

#### (1) Groundwater development potential

According to the results of the development study, groundwater development even in the so called difficult area indicates a potential production of 140 m<sup>3</sup>/km<sup>2</sup> daily. By considering the characteristics of the source of groundwater and the small groundwater basin reserve (hollowed fresh rocks), the groundwater development potential is influenced by the extensiveness of the basin structured area. Since most of these areas cover only about 0.25~0.5 km<sup>2</sup>, only 35~70 m<sup>3</sup>/day can be potentially pumped up from one groundwater basin. It is not advisable to install a motor pump with a high capacity in the basement rock area because it would result to the quick depletion of stored water. For permanent use, therefore, it is better to install hand pumps (6~7 m<sup>3</sup>/day/well).

As for villages where motor pumps are to be installed, pumping shall be limited to 50~70 m<sup>3</sup>/day, and the hand pump well shall supply the remaining quantity of water required in the area. All in all, 2 pure semi-urban facilities (motor pump) and 4 semi-urban and rural facilities (combined type) shall be installed in the basement rock area.

In addition, the water supply amount intended for this area shall be smaller than the water supply amount for the sedimentary area. Also, the scale of the facilities shall be reduced to minimize the risks of groundwater depletion.

#### (2) Facility Maintenance

Many of the facilities in the project area have been abandoned due to malfunctions resulting from poor management and maintenance methods. Although the defective services of the Water Board (shortage of patrol cars and repair tools) are partly to blame, the problem is the direct consequence of the shortage of funds for recurrent costs, such as costs for the purchase of spare parts and fuel.

The residents of the 20 selected villages were confirmed to be capable and willing to share the operation and maintenance fees of the facilities. However, the prevailing customary law of Nigeria (water is for free), and the state law (residents, except those in urban areas, are exempt from charges) makes the

implementation of the charge system difficult. This situation shall be a future study subject.

To lessen the financial burdens (recurrent costs) of the State government and the State Water Board, the scale of the facilities shall be minimized. The water supply amount originally planned for the sedimentary area shall be changed from 30 l/c/d to 20 l/c/d, in addition to that of the groundwater potential mentioned in (1), in accordance with the minimization of the facility scale.

### (3) Division of Study Period in respect to State Division

As previously stated, the project area was divided into two different States. Because of this, many items pertaining to the executing agency and the operation and maintenance system were unconfirmed, and the scale and details of the Kebbi State facilities were left undiscussed. The basic design Study Team, therefore, divided the study phase between the two States, and decided to conduct and compile the study only in Sokoto State. The scale and the number of facilities for Kebbi State shall be patterned from that of Sokoto (see the reference data and project report in the Appendix) before things are discussed and confirmed with the Kebbi Authorities. After the execution system and the maintenance system of the new Kebbi State is confirmed, a special study shall be made and re-investigation should be carried out based on these results..

In accordance with the above mentioned basic policies, a detailed study was conducted in the 12 new Sokoto villages. The summary of the study is shown in Table 5. The detailed study conducted in the 8 Kebbi villages is summarized in Table 6.

Table 7 (Basic Design Comparative Table) shows the contrast between the requests and the results of the detailed study.

The water supply facility consists of the following 3 types:

#### A. Rural Type

- 4" tube wells with hand pumps. Basically, the plan is intended to supply 600~700 residents per well. However, because the areas ideal for well drilling are only limited to a few, only 6 hand pump wells are to be drilled.

#### B. Semi-urban Type

- 4" and 6" wells with motor pumps. Pumped water is stored in the elevated reservoir tank and with the gravity system, water is distributed to the

communal faucets through pipelines. The communal faucet base has two taps and each tap is intended to supply water to 1000 residents.

C. Combined Type

- This type is the combination of A and B, and is only used in the basement rock area. Several hand pump wells shall be added if the amount of water produced by the motor pump is insufficient.

The number of water supply facilities and the use of the existing wells are as follows :

A. Rural Type

- Additional wells are to be constructed and spare hand pumps shall be prepared to supply the lacking amount of water in villages with existing hand pump wells. 20 wells are to be constructed in Tunga Ardo, Bullake, Banamu, Daki Takwas, Soro, Mallamawa and Samalu in addition to two previously constructed wells. All in all, there will be a total of 21 hand pump wells in the above 7 villages.

B. Semi-urban Type

- Only pipelines, reservoir tanks and communal faucet bases shall be constructed in the Dokau and Zugu villages, since the water demands of both villages can be entirely supplied by a pump well (1 each). The water supply system in Dokau shall include wells and 5 communal faucets. In Zugu, 6 communal faucets shall be constructed and the existing wells drilled in the development study shall be converted into motor pump wells after they are redeveloped and tested.

The elevated reservoir tank shall be 5m and 7m in height based on the field leveling results.

C. Combined Type

- The existing wells in Ruwan Bore, Dauran and Yambuki shall be converted to motor pump wells and semi-urban facilities (5 communal faucets in Ruwan Bore and Yambuki, and 4 in Dauran; 5m reservoir tanks in Ruwan Bore and Dauran, and 3m reservoir tanks in Yambuki) shall be installed. However, 2, 5 and 4 hand pump wells shall be respectively constructed in the above villages to supplement the remaining required amount of water which the existing wells cannot provide.

The construction of 5 hand pump wells in Dauran, however, will still be

insufficient due to the small capacity of the existing wells and their locations which make gravity distribution difficult. Therefore, a plan was made to construct a motor pump well at the opposite side of the village. According to the electric prospecting results, however, the groundwater basin of the weathered portion only holds little water. As a result, the water amount allotted per person in this area shall have to be reduced as compared to the two other villages. This change is considered inevitable because of the limited amount of potential groundwater.

With regard to the necessary materials for facility construction and maintenance, the following were considered important and hence, included in the plan.

#### A. Water Supply Facilities to Construct

Rural type facilities in 7 villages, semi-urban type facilities in 2 villages, and a combination of rural and semi-urban type facilities in 3 villages.

- Borehole Wells (4"and 6")	32 sets	(1,760m)
- Borehole wells for redevelopment	5 sets	
- Borehole with submersible motor pump set (4"and 6")	5 sets	
[ Submersible motor pump (2 types, 1 spare each)	7 sets,	
Diesel engine generator (1 spare)	6 sets	]
- Borehole with hand pump set (4")		
(including 3 spares of hand pump set - a total of 35 sets)		
	32 sets	
- Generator House (Floor area 14m <sup>2</sup> , height 3.0m)	5 sets	
- Reservoir tanks (capacity of 32m <sup>3</sup> , height of 3~7m) and precast steel toweres	5 sets	
- Water supply pipes (25 - 100mm in diameter)	4,633 m	
- Communal Faucet Base with 2 taps	25 sets	

#### B. Materials for Maintenance Work

- Station Wagon fully equipped with repair tools for patrol service	2 sets
- Truck mounted well service machine	1 set
- Tools and spareparts	1 set

Table - 5 Study Results of the Type and Scale of Facilities  
(for the 12 villages in Sokoto State)

Village Name	Popu- lation	Geology	Well Construction	Hand pump facility	Pipeline length	Number of communal faucets	Volume of Reservoir tank and tower height	Utili- zation of Existing Boreholes
Tunga Ardo	2,000	Basement	4", 2pcs x 50m = 100m	3 sets	-	-	-	4", 1well
Bullake	1,000	"	4", 2pcs x 100m = 200m	2 sets	-	-	-	-
Ruwan Bore	6,500	"	4", 2pcs x 40m = 80m	2 sets	893m	5 sets	32m <sup>3</sup> , 5m	4", 1well
Dokau	5,000	"	6", 1pc x 150m = 150m	-	633m	5 sets	32m <sup>3</sup> , 5m	-
Bamamu	2,000	"	4", 3pcs x 70m = 210m	3 sets	-	-	-	-
Dauran	12,000	"	4", 5pcs x 40m = 200m	5 sets	1,010m	4 sets	32m <sup>3</sup> , 5m	6", 1well
Yambuki	10,000	"	4", 4pcs x 40m = 160m	4 sets	1,103m	5 sets	32m <sup>3</sup> , 3m	6", 1well
Daki Takwas	5,000	"	4", 4pcs x 40m = 160m	4 sets	-	-	-	-
Zugu	6,000	"	-	-	994m	6 sets	32m <sup>3</sup> , 7m	6", 1well
Soro	2,000	Sedimentary	4", 2pcs x 60m = 120m	2 sets	-	-	-	-
Mallamawa	4,000	"	4", 4pcs x 50m = 200m	4 sets	-	-	-	-
Samalu	3,000	"	4", 3pcs x 60m = 180m	3 sets	-	-	-	-
Total	58,500		32pcs total 1,760m	32sets	4,633m	25sets	(5 sets)	(5 wells)

Table - 6 Study Results of the Type and Scale of Facilities  
(for the 8 villages in Kebbi State)

Village Name	Popu- lation	Geology	Well Construction	Hand pump facility	Pipeline length	Number of communal faucets	Volume of Reservoir tank and tower height	Utili- zation of Existing Boreholes
Maga	7,000	Basement	4", 2pcs x 50m = 100m	2 sets	950m	5 sets	32m <sup>3</sup> , 5m	6", 1well
Takware	18,000	Sedimentary	6", 1pc x 150m = 150m	-	2,316m	12sets	128m <sup>3</sup> , 3m	-
Gudale	6,000	"	6", 1pc x 110m = 110m	-	915m	6 sets	50m <sup>3</sup> , 5m	-
Chibike	2,000	"	6", 1pc x 200m = 200m	-	70m	2 sets	32m <sup>3</sup> , 3m	-
Gendene	3,000	"	6", 1pc x 80m = 80m	-	631m	4 sets	32m <sup>3</sup> , 3m	-
Sambawa	10,000	"	6", 1pc x 150m = 150m	-	860m	7 sets	98m <sup>3</sup> , 7m	-
Kimba	11,000	"	6", 1pc x 120m = 120m	-	992m	8 sets	98m <sup>3</sup> , 3m	-
Kuka Kogo	3,000	"	-	-	473m	4 sets	32m <sup>3</sup> , 3m	6", 1well
Total	60,000		8 pcs total 910m		7,207m	48sets	(8 sets)	(2 wells)

Table - 7 Comparison Table of Request / Basic Design .

Item	Request from Nigerian Government	Basic Design Planned by Survey Team	Difference
(1) Project Area	20 highly prioritized villages among 47 candidate villages in former Sokoto State with an area of 101,000km <sup>2</sup>	12 of the 20 highly prioritized villages belong to the new Sokoto State with an area of 65,000km <sup>2</sup>	New order and organization of Kebbi State with an area of 36,000km <sup>2</sup> has not been confirmed by the Study Team
(2) Year of Implementation	1991-1993	1992-1993	Early implementation is difficult as the Grant Aid System requires proper procedures.
(3) Service Population	118,500	58,500	One state from Division of States. Decrease in Village number due to division of States (Establishment of Kebbi State)
(4) Well Construction	<ul style="list-style-type: none"> <li>• 12 to 20 H/P boreholes in 4 villages</li> <li>• 16 to 20 H/P boreholes in 16 villages</li> </ul>	<ul style="list-style-type: none"> <li>• 31 H/P boreholes in 10 villages</li> <li>• 1 motor pump borehole in 5 villages</li> </ul>	<ul style="list-style-type: none"> <li>① Same as the above</li> <li>② Re-consideration of safe pumping in basement rock area, putting emphasis on the use of hand pump wells (increase in the number of wells)</li> <li>③ Utilization of existing wells (decrease in the number of wells)</li> </ul>
(5) Water Supply Facility Construction	<ul style="list-style-type: none"> <li>• Rural number of H/P facilities in 4 villages</li> <li>• Semi-urban type system in 16 villages</li> </ul>	<ul style="list-style-type: none"> <li>• Rural type system in 10 villages</li> <li>• Semi-urban-Rural Convinced type in 3 villages</li> <li>• Semi-urbantype system in 2 villages</li> </ul>	Same as the above
(6) Materials for Well Construction	<ul style="list-style-type: none"> <li>• Casing and screen Lump for 20 villages</li> </ul>	<ul style="list-style-type: none"> <li>• PVC C/S Total 955m</li> <li>• FRP C/S 760m</li> </ul>	<ul style="list-style-type: none"> <li>• Same as the above</li> <li>• Necessary amount for 12 villages in New Sokoto State</li> </ul>
(7) Hand pump set	<ul style="list-style-type: none"> <li>• 12 to 20 deep well type H/P sets</li> </ul>	<ul style="list-style-type: none"> <li>• Steel C/S 156m</li> <li>• 35 drilled well type H/P sets (including 3 sets for spare)</li> </ul>	Same as the above
(8) Motorized pump	<ul style="list-style-type: none"> <li>• 16 to 20 sets of submersible motor pump</li> </ul>	<ul style="list-style-type: none"> <li>• 7 sets of submersible motor pump (including 2 sets for spare)</li> </ul>	Same as the above
(9) Diesel engine generator	<ul style="list-style-type: none"> <li>• 16 to 20 sets of diesel engine generator</li> </ul>	<ul style="list-style-type: none"> <li>• 6 sets of diesel engine generator including 1 set for spare</li> </ul>	Same as the above
(10) Materials for elevated reservoir tank	<ul style="list-style-type: none"> <li>• 16 to 20 sets of materials for elevated reservoir tank construction</li> </ul>	<ul style="list-style-type: none"> <li>• 5 sets of FRP panel tank material</li> <li>• 5 sets of Steel tower material</li> </ul>	Same as the above
(11) Distribution Pipelines	<ul style="list-style-type: none"> <li>• Lump of 16 villages</li> </ul>	<ul style="list-style-type: none"> <li>• Lump of 5 villages</li> </ul>	Same as the above
(12) Other materials for facility construction	<ul style="list-style-type: none"> <li>- Materials for Hand pump stand</li> <li>- Faucet materials.</li> <li>- Materials for elevated tank</li> <li>- Generator house</li> </ul>	<ul style="list-style-type: none"> <li>- 32 sets of Hand pump stand material</li> <li>- 25 sets of Faucets materials</li> <li>- 5 sets of Material for resorviior tank</li> <li>- 5 sets of Material of generator house</li> </ul>	Same as the above
(13) Survey equipment	<ul style="list-style-type: none"> <li>• Electric Prospecting equipment</li> <li>• Borehole logging equipment</li> </ul>	None	Out of the framework of the water supply system construction
(14) Materials, equipment and vehicles for maintenance of the facilities	<ul style="list-style-type: none"> <li>• Water quality analyses kit</li> <li>• 2 station wagons fully equipped with repair tools</li> <li>• 1 set of Truck-mounted well servicing machine</li> </ul>	Same as the request	
(15) Tools and spare parts	<ul style="list-style-type: none"> <li>• Lump of workshop tools</li> <li>• Lump of tools and spare parts for above equipment and vehicles</li> </ul>	Same as the request	

### 3-2-5 Necessity of Technical Cooperation

Sokoto State Water Board, the project's executing agency, has highly advanced techniques as it deals with groundwater development project studies and the construction and maintenance of the water supply facilities using groundwater as its source.

It is also known to have very good achievements as to the completion of well budgeted projects.

The operation and maintenance aspect on the other hand can be satisfactorily carried out if the shortage of materials, equipment and service vehicles is resolved, as the Water Board holds a large personnel.

It is concluded, therefore, that the dispatchment of technical experts is not highly relevant at all.

### 3-3 Project Description

#### 3-3-1 Executing Agency and Operational Structure

The Sokoto State Water Board (SSWB), which is under the jurisdiction of the State Ministry of Works, Housing and Water Resources, shall be the main executing agency of the project. As shown in Fig. 7, the State Water Board is headed by the General Manager (GM), and its activities are functionally carried out by the Headquarters, the Water Depot (staff room, workhouse, storage) and 7 area offices.

The Headquarters consists of 4 departments, namely the Hydrology and Borehole Department, Planning and Design Department, Building and Repair Department, and Administration, Finance and Commerce Department. In accordance with the type and area of the project, the Headquarters works hand in hand with the Water Depot and the Area Offices.

The General Manager directly supervises the execution of the project, and the Hydrology and Borehole Department, which is in charge of the rural water supply works, is mainly responsible for carrying out the instructions. In accordance with the progress of the construction works, the GM dispatches reinforcement personnel from the headquarters to the 5 area offices (Sokoto, Gusau, Kaura Namoda, Anka, and Gwadabawa) covering the project area, establishes project offices and enforces the management of the works. The operation and maintenance work after the construction of the facilities shall be conducted through the cooperation of the Hydrology and Borehole Department, Building and Repair Department, the Water Depot, and each area office involved.

The area offices are responsible for establishing communication and public relations with the local government authorities (LGA) and the area residents, and the administering of technological guidance concerning facility maintenance. The staffs of the headquarters and the area offices shall conduct routine patrol services, but the repair group of the Water Depot takes over in emergent situations.

At present, the State Water Board fully shoulders all costs including those for the operation and maintenance of the facilities. However, the Nigerian Government is currently conducting a study to establish a system that will entail the beneficiaries sharing of the operation and maintenance costs. The immediate implementation of the system is difficult, however, as it shall have to be passed



over to Congress for further appraisal before a decision is finally reached. The actualization of this system is highly viable though, as it is advocated in the 1st Rolling Plan as the Federal Government's guiding principle.

Furthermore, there is also a high possibility that the management system of the model facilities constructed during the development study shall immediately follow suit. That is because, the Water Association of the villages, which is made up of a leader, an accountant, operator and guardsmen, functions independently by collecting 2 nairas from each house for fuel expenses. However, the State Water Board seems to be directly involved in the management as the operators are employed as area office staffs and are stationed in the site as resident operators. Therefore, with the cooperative management of the Water Board and the residents' independent Management Association and the smooth operation of the model facilities, it is believed that problems like functional stoppage of facilities due to shortage of funds can be overcome.

### 3-3-2 Plan of Operation

This project was planned for the middle to large scale villages in northwestern Nigeria where the water supply system is remarkably behind that of the urban and the small scale villages.

A development study was conducted in the 47 middle to large scale villages without public water facilities in order to supply potable and stable drinking water. Among these 47 villages, 20 villages were highly prioritized. Accordingly, the Nigerian Government requested grant aid from the Japanese Government for the implementation of the project in these selected villages. However, due to the change in Nigeria's administrative structure just before the arrival of the basic design Study Team, the grant aid program which was supposed to be implemented in the two States was only applied in the new Sokoto State (12 villages), as its execution system was the only one confirmed. The project plan in the new Sokoto State is shown below.

- Construction of 32 wells with a total length of 1,760 m in 10 villages;
- Re-development of 5 existing wells in 5 villages;
- Installation of 32 hand pump sets in 10 villages;
- Construction of semi-urban type water supply system in 5 villages. The system shall comprise of a motor pump borehole, an elevated reservoir tank, a distribution pipeline and communal faucets;

- The 7 villages where only hand pump facilities are to be installed are Tunga Ardo, Bullake, Bamamu, Daki Takwas, Soro, Mallawa, and Samalu;
- The 2 villages where only a semi-urban supply system is to be constructed are Dokau and Zugu;
- The 3 villages where combined type facilities are to be constructed are Ruwan Bore, Dauran, and Yambuki.

### 3-3-3 Location and Condition of the Project Sites

New Sokoto State, the project area, is in the northwestern part of Nigeria. Sokoto City, the capital of the State, is located near the northwestern end of the State about 50 km from the border of the Niger Republic. It is 800 km in the north-northeastern direction of the former capital city Lagos (about 1,000 km from the National Highway Route A1) and 450 km in the north-northwest direction of the new capital city Abuja (Sokoto City is approximately 700 km away from Abuja through the National road that passes Kaduna). The surface of the national road is in good condition, and vehicles can speed at an average of about 100 km per hour.

The 12 villages in the new Sokoto State are situated within a distance of 230~280 km from Sokoto City where the State Water Board Headquarters is located. Although it is possible to make a day's trip from Sokoto to each village in the dry season, travelling to some of the villages (located 5 to 20 km away from the national/provincial road) in unpaved local roads becomes difficult in the rainy season.

Except for the Daki Takwas and Zugu villages, the distance from each Water Board area office is within 50 km, making the implementation of the routine patrol service facile.

The infrastructural conditions, such as electricity and telegraphic communication system are underdeveloped. The villages are not provided with commercial electric power, cables and telephones. As the villages are situated in a vast area and are distanced between several to scores of kilometers, the prospect for the installation of electric and communication facilities in the future are dim.