CHAPTER 6: WATER SUPPLY AND SANITATION

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CHAPTER 6. WATER SUPPLY AND SANITATION

6.1 GENERAL BACKGROUND

6.1.1 Historical Perspectives

(1) Urban Water Supply

In pre-colonial times, major cities depended entirely upon undeveloped sources such as rivers and streams, springs, wells, ponds and direct rainfall for their water supply. The colonial administration recognized the key role which the improved water supply could play in the elimination or control of common diseases and in the raising of health level and general welfare of the people. It, therefore, undertook the water supply schemes in such cities as Abeokuta (1911), Lagos (1914), Enugu (1925), Ijebu-Ode (1927), Oyo (1928), Aba (1928), Onitsha (1928), Makurdi (1928), Kano (1929), Kaduna (1930), Akure (1931), Jos (1935), Okene (1936) and Port Harcourt (1937). By 1953 there were 28 urban water supply undertakings, and the figure had risen to 67 by 1960 and 261 by 1970. The amount of improved water consumed in these towns rose from 63 MLD in 1952 to 295 MLD in 1960, 948 MLD in 1974 and 1,799 MLD in 1985. By 1985, the per capita consumption of pipeborne water for the population served ranged from 15 lpd for Ondo to 244 lpd for Benue, with an average figure of 62 lpd.

Since early 1970s, the Governments have invested heavily in urban water supply schemes including dam construction for Benin City, Ibadan, Ilorin, Jos, Kaduna, Katsina and Zaria and the borehole sinking for Maiduguri and Sokoto. Capital allocation to water supply development has increased in absolute terms; however, its share of total capital expenditure declined from 15 percent in 1950 to only 3 percent in 1980. Consequently, inadequate water supply remains as one of the major problems in urban centres; in fact, none of them except in Abuja City is considered capable in supplying adequate amount of the improved water. Long queues or rows of empty containers at public stand pipes, the needs for households to invest in water storage tanks/shallow wells, and the common use of unimproved water in all cities are clear indications of the severe inadequacy. It is not uncommon for pipes to remain dry for days, weeks, months or even years in some parts of cities. Because of the limitation of

municipal supplies, the industrial establishments, housing estates and private rich individuals who have the means often resort to developing their own supplies through the sinking of boreholes.

In 1978, the percentage of houses or compounds served with water ranged from 5 in Bauchi to 73 in Port Harcourt, and only six cities had flush toilets in more than 10 percent of the houses or compounds. The use of pipeborne water in cities is basically "rural" in character, most of it goes for drinking, food preparation, cooking, washing, bathing and laundry, and only little water is used for waste disposal, recreation and amenity purposes. This is no doubt partly due to crushing poverty levels which make it difficult for people to install water-using facilities such as flush toilets, but it is also partly due to inadequate water supply. Pit latrines which are common in most of cities are sometimes located very close to wells and so pollute them with faecal materials, and the introduction of the septic tank system is also the source of groundwater contamination in areas where soils are sandy, such as Lagos, Benin, Onitsha, Owerri, Umuahia and Calabar.

(2) Rural Water Supply

Until recently, virtually all the States gave a relatively low priority to water in their rural development efforts, and in many areas, the rural people themselves thought more in terms of convenience than of expected health benefits from water as their priority need. Many tubewells were sunk in the then North Region in the 1940s, 1950s and early 1960s without the active involvement of the local people; thus, they were open and unprotected, and the people were not made to accept to take care of them. There were no plans to maintain them, and most of them became disused after only a few years. Up to date, roads, schools and dispensaries have been built for many villages which still rely on polluted local streams, ponds, springs or shallow wells for their water supply.

With the establishment of RBDAs in 1976 and DFRRI in 1986, a new era opened in the provision of water to rural areas. A great number of boreholes are being sunk in various parts of the country, fitted with manual or powered pumps, many of which are sunk as part of the nationwide effort to eradicate the Guinea worm disease. Pipeborne water has also been extended to rural areas from central urban undertaking in Funtua and Zaria. However,

because of inadequate supply, the technological problems and the people's ignorance, many of the rural communities served in this way have not been able to derive the maximum benefits therefrom. Thus, it is common to hear of:

- Boreholes especially in areas of ancient rocks, drying up only a few days after commissioned.
- Borehole pumps breaking down and remaining unrepaired because of the lack of spare parts.
- Rural people not using a borehole sunk for them, because nobody told they could use it or because they prefer their traditional water source.

By 1985, the average minimum per capita use of improved water for rural population served varied among the States; Anambra 5 lpd, Bauchi 31 lpd, Bendel 42 lpd, Benue 50 lpd, Borno 32 lpd, Gongola 79 lpd, Imo 5 lpd, Kaduna/Katsina 10 lpd, Kano 33 lpd, Kwara 44 lpd, Lagos 103 lpd, Ogun 19 lpd, Ondo 16 lpd, Oyo 6 lpd, Rivers 2 lpd and Sokoto 10 lpd. It is little wonder that rural people still depended very much upon rivers, streams, ponds, springs and shallow wells for their water supply. During the dry season, some of these sources dry up. In large parts of the eastern States, about half of the rural population live more than 5 km from perennial streams, and women and children spend up to five hours per day collecting water.

(3) General Remarks

The JICA Team considers that for those parts of the country served with improved water, the supply falls far short of the minimum required for good health and a sound environment. The situation in those areas that are not served by improved supplies and have no ready access even to unimproved sources would be worse. Although the reliable data on water use are rather scarce, there is no doubt that the demand for good, clean water far exceeds the supply at present and that this demand is increasing and will continue to increase very rapidly because the water needs of any society change dynamically with increasing per capita income as well as with increasing supply level of improved water. How much water does Nigeria need for domestic and industrial purposes and how may these needs be expected to grow during the NWRMP period? Before these questions are answered, it is

imperative to evaluate the adequacy of present levels of water supply and related degree of satisfaction.

Nigeria was one of the signatories to the International Drinking Water Supply and Sanitation Decade (IDWSSD) whose objective was to supply water to all citizens of the country within the period of 1981-1990. In spite of this, the water supply situation appeared to be deteriorating. One of the reasons for this deterioration was the enormous socio-economic development rate which far outstripped the level of water supply development. Other reasons include low investment level on OM which accounts for frequent breakdown of the production facilities. Additionally, the investment on training of water industry staff is low. Very little incentive is given to local manufacture of the water supply equipment and chemicals with the effect that imported ones are becoming less affordable. As a result of increasing population and no commensurate increase in service level, Nigeria is gradually becoming one of the countries with the lowest level of water supply services in the world.

6. 1. 2 Classification of Water Supply and Sanitation Schemes

The water supply schemes in Nigeria are largely classified into two sectors of the urban water supply with population of more than 5,000 and the rural water supply with population of less than 5,000. The urban water supply schemes are further divided into two for the urban area with population of more than 20,000 and the semi-urban area with population of 20,000 to 5,000. For urban water supply, State Water Agencies (SWAs) are mainly in charge and have planned, implemented and managed waterworks except large dams constructed and managed by RBDAs under FMWRRD. On the other hand, many agencies including FMWRRD, DFRRI, FMHH, SWAs, ADPs, RBDAs, LGs and external agencies such as UNICEF, UNDP, World Bank, JICA, CIDA, Global 2000, etc. are involved in rural water supply.

The sanitation schemes for urban area is under Environmental Planning & Protection Agency except Directorate of Drainage or Directorate of Environmental Pollution Control, Sewerage and Wastewater under the State Ministry. The sanitation schemes for rural area is controlled by the agencies managing rural water supply.

6.1.3 JICA-NWRIS and Database

Since the technical data related to the water supply and sanitation sector in Nigeria were very scarce in the FMWRRD and scattered in different executing agencies, the NWRIS of water supply and sanitation was carried out in 1992/93 by five domestic consultant firms under the contract between and supervision of the Study Team. The Terms of Reference for Water Supply and Sanitation were given as follows:

- Water Supply and Sanitation

a Present situation of existing urban and semi-urban water supply schemes (systems) compiling location and coverage, executing agency, water source works, service population, projected water demand and current water supply, major water conveyance and distribution facilities, treatment plant and its process, water quality before and after treatment, construction cost, completion year, OM cost, water charge, problem areas and so forth.

b Present situation of existing rural water supply schemes on LGA basis summarizing the items similar to above Item a in connection with "Deep Wells".

c Proposed plan of the development for new urban and semi-urban water supply schemes (systems) and of the major rehabilitation for existing ones for the years of 2000 and 2020 compiling the items similar to Item a as deemed relevant.

d Proposed plan of the development for new rural water supply schemes and of the major rehabilitation for existing ones for the years of 2000 and 2020 compiling the items similar to above Item b in connection with "Deep Wells".

In addition, a series of the scheme surveys and the discussions with the Government agencies concerned on the basis of the final reports as submitted in March 1993 have been carried out, and this has led towards the supplement to the above NWRIS. The final inventory of, this sector thus established on the LGA basis is compiled in Vol. Three "Water Resources Inventory Survey" and Vol. Four "Water Resources Database Maps".

Reference is made to para. 1.1 of Chapter 1 where the general background, the difficulties encountered during the course of the survey and the final reports of the NWRIS are described. It may be noted that during the course of the NWRIS, there were many of the discussions regarding the inventory of private shallow wells particularly in the large urban centers, however, there was the complete lack of those inventories in the public authorities, and no account has been made in the NWRMP Study. In general, the Study Team has been strongly impressed on the inherent defectiveness on the database and inventory preparation in each of the executing and public administration agencies. It is recommended that there is a considerable room for improvement for this simple inventory work under the strong direction and coordination of the Department of Planning, Research and Statistics in cooperation with other relevant Departments, and the Water Resources Inventory included in this Final Report should be updated with the procurement and consolidation of additional information in near future.

Attention has also been paid to the number of existing boreholes, for which the NWRIS was conducted in two ways: one under 2 "Deep Wells" and another under 5 "Water Supply and Sanitation". The former is explained in para. PART 3D "Groundwater Resources" in Chapter 3, and the latter is quoted from Tables 6. 1 and 6. 3 in this Chapter. Comparison between the two on Regional basis is made as follows:

Region	Number of Boreholes	
	From Hydrogeology	From Water Supply
North-West	5,322	5,276
North-East	6,764	7,441
Central West	3,341	3,771
Central East	2,641	2,879
South-West	4,081	4,564
South-East	1,085	3,095
Total	23,234	27,026

It may be understood that both the surveys were carried out by different local experts and at different data sources, and the discrepancy between the two is endorsed by the current situation of weakness in preparation of the database and inventory in the Government agencies concerned. One of the explanations on this discrepancy was the inclusion of hand-dug wells in large diameter in the water supply sector.

6.2 PRESENT SITUATIONS

6.2.1 Salient Features of Waterworks

(1) Urban Water Supply

(a) Existing Waterworks

There are two kinds of waterworks: one is those consisting of reservoir dam, intake weir, raw water conveyance pipeline, water treatment plant and distribution system in the service area that use the surface water; and the other is those of borehole wells equipped with hand or mechanical pumps to use the groundwater.

Information of the existing waterworks include the planned service population, planned water supply capacity, and actual water supply capacity at present as identified under the NWRIS and the 1991 population census on the basis of 589 LGAs and are fully compiled in Vol. Three "Water Resources Inventory Survey". The outline of existing works on State level is shown in Table 6.1.

Nationwide

There are 235 existing waterworks using surface water and 8.3×10^3 borehole wells using groundwater for urban water supply in the country. The planned service population by existing waterworks is estimated at 38.9×10^6 in total occupying 79 percent of total urban population of 49.06×10^6 in the country. The planned water supply capacity by waterworks is estimated at 4,200 MLD (108 ℓcd), of which 2,920 MLD (122 ℓcd) is to be supplied by surface water and 1,280 MLD (85 ℓcd) by groundwater. However, the actual water supply capacity by the surface water and groundwater is as small as 1,950 MLD (81 ℓcd) and 690 MLD (46 ℓcd), respectively.

The existing waterworks, especially those using surface water in large city have been constructed by a water supply plan of each of the SWAs without the careful study of service population, water demand, target year to satisfy the water demand, optimum facility scale, OM manner, project cost, water charge, etc. In addition, the existing waterworks have been deteriorated due to improper OM and require rehabilitation and upgrading of the works.

Therefore, the nationwide actual water supply capacity would be as low as 63 percent of the planned supply capacity, as is shown in Table 6. 1.

North-West Region (HA-I)

There are 34 surface waterworks and 1,383 borehole wells for urban water supply in this Region. The planned service population by waterworks is estimated at 3.14×10^6 which cover 74 percent of the total urban population of 4.26×10^6 in the Region. The planned supply capacity of the waterworks is 440 MLD (140 ℓcd), of which the capacity to be supplied by the surface water is 378 MLD (190 ℓcd) while that by the groundwater 62 MLD (54 ℓcd). The urban water supply in Sokoto, Gusau and Katsina cities mostly depend on the surface water, and their planned supply capacity has reached 295 MLD representing 78 percent of total supply capacity of 378 MLD.

The actual water supply capacity in this Region is as small as 213 MLD (107 ℓcd) in the surface water sources and 37 MLD (33 ℓcd) in the groundwater.

North-East Region (HA-VIII)

Since the Region has few surface water resources except in Kano State, the existing waterworks using surface water are provided for only 11 urban areas, while 3,068 borehole wells using groundwater are distributed over the Region. Planned service population is estimated at 6.13×10^6, which is less than the present urban population of 6.84×10^6. The planned supply capacity of the waterworks is estimated at 598 MLD (98 ℓcd), of which 340 MLD (173 ℓcd) is to be supplied by surface water and 259 MLD (62 ℓcd) by groundwater. The urban water supply in Kano, Maiduguri and Bauchi cities is to be served mostly by surface water, and their planned service capacity reaches 286 MLD corresponding 84 percent of the total planned capacity of 340 MLD. The urban water supply in the other States is mainly by the boreholes using groundwater.

The actual supply capacity is 344 MLD (56 ℓcd), of which 195 MLD (100 ℓcd) is by surface water and 149 MLD (36 ℓcd) by groundwater. The actual capacity supplied by surface water for the urban water supply in Kano, Bauchi and Maiduguri cities is as low as 161 MLD compared with their planned

capacity of 286 MLD, because their planned capacity has a large allowance for their actual water demand.

Central-West Region (HA-II)

The Region has large surface water resources but relatively low potential groundwater resources, because the Region consists mostly of Basement Complex rock. There are 57 existing waterworks using surface water and 1,105 waterworks using groundwater. The actual water supply by surface water and groundwater is 470 MLD and 46 MLD respectively, and the waterworks using surface water have been provided to a large extent which compared with those by groundwater. Planned service population is estimated at 5.65×10^6 which cover 95 percent of the total urban population of 5.93×10^6 at present in the Region. A large population of 4.82×10^6 is to be served by surface water and 0.83×10^6 by groundwater.

Planned supply capacity is 740 MLD (131 ℓcd) in total, of which a large capacity of 660 MLD (137 ℓcd) is served by surface water and 79 MLD (95 ℓcd) by groundwater. The waterworks using surface water in the large cities of Kaduna, Zaria, Ilorin, Abuja, etc. have a large cumulative planned supply capacity of 431 MLD representing 65 percent of the total planned supply capacity of 660 MLD and a sufficient allowance for their urban water supply demand. However, the actual supply capacity is 470 MLD (98 ℓcd) for the surface waterworks and 46 MLD (55 ℓcd) for the waterworks using groundwater. The actual supply capacity in the above mentioned cities is especially as low as 256 MLD.

Central East Region (HAs-III and IV)

Since the Central East Region belongs to the most depressed area in the country, the water supply schemes have not progressed. Accordingly, the planned service population by waterworks is 2.09×10^6 which accounts to only 52 percent of the total urban population of 4.04×10^6 in the Region. The service population of 1.7×10^6 depends on 46 waterworks using surface water and that of 0.39×10^6 on 185 boreholes using groundwater. Planned supply capacity is estimated at 250 MLD (148 ℓcd) for surface waterworks and only 35 MLD (88 ℓcd) for boreholes. The existing waterworks using surface water sources are concentrated in Jos of the Plateau State and Yola of the Adamawa State, and

their supply capacity reaches 126 MLD corresponding to 50 percent of the total supply capacity of 250 MLD.

Actual supply capacity also is as small as 141 MLD (83 ℓcd) for the surface waterworks and 20 MLD (51 ℓcd) for the boreholes. The actual supply capacity by surface water in Jos and Yola cities is particularly as low as 89 MLD corresponding to 70 percent the of total planned supply capacity of 126 MLD for those cities.

South-West Region (HA-VI)

Many large commercial cities including Lagos are situated in this Region. Accordingly, a large number of waterworks such as 67 waterworks using surface water and 2,094 boreholes withdrawing groundwater have been provided for urban water supply in the Region. Planned service population by the existing waterworks is as large as 15.54×10^6 which accounts to 94 percent of the total urban population of 16.55×10^6. The planned water supply capacity is as large as 1,520 MLD (98 ℓcd) in total, of which 1,030 MLD (95 ℓcd) is by surface water and 490 MLD (106 ℓcd) by groundwater. The planned supply capacity by surface water in the cities of Lagos, Benin, Osogbo, Ibadan and Abeokuta reaches a large volume of 820 MLD, corresponding to 80 percent of the total planned capacity of 1,030 MLD.

Actual supply capacity, is as low as 743 MLD (68 ℓcd) for surface waterworks and 245 MLD (53 ℓcd) for boreholes. Actual supply capacity by surface water in the above mentioned cities is particularly as low as 570 MLD corresponding to 70 percent of the total planned supply capacity of 820 MLD for those cities.

South-East Region (HAs-V and VII)

Although this Region has large urban population of 11.43×10^6, the waterworks have been found to be insufficient. There are existing 20 waterworks using surface water and 466 boreholes withdrawing groundwater in the Region. The planned service population is only 6.36×10^6 in total corresponding to 56 percent of the total urban population. Planned water supply capacity is estimated at 612 MLD (96 ℓcd) in total, of which 259 MLD (100 ℓcd) is surface water and 353 MLD (93 ℓcd) by groundwater. The planned

supply capacity by surface water in the cities of Enugu, Abakaliki, Owerri and Umuahia occupies a large volume of 198 MLD corresponding to 76 percent of the total planned capacity of 259 MLD. Actual supply capacity is as small as 186 MLD (72 ℓcd) for the surface waterworks and 193 MLD (51 ℓcd) for the boreholes. Actual supply capacity by surface water in the above-cities is especially as low as 166 MLD.

(b) New Waterworks Tentatively Proposed by Agencies

The new waterworks tentatively proposed by the executing agencies which were also surveyed by the NWRIS are summarized in Table 6. 2. These waterworks, however, are mostly at a conceptional plan level and should be reviewed prior to implementation.

(c) National Water Rehabilitation Project

Although over the past three decades most States made substantial investments in urban water supply, the result has often been disappointing. Most facilities soon fell below about 40 percent of their installed capacity, and few consumers receive satisfactory supply. Subsequently, the SWAs found it difficult to maintain and sustain the installed plants and equipment, leading to the rapid fall in operational delivery of these installed facilities. Faced with these critical situations, many State Governments approached the World Bank to borrow funds to rehabilitate their water supply systems; as a result, preparation of the project was initiated in 1984.

The project objective is to improve the level of water supply service in selected urban and semi-urban areas by meeting the highest priority rehabilitation needs and to begin to address the major institutional weaknesses of the SWAs in order to improve their capacity to efficiently operate and maintain the water supply systems. The physical components of the project comprise rehabilitation of existing facilities, overhaul, repair or replacement of plant and equipment to restore the output of water supply schemes to the original design capacities. Spare-parts and maintenance of facilities are also to be provided to strengthen and support the institutional capability of the SWAs. The project includes:

- strengthening the Department of Water Supply and Quality Control, FMWRRD to develop sector guidelines in areas such as water treatment standards, borehole drilling, selection of equipment, and expansion of facilities.
- improvement of manpower planning and development by the SWAs.
- establishment of effective billing and collection systems.
- development of common accounting systems.
- the technical assistance required by the State/FCT water agencies to implement improved financial systems.
- special studies, as and when required, in support of sector development.

The National Water Rehabilitation Fund would provide the loan financing of up to US10×10^6 per State/FCT which would be complemented by US1.8×10^6 on counter-part funds to be provided by each State. Detailed engineering design, construction supervision and overall project coordination would be financed under a loan of US36×10^6 to the US7.4×10^6. The project total costs are estimated at US306.7×10^6.

Review and identification of the rehabilitation needs of the equipment and materials in the urban water supply systems in all 21 States and FCT, including recommendation for improvement in accounting, manpower development and personnel training for the water supply sector were carried out by Messrs. Diyam/Binnie Consultants who presented their final report in April 1990 with the total cost of US816×10^6. Since this amount could not readily be accommodated by both FGN and the World Bank, it was decided that only priority schemes whose total sum per State/FCT not exceeding US10×10^6 would be accommodated.

After the reports of pre-engineering studies for 9 States and FCT submitted by the Consultants were reviewed in January 1990, the World Bank project appraisal and subsequent loan negotiation were carried out; as a result, the loan of Us256×10^6 was approved by the Bank in May 1991. The project is being supervised by a Project Management Consultant (PMC), Lavin International Inc. in association with Schwed Associates and SGV Manila who commenced work in Abuja in March 1991. Regional consultants who are handling the engineering design and construction supervision of the

rehabilitation works have been selected. The objective and description of this on-going project are given below:

Objectives

- The main objective of the project is to increase the quantity and reliability of the supply of potable water throughout the urban centers of the Federation. This will be achieved by rehabilitating some of the existing urban and semi-urban water supply systems to restore them to design capacity and to sustain the increased water supply through institutional strengthening of SWAs. Institutional strengthening will emphasize improved staffing, financial management, operation and maintenance and stores management.
- It is acknowledged that the program of work included in this project will not deal with all of the rehabilitation needs of water supply systems in the Federation. The program concentrates on those items of work included on the agreed schedules, which have been chosen to give the greatest impact in terms of quantity, quality and reliability of supply to consumers and which will improve the capability of SWAs to collect revenue.

Description

- Physical components of the project comprise the rehabilitation of existing facilities by overhaul, repair or replacement of plant and equipment to restore the output of some water supply systems to original design capacities. Spare parts and maintenance facilities are also provided.
- To strengthen and support the institutional capability of SWAs, the project includes assistance to:
  - improve manpower planning and development.
  - establish effective billing and collection systems.
  - develop common accounting systems.
  - implement improved financial systems.

The project also provides the support to FDWR in developing sector guidelines and for carrying out special studies related to the sector.

The Project Launch Workshop was held in Abuja during the period of 22 to 27 November 1992. While the Federal coordination is made by the

Director of Special Duties, the Water Resources Sector, FMWRRD, all of 30 States plus Abuja FCT are eligible to benefit from a US$220×10^6 allocation for physical rehabilitation works, and the FMWRRD is to benefit from the balance of US$36×10^6 for technical assistance and institutional strengthening endeavors. A total of about 250 urban and semi-urban schemes are earmarked for rehabilitation work nationwide. So far, all of the States have signed the subloan agreement and fulfilled the loan conditionalities. Design of the physical rehabilitation works by regional consultants was scheduled to commence in January 1993, and construction to start 6 months later. When completed, the project will result in increased water supply output, more effective institutional framework, more efficient billing and collection systems, better trained staff and less water leakage.

It may be noted that the following major recommendations made on the basis of the above-mentioned workshop papers and discussions were closely related with those to be incorporated into the NWRMP:

1) Need to finalize the national water supply policy to provide the required sector coordination and guidelines with definite institutional responsibilities for all agencies involved in water supply in the country.

2) State master plans should be developed and policy objectives set for SWAs by the State Governments.

3) The SWAs should be given the autonomy they require to function efficiently so as to become financially viable enterprises.

4) In order for the management to discharge its duties effectively, a good organizational structure should be put in place with Chief Executives of SWAs delegating responsibilities to management and other key senior officers.

5) In order to sustain and improve operations, manpower development and training, SWAs should receive adequate attention and funding from the management of the respective Boards and the State Governments.

6) The SWAs should give attention to commercial activities to become financially viable through appropriate categorizing of customers, development of good customer-management strategies,

evolution of realistic tariffication regime, and efficient billing and accounting techniques.

7) Need to encourage the community mobilization and participation in OM of water supply schemes.

(d) Multi-State Water Supply Program

Realizing that the provision under the National Water Rehabilitation Project would not fully satisfy the needs of the States especially in the area of expansion of existing water supply schemes or provision of new ones, the subject program was conceived by the World Bank. The project under the Director of Special Duties, the Water Resources Sector, FMAWRRD is a loan program to assist the project States in improving quantity and reliability of water supply to urban areas, to improve health, productivity and living standards and conditions of women and other persons living in such areas, and to strengthen and make financially viable the SWAs.

Under this project, a joint loan is negotiated for two to five SWAs, and the loan allowed per State ranges from US$ 25 to 40 $\times 10^6$. Initially, seven States (Katsina, Kaduna, Imo, Cross-River, Kano, Anambra and Niger) indicated their wish to participate. Ogun and Plateau States have recently indicated their wish to participate. More States are expected to show interest soon in view of their interest in the National Water Rehabilitation Project. Anambra State had been dropped because of its loan from AfDB. One multi-state water supply project involving Kaduna and Katsina (FY92) is already in place. Under it, water supply facilities in Kaduna, Kawo, Kana, Zonkwa and limited rehabilitation of some rural schemes will be improved. In Katsina State, completion/rehabilitation of Katsina, Funtwa, Dawa and Malumfashi schemes will be undertaken.

The advantage of multi-State approach is to save time and money involved in treating each State separately. This is very cost effective approach to water supply. It also contributes to the strengthening of institutional framework, and billing and collection systems of the SWAs.

(2) Rural Water Supply

(a) Existing Waterworks

The existing waterworks for rural water supply are mainly composed of borehole wells to withdraw groundwater, although some rural areas have the waterworks using surface water. Groundwater is withdrawn by mechanical or hand pumps being installed at boreholes with depth of 50 to 150 m. It may be noted that groundwater has a number of advantages over the surface water for the provision of rural water supply and in general should be used as the source of supply whenever possible. It is available within the community, and is more reliable throughout the year and in the period of drought, and does not require the treatment.

Since the groundwater development by boreholes has been carried out by many agencies and its data are dispersed and in possession of at each agency and State concerned, such data have been collected under the JICA-assisted NWRIS and compiled on the basis of 589 LGAs in Vol. Three "Water Resources Inventory Survey". Planned service population, planned supply capacity and actual supply capacity for the rural water supply are summarized on the State level in Table 6. 3.

Nationwide

There are 30 existing waterworks using surface water and 18.8×10^3 boreholes withdrawing groundwater for rural water supply in the country. Planned rural service population by the existing waterworks is estimated at 5.07×10^6 in total, which covers only 12 percent of the rural population of 39.46×10^6 in the country. Planned population by surface water source is only 0.23×10^6 and that by groundwater reaches a large number of 4.84×10^6. Planned supply capacity by the existing waterworks is estimated at 194 MLD (38 ℓcd) in total, of which 9 MLD (40 ℓcd) is to be supplied by surface water and 185 MLD (38 ℓcd) by groundwater. However, actual water supply capacity is 138 MLD (27 ℓcd), of which 7 MLD (31 ℓcd) is depending on surface water and 131 MLD (27 ℓcd) on the groundwater.

In general, many of the rural areas in Nigeria have faced the serious water shortage for domestic use with the nationwide indicators of the low

service population rate at 9 percent*1 and the small actual per capita water supply amount at 3.5 ℓcd*2. Reference is made to Table 6. 6.

*1 .... Actual water supply capacity : 138.1 MLD (1)
Per capita water demand assumed : 40 ℓcd (2)
Service population: (1) ÷ (2) = 3.45×10^6 (3)
Service population rate:
(3) ÷ Nationwide rural population = 0.087
*2 .... (1) ÷ Nationwide rural population = 3.5 ℓcd

North-West Region (HA-I)

Rural water supply in the Region presently depends only on groundwater developed with the existing boreholes which are numbered at 3.9×10^3, that is 3.4×10^6 wells are operated by hand pumps, only 18 wells by mechanical pumps, and others without pump. The planned service population by the existing boreholes is estimated at 0.85×10^6 in the Region. It can be said that the rural water supply in the Region is placed at a better condition than the other Regions. Planned supply capacity by 3.9×10^3 boreholes is estimated at 34 MLD (40 ℓcd), while the actual supply capacity decreases to 24 MLD (29 ℓcd).

Rural water supply in Sokoto State has progressed compared with that of other States in the Region as shown in the planned service population of 0.44×10^6, planned supply capacity of 18 MLD and actual supply capacity of 12 MLD, which occupies about 50 percent of the total rural water supply in the Region.

North-East Region (HA-VIII)

Rural water supply in this Region also depends only on groundwater sources. There are existing 4.4×10^3 boreholes, of which 2.4×10^3 wells are operated by hand pumps and only 125 by mechanical pumps. Although the Region has the largest rural population of 9.93×10^6 corresponding to 25 percent of the nationwide rural population of 39.46×10^6, the planned service population by existing boreholes is only 1.22×10^6 representing 12 percent of the total rural population in the Region.

Planned water supply capacity by the existing wells is estimated at 49 MLD (40 ℓcd), while the actual supply capacity is as small as 34 MLD (28 ℓcd).

Rural water supply in Borno and Bauchi States is relatively developed as shown in the planned service population of 0.79×10^6, planned supply capacity of 32 MLD, and actual supply capacity of 20 MLD which corresponds to about 65 percent of the total rural water supply in the Region.

Although the groundwater resources potential in the Region generally has enough allowance to meet the demand with the amount of developed groundwater at present, the groundwater in the east part of the Region has a decreasing trend both in water level and yield caused by less rainfall and lowering of Lake Chad water level. Accordingly, particular attention is required for groundwater development in the east part near Lake Chad.

Central West Region (HA-II)

Rural water supply in this Region mostly depends on groundwater sources, although the surface waterworks are existing only at three places. There are 2.67×10^3 boreholes, of which the wells equipped with hand pumps and mechanical pumps are 2.2×10^3 and only 42, respectively.

Although the Region has the smallest rural population of 4.56×10^6 corresponding to only 12 percent of the nationwide population, the planned service population by existing rural waterworks reaches 0.63×10^6 occupying 14 percent of the total rural population in the Region. In total, the rural water supply in the Region is considered to be in a favorable condition as compared to other Regions. Planned water supply capacity is estimated at 25 MLD (39 ℓcd), while the actual supply capacity is as low as 18 MLD (27 ℓcd).

Rural water supply in the Niger State has progressed when compared with that in other States of the Region as shown in planned service population of 0.31×10^6, planned supply capacity of 12 MLD and actual supply capacity of 8 MLD occupying about 50 percent of the total rural water supply in the Region.

Central East Region (HAs-III and IV)

Although this Region has the rural population of 5.63×10^6, the rural water supply has not been developed, as a result, only 2.7×10^3 borehole wells are provided, and there is no waterworks using surface water. Planned service population, therefore, is as small as 0.72×10^6 corresponding to only 13 percent

of the total rural population in the Region. Planned water supply capacity is estimated at 29 MLD (40 ℓcd), while the actual supply capacity is only 21 MLD (29 ℓcd).

South-West Region (HA VI)

Rural water supply in this Region depends on 26 waterworks using surface water and 2.5×10^3 borehole wells. Planned service population is estimated at 1.04×10^6 corresponding to 18 percent of the total rural population of 5.78×10^6 in the Region. The served population by surface water and groundwater is 0.2×10^6 and 0.8×10^6 respectively. Namely, the occupying rate of the waterworks using surface water for rural water supply is relatively as high as 24 percent in the Region. Planned supply capacity is estimated at 34 MLD (32 ℓcd) in total, of which 8 MLD (40 ℓcd) is to be supplied by surface water and 26 MLD (31 ℓcd) by groundwater. Actual supply capacity, is as low as 24 MLD (23 ℓcd) in total, of which 6 MLD (31 ℓcd) is to be supplied by surface water and 18 MLD (21 ℓcd) by groundwater.

The rural water supply in the Delta State is at the lowest level among all the States in the country as could be seen in the planned service population of 68×10^3, planned supply capacity of 2.7 MLD and actual supply capacity of 1.7 MLD.

South-East Region (HAs-V and VII)

Although the Region has a large number of the rural population of 7.49×10^6, the rural water supply schemes have not progressed. Accordingly, the planned service population by existing waterworks is 0.6×10^6 corresponding to 16 percent of the total rural population. There are one existing waterworks using surface water and 26×10^3 boreholes using groundwater. Planned supply capacity is estimated 23 MLD (40 ℓcd), while the actual supply capacity is as small as 17 MLD (29 ℓcd).

Rural water supply in the Region is situated at the lowest in the country. Many States such as Enugu, Anambra, Akwa Ibom and Cross River are at planned service population of less than 100×10^3, planned per capita

supply capacity of less than 40 ℓcd and actual per capita supply capacity of less than 30 ℓcd.

(b) New Waterworks Tentatively Proposed by Agencies

New waterworks for rural water supply is to be promoted as explained hereinafter under item (c). In addition, the States of Adamawa, Enugu, Bauchi etc. have prepared their own rural water supply plans through the feasibility study and intend to implement the waterworks projects based on their plan. Especially, Bauchi State has collected and compiled all data for the existing boreholes and intend to use those data for the proper OM as well as the future development.

(c) National Rural Water Supply and Sanitation Program

This program under the assistance of World Bank, UNDP and UNICEF is an attempt to rationalize the institutional, financial and technical aspects of the Rural Water Supply and Sanitation (RWS/S) and provides the basis for increased financing in this sector. A draft of the Sector Strategy and Action Plan had been discussed at the national workshop in February 1992, and the comments and views adopted then had been incorporated into a final document in July 1992.

Many domestic organizations and external agencies have gained experience in the RWS/S program over the years, and based upon their experience, the emphasis for RWS/S implementation is shifting to community based maintenance with the underlying principles of making the community own their water supply facilities and involving multi-disciplinary specialists in the fields of community development, health and engineering in planning and implementation. With the demand-driven approach, the community would buy their pumps and spare parts through retail outlets, and the local mechanics would be trained to service the equipment. The strategy is, therefore, based upon the sustainability of infrastructure with community management and Government promotion of improved service, and private sector initiative in supplying goods and services.

Under this program the strategy, individual communities will participate in all levels of the decisions on RWS/S and assume the full

responsibility for OM. LGAs will assist the communities in planning their facilities and management, the State personnel will assist LGAs to establish the RWS/S Divisions and provide the training and technical support, and the private sector will provide most of the construction, OM services. The National RWS/S Program would assist the communities that are ready to provide at least 10 percent of the construction cost in cash or kind and also assume the responsibility for its OM by organizing the revenue collection for this purpose.

The Action Plan aims at dividing into four planning zones (NE, NW, SE and SW) in line with the primary health care (PHC) zones, and initiated a pilot project in a limited number of States and three LGAs in each of these States. In accordance with the demand-driven policy, each program will be expanded to cover more areas on the basis of experience and demand after the first three years. The take-off will involve US$ 3×10^6 per zone a year increasing to US$ 10×10^6 per zone a year in foreseeable future. The World Bank, UNICEF and other external agencies will prepare and promote the initial funding cycle in the first three years, and the follow-up financing to scale up the activities in line with demand and progress is expected to depend upon the success of initial phase.

(d) Guinea Worm Eradication Program

Guinea worm infection becomes a cause of death when accompanied secondarily by tetanus bacteria. People become sick when they drink water contaminated with microscopic Guinea worm larvae, which grow in the human body before emerging as a meter-long threadlike worms a year later. The disease has a multiple adverse effects on health, education, and social, religions, political and economic activities of the rural population in Nigeria. Because the peak of Guinea worm infection overlaps with the critical period of labor demand for harvesting or planting, the eradication of Guinea worm would potentially boost the local production of agricultural products especially rice and maize. Reference is made to para. 11.2.1 (7) of Chapter 11 when the water-related diseases in Nigeria is detailed.

The goal to eradicate dracunculiasis was endorsed in April 1991 by the steering committee of the IDWSSD. The UNICEF Executive Board in 1989 included the elimination of Guinea worm in the 1990s as an important element of "A Global Strategy of the Well-Being of Children as An Essential Part of

Overall Development". The FGN has put a mechanism in place by the establishment of the Nigeria Guinea Worm Eradication Program (NIGEP) working in collaboration with such external agencies as UNICEF, JICA, CIDA, UNDP, Global 2000 (USA Carter Centre), etc. for the total eradication of Guinea worm disease by 1995.

The evolution survey indicates that the number of Guinea worms has decreased drastically from 1×10^6 cases per year in 1986 to 35,749 cases in 1994. The 4th National Case Search Statistical Summary explains the Guinea worm cases by State in 1990/91 where the most severely infected were the States of Ondo, Enugu, Benue and Sokoto for the cases of 30×10^3 to 60×10^3, and next were the States of Niger, Plateau, Bauchi, Katsina and Kebbi for the cases of 5×10^3 to 30×10^3. It is projected that given the present trend of development by 1995, the number of worms will have fallen to below 10×10^3 with less than 200 transmission sites.

(e) Rural Water Supply Interventions by External Agencies

During the IDWSSD period (1980 - 90), a substantial increase in the interventions by external agencies took place, notable among which are:

- The UNICEF - assisted WATSAN (water and sanitation) projects to provide a strong interdisciplinary team at the State level with water point survey equipment, drilling rigs and vehicles for proper implementation of the rural water supply were initiated in six (old) States of Imo, Kwara, Gongola, Cross River, Anambra and Niger and are being expanded to five more States of Ondo, Oyo, Benue, Bauchi and Kaduna.
- The World Bank was involved in 1986 in the development of basic strategies for efficient planning and execution of the rural water supply program, while providing the loan for the State ADP operations including the rural water supply component to provide the hand pump-equipped boreholes. As for the State ADPs activities, reference is made to para. 5.1.3 of Chapter 5 "Irrigation and Drainage".
- The UNDP in association with the Government of the Netherlands has financed the RUSAFIYA project with focus upon the LGA - based institutional model and community centered approach for planning and implementation of the sustainable rural water supply

and sanitation schemes, which was started in 1988 including the States of Borno, Bauchi, Benue and Plateau and Abuja FCT.

- The Japan International Cooperation Agency (JICA) has been involved under the grant aid program in the borehole drilling for rural water supply in the then Anambra and Niger States with a focus upon the Guinea worm eradication and the provision of equipment for further water supply development.
- The UNICEF has recently initiated the assistance to the FMWRRD to provide the Water Supply and Sanitation Monitoring System (WASAMS) for regular monitoring of the sector performance.

6.2.2 Present Water Service Level

(1) Urban Water Supply

(a) Water Demand Examined

The water demand for 1991 has been estimated in such manner as described in para. 6.4 of this Chapter, and its result on State level is shown in Table 6.4. The estimated urban water demand on Regional basis is summarized as follows:

Item	NW	NE	CW	CE	SW	SE	Total or Average
Total Population (10^3)	4,262	6,837	5,941	4,034	16,553	11,432	49,059
Service Population (10^3)	2,131	3,418	2,970	2,017	8,276	5,716	24,529
Water Demand (MLD)	187	330	314	185	1,108	506	2,639
Per Capita Demand (ℓcd)	88	99	106	92	134	89	108

Note: Per capita means per service population.

The South-West and South-East Regions require large water demand as compared with other Regions due to a great number of urban population. The per capita demand of the Central-West and South-West Regions shows higher value of 106 to 134 ℓcd, as there are many cities with dense population and large urban activities.

(b) Capacity of Existing Waterworks

The capacity of existing waterworks is estimated based on their planned and operating information by each of SWAs which were collected under the NWRIS. The estimated result on each LGA level is shown in Vol. Three "Water Resources Inventory Survey", and its summary on State level is shown in Table 6.1. The capacity of existing waterworks on Regional basis are shown below:

Capacity of Existing Waterworks for Urban Water Supply

Item	NW	NE	CW	CE	SW	SE	Total
1.Total Population (10^3)	4,262	6,837	5,941	4,034	16,553	11,432	49,059
2.Planned Service Population (10^3)	3,135	6,129	5,643	2,093	15,540	6,364	38,904
3.Supply Capacity (MLD)							
Planned	440	598	740	286	1,523	612	4,199
Actual	250	344	516	161	988	379	2,639
Rate (%)	57	58	70	57	65	62	63
4.Per Capital Supply (ℓcd): Item 3/Item 2							
Planned	140	98	131	137	98	96	108
Actual	80	56	91	77	64	60	68
Actual per Total Population	59	50	87	40	60	33	54

As already explained in para. 6.2.1, the urban planned water supply capacity of existing waterworks in the Regions of the North-East, Central West and South-West has a sufficient allowance to satisfy the present total urban population. Contrary, the served population ratio in the Central East and South-East Regions is placed at considerably low level. Actual supply capacity is as low as 63 percent of planned supply capacity on an average in the country.

(c) Water Service Level

Quantitative evaluation for the present water service level has been made based on the above water demand and supply capacity of existing waterworks:

Estimated Service Population under Actual Supply Capacity

The estimated service population under the actual supply capacity of existing waterworks is assumed by dividing the actual per capita supply by the examined per capita water demand. The estimated service population rate also is assumed by dividing the estimated service population by the total urban population. The estimation result on State level is shown in Table 6. 4, and its Regional level is summarized as follows:

Item	NW	NE	CW	CE	SW	SE	Total
Total Population (10^3)	4,262	6,837	5,941	4,034	16,553	11,432	49,059
Estimated Service Population (10^3)	2,849	3,467	4,890	1,761	7,381	4,276	24,623
Service Population Rate (%)	67	51	82	44	45	37	50
Examined Per Capita Demand (ℓcd)	44	50	53	46	67	44	54
Actual Per Capita Supply (ℓcd)	59	50	87	40	60	33	54

Note: Per capita means per total population.

The estimated service population rate on nationwide level reaches 50 percent which satisfies the water supply target of 50 percent in 1991. The North-West, North-East and Central West Regions show a high service population rate of 50 to 80 percent, because the existing waterworks have actual supply capacity with sufficient allowance. On the other hand, the South-East Region shows considerably a low service population rate of 38 percent, because the existing waterworks in the Region mostly depend on boreholes which can not have a large supply capacity as compared with the waterworks using surface water. Seven States of Sokoto, Kaduna, Niger, Kwara, FCT, Edo and Ogun show a high service population rate of more than 70 percent. On the other hand, eight States of Kogi, Taraba, Delta, Ondo, Oyo, Anambra, Cross River and Rivers show very low service population rate of less than 30 percent.

The actual per capita supply amount on nationwide level reaches 54 ℓcd which could almost satisfy the target supply amount of 54 ℓcd in 1991. The actual per capita supply in Central West Region shows especially a large amount of 87 ℓcd which is 1.5 times for the examined per capita demand of 53 ℓcd. However, the actual per capita supply in South-East Region is as remarkably small as 33 ℓcd which is only 73 percent of the examined per capita demand of 45 ℓcd in the Region. Seven States of Sokoto, Kaduna, Kwara,

Abuja, Edo, Ogun and Lagos show high actual per capita supply of more than 70 ℓcd, but six States of Taraba, Kogi, Ondo, Anambra, Cross River, and Rivers present very low supply of less than 25 ℓcd. As explained above, the South East Region is placed in the critical water shortage area for urban water supply due to the lack of waterwork facilities especially for the surface water.

Estimated Service Population under Planned Supply Capacity

The estimated service population under the planned supply capacity of existing waterworks also is assumed under the condition that they could be operated completely and supply the full capacity. The estimation of State level is shown in Table 6.5, and its Regional summary is as follows:

Item	NW	NE	C.W	CE	SW	SE	Total
Total Population (10^3)	4,262	6,837	5,941	4,034	16,553	11,432	49,059
Estimated Service Population (10^3)	5,010	6,027	7,007	3,122	11,377	6,906	39,449
Estimated Service Population Rate (%)	118	88	118	77	69	60	80
Examined Per Capita Supply (ℓcd)	44	50	53	46	67	44	54
Planned Per Capita Supply (ℓcd)	103	88	125	71	92	54	86

Note: Per capita means per total population.

Although there are the problems as are discussed in para. 6.3.1, when the existing waterworks could function with their full capacity, their planned capacity in the North-West, North-East and Central West Regions would be well satisfied for the total urban population. However, the service population in other Regions could not cover the total urban population, and the lowest service population rate is in the South-East Region with only 61 percent. In general, the planned per capita supply amount in all Regions could satisfy the amount of examined per capita supply.

(d) Qualitative Evaluation

Since the existing waterworks using surface water has not been maintained and operated properly, they have lost their normal water treatment functions. In addition, the disinfection for treated water is not sufficiently operated. Polluted domestic water without proper treatment is often supplied to the service area by many of existing waterworks. In addition, the secondary

pollution is accelerated at the distribution system in service area caused by the untreated water supply.

The groundwater withdrawn by boreholes is supplied generally without treatment. Quality of groundwater varies depending on hydrogeological conditions in the area and causes the following problems in the South Region.

- Groundwater in Lagos and Cross River States include the high iron content which may be necessary to be treated by the iron removal facility.
- Groundwater in Cross River State shows very low PH value and could not be used for domestic water without the PH adjustment by alkalization.
- Groundwater along the coastal area shows a little high content of salinity and ferrous chloride.

(2) Rural Water Supply

(a) Water Demand Examined

The examined rural water demand for 1991 has been given under para. 6. 4, and its result on State level is shown in Table 6. 6. The estimated rural water demand on Regional basis is summarized as follows:

Item	NW	NE	C.W	CE	SW	SE	Total
Total Population (10^3)	6,070	9,931	4,555	5,634	5,778	7,494	39,462
Service Population (10^3)	3,035	4,965	2,277	2,817	2,889	3,747	19,731
Water Demand (MLD)	121	199	91	113	115	150	789
Assumed Per Capita Demand (ℓcd)	40	40	40	40	40	40	40

Note: Per capita means per service population

The North-East and South-East Regions have large rural population and require large water demand of 199 MLD and 150 MLD, respectively.

(b) Capacity of Existing Waterworks

The capacity of existing waterworks mostly depending on boreholes is estimated by their own planned and operated data of each agency which were

collected under the NWRIS. The estimation on each LGA level is shown in Vol. Three "Water Resources Inventory Survey", and its summary on State level is shown in Table 6. 3. The capacity of existing waterworks on Regional level is shown as follows:

Capacity of Existing Waterworks for Rural Water Supply

Item	NW	NE	CW	CE	SW	SE	Total
1.Total Population (10^3)	6,070	9,932	4,555	5,633	5,778	7,494	39,462
2.Service Population (10^3)	848	1,221	650	719	1,041	590	5,069
3.Supply Capacity (MLD)							
Planned	34	49	25	29	34	23	194
Actual	24	34	18	21	24	17	138
Rate (%)	71	69	72	72	72	74	71
4.Per Capital Supply (ℓcd): Item 3/Item 2							
Assumed	40	40	40	40	32	40	38
Actual	29	28	27	29	23	29	27
Actual per Total Population	4	3	4	4	4	2	3

As shown in the above table, the service population covered with the existing waterworks is as small as 5.07×10^6 in the country which represents only 13 percent of the total rural population. Especially, the actual capacity of the existing waterworks in the South-East Region is at an alarmingly low level. Actual supply capacity also is as low as 70 percent for the planned supply capacity on an average.

(c) Quantitative Evaluation

Quantitative evaluation for the present water service level is made in accordance with the above assumed water demand and supply capacity of existing waterworks.

Estimated Service Population under Actual Per Capita Supply Capacity

The estimated service population under the actual supply capacity of existing waterworks and its rate on the basis of the total rural population are assumed as shown in Table 6. 6, and those on Regional level are summarized as follows:

Item	NW	NE	CW	CE	SW	SE	Total
Total Population (10^3)	6,070	9,931	4,555	5,634	5,778	7,494	39,462
Service Population (10^3)	610	850	437	525	600	430	3,453
Service Population Rate (%)	10	9	10	9	10	6	9
Assumed Per Capita Supply (lcd)	40	40	40	40	40	40	40
Actual Per Capita Supply (lcd)	4	3	4	4	4	2	4

Note: Per capita means per service population.

The estimated service population rate under the actual supply capacity of existing waterworks is only 9 percent on nationwide level. This fact shows that the rural water supply in the country faces critical water shortage condition. Actual per capacity supply amount also is as small as 4 ℓcd which is only 10 percent of the assumed per capita supply of 40 ℓcd. Especially, the rural water supply in the South-East Region is placed in the worst situation as shown in the service population rate of 5 to 6 percent.

Estimated Service Population under Planned Supply Capacity

The estimated service population under the planned supply capacity of existing waterworks and its rate on the basis of total rural population also are assumed as shown in Table 6.7, and those on Regional level is summarized as follows:

Item	NW	NE	C.W	CE	SW	SE	Total
Total Population (10^3)	6,070	9,931	4,555	5,634	5,778	7,494	39,462
Service Population (10^3)	848	1,220	627	718	843	587	4,843
Service Population Rate (%)	14	12	14	13	15	8	12
Assumed Per Capita Supply (ℓcd)	40	40	40	40	40	40	40
Actual Per Capita Supply (ℓcd)	6	5	6	5	6	3	5

Note: Per capita means per service population.

When the existing waterworks could fully supply with their own planned capacity, the service population rate increases to 12 percent on nationwide level as compared with that of 9 percent under the actual supply capacity. However, the rural service population under the planned supply capacity is still small, as a consequence, many of the rural water supplies would face the domestic water problem unless new waterworks are provided. Actual per capita supply amount also is as small as 5 ℓcd on nationwide level which is only 12 percent of the assumed per capita supply amount of 40 ℓcd.

(d) Qualitative Evaluation

Rural water supply mostly depends on groundwater sources. Groundwater in the South Region has some quality problems, such as high iron content, low PH, salinity and ferrous chloride, which will require water treatment. Groundwater in the North and Central Regions has no quality problem for domestic water.

6. 2. 3 Raw Water Use for Existing Waterworks

(1) Raw Water Use on State Basis

Daily and annual raw water use for actual water supply by surface water and groundwater on State level are estimated as shown in Tables 6. 8 and 6. 9. Annual raw water use for actual water supply on Regional level is summarized as follows:

(Unit: 10^5 cu.m p.a)

Item	NW	NE	CW	CE	SW	SE	Total
1. Urban Water Supply							
Surface Water	68	62	149	45	236	59	619
Groundwater	12	47	15	6	78	61	219
Sub-Total	80	109	164	51	314	120	838
2. Rural Water Supply							
Surface Water	0	0	0	0	2	0	2
Groundwater	8	11	5	7	6	5	42
Sub-Total	8	11	5	7	8	5	44
3. Total Water Supply							
Surface Water	68	62	149	45	238	59	621
Groundwater	20	58	20	13	83	67	261
Total: (1. + 2.)	88	120	169	58	321	126	882

(a) Nationwide

The raw water use for existing waterworks on nationwide level reaches 882×10^6 cu.m, of which 621×10^6 cu.m depends on surface water and 261×10^6 cu.m on groundwater. The raw water use for urban area except those for the North-East and South-East Regions mostly depends on surface water, which corresponds to 74 percent of the total urban raw water use. On the other hand, the raw water use for rural area is mostly by groundwater, which represents 95 percent of the total rural raw water use.

(b) North-West Region

In this Region, the raw water use for urban water supply by surface water is estimated at 68×10^6 cu.m corresponding to about 85 percent of the total raw water use, and all of the raw water use for rural water supply depends on groundwater sources.

(c) North-East Region

The raw water use by groundwater is relatively large and estimated at 58×10^6 cu.m corresponding to about 50 percent of the total raw water use in the Region. Since the Region has low potential surface water resources, the raw water use for urban water supply by groundwater also reaches a large amount of 47×10^6 cu.m representing about 43 percent of the total raw water use for urban water supply. The raw water use by surface water for Kano, Maidugri and Bauchi cities is 56×10^6 cu.m occupying about 90 percent of the total water use for urban water by surface water.

(d) Central West Region

Since the Region is blessed with surface water resources, the raw water use by surface water is as large as 149×10^6 cu.m accounting to 88 percent of the total raw water use of 169×10^6 cu.m. Especially, the raw water use for urban water supply mostly depends on the surface water.

(e) Central East Region

The raw water use for actual water supply in the Region is only 58×10^6 cu.m in total which is the lowest in the country. The raw water use by groundwater is also small and estimated at only 13×10^6 cu.m corresponding to 22 percent of the total raw water use.

(f) South-West Region

The raw water use in the Region reaches the highest amount of 321×10^6 cu.m in the country and 74 percent of the raw water use is supplied by

the surface water. Especially the raw water use for urban water supply is as large as 314×10^6 cu.m, which represents 98 percent of the total raw water use.

(g) South-East Region

The raw water use in the Region relatively depends on groundwater which is 67×10^6 cu.m corresponding to 53 percent of the total raw water use of 126×10^6 cu.m.

(2) Raw Water Use on HA Basis

Annual raw water use for actual water supply and existing waterwork on SHA basis are estimated as shown in Table 6.10, and that on HA basis is summarized as shown below:

(unit: 10^6 cu.m p.a)

	HA-Ⅰ	HA-Ⅱ	HA-Ⅲ	HA-Ⅳ	HA-Ⅴ	HA-Ⅵ	HA-Ⅶ	HA-Ⅷ	Total
1. Urban Water Supply									
Surface Water	59	145	23	17	10	230	56	79	619
Groundwater	10	13	9	2	29	68	42	47	220
Sub-Total	69	158	32	19	39	298	98	126	839
2. Uural Water Supply									
Surface Water	0	0	0	0	1	1	0	0	2
Groundwater	7	4	5	3	2	5	5	11	42
Sub-Total	7	4	5	3	3	6	5	11	44
3. Total Water Supply									
Surface Water	59	145	23	17	11	231	56	79	521
Groundwater	17	17	14	5	31	73	47	58	262
Total: (1.+2.)	76	162	37	22	42	304	103	137	883

6.2.4 Sanitation and Sewerage

Urban sewerage establishment schemes consist of the sectors for sanitation, sewerage, storm water drainage, and solid waste.

(1) Sanitation and Sewerage Sector

As for the domestic sewage, there are two common types of the toilets consisting of the pit latrine and the water closet which are connected to the

sewage disposal systems. The sewage from the water closet is discharged either into the septic tank system or into the sewerage systems for treatment.

In respect to the treatment and disposal methods in sanitation sector, there is no organized treatment for septage, and some households only add certain chemicals such as caustic soda to their pit latrines and septic tanks. The septage is thrown into the open drains around the houses, and the sludge is periodically collected by disposal car and wasted to disposal area. This practice should be discouraged.

The sewage at parts of housing estates, hotel, school, Government and public office, etc. is collected at district unit and treated by the package plant based on either extended aeration or contact stabilization methods, oxidation pond method, conventional activated sludge method, oxidation ditch method or trickling filter method.

In Lagos Metropolis, for example, the proportion of people using pit latrines, septic tank and sewerage system are estimated as 65 percent, 30 percent and 5 percent, respectively. There are 7 Government operated existing sewerage systems and 31 individual operated existing sewerage systems, 13 systems of which are out of use. On the Government operated system, sewage treatment methods are of oxidation ditch, conventional activated sludge, or extended aeration method. The individual-operated sewage treatment methods are of extended aeration method for 7 systems and package plant based on either extended aeration or contact stabilization methods for the remaining systems. Effluent from the sewerage systems may be discharged to open channel, lagoon, storm drain or swamp. Existing large-scale wastewater treatment works in some States are shown in Table 6.11.

(2) Storm Water Drainage Sector

Storm water drainage schemes have not been implemented but planned in large cities such as Lagos, Abuja, Ibadan, etc. Small scale storm water drainage schemes are implemented at part of Lagos city, Abuja city, etc.

(3) Solid Waste Sector

The solid waste is hauled directly from the generating premises to disposal sites. There are no transfer stations. The sanitary landfill method is crudely employed because the tipped solid waste is not being covered. There is a leachate problem from all the dumping sites. It is of the high priority for the present environmental needs for every State Government and State capital that the solid waste management should also be improved.

6.3 CURRENT PROBLEMS AND NEEDS

6.3.1 Urban Water Supply

(1) Problems in Existing Waterworks Plan

In the States where the target of the water supply has been highly achieved in terms of the estimated SPR and per capita supply, the target under planned supply capacity has reached over 100 percent to a large extent, however, in nine States of Sokoto in the North-West Region, Kano and Borno in the North-East, Kaduna Niger, Kwara and Abuja in the Central West, Adamawa in the Central East, and Lagos in the South-West, the overplanning or overestimation is seemed to be made on existing waterworks projects for the large urban centers.

In many cases of the project planning, the overestimated demographic increases and long-term goals of the projects have resulted in overestimation of the planned service population and planned water supply amount. Even if the plans themselves are not overplanned, the project activities and related efficiencies have been lowered due to the poor OM services for long years after completion of the projects. Such unfavorable conditions of the projects have caused a long stagnation of the project functionings and required a comprehensive rehabilitation of the facilities, for instance, in Sokoto, Kano, Adamawa, etc. The above fact may review that in neglecting the consideration on normal operations of the waterworks projects, the basic data and indices required for the project planning have been given, and the total project works have been implemented for a long period.

The waterworks projects should be carried out in a well-arranged staged development plan based upon the adequate basic data and indices. It is recommended that the waterworks plans should be formulated appropriately with proper check and inspection of the basic data and indices as well as adequate combination of the rehabilitation, replacement, reconstruction and expansion plans under a reasonable financial plan. The basic indices for the waterworks projects, therefore, should be studied and determined in detail giving careful attentions to actual water demand, financing for OM, and rehabilitation and reconstruction of the facilities as well as greater participation and fair benefit distribution of the local inhabitants. In this connection, reference is made to para. 12.4.4 of Chapter 12 "Institution and Legislation" where the special issues in project undertakings are discussed for the items of project preparation, trade-off between project preparation and implementation, and planning and managing the project implementation inclusive of coordinating mechanisms, monitoring and evaluation, and management information.

(2) Lack of Appropriate Technology in Water Supply Systems

(a) General

The JICA Team has observed that the existing waterworks are planned and designed with such systems and unit process as given below:

- The conventional rapid filtration system is mostly applied for the existing waterworks with some exception. Alum for coagulant, lime for PH control and chlorine gas or bleaching powder for disinfectant are used at the system.
- Coagulo-sedimentation is designed generally with clarified type but with horizontal flow type in some waterworks. Rapid sand filter is operated mostly w'th back-washing system with air scour and floating weight control system.

Some existing waterworks have faced the following problems:

(b) Raw Water Intake

The raw water intakes at the reservoir dams have problems such as sedimentation hence decreasing reservoir capacity, dense aquatic weed covering the intake mouth and high content of turbidity in reservoir water. The raw water intakes at pumping stations are lifting the river water directly without providing grid chambers to remove the sediment load consisting of sand and coarse materials, hence, wearing out the pump blade and others, resulting in the costly maintenance and repair works.

(c) Feeding System of Alum and Lime

Although the feeding operations of alum and lime are well made generally, the over-feeding operations are found at some existing waterworks. Economical and effective feeding control methods should be worked out taking into account the variation of turbidity content in raw water, selection of proper feeding point and provision of feeding devices.

(d) Coagulo-Sedimentation System

For the coagulo-sedimentation system, simple and non-mechanical method which can treat properly the raw water with high turbidity content should be applied. For example, the system consisting of gravity fall type for mixing method, vertical buffing type for flocculation method, and horizontal flow and hopper bottom type for sedimentation method may be considered. By applying the above simple structure and easy OM system for the waterworks, the low efficiency of water treatments caused by mechanical defect, shortage of spare parts, etc., would be improved, and the OM could be made properly by the staff's technology under primary training.

(e) Rapid Filter System

A simple and non-mechanical type of the rapid filter system which can be operated with less energy and more stability should be applied instead of a particular type provided by existing purification manufacturers. Many existing rapid filter types have faced such problem as the high energy consumption in operation, the non-uniformity in filtering work, the contamination of filter layer due to improper washing system and insufficient

washing operations, and the lowering of treatment efficiency caused by defect of air compressor and air control valve and filter control devices.

(f) Disinfection System

There are many waterworks to use the chlorine gas for disinfection. This method requires the high initial investment and the difficulty of safety operations and complicated maintenance, although the running cost for this method is lower. It is recommendable to use the bleaching powder from the viewpoint of easy and safe OM.

(g) As a Whole

It is necessary to upgrade the technology for planning, designing and OM of the waterworks as well as the knowledge to understand the water supply functions and economical management for the waterworks.

(3) Insufficiency in Waterworks Management

(a) Technical Management

Many existing waterworks have been operated and maintained without an integrated management plan which should include the following items:

- Rational implementation plan with a proper OM manual such as periodical check and inspection, rehabilitation, replacement, reconstruction, and expansion.
- Revenue and expenditure plan for the above implementation plan.
- Water charging plan for water users to meet the above expenditure.
- Provision of the spare parts for equipment and their purchasing budget.
- Provision of the skillful staff for OM and the training program for upgrading the technical level of OM.

For the reason of lack of the proper water management as mentioned above, many of the existing waterworks have supplied less water amount than their designed supply capacity. In addition, the existing waterworks can not recover their designed supply capacity by simple rehabilitation and replacement, and the new waterworks with large investment are inevitably required in many cases.

(b) Commercial Operations

Water charge on some waterworks is scheduled as shown in Table 6.12. However, the consumers paying water charge are found scarce, because the public water supply is mostly considered as the social services oriented and tied to health care delivery which should be performed by the Governmental fund, and also based upon the fact that the public water supply services are not always reliable. It is necessary to improve the public water supply service level and to prepare at least the fund for OM, rehabilitation and replacement based on water charge, otherwise a large amount of Governmental budget may be required to achieve the water supply operations program in adequate manner. To improve this procedure, the general concepts to be incorporated are compiled in para. 12.2 of Chapter 12 where the decentralization, accountability and financial autonomy, users participation, gender issues, water users participation, private sector participation, and so forth are explained. In addition, special remarks with respect to the decentralization of SWAs' functions are also compiled in para. 12.4.2 (3) in Chapter 12.

It may be noted that from the worldwise experiences, nothing disrupts the operations of waterworks more than being dependent upon unpredictable Government subventions to cover the operating cost. This means that the decision on procurement of inputs and maintenance and repair of equipment cannot be made in time to prevent the service interruptions. In turn, the service interruptions damages the waterworks image with consumers who become reluctant to pay for water delivered only intermittently, and then this reduces the SWA income which is made more dependent upon the Government subventions to maintain the water supply services. This vicious process can become a downward spiral with worsening the financial situation, and the progressive deterioration of equipment and service reliability. The key to breaking out of this downward spiral in the quality of water supply services is

to commercialize the operations of waterworks in order that they may eventually achieve the financial autonomy to a full extent.

It is often mentioned that even low-income consumers are prepared to pay for the cost of good quality water if the services are reliable. Proof of this is that the consumers frequently pay much higher prices when purchasing water from street vendors than the public waterworks. In all cases, the street vendors are charging more than US$1 per cu.m of water, which can be compared to the present water charges in major cities as are compiled in Table 6.12. In addition, the street vendors offered little assurance that their water quality was acceptable.

Taking into account the conditions that the SWA financial resources are insufficient and the consumers are willing to pay for the cost of drinking water, what financial goals should the SWAs set for themselves ? It can be considered that a total financial self-sufficiency may be unrealistic for most of the SWAs in the near future, since they have a backlog to invest the BMR works and to expand their services to the consumers not presently being serviced. Nevertheless, it appears feasible to expect that at the end of the following BMR works, the SWAs could generate sufficient resources through the sale of water to (1) meet its OM expenditures including overhead and routine maintenance, and (2) to make a reasonable contribution towards the capital costs of major BMR works and for extending the services to previously unserviced consumers:

- The equipment rehabilitation and maintenance program to increase the amount of water delivered to a level that is close to design capacity.
- The program to identify and repair the leaks in water transmission and distribution networks as well as in illegal consumer connections.
- The program to identify, enumerate and classify existing and potential water consumers, to bill all serviced clients regularly and to collect for the water billed, while the clients who do not pay within a reasonable period should be disconnected until they settle their bills.

It would be possible to structure a water tariff that takes into account the community health and social equity while achieving the desired level of income for SWAs. Different tariffs may be applied to water consumers to ensure that the low-income groups receive water at affordable prices, while middle and higher income consumers make a substantial contribution to the cost of services. In addition, the SWAs should examine whether or not to meter the water consumed, which may have such advantages as (1) a fair basis for charges, (2) a trend to reduce consumption and avoid the water waste, and (3) the identification of leaks for repair, and such disadvantages as the added cost of installing meters and reading them.

In Nigeria, it has been evaluated that the legislation establishing the SWAs usually given them a clear mandate to provide water to urban (and sometimes rural) consumers, and although the SWAs are constituted as autonomous entities, many of them function as a department of the State administration. And, this integration in the civil service may be the largest obstacle to commercialization of the water services. Total or partial privatization of the water services is an option to be considered, because the worldwide facts indicate that the water services have been provided successfully by the privately-owned companies to many communities for some considerable time. In this occasion, the provision of water by private companies has taken place within adequate legal and institutional frameworks to ensure that the public interests are safeguarded. Privatization of the water services can be done in different degrees and stages over time, of which the most applicable to the Nigerian conditions appear to be the contracts of service, management, lease and concessionaire. These contracts are outlined in para. 12.2.7 of Chapter 12 "Institution and Legislation".

(4) BMR Works for Existing Waterworks

The actual water supply capacity of existing waterworks in 13 States satisfies their projected water demand in 1995, and the service population rate by existing waterworks on nationwide level reaches about 50 percent which also satisfies the national program target. When the existing works could be operated properly with their planned supply capacity, number of the States to satisfy their projected water demand would increase to 24, and the service population rate on the nationwide level also would increase to 78 percent. The BMR works for existing waterworks, therefore, are urgently required to

achieve the planned supply capacity. It may be noted that some of the States can not satisfy their projected water demand even if their waterworks are rehabilitated and upgraded, because the original planned supply capacity is smaller than the projected water demand. However, the existing waterworks under the following conditions could not recover the water supply capacity even if the rehabilitation and upgrading works are carried out:

- The waterworks have been operated more than 20 years after completion.
- The waterworks with lower water supply functions due to poor and improper OM.
- The waterworks having the difficulty to carry out the rehabilitation and upgrading works due to large defects and more technical problems for improvement.

Therefore, the BMR works should be carried out studying the present problems and defect parts in the existing waterworks in a careful manner. Some of the water treatment plants may be reconstructed instead of the rehabilitating and upgrading works from the viewpoint of water supply functions and investment cost. It is necessary to prepare an appropriate improvement plan based on the integrated management plan as described in para. 6.3.1 (3) (a) taking into account its role to be discharged under the long-term water supply plan.

6.3.2 Rural Water Supply

(1) General

The physical problems and needs on provision and subsequent OM of the tubewells for rural water supply are explained in detail from the viewpoint of groundwater use in para. 3D. 5 of Chapter 3 "Water Resources and Management".

Recent attention is being focussed on the rural communities for the improvement of their living conditions with a series of the programs for primary health care (PHC), rural water supply and sanitation (RWS/S), Guinea worm eradication, agriculture and other rural infrastructure development at varying degrees of commitment. Being second only to air as the BHN, the

water supply has naturally been in the front of these programs; however, not much has been done to ensure the sustainable development of this vital sector in the rural areas.

Sustainability is probably the central issue which engaged and is engaging the rural water supply sector developers during the IDWSSD and beyond. The key issues of sustainability have been elucidated during the course of the IDWSSD, mainly through pilot and demonstration programs as well as various training courses, seminars and workshops, regional and global consultations. These issues are at various stages of development, testing and application in Nigeria and have been set forth in the National RWS/S Sector Strategy and Action Plan as introduced in para.6.2.1 (2), (c) which all those involved in the Sector should familiarize themselves with. The key elements of sustainable rural water supply may fall under six main categories as explained below:

(2) National Policy Guidelines

What remains to be done at present is to translate the National RWS/S Sector Strategy and Action Plan into a national policy guideline. This will strengthen the implementation of the National RWS/S Program within the context of which only sustainable water supply to rural communities can take place, and the confidence of multi- and bilateral support agencies can be gained. There is, however, the need to raise the awareness and secure the political will of those in the Government.

(3) Strong and Stable Institutional Framework

The institutional arrangement for rural water supply is well spelt-out in the above Sector Strategy and Action Plan; however, there may be some salient and practical issues that need to be considered if this arrangement is to ensure the sustainable rural water supply.

One of the most critical aspects in the institutional arrangement is a strong and stable leadership. It is important to ensure that in choosing the heads for the RWS/S units at three levels of the Government, attention should be paid to select the people who can provide the strong and facilitative leadership and have an exposure on or potential for inter-agency cooperation.

The building of institutional capacity that is the most important factor for suitable rural water supply means both training and equipping of the units at all levels particularly the training of managers and professionals as well as the private sector for drilling operations and hand pump installation / repairs. Capacity building is a time consuming activity when considered in terms of developing the ability of communities to own and manage their water supply facilities.

Close linkage between the apex agencies at three tiers of the Government and other sector agencies both national, external and non-Governmental is necessary to ensure that all agencies are kept abreast with the policy development and program status; the review is made in the implementing approaches and training requirements; and the duplication of efforts is avoided. The Sector Strategy and Action Plan recommends collaborative committees at Federal, State and LGA levels. And also, both the external agencies and NGOs are keen on having a unified approach towards the involvement in the sector as well as relating closely to the Government agencies. To conserve the water resources in terms of quantity and quality, the proposed Department of Water Administration that is discussed in para. 12.3.3 of Chapter 12 "Institution and Legislation" need to be consulted and coordinated with other water users in the rural water supply program planning, implementation and monitoring.

(4) Community Ownership

In the past, the rural water supply has been dominated by the approach of Governmental provision of facilities which are constructed, owned and maintained by the Government. This has not worked at all, and it is quite clear that another approach to place the ownership of the facilities in hands of the communities is the best.

First of all, each community should be aware of its most pressing needs and determine its development priority. In the beginning, a need assessment in a form of rapid reconnaissance survey of all communities should be done by a LGA RWS/S unit, for which the communities are prioritized on the basis of their perceived or indicated needs, and only those with water supply as their top priority should be considered for involvement in a project undertaking.

The project planning and implementation should take place within a partnership arrangement where the communities take the lead and the Government provide support, so that the communities are fully aware of their responsibilities and have an opportunity to develop the confidence in all the support agencies involved. Cost sharing is a major aspect of any community participation, for which the Sector Strategy and Action Plan stresses a 10 percent community contribution towards the initial construction costs and a full responsibility for the financing and managing OM of the facilities. Within the context of community participation, women should be involved in all aspects and stages of planning and implementation. The information relevant to the Women in Development (WID) are compiled in para. 12.2.4 of Chapter 12. In addition, to ensure that the communities are able to sustain their water supply facilities, support should be available to them in close proximity. Such support includes the availability of trained area mechanics for more difficult repair works and the spare parts distribution network to ensure the availability of pump parts at retail outlets close to the community. In this connection, the effort in development of local manufacturing capacity for both complete pumps and spare parts should be intensified.

(5) Project Planning and Implementing Approach

Within the context and timeframe of a national rural water supply program, there should be a shift in planning and designing individual projects from the more prescriptive and inflexible blue-print approach to the more adaptable learning process approach. The latter approach may allow all partners concerned with the project to test and continually modify the implementing methods in the light of experience so that more appropriate approach which is socio-culturally viable, technically feasible and financially affordable will emerge. This is particularly useful at the initial stages of the program implementation when most of the implementing methods are still being tested and developed in the pilot and demonstration projects before a full-scale replication is undertaken.

Certain aspects in appropriate planning and implementation would include (1) community development approaches, (2) low-cost water development such as hand-drilling and-digging, (3) community participation in small pipe scheme, and (4) ways and means of securing the financial contribution of the Government. These aspects need to be further developed and refined in the demonstration projects, while the learning process approach should be fully employed for these projects.

(6) Rural Water Supply Monitoring

Monitoring is an important aspect of any development as is explained in para. 12.4.4 (5) in Chapter 12 "Institution and Legislation" and needs to be incorporated in the program, because this enables the planners and users to follow progress, identify the problems so that the modification in approach could be made towards better performance. Of greater importance, however, is the handling of the information obtained during the monitoring exercise. Quite often, there is the mechanical gathering and storage of data without utilizing them. The training in data gathering and analysis needs to be given to all planners, professionals and extension agents at all levels who should know what to do with such information they gather as water source and use, population and general perceptions from the meetings with communities. The data obtained should be analyzed and stored in a retrievable manner.

6.4 NWRMP TOWARDS THE YEAR 2020

6.4.1 Introduction

The water supply sector in the National Water Resources Master Plan (NWRMP) has looked closely into two items: (1) the projection of water demand by the year 2020 that may be a factor to be given to the 2020 water resources use rate in relevant basins; and (2) the proposal of water supply schemes by water sources by 2020 that may lead to approximation of the budgetary requirement to meet the projected water supply demand. Both items have been examined based upon the foundation of the present situations as are in paras. 6. 2 and 6. 3 and also of the population projection as is in para. 2.3 of Chapter 2 "Socio-Economy and Land Use", all of which have been discussed on the basis of each of 589 LGAs within the context and timeframe as imposed upon the Study. In connection with this analytical framework, less emphasis has been made to the establishment of individual projects while appropriate division of the future waterworks by surface and groundwater sources on LGA basis has been sought taking into account the water resources potentials as are compiled in Chapter 3 "Water Resources and Management" and also the proposal on multipurpose dam projects and related irrigation water demand as are provided in Chapters 4 "Water Source Works" and 5 "Irrigation and Drainage".

It is noted that all of the analyses for the above-mentioned items to prepare the NWRMP on the water supply sector have been made on the basis of each of 589 LGAs as the minimum unit, and the outcomes from these analyses are compiled in Vol. Three "Water Resources Inventory Survey", while the information summarized on State and Regional level are attached in many tables of this Chapter for ready reference.

6.4.2 Water Supply Demand Projected

(1) Government Policies and Targets

According to "Master Plan for Water Supply & Sanitation" (1984 Draft), the Government policies and targets are given as follows taking the year 2000 as target:

		Urban Area			Rural Area		
		1984	1990	2000	1984	1990	2000
Population	(10^6)	25	38	57	69	71	83
SPR (%)		80	95	100	80	95	100
Per Capita Supply	(ℓcd)	180			90		

And according to "National Water Supply Policy" (1992) submitted by the NTCWR, the targets of service population rate (SPR) and per capita supply are described taking the year of 2015 as the target and three demographical classifications as urban area with more than 20,000 people, semi-urban area with 20,000 ~ 5,000 and rural area with less than 5,000.

		Urban Area			Semi-urban Area			Rural Area		
		1995	2005	2015	1995	2005	2015	1995	2005	2015
SPR	(%)	60	80	100	60	80	100	60	80	100
Per Capita Supply	(ℓcd)	120			90			60		

(2) Major Factors Incorporated

(a) SPR

Although the Government has been trying to realize the targets along with its policy, it seems rather difficult to achieve those taking into account the present water supply conditions such as 50 percent SPR for the urban area and

9 percent SPR for the rural area in 1991. On the other, Nigeria was one of the signatories to the International Drinking Water Supply and Sanitation Decade (IDWSSD) whose objective was to supply water to all citizens of the country between the period 1981 - 1990.

It may be considered that the poor record as mentioned above in terms of water supply development underscores the need to reorient the Government policies in future to ensure that the sustainable improvement in the quality of living standard for vast majority of the population is achieved at least during the NWRMP period. It should be understood that the income growth and its more equitable distribution are in themselves to be recognized as means of achieving a desirable goal of providing for the fulfillment of Basic Human Needs (BHN) of a greater percentage of the population than has in the past been the case, where the water supply is one of the BHN.

The service population rates required for the public water supply schemes during the course of NWRMP period have been projected as follows:

- Access to the safe water through positive implementation of the public water supply program in the NWRMP target year of 2020 has been taken at 80 percent of the population both for the urban and rural which may be compared with 31 percent in 1991. This service population rate in 2020 has been targeted with special reference to that of the Pre-Plan Vision Document Towards A Perspective Development Plan for the Federal Republic of Nigeria (80 percent in 2010) additionally taking into account the remaining availability of traditional private supplies of safe water usually by streams, springs and hand-dug wells as well as the manpower requirement and related service improvement as a whole. As a matter of fact, this target may be optimistic and a challenging task, as for the National Perspective Plan, reference is made to para. 2.6.1 of Chapter 2 "Socio-Economy and Land Use".
- During the course of the NWRMP period, the service population rates in 2000, 2005, 2010 and 2015 have been interpolated at the percentages of 60, 65, 70 and 75, respectively.

(b) Projected Water Demand Level under Six Categories

b. 1) Classification

Since the water demand varies in accordance with the community population size and related activities, the level of water demand has been classified into those for the following six categories of A to F referring to the feasibility reports of existing schemes, proposed schemes and multi-state water supply project and the planning criteria of National Water Rehabilitation Project:

A : Demand level to be required for urban activity with population of more than 1×10^6.

B : Demand level to be required for urban activity with population of 1×10^6 to 500×10^3.

C : Demand level to be required for urban activity with population of 500×10^3 to 20×10^3.

D : Demand level to be required for semi-urban activity with population of 20×10^3 to 10×10^3.

E : Demand level to be required for semi-urban activity with population of 10×10^3 to 5×10^3.

F : Demand level to be required for rural activity with population of less than 5×10^3.

Detail of the unit water demand for each category for respective years is given in Table 6. 13.

b. 2) Per Capita Consumption for Domestic Use

The per capita consumption for domestic use would increase toward the year 2020 in accordance with the improvement of living standard and the propagation of flush toilets. Annual increasing rate of the per capita consumption for each water demand level is estimated as follows:

Water Demand Level		House Connection						Public Post
		A	B	C	D	E	F	
Increasing Rate %	1991-2000	2.1	2.1	2.1	1.8	1.3	0.8	0.4
	2000-2020	2.1	2.1	2.1	1.8	1.8	0.8	0.8

- Increasing rate by improvement of living standard:

  Rate = 0.7 + 0.47X

  where, X: Annual increasing rate of GDP for urban area.

- Increasing rate by flush toilets:

  Rate = 0.015 (Y-Z)

  where, Y; Diffusion rate to target year

  Z; Diffusion rate as of 1991

Per capita consumption for domestic use by the public post is assumed at 25 ℓcd in 1991 referring to the data as applied to the similar other countries which are shown in Table 6.14. And, the year 1991 has been taken at a starting year for the calculation of unit water demand to be given to subsequent projection.

b. 3) Special Use Allowance

Special use allowance is defined at the allowance for industrial, commercial and institutional use to the domestic one. The special use allowance rates which are shown in Table 6.13 are given referring to the actual or planned data of the water supply schemes formulated by some States as shown below:

Actual rate in Lagos	:	29~36%
Proposed rate in Kaduna State Program	:	35%
Proposed rate in Katsina Multi-State Program	:	27~3%
Proposed rate in Cross River State	:	25%

b. 4) Planned Rates of Effectiveness

Planned rate of the effectiveness is assumed as follows:

- For water demand level of A to D, the rate is 65 percent in 1991, 70 percent in 2000 and 80percent in 2020.
- For water demand level of E, the rate is 70 percent in 1991, 75 percent in 2000 and 82 percent in 2020.
- For rural water demand level of F, the rate is constant at 90 percent.

b. 5) Load Factor

Load factor means the rate between maximum daily supply amount and average daily supply amount. This rate is given at 1.15 based on the actual data in Lagos and Abuja waterworks.

(c) Population Distribution by Water Demand Level

Population distribution by the water demand level at each LGA is assumed based on the population density of each LGA or current status of cities and towns. As a result, the population distribution by the water demand level at each State is summarized in Table 6.15.

(3) Projected Water Demand

In accordance with the above-mentioned factors of per capita water demand and population distribution, the computed water demand on State level for 2000 and 2020 is shown in Table 6.16 for urban, rural and total, while those on LGA level are compiled in Vol. Three "Water Resources Inventory Survey".

(4) Raw Water Demand by Water Source

Daily and annual raw water demands by surface and groundwater on State basis are summarized in Tables 6.17 and 6.18. Annual raw water demands by each water source on HA basis are in Table 6.19. Division of the annual raw water demands for urban and rural into both the surface and groundwater resources as shown in Table 6. 18 has been made taking the water resources potential and water use rates for respective surface and groundwater as are examined in Chapter 3 "Water Resources and Management" and also the

implementation program for the proposed medium- and small-scale multipurpose dams as are discussed in Chapter 4 "Water Source Works".

6.4.3 Water Supply and Sanitation Schemes Proposed

(1) General

(a) Needs for the Water Supply Capacity to be Improved/Augmented

The water supply-demand balance in the year 2020 has been presented according to the projected water demand as mentioned in para. 6.4 and the actual water supply capacity and the capacity to be improved by the BMR works of existing waterworks as examined in para. 6.3. The water balance in 2020 is shown on State level in Table 6.20 and summarized on Regional level as follows:

(unit: MLD)

Item	NW	NE	CW	CE	SW	SE	Total
Urban Water supply							
Projected Demand	1,010	1,827	2,423	1,510	7,656	3,649	18,075
Actual Supply Capacity	250	344	516	161	988	379	2,639
Deficit Capacity	770	1,491	1,909	1,348	6,668	3,269	15,456
Rural Water Supply							
Projected Demand	640	1,069	705	909	816	1,058	5,197
Actual Supply Capacity	24	34	18	21	24	17	138
Deficit Capacity	616	1,035	687	888	792	1,041	5,059
Total							
Projected Demand	1,650	2,896	3,128	2,419	8,472	4,707	23,272
Actual Supply Capacity	275	378	534	182	1,012	396	2,777
Deficit Capacity	1,386	2,525	2,597	2,236	7,460	4,310	20,515

The water supply towards the year 2020 will face a serious water shortage problem even if the existing waterworks could supply with their full planned capacity. In order to achieve the water supply target, it is necessary to operate the planned capacity of existing waterworks in a well-arranged manner and to provide additional waterworks to a large extent to meet the deficit capacity in the above table.

(b) System Components and Costs Required for Water Supply Schemes

The water supply plan is prepared using the following items:

- BMR works to ensure full operations of the planned capacity for existing waterworks and also additional waterworks.
- Implementation of the additional waterworks.
- Reconstruction of existing and additional facilities which will be gradually deteriorated and loose their supply function after their life-span.

The additional waterworks schemes for urban water supply are composed of those by surface water and by groundwater, and the additional waterworks schemes for rural water supply are composed of those by surface water and by boreholes with mechanical pump or hand-pump for groundwater withdrawal.

These schemes have the following system configurations, and the project construction costs for each category cost are estimated based on the prices as of February 1994:

- Urban water supply scheme by surface water
  System : Intake Facility → Conveyance Facility → Treatment Plant → Transmission Facility → Distribution Facility
  Construction Cost : 10×10^6 Naira/MLD

- Urban water supply scheme by groundwater
  System : Borehole with Mechanical Pump → Overhead Tank → Distribution Facility
  Operation time : 18 hrs
  Planned Pumpage : Refer to Table 6.21 based on the NWRIS.
  Construction Cost : Refer to Table 6.21.

- Rural water supply scheme by surface water
  System : Intake → Conveyance → Simple Treatment Plant (slow sand filter system) → Distribution Facilities
  Construction Cost : 6×10^6 Naira/MLD

- Rural water supply scheme by borehole with mechanical pump

  System : Borehole with mechanical pump → Overhead Tank → Distribution Facility

  Unit Pumpage : 168 m^3/day

  Construction Cost : 2.1×10^6 Naira/unit

- Rural water supply scheme by borehole with handpump

  System : Borehole with handpump

  Planned unit capacity: 8.4 m^3/day

  Construction Cost : 0.16×10^6 Naira/unit

Note: In the rural water supply schemes, the 10 percent community contribution in the initial construction costs as is stressed in para. 6.3.2(4) is not taken into account.

The proposed water supply schemes should be established based on the rational implementation program taking into account OM, periodical check and inspection, replacement, rehabilitation, reconstruction and expansion for the waterworks as described in para. 6.3.

In the water supply schemes, the waterworks by surface and groundwater should be rehabilitated at every 15 years and 10 years, respectively and reconstructed at every 30 years and 20 years, respectively. The costs of OM and replacement will be, in principle, borne by the beneficiaries taking into account the possibility of water charge collection to a large extent and the Government subvention to a minimum limit. For reference, the calculation of chargeable water rates for the cases of (1) OM & replacement recovery and (2) full cost recovery for the proposed water supply schemes is given in para. 2.7.3 (4) of Chapter 2 "Socio-Economy and Land Use".

(2) Urban Water Supply Schemes

(a) Water Supply -Demand Relation

The water supply-demand balance projected for planning on State level in 2020 is shown in Table 6.20 (7), and its result on Regional level is summarized as follows:

(Unit: MLD)

Item	NW	NE	CW	CE	SW	SE	Total
Planned Capacity	1,010	1,827	2,423	1,510	7,656	3,649	18,075
Surface Water	563	934	1,945	1,074	5,324	926	10,767
Groundwater	447	893	478	436	2,332	2,723	7,308
Deficit Capacity	771	1,491	1,909	1,348	6,668	3,269	15,456
Surface Water	362	745	1,476	933	1,582	741	8,838
Groundwater	409	746	433	415	2,086	2,528	6,618
Actual Capacity	250	344	516	161	988	379	2,639
Surface Water	213	195	470	141	743	186	1,949
Groundwater	37	149	46	20	245	193	690
BMR Capacity	112	241	216	152	511	236	1,467
Surface Water	80	137	186	139	269	73	892
Groundwater	24	104	30	13	242	163	575
New Waterworks	659	1,251	1,693	1,196	6,157	3,033	13,989
Surface Water	274	608	1,290	793	4,313	668	7,946
Groundwater	385	643	403	403	1,844	2,366	6,044

It is necessary to implement the construction for additional waterworks and the BMR works for existing waterworks and additional waterworks, and also to perform the proper OM for existing and additional waterworks in order to ensure a sustainable maintenance of the water supply capacity mentioned in the above table.

(b) Implementation Program

The implementation programs on State or LGA level should be prepared in paying particular attention to the following items so as to carry out the water supply schemes as mentioned in the para. 6.4.3(2)(a):

- The inhabitants should receive possibly a fair share of the benefit from the projects.
- The project works should be carried out by staged implementation in response to the increasing water demand so that the larger benefit on the investment can be generated.

Since the urban water supply demand is considerably large, the water resources development and management for surface water should be carried out in a multipurpose nature in cooperation with irrigation development, and especially, these large-scale water supply works should be implemented covering not only densely populated urban areas but their peripheral small municipalities together with the effective utilization of existing waterworks.

The water demand nationwide will increase up to the year 2020 as shown in Figure 6.1. In line with this trend of the water demand, a rational water supply scheme should be prepared so as to possibly ensure fair sharing of the project benefit. An outline of the proposed works for the BMR, additional waterworks and reconstruction as included in the above plan on the State level for the respective working stages of 1991 to 2000, 2001 to 2005, 2006 to 2010, 2011 to 2015, and 2016 to 2020 during the course of the NWRMP period is shown in Table 6.22, and those on Regional level is summarized in the next page table:

		New Waterworks				BMR				Reconstruction			
		T	SW	GW		T	SW	GW		T	SW	GW	
		MLD	MLD	MLD	NO.	MLD	MLD	MLD	NO.	MLD	MLD	MLD	NO.
NW	2000	99	27	72	334	38	23	15	71	0	0	0	0
	2005	43	0	43	200	74	32	42	195	0	0	0	0
	2010	99	37	62	288	290	213	77	357	15	0	15	71
	2015	177	89	88	408	70	27	43	200	65	23	42	195
	2020	255	134	121	562	75	0	75	348	102	25	77	357
	Sub Total	673	287	386	1792	547	295	252	1171	182	48	134	623
NE	2000	108	29	79	221	130	85	45	129	0	0	0	0
	2005	88	59	29	74	229	33	196	572	0	0	0	0
	2010	228	109	119	277	343	195	148	396	45	0	45	129
	2015	351	178	173	485	58	29	29	74	281	85	196	572
	2020	477	233	244	705	209	59	150	428	181	33	148	396
	Sub Total	1252	608	644	1762	969	401	568	1599	507	118	389	1097
CW	2000	134	79	55	226	97	79	18	83	0	0	0	0
	2005	71	38	33	136	153	95	58	265	0	0	0	0
	2010	348	277	71	306	419	364	55	226	18	0	18	83
	2015	473	373	100	429	209	176	33	136	137	79	58	265
	2020	670	525	145	625	145	58	87	380	150	95	55	226
	Sub Total	1696	1292	404	1722	1023	772	251	1090	305	174	131	574
CE	2000	133	57	76	319	84	76	8	38	0	0	0	0
	2005	129	90	39	165	60	35	25	116	0	0	0	0
	2010	229	167	62	262	217	141	76	319	8	0	8	38
	2015	295	215	80	348	96	57	39	165	101	76	25	116
	2020	429	273	156	664	155	90	65	280	111	35	76	319
	Sub Total	1215	802	413	1758	612	399	213	918	220	111	109	473
SW	2000	923	612	311	1122	304	207	97	168	0	0	0	0
	2005	654	508	146	544	369	47	322	463	0	0	0	0
	2010	1049	773	276	871	1131	756	375	1164	97	0	97	168
	2015	1512	1042	470	1245	758	612	146	544	529	207	322	463
	2020	2037	1396	641	1691	881	508	373	1038	422	47	375	1164
	Sub Total	6175	4331	1844	5473	3443	2130	1313	3377	1048	254	794	1795
SE	2000	499	88	411	391	117	20	97	73	0	0	0	0
	2005	263	39	224	210	300	43	257	177	0	0	0	0
	2010	522	114	408	349	597	186	411	391	97	0	97	73
	2015	740	187	553	471	312	88	224	209	268	20	248	177
	2020	1010	241	769	706	529	39	490	416	471	60	411	391
	Sub Total	3034	669	2365	2127	1855	376	1479	1266	836	80	756	641
TOTAL	2000	1896	892	1004	2613	770	490	280	562	0	0	0	0
	2005	1248	734	514	1329	1185	285	900	1788	0	0	0	0
	2010	2475	1477	998	2353	2997	1855	1142	2853	280	0	280	562
	2015	3548	2084	1464	3386	1503	989	514	1328	1381	490	891	1788
	2020	4878	2802	2076	4953	1994	754	1240	2890	1437	295	1142	2853
	Sub Total	14045	7989	6056	14634	8449	4373	4076	9421	3098	785	2313	5203

(c) Costs Required

The costs required for the above mentioned schemes on State level except for OM are shown in Table 6.25, while those on Regional level are summarized below:

(Unit: 10^6 Naira)

		New Waterworks					RWR					Reconstruction					Total				
		SW	GW			T	SW	GW			T	SW	GW			T	SW	GW			T
			MP	HP	T			MP	HP	T			MP	HP	T			MP	HP	T	
		MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN
NW	2000	0	1,252	1,258	2,510	2,510	0	0	73	83	83	0	0	0	0	0	0	1,260	1,331	2,591	2,591
	2005	0	525	534	1,059	1,059	0	10	213	223	223	0	0	0	0	0	0	535	747	1,282	1,282
	2010	0	688	725	1,414	1,414	0	596	629	1,225	1,225	0	11	146	183	183	0	1,302	1,500	2,802	2,802
	2015	0	914	915	1,829	1,829	0	250	261	511	511	0	21	426	447	447	0	1,185	1,608	2,793	2,793
	2020	0	1,176	1,181	2,357	2,357	0	336	435	771	771	0	1,251	1,258	2,509	2,509	0	2,763	2,874	5,637	5,637
	Sub total	0	4,556	4,613	9,169	9,169	0	1,200	1,617	2,817	2,817	0	1,288	1,830	3,119	3,119	0	7,045	8,060	15,105	15,105
NE	2000	0	2,150	2,171	4,321	4,321	0	37	55	92	92	0	0	0	0	0	0	2,187	2,226	4,413	4,413
	2005	0	851	837	1,728	1,728	0	88	183	271	271	0	0	0	0	0	0	939	1,060	1,999	1,999
	2010	0	1,176	1,181	2,357	2,357	0	1,024	1,086	2,110	2,110	0	11	110	181	181	0	2,211	2,377	4,654	4,654
	2015	0	1,502	1,544	3,046	3,046	0	405	438	843	843	0	185	366	551	551	0	2,092	2,348	4,440	4,440
	2020	0	1,989	2,000	3,989	3,989	0	593	646	1,239	1,239	0	2,155	2,171	4,321	4,321	0	4,736	4,817	9,553	9,553
	Sub total	0	7,668	7,733	15,441	15,441	0	2,151	2,408	4,559	4,559	0	2,412	2,647	5,059	5,059	0	12,231	12,828	25,059	25,059
CW	2000	30	1,151	1,162	2,313	2,343	0	55	66	59	59	0	0	0	0	0	30	1,164	1,208	2,372	2,402
	2005	12	550	554	1,104	1,116	0	29	111	146	146	0	0	0	0	0	12	579	631	1,250	1,262
	2010	24	762	800	1,562	1,586	2	549	580	1,129	1,131	0	21	92	120	120	26	1,332	1,473	2,805	2,831
	2015	24	1,050	1,048	2,098	2,122	13	262	227	539	552	0	61	232	293	293	37	1,373	1,557	2,930	2,967
	2020	36	1,426	1,468	2,814	2,910	5	336	486	822	827	0	1,151	1,162	2,313	2,313	41	2,953	3,056	5,009	5,050
	Sub total	126	4,939	5,012	9,951	10,077	20	1,229	1,466	2,694	2,715	0	1,233	1,487	2,726	2,726	146	7,401	7,965	15,366	15,512
CE	2000	0	1,562	1,600	3,162	3,162	0	16	58	74	74	0	0	0	0	0	0	1,578	1,658	3,236	3,236
	2005	0	739	725	1,464	1,464	0	36	134	170	170	0	0	0	0	0	0	775	859	1,634	1,634
	2010	0	1,012	1,048	2,060	2,060	0	144	800	1,544	1,544	0	33	115	148	148	0	1,189	1,563	3,752	3,752
	2015	0	1,388	1,410	2,798	2,798	0	352	368	784	784	0	76	267	343	343	0	1,816	2,039	3,855	3,855
	2020	0	1,901	1,925	3,826	3,826	0	498	582	1,080	1,080	0	1,562	1,600	3,162	3,162	0	3,961	4,107	8,068	8,068
	Sub total	0	6,602	6,708	13,310	13,310	0	1,646	1,936	3,582	3,582	0	1,611	1,982	3,653	3,653	0	9,919	10,626	20,345	20,345
SW	2000	102	1,363	1,390	2,753	2,855	3	12	66	78	81	0	0	0	0	0	105	1,375	1,456	2,831	2,936
	2005	54	638	648	1,286	1,340	3	27	129	156	159	0	0	0	0	0	57	665	777	1,442	1,499
	2010	72	782	781	1,563	1,635	11	569	595	1,165	1,176	0	25	131	156	156	83	1,376	1,606	3,048	3,127
	2015	102	1,015	1,006	2,101	2,203	43	306	328	628	671	6	57	258	315	321	151	1,436	1,668	3,104	3,255
	2020	132	1,451	1,467	2,918	3,050	23	315	455	831	854	6	1,363	1,393	2,753	2,759	161	3,189	3,393	6,582	6,743
	Sub total	462	5,249	5,372	10,621	11,123	83	1,261	1,673	3,038	3,121	12	1,445	1,778	3,224	3,236	557	8,101	8,822	16,923	17,480
SE	2000	6	2,062	2,096	4,158	4,164	0	3	46	53	53	0	0	0	0	0	6	2,068	2,142	4,211	4,217
	2005	6	863	877	1,740	1,746	0	17	135	152	152	0	0	0	0	0	6	880	1,012	1,892	1,898
	2010	6	1,176	1,181	2,357	2,363	0	982	1,048	2,030	2,030	0	14	93	107	107	6	2,172	2,322	4,494	4,500
	2015	8	1,537	1,581	3,118	3,126	3	814	836	849	852	0	36	270	306	306	9	1,386	2,289	4,273	4,282
	2020	12	2,075	2,115	4,190	4,202	2	567	637	1,204	1,206	0	2,062	2,096	4,158	4,158	14	4,704	4,849	9,552	9,566
	Sub total	38	7,713	7,850	15,563	15,593	5	1,384	2,304	4,288	4,293	0	2,112	2,459	4,571	4,571	43	11,899	12,613	24,422	24,463
Total	2000	138	9,540	9,677	19,217	19,355	3	93	366	437	440	0	0	0	0	0	141	9,633	10,021	19,654	19,795
	2005	72	4,166	4,215	8,381	8,453	3	207	911	1,118	1,121	0	0	0	0	0	75	4,373	5,126	9,499	9,574
	2010	102	5,547	5,716	11,263	11,365	13	4,538	4,893	9,378	9,392	0	133	688	881	881	115	10,208	11,243	21,551	21,666
	2015	132	7,466	7,584	15,050	15,182	59	3,984	2,106	4,090	4,149	6	436	1,819	2,255	2,261	197	9,886	11,509	21,395	21,592
	2020	180	10,018	10,136	20,154	20,334	20	2,749	9,202	5,951	5,981	8	9,539	9,677	19,216	19,222	216	22,906	23,015	45,921	45,537
	Sub total	624	36,767	37,328	74,095	74,719	108	9,571	21,402	20,975	21,083	12	10,168	12,184	22,352	22,364	744	56,506	60,914	117,420	118,166

(3) Rural Water Supply Schemes

(a) Water Supply-Demand Relation

Rural water supply schemes proposed towards the year 2020 is composed of the following:

- BMR works of the existing and additional waterworks.
- Construction of additional waterworks.
- Reconstruction and expansion of the existing and additional waterworks facilities.

The additional waterworks for rural water supply will be achieved through development of the boreholes with hand-pump or the small piped-system using boreholes with mechanical pump. The water balance for the rural water supply plan on State level in 2020 is shown in Table 6.20 (8), and the outline on Regional level is summarized as follows:

(Unit : MLD)

Item	NW	NE	CW	CE	SW	SE	Total
Planned Capacity	640	1,069	705	909	816	1,058	5,197
Surface Water	0	0	23	0	85	6	114
Groundwater	640	1,069	682	909	731	1,052	5,083
Actual Capacity	24	34	18	21	24	17	138
Surface Water	0	0	1	0	6	0	7
Groundwater							
Mechanical Pump	2	12	4	5	4	2	29
Hand-Pump	22	22	13	16	14	15	102
BMR Capacity	10	15	7	8	10	6	56
Surface Water	0	0	0	0	2	0	2
Groundwater							
Mechanical Pump	1	9	3	4	3	2	22
Hand-Pump	9	6	4	4	5	4	32
New Waterworks	606	1,020	680	880	782	1,035	5,003
Mechanical Pump	364	613	395	528	423	617	2,940
Hand-Pump	242	407	263	352	282	412	1,958
Surface Water	0	0	22	0	77	6	105

It is necessary to implement the construction of additional waterworks, the BMR works for the existing and additional waterworks and

also to perform proper OM for the existing and additional waterworks in order to ensure proper upkeep of the water supply capacity mentioned in the above table.

(b) Implementation Program

The implementation program on State or LGA basis will be prepared paying careful attention to the following items to achieve the water supply plan as mentioned in para. 6.4.3 (3)(a):

- All the inhabitants should receive possible fair share of the project benefit.
- The project should be implemented in staged development to meet the increasing water demand so that the benefit generated can grow steadily in proportion to the investment.

For reference, the National Rural Water Supply and Sanitation Program as already formulated and is explained in para. 6.2.1 (2)(c) includes 87×10^3 boreholes with handpump and 8×10^3 small piped system using boreholes with a mechanical pump for 57.7×10^6 rural population in the target year 2005 and requires an investment of $9,775 \times 10^6$ Naira for borehole with hand-pump and $17,336 \times 10^6$ Naira for small piped system. In accordance with the findings of the NWRMP Study, the National RWS/S Program may be subject to appropriate modification.

The water demand nationwide will take an increasing trend up to the year 2020 as shown in Figure 6.2. The rational rural water supply scheme will be prepared so as to ensure a possible fair share of the project benefit for all inhabitants and to supply adequately in response to the increasing water demand trend.

Outline of the proposed waterworks on the above plan on State level for the respective plan stages of 1991 to 2000, 2001 to 2005, 2006 to 2010, 2011 to 2015, 2016 to 2020 are shown in Table 6.23, while those on Regional level are summarized in succeeding page:

		New Waterworks						RMR						Reconstruction					
		T	SW	MP		MP		T	SW	MP		GW		T	SW	MP		GW	
		MLD	MLD	MLD	NO.	MLD	1000	MLD	MLD	MLD	NO.	MLD	1000	MLD	MLD	MLD	NO.	MLD	1000
NW	2000	166	0	100	596	66	7.86	9	0	1.3	8	1.7	0.91	0	0	0	0	0	0
	2005	70	0	42	250	28	3.34	24	0	1.7	10	22.4	2.65	0	0	0	0	0	0
	2010	93	0	55	328	38	4.53	166	0	100	596	66.0	7.86	9	0	1.3	8	1.7	0.91
	2015	121	0	73	435	48	5.72	70	0	42	250	28.0	3.34	24	0	1.7	10	22.4	2.66
	2020	156	0	94	560	62	7.38	102	0	56.3	336	45.7	5.44	165	0	100	596	66	7.86
	Sub Total	606	0	364	2,169	242	28.83	371	0	201.3	1,200	169.8	20.21	198	0	103	614	90.1	11.43
NE	2000	286	0	172	1,024	114	13.57	12	0	6.2	37	5.8	0.69	0	0	0	0	0	0
	2005	114	0	68	405	46	5.48	34	0	14.8	88	19.2	2.29	0	0	0	0	0	0
	2010	156	0	94	560	62	7.38	286	0	172	1,024	114	13.57	12	0	6.2	37	5.8	0.69
	2015	201	0	120	715	81	9.65	114	0	68	405	46	5.48	34	0	14.8	88	19.2	2.29
	2020	264	0	159	947	105	12.50	168	0	100.2	597	67.8	9.07	286	0	172	1,024	114	13.57
	Sub Total	1,021	0	613	3,651	408	48.58	614	0	361.2	2,151	252.8	30.10	332	0	193	1,149	135	16.35
CW	2000	158	5	92	548	61	7.26	7	0	2.2	13	4.9	0.58	0	0	0	0	0	0
	2005	75	2	44	262	29	3.46	17	0	4.9	29	12.2	1.45	0	0	0	0	0	0
	2010	107	4	61	363	42	5.00	158	1	92	548	61	7.26	7	0	2.2	13	4.9	0.58
	2015	143	4	84	500	55	6.55	78	5	44	262	29	3.46	17	0	4.9	29	12.2	1.45
	2020	196	6	114	678	76	9.05	142	2	83.2	376	46.9	5.58	153	0	92	548	61	7.27
	Sub Total	679	21	395	2,352	263	31.32	368	8	206.3	1,228	154	18.33	177	0	99.1	590	78.1	9.30
CE	2000	209	0	125	744	84	10.00	9	0	2.7	16	6	0.72	0	0	0	0	0	0
	2005	97	0	59	352	38	4.53	20	0	6	36	14	1.67	0	0	0	0	0	0
	2010	136	0	81	482	55	6.55	209	0	125	744	84	10.00	9	0	2.7	16	6	0.72
	2015	185	0	111	661	74	8.81	97	0	59	352	38	4.53	20	0	6	36	14	1.67
	2020	253	0	152	905	101	12.03	145	0	83.7	498	62	7.27	209	0	125	744	84	10
	Sub Total	880	0	528	3,144	352	41.92	480	0	276.4	1,646	204	24.19	238	0	133.7	796	104	12.39
SW	2000	153	17	109	649	73	8.69	10	1	2	12	6.9	0.82	0	0	0	0	0	0
	2005	94	9	51	304	34	4.05	59	1	4.5	27	13.5	1.61	0	0	0	0	0	0
	2010	114	12	61	363	41	4.88	182	5	109	649	73	8.69	9	0	2	12	6.9	0.82
	2015	160	17	86	512	57	6.79	102	17	51	304	34	4.05	22	1	7.5	27	13.5	1.61
	2020	215	22	116	691	77	9.17	120	9	63	375	47.9	5.70	182	1	109	649	73	8.69
	Sub Total	782	77	423	2,519	282	33.58	438	33	229.5	1,366	175.3	20.87	213	2	118.5	688	93.4	11.12
SE	2000	276	1	165	982	110	13.10	6	0	1.2	7	4.9	0.58	0	0	0	0	0	0
	2005	116	1	69	411	46	5.48	17	0	2.6	17	14.2	1.69	0	0	0	0	0	0
	2010	157	1	94	560	62	7.38	276	0	165	982	110	13.10	6	0	1.2	7	4.9	0.58
	2015	207	1	123	732	83	9.88	116	1	69	411	46	5.48	17	0	2.6	17	14.2	1.69
	2020	279	2	166	988	111	13.22	163	1	95.2	567	68.9	7.96	275	0	165	982	110	13.1
	Sub Total	1,035	6	617	3,673	412	49.06	577	2	333	1,984	242	28.81	298	0	168.8	1,006	129.1	15.37
TOTAL	2000	1,248	23	763	4,543	508	60.48	53	1	15.6	93	36.2	4.30	0	0	0	0	0	0
	2005	566	12	333	1,984	221	26.33	131	1	34.5	207	95.3	11.37	0	0	0	0	0	0
	2010	783	17	446	2,656	300	35.72	1,237	9	763	4,543	508	60.47	52	0	15.6	93	36.2	4.3
	2015	1,017	22	597	3,555	398	47.39	575	23	331	1,982	221	26.34	134	1	31.5	207	95.5	11.37
	2020	1,363	30	801	4,770	532	63.34	810	12	481.6	2,749	316.2	40.03	1,270	1	763	4,542	503	60.49
	Sub Total	5,003	104	2,940	17,508	1,959	233.29	2,846	43	1605.7	9,574	1197	142.51	1,456	2	810.1	4,842	640.7	76.16

(c) Costs Required

The costs required for the above mentioned schemes on State level are shown in Table 6. 26, while those on Regional level is summarized below:

(Unit: 10^6 Naira)

		New Waterworks					DWR					Reconstruction					Total				
		SW	GW			T	SW	GW			T	SW	GW			T	SW	GW			T
			MP	HP	T			MP	HP	T			MP	HP	T			MP	HP	T	
		MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN	MN
NW	2000	0	1,252	1,258	2,510	2,510	0	0	11	11	11	0	0	0	0	0	0	1,260	1,311	2,571	2,571
	2005	0	525	534	1,059	1,059	0	10	213	223	223	0	0	0	0	0	0	535	747	1,282	1,282
	2010	0	699	725	1,424	1,424	0	595	629	1,225	1,225	0	17	146	163	163	0	1,312	1,500	2,812	2,812
	2015	0	914	915	1,829	1,829	0	250	267	517	517	0	21	426	447	447	0	1,185	1,608	2,793	2,793
	2020	0	1,176	1,181	2,357	2,357	0	336	435	771	771	0	1,251	1,258	2,509	2,509	0	2,763	2,874	5,637	5,637
	Sub total	0	4,556	4,613	9,169	9,169	0	1,200	1,612	2,811	2,811	0	1,289	1,830	3,119	3,119	0	7,045	8,060	15,105	15,105
NE	2000	0	2,150	2,171	4,321	4,321	0	33	55	92	92	0	0	0	0	0	0	2,183	2,226	4,413	4,413
	2005	0	858	877	1,728	1,728	0	88	183	271	271	0	0	0	0	0	0	939	1,060	1,999	1,999
	2010	0	1,126	1,161	2,352	2,352	0	1,024	1,086	2,110	2,110	0	91	110	181	181	0	2,241	2,322	4,654	4,654
	2015	0	1,502	1,544	3,046	3,046	0	695	838	843	843	0	185	366	551	551	0	2,092	2,348	4,440	4,440
	2020	0	1,989	2,000	3,989	3,989	0	597	846	1,243	1,243	0	2,150	2,171	4,321	4,321	0	4,736	4,817	9,553	9,553
	Sub total	0	7,666	7,773	15,441	15,441	0	2,151	2,408	4,559	4,559	0	2,412	2,647	5,059	5,059	0	12,231	12,828	25,059	25,059
CW	2000	30	1,151	1,182	2,313	2,343	0	13	46	59	59	0	0	0	0	0	30	1,164	1,208	2,372	2,402
	2005	12	550	556	1,104	1,116	0	29	117	146	146	0	0	0	0	0	12	579	673	1,250	1,262
	2010	24	782	800	1,582	1,586	2	583	580	1,125	1,127	0	27	93	120	120	26	1,332	1,473	2,805	2,831
	2015	24	1,050	1,048	2,098	2,122	13	282	277	559	552	0	61	232	293	293	37	1,373	1,557	2,930	2,967
	2020	36	1,426	1,448	2,874	2,910	5	326	466	822	827	0	1,151	1,162	2,313	2,313	41	2,953	3,056	6,009	6,050
	Sub total	126	4,939	5,012	9,951	10,077	20	1,233	1,466	2,691	2,711	0	1,239	1,487	2,726	2,726	146	7,401	7,965	15,366	15,512
CE	2000	0	1,562	1,600	3,162	3,162	0	16	58	74	74	0	0	0	0	0	0	1,578	1,658	3,236	3,236
	2005	0	739	725	1,464	1,464	0	36	134	170	170	0	0	0	0	0	0	775	859	1,634	1,634
	2010	0	1,012	1,048	2,060	2,060	0	744	808	1,552	1,552	0	33	115	148	148	0	1,789	1,963	3,752	3,752
	2015	0	1,388	1,410	2,798	2,798	0	352	362	714	714	0	76	267	343	343	0	1,816	2,039	3,855	3,855
	2020	0	1,901	1,925	3,826	3,826	0	498	582	1,080	1,080	0	1,562	1,600	3,162	3,162	0	3,961	4,107	8,068	8,068
	Sub total	0	6,602	6,708	13,310	13,310	0	1,646	1,936	3,582	3,582	0	1,671	1,982	3,653	3,653	0	9,919	10,626	20,545	20,545
SW	2000	102	1,363	1,390	2,753	2,855	3	12	66	78	81	0	0	0	0	0	105	1,375	1,456	2,831	2,936
	2005	54	638	668	1,286	1,340	3	27	129	156	159	0	0	0	0	0	57	665	797	1,442	1,499
	2010	72	762	781	1,543	1,615	11	649	696	1,345	1,356	0	25	131	156	156	83	1,436	1,608	3,044	3,127
	2015	102	1,075	1,088	2,163	2,265	43	308	328	620	663	6	57	258	315	321	151	1,438	1,668	3,106	3,257
	2020	132	1,451	1,467	2,918	3,050	23	375	456	831	854	6	1,363	1,390	2,753	2,759	161	3,189	3,313	6,502	6,663
	Sub total	462	5,289	5,372	10,661	11,123	83	1,367	1,675	3,038	3,121	12	1,445	1,779	3,224	3,236	557	8,101	8,822	16,923	17,680
SE	2000	6	2,062	2,098	4,158	4,164	0	7	46	53	53	0	0	0	0	0	6	2,069	2,142	4,211	4,217
	2005	6	863	877	1,740	1,746	0	17	135	152	152	0	0	0	0	0	6	880	1,012	1,892	1,898
	2010	6	1,176	1,181	2,357	2,363	0	982	1,048	2,030	2,030	0	14	93	107	107	6	2,172	2,322	4,494	4,500
	2015	6	1,537	1,581	3,118	3,124	3	611	638	849	852	0	36	270	306	306	9	1,984	2,289	4,273	4,282
	2020	12	2,035	2,115	4,150	4,202	2	563	637	1,204	1,206	0	2,062	2,096	4,158	4,158	14	4,704	4,848	9,552	9,566
	Sub total	36	7,813	7,850	15,563	15,599	5	1,980	2,304	4,288	4,293	0	2,112	2,459	4,571	4,571	41	11,809	12,613	24,422	24,463
Total	2000	138	9,540	9,677	19,217	19,355	3	93	364	457	460	0	0	0	0	0	141	9,633	10,041	19,674	19,815
	2005	72	4,186	4,215	8,401	8,473	3	207	911	1,118	1,121	0	0	0	0	0	75	4,393	5,126	9,519	9,594
	2010	102	5,537	5,716	11,253	11,355	13	4,538	4,839	9,378	9,392	0	193	686	881	881	115	10,308	11,241	21,551	21,666
	2015	132	7,466	7,584	15,050	15,182	59	1,984	2,106	4,090	4,149	6	436	1,819	2,255	2,261	197	9,886	11,509	21,395	21,592
	2020	180	10,018	10,136	20,154	20,334	30	2,749	3,202	5,951	5,981	6	9,539	9,677	19,216	19,222	216	22,306	23,015	45,321	45,537
	Sub total	626	36,763	37,328	74,095	74,719	108	9,571	11,402	20,995	21,083	12	10,168	12,184	22,352	22,368	744	56,506	60,914	117,420	118,164

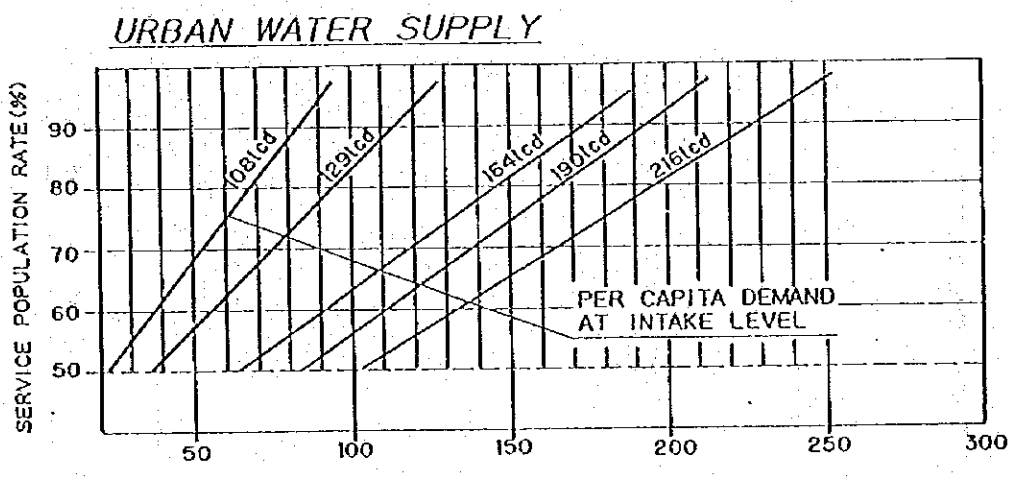
(4) Summary of Water Supply Schemes on State Level

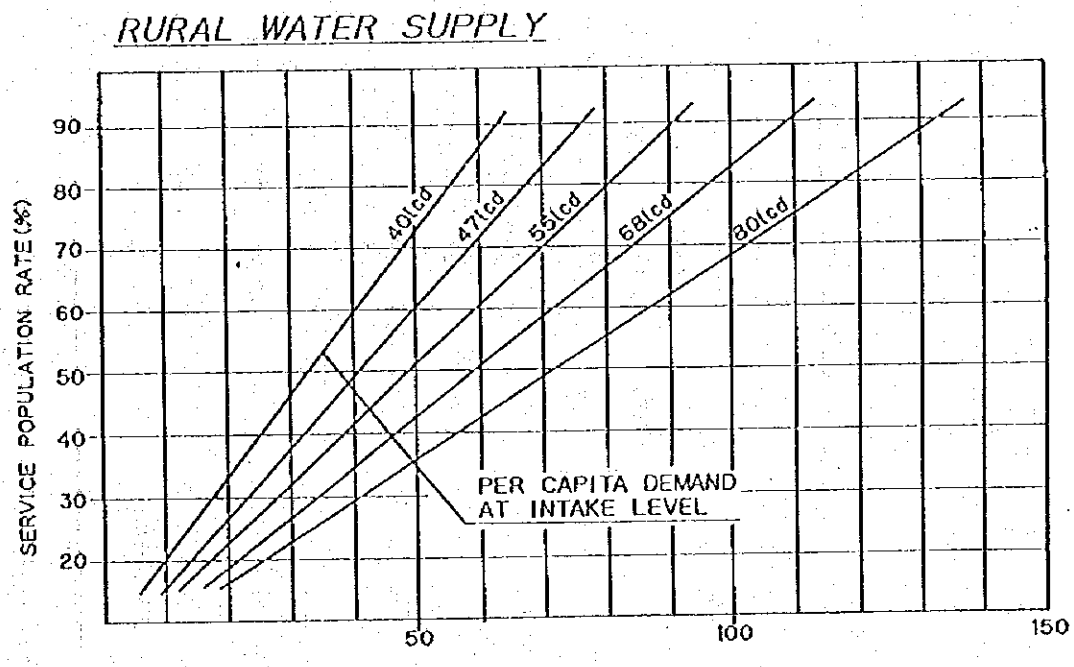
Individual discussions of the water supply plan and schemes towards 2020 for each of the urban and the rural have been made in the previous paragraphs. Since there are many information compiled therein, a simple presentation of the proposed water supply plan as a whole for more clear reference and easy understanding on State level has been worked out in Table 6.24 compiling the information on (1) population in 1991 and 2020 (urban, rural and total), (2) water demand in 2020 and present water supply capacity, (3) proposed capacity toward 2020 (surface and groundwater) and (4) number of boreholes (at present and proposed towards 2020).

(5) Water Supply Sector Funding

As is explained in para. 4.2.3 of the Main Text, the costs required to achieve the rather optimistic and challenging targets given to the water supply component in the NWRMP have been approximated at 323×10^9 Naira for 25 years by the year 2020 or 12.9×10^9 Naira per year on average during that period which is equivalent to 3.1 times the anticipated annual budget as extrapolated from the present budget allocation of this component. Although the Study Team implies that rather moderate outlook in the FGN budgetary situation inclusive of resource inflow could be expected beyond 2000, there would be the need to make the sensitivity testing on the targets for water supply plan in the NWRMP in terms of the budgetary arrangement.

In general, the costs required for water supply sector vary according to the level or degree of (1) the service population rate and (2) the per capita water demand. First of all, the relationship among (1) the service population rate, (2) the per capita water demand at intake level (raw water) and (3) the costs required for the NWRMP has been comprehensively given both for the urban and the rural cases through careful examination on the outcome of the NWRMP targets, as shown in the following figures:





From these two figures, the costs required for provision of the water supply facilities in the NWRMP in relation with various alternative targets can be computed. The table given below compiles the costs required for some of the various targets thus quoted from two figures and appropriately combined both for the urban and rural and then compares those annual required costs with the annual budgets anticipated during the NWRMP period as explained previously.

SENSITIVITY TESTING FOR ALTERNATIVE TARGETS IN THE WATER SUPPLY SECTOR DURING THE NWRMP

Case		Present	Proto Type	Alternative Targets in 2020								
				1	2	3	4	5	6	7	8	9
1. Urban Water Supply												
1.1	Service Population Rate (%)	50	80	80	80	80	70	70	60	60	60	60
1.2	Per Capita Demand (ℓcd)											
	at intake level	108	216	190	164	164	164	129	164	129	164	129
	at consumption level	61	150	132	114	114	114	90	114	90	114	90
1.3	Costs Required (10^9 Naira)		196	165	145	145	118	75	91	55	91	55
2. Rural Water Supply												
2.1	Service Population Rate (%)	9	80	80	80	40	40	40	40	40	30	30
2.2	Per Capita Demand (ℓcd)											
	at intake level	40	80	68	55	55	55	47	55	55	47	47
	at consumption level	31	60	51	43	43	43	37	43	43	37	37
2.3	Costs Required (10^9 Naira)		118	96	80	37	37	33	37	37	33	33
3. Total												
3.1	Costs Required (10^9 Naira)		314	261	225	182	155	108	128	92	124	88
3.2	Average Annual Costs (10^9 Naira) (3.1 ÷ 25 years)		12.56	10.44	9.00	7.28	6.20	4.32	5.12	3.68	4.96	3.52
3.3	Annual Budget Anticipated during the NWRMP Period (10^9 Naira)		←				4.17					→
3.4	3.2/3.3		3.01	2.50	2.16	1.74	1.48	1.04	1.23	0.88	1.19	0.84

Note: The above costs do not include those allocated from multipurpose dams.

If the budgetary arrangement during the NWRMP period is kept at the present level without any extra increase in funds, the following conditions for water supply would be achieved as of the end of 2020:

Case	Urban Water Supply		Rural Water Supply	
	Service Population Rate	Per Capita Demand at Intake Level	Service Population Rate	Per Capita Demand at Intake Level
	(%)	(ℓcd)	(%)	(ℓcd)
1.	70	129	40	47
2.	60	164	30	47
Present Condition	50	108	9	40
NWRMP Target	80	216	80	80

(6) Sanitation and Sewerage Plan

Planned daily maximum sewage amount is the sum of domestic sewage amount, commercial wastewater and groundwater. The domestic sewage amount is derived by multiplying the maximum per capita sewage amount by planned population. In general, the planned daily maximum sewage amount would be almost equal to the planned daily maximum water supply amount of the water supply plan.

For the year 2020 at Regional level, the relationship between the water potential and planned sewage amount, and the estimated BOD based on the assumption that the input sewage BOD is the same as the domestic sewage BOD of 180 mg/ℓ have been examined, and the salient information are given below:

		NW	NE	CW	CE	SW	SE	total
① Surface Water Resources Potential	(10^6 cu.m)	22,400	8,200	32,600	83,000	35,400	85,700	267,30
② Planned Sewage Amount	(10^6 cu.m)	530	920	990	770	2,690	1,490	7,390
③ Planned Sewage Amount for (A) & (B) Categories on Water Demand Level	(10^6 cu.m)	53	163	262	80	1,392	205	2,155
④ ②÷①	(%)	2.4	11.2	3.0	0.9	7.6	1.7	2.8
⑤ Estimated BOD	(mg/ℓ)	4.3	20.2	5.4	1.6	13.7	3.1	5.0

In analyzing the conformity of the water sources for water supply, reference is made to the Environmental Water Quality Standards of Japan which limit the BOD to be less than 3 mg/ℓ. As is seen from the above table, the North-East and South-West Regions where the planned sewage amount is considerably high

against the surface water resources potential indicate that the BOD is to be a way over the limit, hence placing the water sources for water supply unfit. Even in the surrounding areas of large cities in other Regions, it is anticipated that the estimated BOD would be much higher than the limit. Among the six socio-economic categories for water demand projection as given under para. 6.4.2 (2), the planned sewage amount for A and B categories accounts to 2.16×10^9 cu.m which would be about 30 percent of the total planned sewage amount. Especially for these Regions, an appropriate sanitation and sewerage plan should be formulated, and its early implementation would be of an absolute necessity.

In principle, the NWRMP for sanitation component calls for the different technology options and mixes considered for the three socio-economic strata for water supply in connection with its six categories on water demand level as mentioned above:

- For category (F): rural area, VIP latrines, pour flush and upgraded pit latrines are recommended.
- For categories (D) and (E): semi-urban area and category (C): urban area, the septic tanks, VIP latrines, pour flush and upgraded / improved pit latrines would be connected to conventional public sewage disposal plant.
- For categories (A) and (B): urban area where the population density is more than 5,000 per sq.km, it is suggested to provide a public sewerage system to be connected to the households, private undertakings and public facilities with an end-treatment for the waste water resulting from people's daily life and work. These systems to be separated from storm-water channels would be installed in stage-by-stage manner in the context of overall urban planning, and their end-treatment works would function to dispose the effluents discharged from sewerages with appropriate technical standards of water quality for conservation of the downstream public water bodies.

TABLE 6.1 PRESENT URBAN WATER SUPPLY BY WATERWORKS

State	Surface Water						Ground Water										Total				
	Planned Service Popu.	No.	Planned Capacity		Actual Capacity		Planned Service Popu.	Borehole					Planned Capacity		Actual Capacity		Planned Service Popu.	Planned Capacity		Actual Capacity	
								HP	LMP	MP	W	Total									
	'1000		MLD	lcd	MLD	lcd	'1000	NO.	NO.	NO.	NO.		MLD	lcd	MLD	lcd	'1000	MLD	lcd	MLD	lcd
(NW)																					
Zebbi	256	8	30.2	129.9	20.2	79.5	271	211	17	24	31	283	12.3	45.4	7.5	28.2	525	42.9	81.2	28.1	53.5
Sokoto	805	18	263.8	327.7	144.6	179.6	228	656	33	98	90	823	91.4	43.1	18.8	25.6	1533	295.3	192.6	163.4	106.6
Katsina	934	8	83.6	89.7	46.2	49.6	143	160	0	100	17	277	18.2	127.3	10.6	74.1	1077	102.0	94.7	58.8	54.6
Sub Total	1995	34	378.3	189.8	219.0	109.9	1142	1027	56	222	78	1383	61.9	54.2	37.3	32.7	3135	440.2	140.4	250.3	79.8
(NE)																					
Kano	1101	9	225.9	204.6	162.3	129.2	776	617	0	261	0	878	59.0	63.0	28.6	37.0	1878	274.3	146.0	171.1	91.1
Jigawa	20	1	1.9	95.0	1.3	65.0	696	217	0	251	16	484	44.1	63.4	25.5	36.6	716	46.0	64.2	26.8	37.4
Yobe	0	0	0.0	0.0	0.0	0.0	401	195	31	62	69	363	25.4	63.8	14.0	34.9	401	26.4	65.8	14.0	34.9
Borno	513	0	67.0	130.6	23.0	44.8	1665	61	109	503	336	1013	58.2	59.0	58.4	35.1	2178	165.2	75.8	81.4	37.4
Bauchi	327	1	45.5	139.1	28.7	87.8	828	3	105	130	92	330	41.0	65.3	20.2	32.2	955	86.5	90.6	48.9	51.2
Sub Total	1961	11	339.3	173.2	195.3	99.6	4168	1093	251	1211	513	3068	256.1	62.1	148.9	35.7	6129	598.4	97.6	344.2	56.2
(NW)																					
Kaduna	2546	10	303.5	119.2	231.3	90.8	248	122	0	120	9	251	21.5	86.7	12.5	50.4	2794	325.0	116.3	243.8	87.3
Niger	740	18	91.2	123.2	60.8	82.2	225	250	0	145	38	433	28.8	128.1	17.1	76.0	965	119.6	124.1	77.9	80.7
Kwara	1194	20	124.5	104.3	83.4	69.9	298	136	9	123	92	284	23.4	78.5	13.8	43.0	1492	147.9	99.1	96.2	64.5
Kogi	161	9	21.9	136.0	15.0	93.2	54	35	28	0	20	83	6.9	90.7	5.2	59.3	215	26.8	124.7	18.2	84.7
F.C.T	174	0	120.0	689.7	80.0	459.8	3	0	0	1	5	6	0.2	66.7	0.1	33.3	177	120.2	678.1	80.1	452.5
Sub Total	4815	57	661.1	137.3	470.5	97.7	828	563	31	389	102	1105	78.8	94.9	45.7	55.2	5643	739.2	131.1	516.2	91.5
(CE)																					
Adamawa	492	11	91.2	185.4	49.1	99.8	166	0	220	0	0	220	21.6	130.2	12.4	74.7	658	112.8	171.4	56.1	85.3
Taraba	145	5	8.7	59.8	5.3	35.8	15	0	25	0	0	25	5.2	346.7	2.9	193.3	160	13.9	85.3	8.1	49.7
Plateau	640	24	114.9	179.5	62.3	97.3	151	0	20	0	0	20	5.9	39.1	3.9	25.8	791	120.7	152.6	66.2	83.7
Benue	439	6	36.8	83.8	30.1	71.2	61	0	12	0	0	12	1.8	29.5	0.8	13.1	401	38.6	80.2	30.9	64.2
Sub Total	1709	46	251.6	146.0	141.4	83.2	393	0	195	0	0	195	34.5	87.8	20.0	50.9	2093	286.0	136.6	161.3	77.1
(SW)																					
Delta	105	4	6.1	58.1	4.1	39.0	436	0	86	0	0	86	59.1	331.8	36.0	82.6	541	59.2	109.4	40.1	74.1
Edo	746	7	73.2	98.1	49.9	66.1	331	0	114	0	0	114	85.4	230.5	52.6	78.0	1077	158.6	114.2	102.5	72.4
Ondo	662	15	59.1	89.3	34.1	52.4	208	31	43	0	9	82	22.6	108.9	14.2	68.5	870	81.7	93.9	48.5	56.8
Osun	908	9	80.2	88.3	52.3	57.6	122	105	43	0	84	232	7.6	83.9	5.1	41.8	1030	87.9	85.3	57.4	55.7
Oyo	2260	8	172.0	76.1	92.5	40.9	201	166	85	0	28	281	15.4	73.7	9.3	44.5	2469	187.4	75.9	101.8	41.2
Ogun	1060	22	96.2	89.1	67.9	62.9	718	180	101	20	4	305	108.8	351.5	64.2	89.4	1778	205.1	114.1	132.1	73.5
Lagos	5139	2	545.1	106.1	441.9	86.0	2216	542	91	315	26	974	188.1	86.9	59.0	26.6	7355	733.1	99.7	500.9	68.1
Sub Total	10900	67	2031.9	94.7	742.7	68.1	4640	1028	585	335	145	2094	491.2	105.9	245.4	52.9	15540	1523.0	98.0	988.1	63.8
(SE)																					
Enugu	1120	2	123.9	110.1	91.2	81.5	663	10	52	0	13	75	56.5	82.2	29.0	43.7	1783	177.9	99.8	120.3	67.5
Anambra	343	6	21.6	63.0	11.5	33.5	348	28	34	8	30	100	34.1	98.0	16.2	46.6	691	55.7	80.6	27.7	40.1
Imo	259	2	36.1	139.2	23.5	91.6	900	0	78	0	0	78	103.0	114.4	60.1	67.4	1198	139.6	116.5	83.1	73.5
Cross River	300	8	19.3	64.3	10.1	33.7	187	0	15	0	0	15	18.9	101.1	7.6	41.7	487	38.2	78.4	17.9	36.8
Abia	513	4	57.6	112.3	45.5	88.7	273	0	34	0	0	34	28.4	104.0	18.9	69.2	786	85.9	109.3	64.4	81.9
Akwaibom	0	0	0.0	0.0	0.0	0.0	822	0	62	0	0	62	74.6	119.9	33.6	54.3	822	74.6	119.9	33.6	54.3
Rivers	0	0	0.0	0.0	0.0	0.0	787	16	70	0	15	101	39.9	50.1	26.6	33.4	787	39.9	50.1	26.6	33.4
Sub Total	2574	20	258.5	100.4	185.7	72.1	3180	54	346	8	58	466	353.4	93.2	193.0	50.9	6554	611.8	96.1	378.8	59.5
Nationwide	23913	235	2921.1	122.0	1948.6	81.4	14961	3785	2455	2165	895	9301	1270.3	85.4	890.3	46.1	38904	4199.1	107.9	2838.9	67.8

SPR : Service Population Rate
W : Borehole without Pump
MP : Borehole with Mechanical Pump
HP : Borehole with Hand Pump

TABLE 6.2 NEW WATERWORKS TENTATIVE PROPOSED

	Planned Service population (×1000)	Incremental Planned Supply Amount (MLD)	Existing Capacity (MLD)	Target Year
Katsina				
Katsina	482 (209)	25.0	25	2000
Katsina	883 (401)	40.0		2005
Daura	49 (16.7)	0.6	1.8	2000
Daura	99 (50)	3.5		2005
Funtua	126 (708)	60	4.5	2005
Malumfashi	169 (102)	10.8	4.6	2005
Danmusa	171 (125)	9.6	3.5	2005
Dutsima				
Kaduna				
Paki	(78)	6.9		2005
Kavru	(47)	5.0		2005
Piti	(43)	2.7		2005
Zonkwa	(36)	1.7		2005
Jemma	(50)	5.7		
Enugu				
Enugu	(364)	80.0	92	2000
Nsukka	(71)	8.2	7	2002
Yobe				
Potiskum	(105)	15.9	–	2015
Damagun	(50)	15.9	–	2000
Borno				
Damboa-Jemri	(83)	5.6	–	2005
Maiduguri	–	–	–	–
Cross River				
Calabar	995	280	20.2	2015
A kamkpa	97	25.5	3.0	2015
Ikom	134	27.5	0.7	2015
Itigidi	33	5.8	0.7	2015
Obubra	65	12.6	0.3	2015
Obudu	80	15.1	0.9	2015
Ogaja	98	15.6	3.9	2015
Ugep/Ediba	260	132.4	2.8	2015
Lagos				
Lagos	12,067 (5550)	696	622	2000

( ): Incremental Service Population

TABLE 6.3 PRESENT RURAL WATER SUPPLY BY WATERWORKS

State	Surface Water						Ground Water										Total					
	Planned Service Popu.	No.	Planned Capacity		Actual Capacity		Planned Service Popu.	Borehole					Planned Capacity		Actual Capacity		Planned Service Popu.	Planned Capacity		Actual Capacity		
								HP	LMP	MP	Y	Total										
	'1000		M.D	l.c.d	M.D	l.c.d	'1000	NO.	NO.	NO.	NO.		M.D	l.c.d	M.D	l.c.d	'1000	M.D	l.c.d	M.D	l.c.d	
(NW)																						
Kebbi	0	0	0.0	0.0	0.0	0.0	200	765	0	3	248	1016	8.0	40.0	6.0	30.0	200	8.0	40.0	6.0	30.0	
Sokoto	0	0	0.0	0.0	0.0	0.0	440	1821	0	11	82	1914	17.6	40.0	12.4	28.2	440	17.6	40.0	12.4	28.2	
Katsina	0	0	0.0	0.0	0.0	0.0	208	810	0	5	145	958	8.3	39.9	6.0	28.8	208	8.3	39.9	6.0	28.8	
Sub Total	0	0	0.0	0.0	0.0	0.0	848	3396	0	19	479	3893	33.9	40.0	24.4	28.8	848	33.9	40.0	24.4	28.8	
(NE)																						
Kano	0	0	0.0	0.0	0.0	0.0	175	719	0	6	0	719	7.0	40.0	4.9	28.0	175	7.0	40.0	4.9	28.0	
Jigawa	0	0	0.0	0.0	0.0	0.0	125	41	0	0	965	1006	5.0	40.0	4.9	39.2	125	5.0	40.0	4.9	39.2	
Kebbe	0	0	0.0	0.0	0.0	0.0	128	276	0	9	271	556	5.1	39.8	3.8	29.7	128	5.1	39.8	3.8	29.7	
Borno	0	0	0.0	0.0	0.0	0.0	348	112	0	68	586	766	13.9	39.9	8.7	25.0	348	13.9	39.9	8.7	25.0	
Bauchi	0	0	0.0	0.0	0.0	0.0	445	1281	0	42	5	1326	17.8	40.0	11.1	24.9	445	17.8	40.0	11.1	24.9	
Sub Total	0	0	0.0	0.0	0.0	0.0	1221	2429	0	125	1825	4379	48.8	40.0	31.0	27.8	1221	48.8	40.0	31.0	27.8	
(CW)																						
Kaduna	0	0	0.0	0.0	0.0	0.0	150	582	0	7	34	623	6.0	40.0	4.2	28.0	150	6.0	40.0	4.2	28.0	
Niger	0	0	0.0	0.0	0.0	0.0	305	1154	0	21	181	1316	12.2	40.0	8.4	27.5	305	12.2	40.0	8.4	27.5	
Kwara	0	0	0.0	0.0	0.0	0.0	85	340	0	14	84	558	3.4	40.0	2.3	27.1	85	3.4	40.0	2.3	27.1	
Kogi	22	3	0.9	40.9	0.6	27.3	88	223	0	0	136	363	2.6	29.5	2.0	22.7	110	3.5	31.8	2.6	23.6	
F.C.T	0	0	0.0	0.0	0.0	0.0	0	0	0	0	1	1	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	
Sub Total	22	3	0.9	40.9	0.6	27.3	628	2299	0	42	421	2866	24.2	38.5	16.9	26.9	650	25.1	38.6	17.5	26.9	
(SE)																						
Adamawa	0	0	0.0	0.0	0.0	0.0	133	365	0	8	190	563	5.3	39.8	3.9	29.3	133	5.3	39.8	3.9	29.3	
Taraba	0	0	0.0	0.0	0.0	0.0	190	188	0	32	0	205	7.6	40.0	4.6	24.2	190	7.6	40.0	4.6	24.2	
Plateau	0	0	0.0	0.0	0.0	0.0	273	1046	0	5	271	1322	10.9	39.9	8.1	29.7	273	10.9	39.9	8.1	29.7	
Benue	0	0	0.0	0.0	0.0	0.0	123	466	0	2	136	604	4.9	39.8	4.4	35.8	123	4.9	39.8	4.4	35.8	
Sub Total	0	0	0.0	0.0	0.0	0.0	719	2065	0	52	597	2694	28.7	39.9	21.0	29.2	719	28.7	39.9	21.0	29.2	
(SW)																						
Delta	0	0	0.0	0.0	0.0	0.0	68	88	0	12	1	99	2.7	39.7	1.7	25.0	68	2.7	39.7	1.7	25.0	
Edo	65	1	2.6	40.0	2.1	32.3	70	20	0	0	0	20	0.2	2.9	0.1	1.4	135	2.8	20.7	2.2	16.3	
Ondo	32	5	1.3	40.6	1.0	31.2	130	469	0	0	0	469	3.9	30.0	2.8	21.5	162	5.2	32.1	3.8	23.5	
Ogun	35	4	1.4	40.0	1.3	37.1	170	648	0	0	193	841	5.4	31.8	4.1	24.1	205	6.8	33.2	5.3	24.9	
Oyo	15	2	0.6	40.0	0.5	33.3	130	541	0	0	21	562	4.6	35.4	3.3	25.4	145	5.2	35.9	3.8	26.2	
Ogun	50	11	2.0	40.0	1.5	30.0	155	210	0	22	52	284	5.9	38.0	3.3	18.7	246	7.9	31.9	5.2	21.0	
Lagos	0	0	0.0	0.0	0.0	0.0	78	209	0	5	101	315	3.1	39.7	2.2	28.2	78	3.1	39.7	2.2	28.2	
Sub Total	197	28	7.9	40.1	6.2	31.5	844	2513	0	39	368	2920	25.8	30.6	17.9	21.2	1041	33.7	32.4	24.0	23.1	
(SE)																						
Enugu	0	0	0.0	0.0	0.0	0.0	35	101	0	0	98	205	1.4	40.0	1.1	31.4	35	1.4	40.0	1.1	31.4	
Anambra	0	0	0.0	0.0	0.0	0.0	45	174	0	0	79	253	1.8	40.0	1.4	31.1	45	1.8	40.0	1.4	31.1	
Imo	0	0	0.0	0.0	0.0	0.0	103	323	0	0	186	509	4.1	39.8	3.2	31.1	103	4.1	39.8	3.2	31.1	
Cross River	0	0	0.0	0.0	0.0	0.0	73	307	0	0	62	369	2.9	39.7	2.1	28.8	73	2.9	39.7	2.1	28.8	
Abia	10	1	0.4	40.0	0.3	30.0	133	421	0	7	130	558	5.3	39.8	3.8	28.6	143	5.7	39.9	4.1	28.7	
Akwaibom	0	0	0.0	0.0	0.0	0.0	83	291	0	2	101	394	3.3	39.8	2.4	28.9	83	3.3	39.8	2.4	28.9	
Rivers	0	0	0.0	0.0	0.0	0.0	108	135	0	15	133	283	4.3	39.8	2.9	26.9	108	4.3	39.8	2.9	26.9	
Sub Total	10	1	0.4	40.0	0.3	30.0	580	1808	0	24	791	2623	23.1	39.8	16.9	29.1	590	23.5	39.8	17.2	29.2	
Nationwide	229	30	9.2	40.2	7.1	31.0	4840	13588	0	300	4437	18325	184.5	38.1	131.1	27.1	5069	193.7	38.2	138.1	27.2	

SPR : Service Population Ratio
Y : Borehole without Pump
LMP : Borehole with Large Scale Piped System
MP : Borehole with Mechanical Pump
HP : Borehole with Hand Pump

TABLE 6.4 PRESENT URBAN WATER SERVICE LEVEL UNDER ACTUAL SUPPLY CAPACITY

State	Examined Demand						Actual Supply Capacity					Estimated	Estimated
	Popu.	Service Popu.	SPR	Supply Amount		*1	Planned Service Popu.	Planned SPR	Actual Supply Capacity		*2	Service Popu.	SPR
	*1000	*1000	%	MLD	lcd	lcd	*1000	%	MLD	lcd	lcd	*1000	%
(NW)													
Kebbi	658	329	50.0	25.55	77.7	38.8	525	79.8	28.1	53.5	42.7	362	55.0
Sokoto	1865	933	50.0	83.81	89.9	44.9	1533	82.2	163.4	106.6	87.6	1818	97.5
Katsina	1738	869	50.0	77.69	89.6	44.6	1077	62.0	58.8	54.6	33.8	656	37.7
Sub Total	4261	2131	50.0	187.25	87.9	43.9	3135	73.6	250.3	79.8	58.7	2848	66.8
(NE)													
Kano	2615	1308	50.0	157.66	120.6	60.3	1879	71.9	171.1	91.1	65.4	1419	54.3
Jigawa	814	407	50.0	30.43	74.8	37.4	716	88.0	26.8	37.4	32.9	358	44.0
Yobe	391	196	50.0	16.55	84.7	42.3	401	102.6	16.0	39.9	40.9	189	48.3
Borno	1520	760	50.0	75.47	99.3	49.7	2178	143.3	81.4	37.4	53.6	820	53.9
Bauchi	1496	748	50.0	59.30	79.3	39.6	955	63.8	48.9	51.2	32.7	617	41.2
Sub Total	6836	3418	50.0	339.41	99.3	49.7	6129	89.7	344.2	56.2	50.4	3466	50.7
(CW)													
Kaduna	2737	1369	50.0	145.51	106.3	53.2	2791	102.1	243.8	87.3	89.1	2293	83.8
Niger	1191	596	50.0	52.26	87.8	43.9	965	81.0	77.9	80.7	65.4	888	74.5
Kwara	1033	517	50.0	66.02	127.8	63.9	1492	144.4	96.2	64.5	93.1	753	72.9
Kogi	767	384	50.0	31.78	82.9	41.4	215	28.0	18.2	84.7	23.7	220	28.6
F.C.T	213	107	50.0	18.03	169.3	84.6	177	83.1	80.1	452.5	376.1	473	222.1
Sub Total	5941	2971	50.0	313.60	105.6	52.8	5643	95.0	516.2	91.5	86.9	4890	82.3
(CE)													
Adamawa	995	498	50.0	42.39	85.2	42.6	658	66.1	56.1	85.3	56.4	658	66.2
Taraba	487	244	50.0	18.91	77.7	38.8	163	33.5	8.1	49.7	16.6	104	21.4
Plateau	1669	835	50.0	84.81	101.6	50.8	791	47.4	66.2	83.7	39.7	651	39.0
Benue	883	442	50.0	38.65	87.5	43.8	481	54.5	30.9	64.2	35.0	353	40.0
Sub Total	4034	2017	50.0	184.76	91.6	45.8	2093	51.9	161.3	77.1	40.0	1761	43.7
(SW)													
Delta	1610	805	50.0	66.38	82.5	41.2	541	33.6	40.1	74.1	24.9	486	30.2
Edo	1381	691	50.0	60.33	87.4	43.7	1477	107.0	106.9	72.4	77.4	1224	88.6
Ondo	2457	1229	50.0	113.01	92.0	46.0	870	35.4	48.9	56.2	19.9	532	21.6
Osun	1624	812	50.0	84.43	104.0	52.0	1030	63.4	57.4	55.7	35.3	552	34.0
Oyo	2267	1134	50.0	166.88	147.2	73.6	2469	108.9	101.8	41.2	44.9	691	30.5
Ogun	1645	823	50.0	92.56	112.5	56.3	1798	109.3	132.1	73.5	80.3	1174	71.4
Lagos	5568	2784	50.0	524.35	188.3	94.2	7355	132.1	500.9	68.1	90.0	2659	47.8
Sub Total	16552	8276	50.0	1107.94	133.9	66.9	15540	93.9	988.1	63.6	59.7	7381	44.6
(SE)													
Enugu	1989	995	50.0	93.41	94.0	47.0	1783	89.6	120.3	67.5	60.5	1280	64.4
Anambra	1836	918	50.0	83.90	91.4	45.7	691	37.6	27.7	40.1	15.1	303	16.5
Imo	1710	855	50.0	65.35	76.4	38.2	1198	70.1	88.1	73.5	51.5	1153	67.4
Cross River	872	436	50.0	40.68	93.3	46.7	487	55.8	17.9	36.8	20.5	192	22.0
Abia	1318	659	50.0	64.45	97.8	48.9	786	59.6	64.4	81.9	48.9	658	50.0
Akwaibom	1246	623	50.0	49.60	79.6	39.8	622	49.9	33.8	54.3	27.1	425	34.1
Rivers	2461	1231	50.0	108.95	88.5	44.3	797	32.4	26.6	33.4	10.8	300	12.2
Sub Total	11432	5716	50.0	506.37	88.6	44.3	6364	55.7	378.8	59.5	33.1	4276	37.4
Nationwide	49056	24528	50.0	2639.33	107.6	53.8	38904	79.3	2638.9	67.8	53.8	24621	50.2

SPR : Service Population Rate
*1, *2 : Per Total Population