(a) Plan Formulation

- In principle, the irrigation area is located immediately downstream of a dam consisting of wetlands, and OM of the dam and reservoir would be possibly made by the WUA under the guidance of RBDA.
- Priority is given to the gravity irrigation system with the exception of the use of primary low-head pumps for part of the service area.
- There may be the land of depression and defunct river courses in the service area which will be mobilized as community fish ponds or night storages to be connected with the irrigation canals.
- Inclusion of other objectives such as domestic water supply, fisheries, mini-hydro, afforestation, etc. should be examined as a core of the integrated regional development by the agencies concerned.

(b) Project Implementation

- Simple procedures in design through the preparation of manuals for canals and appurtenant works by the FMWRRD should be employed as much as possible.
- Majority of the construction works should be carried out by RBDA on force account basis organizing a mobile unit for construction equipment and with the participation of WUA and local people as labor force to a maximum extent. This mobile unit is also applied to OM needs.

(4) Proposed Public Schemes in Pump and Creek Type

There may be the possibility of implementing the irrigation projects by primary pumps along the major rivers such as the Niger and main tributary rivers in South Region where the dry season runoff is sufficient for diversion. In any case, the recommended condition would be to take up the service area less than 300 ha per project with only the primary pump of head less than 10 m.

In the Niger Delta where the fertile soils may be distributed being suitable for agriculture, invading flood from adjoining rivers and inundating by high intensity rainfalls have prevented the progress in agricultural development, while this fact is against the common views that the deltas all over the world have been thoroughly developed for their wealth of resources for

centuries. As a matter of fact, it would not be possible in this Study to establish a scope of work for the required flood and erosion control in the Niger Delta because of the lack of data; therefore, any plan for irrigated agriculture is not compiled in the NWRMP.

In the South coastal area, the potential of developing a series of the coastal creek irrigation schemes may be identified to some extent. These small-scale schemes are of rather complex nature including polder dikes for flood protection and primary low-head pumps for both functions of irrigation and drainage for the service area of 300 ha. When taking up this type of the projects, the FMWRRD is asked to confirm their land tenure arrangement appropriate for conducting sustainable irrigated agriculture and related OM.

(5) Proposed Irrigation Development Towards the Year 2020

The irrigation area to be developed by the end of the NWRMP so far examined is shown by project type on Regional basis in the beginning of this paragraph. It may be noted that the NWRMP has been directed to include majority of the proposed irrigation development in the Central and South Regions taking into account the available water resources as well as well-balanced regional development as a whole. In comparison with existing irrigation schemes mostly in the dry north, one of the factors for irrigation efficiency in terms of water storages has been greatly improved resulting from more effective rainfall. This may be understood from the figures of active reservoir capacity and irrigable area.

The water demand for irrigation during the NWRMP period will be increased from 2.09×10^9 cu.m at current level to 16.75×10^9 cu.m in 2020:

(unit: 10^9 cu.m)

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VIII	Total
(1) Public Irrigation Schemes							
Existing	0.58	0.86	0.63	0.51	0.66	0.41	3.65
Proposed	0.58	0.05	2.85	3.29	1.02	2.01	9.80
Sub-total	1.16	0.91	3.48	3.80	1.68	2.42	13.45
(2) Private Irrigation Schemes							
Existing	0.32	0.88	0.08	0.02	0	0.03	1.33
Proposed	0.37	0.83	0.23	0.38	0.07	0.09	1.97
Sub-total	0.69	1.71	0.31	0.40	0.07	0.12	3.30
Total	1.85	2.62	3.79	4.20	1.75	2.54	16.75

3. 2. 4 Water Supply and Sanitation

(1) General Targets

The poor record in terms of water supply and sanitation 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 during the NWRMP period. 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) for a greater percentage of the population than has in the past been the case.

The water demand required for public water supply schemes in 2020 has been projected on the basis of the following indicators:

- Access to the safe water through positive implementation of the public water supply programs has been taken at 80 percent of the population which may be compared with 31 percent in 1991 as estimated by the JICA Team. This service population rate in 2020 has been targeted with reference to that of the National Perspective Plan (80 percent in 2010) additionally taking into account the remaining availability of the 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.
- Per capita water demand in 2020 involved in the NWRMP has been taken at 216 ℓcd at intake point and 150 ℓcd at consumption level for the urban area as a national average and at 80 ℓcd at intake and 60 ℓcd at consumption for the rural area. In computation of the water demand, six categories have been employed at the level to be required for socio-economic activity with the population of (a) more than 1.0×10^6, (b) 1.0 to 0.5×10^6, (c) 500 to 20×10^3, (d) 20 to 10 $\times 10^3$, (e) 10 to 5×10^3 and (f) less than 5×10^3 (for rural).
- In accordance with the demographic data available only at LGA level, all of the water supply demand has been computed in line with the projected LGA population in 2000 and 2020 as minimum unit. In principle, the projected water demand for rural area would be taken from the groundwater resources while for the urban area mainly by the surface water and supplementarily by the groundwater in view of the water resources availability. The projected water demand at intake level in 2020 thus computed is compared with that of 1991:

(unit: 10^6 cu.m)

	1991			2020			Increasing Rate
	Urban	Rural	Total (1)	Urban	Rural	Total (2)	(2)/(1)
Surface Water	620	0	620	3,420	40	3,460	5.6
Groundwater	220	40	260	2,320	1,610	3,930	15.1
Total	840	40	880	5,740	1,650	7,390	8.4

Major indicators on the proposed public water supply schemes summarized on six Regional basis are introduced below:

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VII	Total or Average
1. Service Population in 2020 (10^6)							
Urban	5.6	9.2	11.5	8.1	29.2	20.2	83.8
Rural	8.0	13.4	8.8	11.4	10.2	13.2	65.0
Total	13.6	22.6	20.3	19.5	39.4	33.4	148.8
2. Intake Capacity to be Provided in 2020 (10^6 cu.m)							
2.1 Urban Water Supply	320	580	770	480	2,430	1,160	5,740
Surface Water	180	300	620	340	1,690	290	3,420
Groundwater	140	280	150	140	740	870	2,320
Per Capita (ℓcd)	180	199	211	186	262	181	216
2.2 Rural Water Supply	210	340	220	290	260	330	1,650
Surface Water	0	0	10	0	30	0	40
Groundwater	210	340	210	290	230	330	1,610
Per Capita (ℓcd)	80	80	80	80	80	80	80
2.3 Total Supply	530	920	990	770	2,690	1,490	7,390
Surface Water	180	300	630	340	1,720	290	3,460
Groundwater	350	620	360	430	970	1,200	3,930

Sanitation coverage has always lagged behind that of the water supply component. For better management and more health and environmental impacts, the sanitation component should be fully integrated with the water supply sector so that it can be enhanced by the overwhelming interests that accrue from water supply. Although the sanitation for excrete disposal is essentially a household affair, the FGN should promote the research and training and articulate the necessary strategy for proliferation of the low cost sanitation technology encouraging local manufacturing of water closets to reduce cost and constructing sanitation facilities in all public places such as markets, motor parks, schools and so on.

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 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 plants by vehicle.
- 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. For reference, the water supply demand for urban areas categorized at (a) and (b) as enumerated for 2020 amounts to 2,160 $\times$ 10^6 cu.m throughout the country.

(2) Urgent BMR for Existing Water Supply Facilities

At this stage, there are many portions of the deteriorated and defective waterworks and boreholes throughout the country mainly due to poor OM and partly to the lack of repair works so that the water supply capability would be 50 to 70 percent of the respective design capacity. Accordingly, urgent action program should be taken for the restoration of facility functions to a maximum level in the BMR manner along with an extension line of on-going National Water Rehabilitation Project and others. A comparison between the design capacity and available capacity for existing water supply facilities is summarized below:

(unit: 10^6 cu.m)

	NW HA-I	NE HA-Ⅵ	CW HA-Ⅱ	CE HA-Ⅲ/Ⅳ	SW HA-Ⅵ	SE HA-Ⅴ/Ⅶ	Total
1. Available Capacity							
Surface Water	70	60	150	40	240	60	620
Groundwater	20	60	20	10	80	70	260
2. Design Capacity							
Surface Water	100	100	210	90	320	80	900
Groundwater	30	100	30	20	160	120	460
3. Availability Rate: 1/2							
Surface Water (%)	70	60	71	44	75	75	69
Groundwater (%)	67	60	67	50	50	58	57

As for the surface water sourced waterworks, the present availability in the North-East and Central East Regions is quite low originating from the functional disorder at the intakes and treatment plants in the States of Kano and Adamawa. On the other hand, the rehabilitation of groundwater sourced water supply schemes is needed more at national level, particularly in the South and North-East Regions where many mechanical pumps are installed.

(3) Water Supply Capacity Proposed by the Year 2020

In accordance with the water demand at intake points computed for the year 2020 on the basis of the above-introduced conditions, the capacity of water supply schemes in 2020 will be increased as follows:

(unit: 10^6 cu.m)

	NW HA-I	NE HA-VIII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VII	Total
1. Capacity after BMR of Existing Facilities							
(1) Urban Supply	120	190	230	100	480	190	1,310
Surface Water	90	110	210	90	330	80	910
Groundwater	30	80	20	10	150	110	400
(2) Rural Supply	10	10	10	10	10	10	60
Surface Water	0	0	0	0	0	0	0
Groundwater	10	10	10	10	10	10	60
(3) Total Supply	130	200	240	110	490	200	1,370
Surface Water	90	110	210	90	330	80	910
GroundWater	40	90	30	20	160	120	460
2. Additional Capacity to be Provided							
(1) Urban Supply	210	400	540	380	1,950	960	4,440
Surface Water	90	190	410	250	1,370	210	2,520
Groundwater	120	210	130	130	580	750	1,920
(2) Rural Supply	190	320	220	280	250	330	1,590
Surface Water	0	0	10	0	20	0	30
Groundwater	190	320	210	280	230	330	1,560
(3) Total Supply	400	720	750	660	2,200	1,290	6,020
Surface Water	90	190	420	250	1,390	210	2,550
Groundwater	310	530	330	410	810	1,080	3,470
3. Total: 1.(3)+2.(3)	530	920	990	770	2,690	1,490	7,390
Surface Water	180	300	630	340	1,720	290	3,460
Groundwater	350	620	360	430	970	1,200	3,930

It may be understood that a total supply capacity of 7.39×10^9 cu.m in 2020 is equivalent to be 5.4 times as large as the present capacity of 1.37×10^9 cu.m after the BMR; in particular, that from the groundwater resources will be 8.5 times so that the schemes to withdraw the groundwater should be expanded at more rapid pace. The general trend on Regional level remarks that the additional capacity to be provided in the South-West Region where the urban

area is more concentrated would occupy more than 50 percent of the nation's total of 2.56×10^9 cu.m, while the additional capacity by groundwater in the South-East Region that is estimated at 1.08×10^9 cu.m would be taken at some 30 percent of the nation's total. It may be mentioned that in the States of Akwa Ibom, River, Imo and Cross River where the urban area is located along the coastal belt, the groundwater potential is quite high and the installation and operation cost for boreholes are rather low so that the groundwater development plan will be mainly incorporated even into the urban water supply scheme.

As far as the groundwater exploitation is concerned, the number of additional public boreholes to be installed by 2020 has been estimated at some 265×10^3 in contrast with the current number of 21.4×10^3:

(unit: 10^3)

	NW HA-I	NE HA-VIII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VII	Total
1. Number of Exiting Deep Wells after BMR							
For Urban	0.26	0.86	0.36	0.19	0.63	0.35	2.65
For Rural	3.90	4.37	2.67	2.69	2.47	2.65	18.75
Total	4.16	5.23	3.03	2.88	3.10	3.00	21.40
2. Number of Additional Deep Wells to be Installed							
For Urban	1.8	1.8	1.7	1.7	5.5	2.1	14.6
For Rural	31.0	52.2	33.7	45.1	36.1	52.7	250.8
Total	32.8	54.0	35.4	46.8	41.6	54.8	265.4
2. Total Number							
For Urban	2.06	2.66	2.06	1.89	6.13	2.45	17.25
For Rural	34.90	51.20	36.37	47.79	38.37	55.35	269.55
Total	36.96	53.86	38.43	49.68	44.50	57.80	299.80

(4) Some Implications on Water Supply and Sanitation

Many entities are currently involved in this sector including: FMWRRD, DFRRI, FMHH, FMWH, RBDAs, SWAs, ADPs, SEPAs, LGs, and external support agencies such as UNICEF, UNDP, World Bank, JICA, CIDA, Global 2000, etc. It appears that these institutions employ their own implementation strategies and involve individual communities and LGAs to varying degrees. In most cases, however, their services have been introduced with little or no community involvement. There is at present no clear leadership in this sector, while the prime responsibility should remain vested in a State agency.

Appropriate roles for the FGN agencies is to prepare the basic strategies, to advise and assist the States in formulating programs and implementing and monitoring the State programs. The FMWRRD would be better placed than the other agencies to provide the above services with particular reference to the enforcement of the Water Resources Decree where an article is given to make proper provision for the procedures for technical assistance and rehabilitation and improvement support to public authorities having the responsibility for public water supply. In the planning and implementing of any major investment in this sector, the views of relevant Federal agencies should be taken into account, for which a committee similar to that formed to coordinate the activity of the UNICEF program for rural area would be useful in this respect.

The technology chosen should give any community the highest service level that it is willing and able to pay for, will benefit from and has the institutional capacity to sustain. At present, there are no guideline covering the design of water supply and sanitation installations in Nigeria. Reasons for the need to provide proper guidance to the agencies implementing sector investments include, among others, the choice between different levels of service, proper materials and construction methods, the choice between types of supply source, the water quality standards and monitoring and the wishes of beneficiaries. In particular, an emphasis should be placed upon a policy that the key decision-makers in a community should be fully involved in all development activities from their inception. It is recommended that a detailed procedure on all of the above-mentioned should be formulated as one of the Federal regulations for proper implementation of the Water Resources Decree.

3.2.5 Control and Prevention of Gully Erosion

(1) General Targets

The gully disaster is a special problem that is largely man-made, because the causes of gully erosion are quite complex, and as a consequence, many Government agencies are concerned with the attempts to find possible solutions. The causes include the soil degradation associated with land pressure and related vegetative deterioration, inadequate construction of roads and urban surface drainage and mining operations. The Federal agencies

concerned with attempted solutions include the FMANR, the FMWRRD, the FMWH and the Mines Department while the State MANRs or MWHs are also involved. It is stressed that the whole operations should come under a central unit in the FEPA that may be called at the Federal Gully Control Coordination Unit which could take the form of a technical secretariat to the Sub-Committee on Erosion and Flood Control of the National Committee on Ecological Problems that approves most Federal funding for gully control.

The NWRMP on the gully erosion disaster has been divided into two: (1) gully erosion restoration works and (2) gully erosion prevention measures:

- The gully erosion restoration works may include the primary remedial short-term measure and the full-scale restoration works. Technically, the former measures to address the gully erosion may be through gully infill schemes, and these should only be implemented if additional measures such as appropriate drainage works are taken to prevent the repetition of the phenomenon. Actual situation indicates that this remedial short-term measure has rarely been implemented, and the gullying has inevitably increased with time in size. When the gully is expanded more, a full-scale restoration works in civil engineering mode with costly arrangement should be carried out in urgent manner, for which the guidelines and criteria for planning, design, construction and surveillance at a master plan level has been incorporated. Additional attention has been paid to the Sabo works along the river courses downstream of the areas where a large amount of the eroded sediment is produced.
- Since the expenditures on gully erosion control works are not for productive investment, it is imperative to implement the preventive measures for gully erosion occurrence in an exhaustive manner. To prevent future gully erosion, it is a pre-requisite that the construction control and guidelines on public and private works projects should be prepared for observation by their executing agencies, in association with appropriate performance bonds to minimize the impact of gully erosion. In addition, the NWRMP has worked out, for due reference, the preparation of a gully erosion hazard map and the outline of forecasting and warning systems and education and campaign programs.

(2) Action Program

The policy action, therefore, requires the implementation of construction guidelines immediately for public and private works projects being supported by an environmental assessment review process and suitable penalties upon establishment of appropriate regulatory institutions. It is a JICA Team's view that the Department of Soil Erosion and Flood Control would be responsible for this matter in close cooperation of the proposed Department of Water Administration, FMWRRD who has the mandatory responsibility to enforce the Water Resources Decree in terms of the coordination of watershed conservation program under the Federal coordination of the above-proposed Central Unit in FEPA.

Although it would not be easy to find the lasting solutions to the gully erosion problems particularly in the areas with extreme land pressure and limited scope for resettlement, the Department of Soil Erosion and Flood Control would take the following functions that should provide the continuity of management:

- ensuring adequate liaison with the Federal and State agencies and private entities whose work could induce gullying as well as with those agencies concerned with control measures.
- scrutinizing major road contracts, town plans and mining leases to ensure that adequate provision is included to prevent gullies being induced by the works involved, with the powers to require changes in design and to stop unapproved works.
- commissioning the survey of extent of gullies and the predominant land use in the affected areas.
- designing, commissioning and administering the trials of gully control techniques giving prominence to appropriate civil engineering techniques combined with low-cost vegetative control measures.
- assisting the executing agencies in the preparation and supervision of contracts for gully control works including any survey work required.
- administering the Federal budget allocation for gully control.

3. 2. 6 Other Water-Related Components

(1) Hydropower Generation

With respect to the power demand-supply projection, reference has mainly been made to the 25-Year NEPA Power System Development Study presented in 1988. While any projection made would have to be regarded as mere guestimation, the JICA Team has organized the following scenarios:

- It appears that the natural gas is the best fuel in the future with the combined cycle sets of 500 MW for each power plant to be located near the gas fields, while the gas turbines are mainly used to supply the peak loads.
- It would be extremely difficult for hydro sites to become competitive as baseload units against the cheaper gas-fuelled combined cycles. In addition, it is a better way to operate the existing hydro units as peaking units. In the above-mentioned Study, no new hydro plant is selected within the optimum generation mix until 2010.
- In the short-term, the NEPA generating system where the real reserve margin is currently smaller than 20 percent will face severe shortage when the power plants under construction are not fully available and the existing units are not reconditioned. Quick BMR works for the power units, therefore, are highly recommended. In addition, this system composed of the high share of hydro capacity and the lack of reliable thermal plants will be difficult to operate in view of the risk of inflow decrease into major hydro.
- It is needless to say that it is to add, to the recommendations related with the NEPA investment framework, some immediate countermeasures (1) on human and organizational factors with substantial influence on OM of the power systems and on their reliability which include training and spare parts management and (2) on reinforcement of the Oshogbo National Control Center.

The NWRMP has paid attention to major hydro sites already proposed at Zungeru on the lower Kaduna and at Mambilla on the upper Donga, although not economically justified presently for generation alone, and also to the amalgamation of four RBDA hydro sites into NEPA system:

- Zungeru (950 MW) designed to utilize the spillage from existing Shiroro hydro would have a serious problem of a huge resettlement requirement taking a long lead-time for solution, and it may be judged that the Zungeru in multipurpose nature would not be commissioned into the NEPA system before 2010.
- Mambilla (2,600 MW) is a very ambitions project with very complex water utilization system in remote area; however, this has many issues to be clarified including the engineering feasibility and the prior agreement of Cameroon. It may be noted that this project so far proposed is judged optimistic because this depends on various actions to be taken; therefore, the timing can not be predicted with any degree of certainty at this stage.
- To date, four RBDA dams have been built with hydro component in accordance with the FMWRRD policy on multipurpose development of the surface water; however, these hydro units have been planned and developed by individual RBDA without any contact and cooperation of the NEPA. Because of the power distribution problems and the limited manpower available in RBDAs, it is highly recommended that all of the hydro units be amalgamated into the NEPA system operations as quickly as possible after proper settlement of the official procedures as required. These hydro units include Bakolori (3MW, existing), Oyan (9MW, installed in 1993), Ikere Gorge (6MW, scheduled) and Dadin Kowa (34 MW, not scheduled).
- As is stated in para. 2.3.5, critical review on the function of the Dadin Kowa Dam as commissioned in 1988 has been made; to this end, it is recommended that main objective of this dam be changed to the hydro as peaking units for quick recovery of the previous huge investment in line with many salient advantages. To realize this, the administrative procedures required for the transfer of RBDA's properties to NEPA should be concluded under the positive arrangement of the FGN.

The NWRMP Study has made careful examination of the 1:50,000 FSN topographical maps to site, on a preliminary basis, a series of possible medium-and small-size multipurpose dams, as are explained in para. 3.2.2. It is suggested that any potential mini-hydro site will be identified through the pre-feasibility study of the dam projects to be commenced in near future involving the State Rural Electrification Boards under proper coordination of NEPA, and this isolated rural electrification scheme will be positively promoted in the later stage of the NWRMP period after instituting appropriate administrative procedures. During this examination work, five potential

multipurpose dam projects which may fall into a large-scale group have been preliminarily screened out on the left side of the Benue River with major objectives of the peaking hydro units and subsequent large-scale public irrigation covering the downstream wetlands. These include Suntai, Karamti, Mayo Yim, Su and Kam which would not be qualified in the framework of medium and small-scale dam projects as recommended in the NWRMP. It is also suggested that a pre-feasibility study be included in the NWRMP taking into account the NEPA optimal generation mix and transmission system in future.

(2) Inland Navigation

Any of the future action programs to be involved in the inland navigation sector under the NWRMP has not been investigated within the inevitable competition with the present favorable road transport against a huge investment needed for the proposed capital and maintenance dredging along the Niger and Benue Rivers. It is, thus, suggested that the programs and projects currently being undertaken by the FIWD would be continued without any expansion within the foreseeable future; to this end, the improvement of the Niger navigability would be carried out in two steps, viz. (1) river channel management for the navigation including hydrological and morphological observation and study to a limited extent for the dredging of local critical parts and bed-regulation by means of groynes, training-walls and bank stabilization of difficult crossings and flats, and (2) probable discharge regulations by the Jebba and Shiroro major reservoirs in cooperation with the NEPA under the direction and coordination of the FMWRRD.

In addition, a proposal to provide the barrage(s) in the lower Niger as is seen in the 1984 report "Niger River Channel Development Programme" has been discussed for navigable improvement. As a matter of fact, this proposal may be an ultimate option for comprehensive development of the lower Niger basin taking an opportunity for implementation of the relevant sectors. At this stage, it would be difficult to organize a multipurpose water resources development project with a focus upon the proposed barrages and associated environmental impacts.

From the historical point of view, the FIWD is still in charge of the hydrological monitoring work over the rivers of Niger and Benue as the major

input into the river management for navigation. In accordance with the promulgation of the Water Resources Decree, the FMWRRD should be in charge of the river management and related resources as a whole for public use and benefit. In this connection, the FIWD-managed monitoring gages at Jiddere Bode, Baro, Lokoja, Onitsha and Aboh along the Niger and Wuro Boki, Yola, Numan, Lau, Agwan, Taru, Ibi, Makurdi and Umaisha along the Benue should be transferred to the FMWRRD being incorporated into the nationwide surface water monitoring system proposed. As for the Navigable Waterways Decree, No.56 of 1988, proper adjustment with the Water Resources Decree is of an urgent priority.

(3) Inland Fisheries

The optimization of benefits derivable from the water resources management and development through inland fisheries can only attain meaningful achievements through integration with aquaculture in general and other interests in particular to be properly associated with future operations of the existing and proposed water projects in the NWRMP. Three aspects such as (1) fisheries in wetlands, (2) fisheries in existing reservoirs and (3) aquaculture in the water resources projects have been included with the effort to be made along with the FGN policy of developing the nationwide self-sufficiency in fish production. It may be noted that the DOF, FMANR does not embark upon direct fish production but executes the projects and programs which are aimed at accelerating the private sector participation in fish production, utilization and conservation.

In the NWRMP, a plan to build a series of the small to medium-sized dams for multipurpose in the tributary basins has been contemplated as a basic infrastructure for positive rural development. In principle, these potential sub-projects may be located immediately upstream of the inland valleys to be irrigated as a main objective. In this occasion, the FMWRRD should pay a special attention to release the minimum maintenance flow in order to mitigate adverse impacts to be given to its downstream riverine ecosystems. When necessary, the fish ladders and other passage ways for fish movement up and down the stream should be taken into account for attachment to the hydraulic structures.

The urgent need to put into the most productive use the nation's aquatic environment such as existing reservoirs, lakes, lagoons and rivers should be recognized, while the ecological aspects of these water bodies are examined with a view to assessing their suitability for development of their fisheries resources. This strategy may be promoted with the following issues:

- massive recreation of the major river courses all over the conutry's river systems.
- Repopulation of the major reservoirs and others with fish fingerlings.
- Monitoring, control and surveillance of the stocked reservoirs and other water bodies.

There is the fundamental need to develop vast aquaculture potentials to bridge the national fish demand-supply gap if the ventures are found to be profitable. In connection with the promotion of medium and small-scale dams projects in multipurpose nature, the aquacultural ventures should be given with the priority including (1) reservoir fisheries, (2) the fish pond operations by a cooperative or private entity within the irrigation service area or outside it with a water conveyance channel, and (3) the small integrated vegetables, animal breeding and fish farm to be operated by individuals.

In order to promote the fisheries component to be included in the above-introduced projects, the DOF experts in respective fields should be assigned to all stages in their project cycles to be conducted by the FMWRRD for possible inclusion of the aquaculture. In parallel with this activity, model fish farms basically being extension-oriented would be operated to test the realization of possible benefits from integrating the fisheries with potential water resources projects and also to afford local farmers easy access during the project cycle. Needless to say, the DOF is highly recommended that the quick action program to overcome the current problems including (1) the need of more adaptive research being composed of the improvement of broodstock, fish seeds and feeding rates, fish diseases, stocking densities and fish biology, and water quality, (2) inappropriate supply of improved and certified varieties of fish fry and fingerling, and (3) development of fisheries manpower for optimum performance in aquaculture development and related production activities, should be launched.

3.3 REGIONAL DEVELOPMENT AND MANAGEMENT

3.3.1 General

Each Component of the NWRMP to be involved in the water resources sector has been discussed in the previous paragraph 3.2 "Component of the Water Resources Sector". This paragraph intends to translate such proposals as called for by each component into the basin-wide management issues. First of all, some of the important indicators on water use and balance for each of the surface and groundwater resources by the end of the NWRMP period (2020) which are in contrast with those under the current condition as is compiled in para. 2.3.1 are summarized below:

(Unit: 10^6 cu.m)

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VII	Total or Average
1. Surface Water							
(1) Potential	22,400	8,200	32,600	83,000	35,400	85,700	267,300
(2) Water Demand	2,030	2,920	4,410	4,560	3,470	2,820	20,210
Public Irrigation	1,160	910	3,480	3,820	1,680	2,420	13,470
Private Irrigation	690	1,710	300	400	70	110	3,280
Public Water Supply	180	300	630	340	1,720	290	3,460
(3) Water Use Rate: (2)/(1) (%)	9.1	35.6	13.5	5.5	9.8	3.3	7.6
2. Groundwater							
(1) Potential	4,340	5,580	8,180	11,380	9,020	13,430	51,930
(2) Water Demand	350	620	360	430	970	1,200	3,930
Public Irrigation	-	-	-	-	-	-	-
Public Water Supply	350	620	360	430	970	1,200	3,930
(3) Water Use Rate: (2)/(1) (%)	8.1	11.1	4.4	3.8	10.8	8.9	7.6

Towards 2020, the undertaking of water resources projects and programs proposed in association with the strategies of each service component will increase the water demand from $2,730 \times 10^6$ cu.m in the present situation to $24,140 \times 10^6$ cu.m or 8.8 times. As far as the water use rate is concerned, both water resources will take the similar rates of around 7.6 percent in 2020 from nation's average point of view; however, attention should be paid to higher rates of 35.6 percent in HA-VIII for surface water and of around 11 percent in both HAs-VIII and VI for groundwater. Needless to say, these higher rates as a whole propose the strengthening of water resources monitoring and require more deliberate water operations of water-related projects within their water use rights to be granted under the Water Resources Decree.

3. 3. 2 Lake Chad Basin (HA-VIII)

(1) Water Source Works

There are many water source works already completed with large capacities; however, the current water use from those works is almost at unsatisfactory level. The action program to be taken during the initial period of the NWRMP is to demarcate the potential service area for additional irrigation and water supply in connection with the reservoir operations study for each storage and to establish its appropriate reservoir operation rule. Because of less surface water potential in this Region, a proposal to provide new water source works has been limited to the small ones at the tributary basins where surplus potential has been identified at a master plan level.

It may be noted that one of the highlights to be recommended in this NWRMP is to make artificial flood releases for Hadejia-Yobe Wetlands from existing large water storages at Tiga and Challawa Gorge. This program is attached with the top priority in connection with the reservoir operations study as mentioned above and also in the preparation of a nationwide model for the recovery of other wetlands functions. Reference is made to para. 3.2.2 (2) (b).

Reference is made to the water demand in the Borno State which is on the increase in agricultural and other socio-economic sectors in line with a steady pressure on desertification and population. The CBDA has a plan to extend the conveyance canal by 25 km from the Lake Chad for satisfactory operations of SCIP, Phase 1; however, in view of the investment efficiency and current unfavorable irrigation practices, the JICA Team is not in a situation to consent to this proposal while waiting for a favorable turn of the Sahelian drought. It is also to be noted that apart from the normal surface and groundwater resources, a special effort is being made by the University of Maiduguri with a particular attention to a fact that many natural depressions being flooded during rains have never been utilized and lost by evaporation. Their research work is to start with a concept that these depressions may serve as farm ponds for crops, livestock and many other domestic purposes after detailed topographical survey and continuous monitoring of physical behaviors of these ponds.

(2) Irrigation Service

Potential public irrigation service area under existing water source works that has been preliminarily computed at 90×10^3 ha in total may be divided into two: the area presently served of 27×10^3 ha and the undeveloped of 63×10^3 ha. The latter may be further sub-divided into two: (1) 42×10^3 ha under the dams and (2) 21×10^3 ha under existing primary pumps around the Lake Chad and the Yobe River. Expansion of 21×10^3 ha would be subject to the water availability of Lake Chad and Yobe River which should be carefully monitored. On the other hand, an irrigable area under the proposed small water storages in tributaries may amount to 5×10^3 ha as a Basin total, and this should be developed after careful study and cautious preparation in multipurpose nature.

Private irrigation potential identified in this Region shows 190×10^3 ha, of which 98×10^3 ha is already under irrigation by the State ADPs. Of the remaining 92×10^3 ha, about two-thirds is located in the Hadejia-Yobe wetlands being subject to the artificial flood releases as mentioned above. This type of irrigation should be practiced as quickly as possible being ahead of the implementation of public schemes for favorable switch -over.

(3) Water Supply and Sanitation Component

The water demand for public water supply schemes predicted in 2020 amounts to 300×10^6 cu.m by surface water and 620×10^6 cu.m by groundwater, reflecting the remaining water resources potential in this Region.

Of the water supply schemes by surface water, 110×10^6 cu.m may be achieved by existing waterworks capacity. In the Kano State where surface water demand is in the highest position occupying 75 percent of the Basin, the water intake capacity of 220×10^6 cu.m with 70×10^6 cu.m for existing and 150×10^6 cu.m for new would be required, and all of these water demand have been arranged by the water release from existing water storages; therefore, new waterworks will be installed through adequate demand prediction and proper coordination with the H-JRBDA, and concurrently the provision of public sewerage system will be carried out to preserve urban environment for the densely populated area.

Existing water supply capability by groundwater in this Region has been evaluated at 100×10^6 cu.m, and additional demand estimated at 530×10^6 cu.m will be achieved by the provision of new boreholes; to this end, a total number of the boreholes will reach 53.86×10^3 in 2020. This means that some 2×10^3 boreholes with the assumed average yield of 12 cu.m per hour each will be installed every year during the NWRMP period. It is a pre-requisite that careful aquifer monitoring will be needed in general. In particular, the Maiduguri area where the present aquifer behaviors are critical will be strictly monitored with the provision of a series of observation wells taking a close relation with the reservoir operations of Alau Dam.

3.3.3 Sokoto-Rima Region (HA-I)

(1) Water Source Works

When the Black Flood from Niger is excluded, the surface water resources in this Region would have a potential of 9.8×10^9 cu.m being organized with 6.0×10^9 cu.m over the Sokoto-Rima drainage and 3.8×10^9 cu.m over other small basins. Accordingly, careful consideration has been included in the preparation of the NWRMP:

- There are many problems in existing major storages at Jibiya, Zobe, Goronyo and Bakoroli as are pointed out in para, 2.3.3. Top priority should be given to the preparation of reservoir operations rules in detail demarcating the extent of water use downstream.
- The S-R RBDA has a plan of implementing three large dams at Karaduwa (SHA-I_2), Kaya (SHA-I_3), and Gwaigwaya (SHA-I_4) in the upper Rima to meet the local demand. Construction of these dams will give a great impact to existing storages at Zobe and Goronyo. Careful study on the reservoir operations for a series of these dams at a feasibility level, therefore, should be carried out, and if affirmative, the implementation of this plan will be made with a schedule in the later stage of the NWRMP period.
- There would be the possibility of constructing large dams in the upper Sokoto; however, taking into account the substantial reduction of White Flood inflow into the NEPA Kainji reservoir, no proposal has been incorporated into the NWRMP.
- To date, less development has been achieved along small rivers on the both sides of the Niger River which are located within the

Kebbi State. In view of positive rural development over this State, a series of medium and small-sized dam projects for public irrigation over the downstream wetlands have been incorporated into the NWRMP giving minor impact to the NEPA Kainji hydro; however, prior consultation with NEPA should be required. It may be noted that the Danzaki Basin (SHA-I_{10}) where a high potential on surface water and irrigable land is identified has been selected as one of the Priority Basins with 14 medium and small dams under the S-R RBDA in the NWRMP.

(2) Irrigation Service

It has been estimated at a master plan level that potential irrigable area under existing dams is 60×10^3 ha, of which only 8×10^3 ha are currently irrigated. Of the remainder, 46×10^3 ha are situated along the Rima River, and almost all of these irrigation schemes would belong to a large-scale category over 5,000 ha each for which a full-scale feasibility study is required in parallel of the above-mentioned reservoir operations study.

Newly proposed public irrigable area of 60×10^3 ha mostly under new dams as assumed in the NWRMP should be studied in detail by 2000 for plan formulation and implemented in such manner that private irrigation is practiced in advance.

(3) Water Supply and Sanitation Component

Since this Region has the least population of 17.0×10^6 predicted in 2020 among others and also only two large urban centers such as Sokoto and Katsina, the demand for domestic water supply estimated by the end of the NWRMP is not so large being 180×10^6 cu.m by surface water and 350×10^9 cu.m by groundwater. The waterworks by surface water are concentrated in the above two urban centers, of which a series of the waterworks have been constructed for Sokoto with a total capacity of 60×10^9 cu.m, and the strengthening of Katsina waterworks is currently under planning to divert water from the Zobe storage. There is no particular problem except for the attention to well-organized OM of existing waterworks. In the Sokoto urban area, there would be the need to provide the public sewerage systems for urban sanitation which will be in the stage of a discussion during the course of the NWRMP.

As for the water supply by groundwater resources, 30×10^6 cu.m would be provided by existing boreholes, and additional 32,800 boreholes would be sunk to satisfy the water demand of 350×10^6 cu.m in 2020. Since the density of boreholes around Sokoto will be large during the course of the NWRMP period, it is essential to provide the aquifer monitoring system for careful groundwater withdrawal which should be completed by 2000 for ready surveillance.

3.3.4 Niger Region (HA-II)

(1) Water Source Works and Irrigation Service

Although this Region has a surface water potential of 32.6×10^9 cu.m, existing farmland of 67.0×10^3 sq.km and large urban centers such as Kaduna, Zaria, Minna, Ilorin, Abuja FCT, etc., the surface water development at present level appears to be immature with the water availability of 670×10^6 cu.m for public irrigation and 150×10^6 cu.m for domestic water supply under the water storages with a 940×10^6 cu.m capacity. This, therefore, means that this Region has the highest potential in Nigeria for the development of surface water resources.

The JICA Team has examined the possibility of surface water development by water storages from every corner; to this end, the following inventory of the proposed dams to be included in the NWRMP has been obtained:

	Number of New Dams	Active Reservoir Capacity (10^6 cu.m)	Available Reservoir Water (10^6 cu.m)			Possible Irritable Area (10^3 ha)
			Total	Public Irrigation	Public Water supply	
Large/Medium Dam	74	2,940	2,140	1,930	210	170
Small Dam	230	1,150	920	830	90	70
Total	304	4,090	3,060	2,760	300	240

Virtually, there is the possibility of developing the medium and small-sized dams throughout all of the tributary basins; in particular, the basins of Galma and Karami in the upper Kaduna and of Gbako and Awun along the Niger River would have a concentration of such proposed dams. In view of the priority and model basins in this Region, two Priority Basins have been selected for early implementation as package programs including the Gbako

(HA-II$_{14}$) under the Upper Niger RBDA and the Awun (HA-II$_4$) under the Lower Niger RBDA. In succession to development of the Priority Basins, other proposed medium and small dams will be implemented on the basis of the experience gained with a schedule of the identification by 2000 and construction at an annual pace of six small dams and two medium and large dams during the period of 20 years including the feasibility study and engineering design for each.

(2) Water Supply and Sanitation Component

It has been computed that the surface water demand for domestic use in urban areas by 2020 amounts to 630×10^6 cu.m that is the second largest next to the South-West Region, of which existing waterworks have a capacity of 210×10^6 cu.m. The remaining 420×10^6 cu.m would be sufficiently soured by the multipurpose water storages or direct diversion from perennial rivers, and the related waterworks will be adequately constructed in accordance with the growth of water demand during the NWRMP period. The States of Kaduna, Kwara and Niger would need additional capacity of 210×10^6 cu.m, 96×10^6 cu.m and 57×10^6 cu.m, respectively, while it has been judged that existing water storages for Abuja FCT would meet the 2020 water supply demand.

In the HA-II Basin, the urban water needs will be met by surface water, while the groundwater will be withdrawn for rural water supply with the deep well capacity of 370×10^6 cu.m proposed in 2020. While the present capacity of groundwater exploitation is estimated at 30×10^6 cu.m, additional number of the boreholes to be drilled would be around 35.4×10^3 based upon the capacity of 12 cu.m per hour per each mostly being covered by the Basement Complex area. This may be translated at annual drilling of 1.4×10^3 boreholes towards 2020.

3.3.5 Benue Region (HAs-III and -IV)

(1) Water Source Works and Irrigation Service

While this Region is blessed with the most highest potential in terms of surface water and farmland resources in Nigeria, the present status indicates that these resources are quite underdeveloped from the socio-political point of

view taking the resources so far developed at $1,600 \times 10^6$ cu.m and the water use at 210×10^6 cu.m. Majority of the large-scale surface water development have been carried out along the Gongola River at Dadin Kowa and Kiri, of which almost no water use has been achieved at Dadin Kowa and only three percent of the Kiri inflow is being diverted. Potential irrigable area under existing water storages in this Region has been estimated at 40×10^3 ha with the present irrigation water supply for only 12×10^3 ha; therefore, the top priority in the NWRMP is to complete the irrigation schemes for 28×10^3 ha in urgent manner. Special attention has been paid to the function to be borne by Dadin Kowa which should be directed to the hydropower to be managed by the NEPA, as is explained in paras. 2.3.5 and (1) of 3.2.6.

In other major tributaries in this Region including Kilange, Hawal, Belwa, Mayo Ine, Taraba, Donga, Ankwe, Katsina-Ala, Mada and so on where the water resources development has taken place to a minor extent, many of the proposed small and medium-scale dams have been preliminarily identified during the course of the Study, as is summarized below:

	Number of New Dams	Active Reservoir Capacity (10^6 cu.m)	Available Reservoir Water (10^6 cu.m)			Possible Irritable Area (10^3 ha)
			Total	Public Irrigation	Public Water supply	
Large/Medium Dam	92	3,340	2,350	2,110	240	170
Small Dam	270	1,350	1,080	970	110	80
Total	362	4,690	2,430	3,080	350	250

In order to achieve a sound development of these water resources, the Priority Basin has also been identified for appropriate implementation in orderly manner as a model in this Region including the Kilange ($HA\text{-}III_1$) under UBRBDA and the Katsina-Ala ($HA\text{-}IV_5$) under LBRBDA. It may be noted that five large-scale multipurpose dams have been screened out for the NEPA consideration as is stated in para. 3.2.6 (1).

(2) Water Supply and Sanitation Component

There are a few urban centers in this Region where the 2020 demand for public waterworks by surface water has been estimated at 340×10^6 cu.m, of which Jos urban in the Plateau State would occupy 56 percent. The Jos area has already some water storages for urban supply, and its future demand would

be met through the implementation of medium and small dam projects proposed in the NWRMP, while the most densely populated center in Jos would be directed to install a public sewerage system(s) for proper maintenance of urban sanitary environment as a unique resort city during the NWRMP period. For other areas, a series of multipurpose medium and small dams proposed would release water to be required for their water supply, including those of Benue left area covered by Basement Complex area.

The present situation on rural water supply in this Region is at the lowest level with only 20×10^6 cu.m of the supply capacity. It is, therefore, proposed that a positive attitude to provide 46.8×10^3 boreholes be incorporated to meet the water demand of 407×10^6 cu.m in 2020 including part of the urban area. In particular, the States of Plateau and Benue in the lower Benue where the rural population is higher would need additional 29×10^3 boreholes to satisfy the 2020 water demand of 242×10^6 cu.m.

3.3.6 Western Littoral Region (HA-VI)

(1) Water Source Works and Irrigation Service

In this Region with the surface water potential of 35.4×10^9 cu.m, the irrigation development is still in immature stage due to the lack of foundation to promote supplementary irrigation in connection with the farmers' participation as is described in para. 2.2.2. For instance, existing large dams at Oyan and Ikere Gorge have a plan to irrigate 45×10^3 ha; however, the present irrigable area remains only at 4,000 ha. It is of urgent matter to make every effort for completion of these irrigation systems after solution of the present bottlenecks by 2000.

As a whole, there are extensive farmlands along the tributary rivers where the rained paddy production is made with the water shortage during the dry season. On the other hand, this Region has achieved rapid progress of the urbanization, and 21 dams have been built to date for the urban waterworks resulting in imbalanced situation of the water storage capacity (350×10^6 cu.m), water demand (500×10^6 cu.m) and actual supply (235×10^6 cu.m). Taking into account these critical circumstances, the NWRMP has been

oriented to provide more multipurpose medium and small dams for strengthening the downstream activities:

	Number of New Dams	Active Reservoir Capacity (10^6 cu.m)	Available Reservoir Water (10^6 cu.m)			Possible Irritable Area (10^3 ha)
			Total	Public Irrigation	Public Water supply	
Medium Dam	41	910	830	500	330	30
Small Dam	100	500	450	405	45	30
Total	141	1,410	1,280	905	375	60

The above-proposed water resources development would be implemented over the tributary basins mainly of the rivers of Ogun, Oshun, and Osse in the upper part of this Region where a large-scale dam requiring the issue of farmland submergence and household resettlement to a large extent may be eliminated. On the premise that a series of the proposed medium and small dams will be properly implemented during the NWRMP period, the upper Ogun Basin (HA-VI_2) under O-O RBDA and the Osse Basin (HA-VI_8) under B-O RBDA where a high demand of irrigation and water supply is anticipated have been selected as the Priority Basins which would be developed in an earlier stage in such similar manner as is explained in other Regions. It may be noted that small-scale irrigation schemes in pump and creek type as is explained in para. 3.2.3 has been included in the NWRMP to be applied for the coastal zone where the supplementary irrigation is required for the stabilization of community-based agriculture.

(2) Water Supply and Sanitation Component

In this Region where the proportion of urban centers is extremely high, the urban water demand for public waterworks by surface water will grow at a rapid pace during the NWRMP period reaching 1.72×10^9 cu.m in 2020 that may occupy 50 percent of the nationwide demand. This huge demand is divided into two: 330×10^6 cu.m for existing capacity and $1,390 \times 10^6$ cu.m for additional capacity by 2020. In particular, the States which require a large-scale expansion are Lagos (850×10^6 cu.m), Oyo (250×10^6 cu.m), Ondo (120×10^6 cu.m) and Ogun (90×10^6 cu.m). For Lagos State, future expansion would be possible by water release from existing large storages at Oyan and Ikere Gorge, and other States would need water to be allocated from the proposed medium and small dams for upper area and from the direct pump

diversion from perennial rivers for lower area. In line with a steady growth of the urban water use in densely populated districts, attention should be paid to the need to provide the public sewerage systems in a step-by-step manner for favorable environment.

Many urban areas along the coastal belt are currently withdrawing the groundwater for their domestic needs with capacity of 810×10^6 cu.m, and this will be increased to that of 970×10^6 cu.m in 2020. On the other hand, the groundwater is the main source of public rural water supply schemes, and its demand will grow to a level of 260×10^6 cu.m in 2020. In the aggregate both for urban and rural, the States which need more groundwater exploitation would be Delta (170×10^6 cu.m), Ondo (170×10^6 cu.m), Oshun (150×10^6 cu.m) and Oyo (110×10^6 cu.m). With an average yield of a borehole at 30 cu.m per hour, approximate estimate of 42×10^3 boreholes will be sunk to meet the domestic water demand by 2020. It may be noted that the groundwater exploitation around Lagos is currently in a critical situation so that the NWRMP has delineated a plan to provide a local monitoring and surveillance program for the aquifer behaviors.

3.3.7 Eastern Littoral Region (HAs-V and -VII)

(1) Water Source Works and Irrigation Service

This Region has the surface water potential of 85.7×10^9 cu.m that is equivalent to be 32 percent of the nation's total; however, less development has been achieved to date including the domestic water supply by small dams and diversion weirs and the irrigation by primary pumps. Almost all of the present public irrigation schemes would not reach their full functions due to the defect of primary pump units and other constraints, and the BMR for these schemes should be given top priority in the NWRMP.

In particular, no surface water development in the northern hilly area has taken place to date, and the States of Enugu, Anambra and Abia as well as the upper area of Cross River State would need more surface water for their urban water supply due to costly groundwater withdrawal. In consequence, the northern area of this Region where the dry season runoff is not so much has

been prepared in the NWRMP to build a series of medium and small dams along the tributary courses:

	Number of New Dams	Active Reservoir Capacity (10^6 cu.m)	Available Reservoir Water (10^6 cu.m)			Possible Irritable Area (10^3 ha)
			Total	Public Irrigation	Public Water supply	
Medium Dam	43	970	920	670	250	50
Small Dam	150	750	680	605	75	45
Total	193	1,720	1,600	1,275	325	95

While there would be no possibility to construct a large dam in this Region, reference has been made to a high potential of developing medium and small dams along the Mamu tributary into the Anambra and the Aloma, Aya and Abo Ine tributaries into the Cross. In this connection, the NWRMP has designated the Mamu Basin (HA-V_4) under A-I RBDA and the Aya (HA-VII_2) under CRBDA as the Priority Basins for earlier development.

In the coastal stretch where the dry season runoff is available, a series of small irrigation schemes in pump and creek type would be possible, and a total of 55×10^3 ha has been included in the NWRMP through proper understanding of the topography and land use as a whole except for the Niger Delta as explained in para. (4) of 3.2.3; however, any delineation of each scheme has been difficult to be made on the presently available topographical maps.

(2) Water Supply and Sanitation Component

It is noted that the Region is favored with the groundwater resources and related low cost for withdrawal except for the hilly area in Enugu and Anambra. General situation of water supply depends upon the groundwater exploitation especially in the States of River, Akwa Ibom and Cross River. The NWRMP has predicted that the water supply capacity in 2020 would be increased to 1.2×10^9 cu.m by groundwater and to 290×10^6 cu.m by surface water. Additional boreholes to be drilled will be 54.8×10^3 in number on the base of each yield at 65 cu.m per hour. In view of probable overdrafting in and around Port Harcourt, adequate aquifer monitoring system has been included in the NWRMP.

(3) Control and Prevention of Gully Erosion

Reference is made to paras.2.2.4, 2.3.7 and 3.2.5 where the quick restoration of man-made gullying disasters and related proper erosion prevention measures are discussed.

3.4 ENVIRONMENTAL MANAGEMENT

3.4.1 General Targets

The NWRMP has addressed in para. 2.4 the significant environmental problems on a regional as well as a project basis including drought and desertification, long-term flow reduction in major rivers, soil degradation, deforestation, soil erosion, flooding, water pollution, water-related diseases, losses of wildlife and fisheries, and dislocation and resettlement of large groups of people.

The present situation on the most complex and overriding causes of environmental degradation in Nigeria demands that the agencies responsible for the water resources management and development take a proactive rather than a reactive role in the management of environmental resources. At the present time, the FEPA that is charged with overseeing the environmental impact assessment of development projects appears to be unprepared to assume a leadership role in the water resources and environmental management. Given this situation, it is highly recommended that the FMWRRD be prepared to take a unilateral action, if necessary, to ensure that the watershed integrity is maintained and strengthened and the water resources are protected.

Two primary approaches to the environmental management in the water resources sector have been detailed in the NWRMP: (1) watershed management and (2) environmental impact assessment (EIA):

- Watershed management programs consider the requirements and implications of the entire watershed when formulating and implementing the development planning and policies. The Water Resources Decree, No. 101 of 1993 has given the FMWRRD significant powers to coordinate the measures and control of the

activities for proper watershed management and resources protection. This should be used as the basis for the development of an aggressive management and enforcement program to protect and maintain the water resources.

- The use of EIA as an integral part of the environmental resources planning and water resources development project management cycle should be made on the basis of the Environmental Impact Assessment Decree, No. 86 of 1992 which requires the EIA for many types of the water resources projects and programs affecting watershed management. This may also be the basis for the approach to early impact assessment, coordination/ communication/ notification, and provide a structured approach to the evaluation of potential environmental impacts. For this, the FMWRRD is to be involved to develop detailed procedures working with other Ministries as appropriate to be applied by all levels of the Government and private developers. The approach may also involve the public and Government to help promote "tenure" and local ownership of project elements in keeping with the NWRMP strategy to smaller, decentralized facilities serving the local population.

3.4.2 Procedures Proposed for EIA

(1) General Overview

The EIA is a process used in the project planning and management cycle to predict the environmental consequences and to plan appropriate measures to reduce the adverse effects of proposed water resources projects. Such projects, by their very nature, may generate a wide range of the environmental impacts in terms of human health, water quality, ecology and socio-economics as a result of their improper location, inappropriate design, unplanned construction, unskilled and poor OM, and the misuse of natural resources.

The major role of the EIA process is to identify and describe the environmental hazards which may ensue from a project, and then specify necessary Environmental Protection Measures (EPM) or an Environmental Management Plan (EMP) for the project, which includes : (1) mitigation measures necessary to reduce predictable adverse effects, (2) measures for off-

setting probable adverse effects, and (3) other technical and institutional measures for environmental enhancement. It is likely that all of the water resources projects would require some form of the EIA.

Although the minimum content requirements for the EIA process are included in page 980 of the EIA Decree, the NWRMP recommends the FMWRRD with more stringent requirements for his projects and others to be performed by any Government agency where the water resources are potentially threatened. These additional requirements are detailed in Chapter 11 of Vol. 2 "Sector Report". The NWRMP also recommends that the FMWRRD should review all of the projects that potentially affect the water resources; if the developer is a private company or individual, the FMWRRD should review and approve the details of his project before forwarding the documentation to the FEFA for review and approval.

(2) Approach to the Proposed Project Cycle and Review

In evaluating the potential of any development project to affect the water resources, the FMWRRD should implement a consistent process of consultation and review that combine planning, regional and local needs and concerns, and access to the information to allow the widest possible discussion of potential impacts. This consultation and review may be done over a total of six major project stages including project concept, pre-feasibility, feasibility, design/ engineering, implementation and post-implementation.

While the EIA Decree specifies that all projects meeting certain size requirements should undergo an environmental review procedure, the timing of this review procedure should be such that a project moves forward with dispatch, while at the same time providing for adequate coordination and notification, and to allow the interested and affected parties to submit the input regarding the proposed project.

(a) Project Concept and Scoping

This step brings together the various planning elements which are responsible for planning for future growth, matching human needs with resources and maintaining environmental resources, formalizing the description of requirements for the proposed project and the goal that the

project is expected to accomplish. This is called the Statement of Purpose and Need to be developed by the project executing agency. While this step is not specifically called for by the EIA Decree, it is recommended as a way to document the project plan and to assist in evaluating the proposed project in terms of existing planning activities.

The EIA Decree specifies the need for "Pre-Notice" of a project to the FEPA. This step alerts the FEPA that a project requiring the environmental evaluation has advanced to the stage of being seriously considered; this environmental evaluation will be necessary for the project to continue further. The Project Concept Announcement also notifies other agencies and the public that a project is in the advanced planning stage. These interested parties may submit the input regarding the purpose, need, and potential environmental effects of the project. The project executing agency should consider this input for the final planning of the project.

(b) Screening Report

A Screening Report is required for all projects addressed by the EIA Decree. For projects that potentially affect the watershed integrity, the FMWRRD may place additional documentation and review requirements on the project proponent. The Screening Report is essentially an environmental checklist, comparing a detailed description of the proposed project to specified evaluation criteria to determine if potential environmental impacts are minor or potentially serious. The results of the Screening Report may lead the project executing agency to modify the project to avoid some potentially serious environmental problems. Project alternatives which may achieve the aims of the project are also formulated at this stage. If environmental information required to make a general determination regarding the effects of the project is lacking, the environmental study should be identified and implemented to provide the needed information.

The result of this stage of the project cycle is a formal Screening Report that describes the project and its alternatives, and evaluates the project for potential environmental impacts. The Screening Report should be reviewed and approved by the FEPA before the project can proceed. If the project affects the water resources, and the FMWRRD has placed additional requirements on

the project, the FMWRRD should review and approve the Screening Report prior to it being submitted to the FEPA.

(c) Feasibility

This step in the project cycle is used to evaluate the feasibility of the project in terms of its potential impact on the environment and its potential effect on sustainable development of the natural resources. This evaluation requires a detailed analysis of the impacts of the project in an Environmental Impact Assessment report.

In the Pre-Feasibility stage, the project executing agency identifies significant issues through the scoping process, and conducts any studies required to provide information to analyze potential environmental impacts of the project. The EIA report uses this information to provide a detailed environmental assessment of the proposed project and its feasible alternatives. The determination as to whether any element of the proposed project will potentially have a significant impact on the environmental resources is based on the use of defined significance criteria in each environmental area. The EIA report should identify the mitigation measures to assure that potentially-significant impacts are reduced to non-harmful levels. If mitigation for some environmental impacts is required, the EIA should recommend a monitoring program to be implemented during project construction and/ or operation to ensure that the recommended measures are adequate to reduce the impact to a level of insignificance.

The EIA Decree specifies that the FEPA should review and approve any EIA report prepared for a project. In addition, a public review period should be provided so that affected communities and individuals can make known their concerns regarding the proposed project. The FEPA should consider the input of affected agencies and individuals when deciding to approve a project EIA, and in recommending and approving appropriate mitigation measures and monitoring programs. The outcome of this step is an approved project ready to go forward with design and construction, subject to the requirements of FEPA and FMWRRD regarding permit conditions (mitigation measures) for construction and operation, and monitoring requirements to ensure that the environmental guidelines are met. The FEPA

is required by the EIA Decree to issue a Certification Announcement that the project has received adequate environmental review.

(d) Significance Criteria for EIA

The criteria which will indicate whether the potential environmental impact is significant should be developed in such a way that:

- agencies affected by the project or that are responsible for its implementation should agree on the criteria used.
- the criteria should be reasonable rather than exotic, based on the economic, social, and environmental concerns.
- the criteria should be defendable based on the past experience and statutory mandate, and enforceable based on the agency mission and powers.

While some of the significance criteria for use in evaluating the environmental effects of proposed projects have been suggested at a master plan level as is compiled in Chapter 11 of Vol. 2 "Sector Report", the FMWRRD should draft more detailed significance criteria and tailor them to specific water resources development projects on a case-by-case basis. The criteria will likely vary by region and for different projects.

(e) Post-Implementation

Historically, Nigeria has not performed the EIA on water resources development projects, or maintained the data related to the environmental impacts of those projects. As are discussed in other sections of the NWRMP, the need is great for developing and maintaining these data which can then be used to evaluate the design and operation requirements for future projects, as well as determine the level of success of mitigation measures to reduce environmental impacts.

(3) Guidelines for EIA of the Water Resources Projects

The NWRMP has presented preliminary guidelines for developing the EIA for some types of the water resources projects including dam and reservoir,

water supply and others for FEPA and FMWRRD consideration and reference to subsequent action program. A discussion of the impacts on the health of local inhabitants associated with all types of water-related projects and approaches to their assessment has been made first, and the recommendations regarding the impact assessment, monitoring and proposed studies have been included. All of these guidelines are compiled in Chapter 11 of Vol. 2 "Sector Report".

3.5 WATER RESOURCES MANAGEMENT AND ORGANIZATION

3.5.1 Water Resources Decree, No. 101 of 1993

The mandate of the Water Resources Decree has given the FMWRRD significant powers to implement the legal measures for nation's water resources including watershed management and resources protection, and appropriate enforcement of this Decree has been taken as the top priority to be carried out in the NWRMP within the most practicable date as is listed up in para. 3. 1. As a matter of fact, the Water Resources Decree outlines the basic framework to have the FMWRRD perform the public administration of the water resources which should play as catalyst for socio-economic development; therefore, it is stressed that a series of the regulations in accordance with Section 19 of this Decree should be urgently prepared for practicable enforcement of each Provision as is also explained in para.3. 1. It may be noted that proper adjustment with the Navigable Waterways Decree, No. 56 of 1988 should be made as is stated in para. (2) of 3.26 and proper tie-up with the Environmental Impact Assessment Decree, No. 86 of 1992 is also essential as is explained in para. 3. 4 of this Chapter.

The development, utilization and preservation of many physical and economic resources represented by the water resources are normally determined by the basic public policies as expressed by existing legislations and regulatory legislations as may be enacted for specific objectives. While the objectives of water resources operations, design and planning are embodied in the general socio-political objectives, these are expressed in two forms: (1) those long-standing policies which no legislative body has seen fit to overturn, and (2) the fermentation of current dynamic politics. The latter are most generally concerned with the quality of life today and its distribution to society. The

persistence of the former suggests that they are reflective of the more stable objectives of society, hence, of the concern for the quality of life for tomorrow.

The objectives of water resources systems can probably be described as a spectrum of goals, rather than the maximization of a single scalar numerial quantity. It may be interpreted to approximate the fundamental objectives of water resources systems as follows:

- To control or otherwise manage the water resources of the cognizant geographic or political subdivision so as to provide for protection against injurious consequences of excesses or deficiencies in quantity or quality.
- To provide or maintain water in such places and times and in adequate quantity or quality for human or animal consumption, food production, industrial production (including energy), and for the environmental and conservation purposes considered desirable by the body politic.
- To accomplish all of the above with a minimum expenditure of the physical, economic and human resources available. The real problem of defining objectives becomes apparent only when the above "principle" is applied to a particular proposal for a course of action to provide for some desire. Axioms which in the abstract can be agreed to by all concerned may split into two questions of conflict: "who is to benefit and in what amounts?" and "who is to pay and in what amounts?".

When the national and regional water planning is effective, the one-at-a-time project approach will need to be replaced by long-range plan of sequential development which will allow the greatest flexibility, provide for regional as well as localized growth where warranted, and yet provide water to all concerned at the lowest possible costs. Environmental preservation urges that long-range regional and national water policies and programs be developed. Population-growth rates and resource-utilizaion rates are such that important alternatives may be easily and irreversibly foreclosed by a piecemeal project-by-project type of water planning.

Presuming that long-range regional planning can and will resolve the inequities and diseconomies introduced by the "first in time, first in right" problem, substantial economies can be gained by making the most of sequential-investment alternatives. Failing this, regional and interregional

political competition will no doubt prevent these cost savings to be realized and something substantially less than optimal water resources development can be expected.

3. 5. 2 Organization

(1) NCWR/NTCWR

The highest water resources policy formulating body is the NCWR chaired by the Federal Minister of Water Resources and Rural Development, and its members include all of the State Government Commissioners responsible for water resources development as well as the representatives of other Federal agencies which are concerned directly and indirectly with water use. The NTCWR which makes the recommendation and provides the technical advice to the NCWR is chaired by the Director General, and its members include the Department Directors of FMWRRD, the Managing Directors/General Managers of RBDAs, NEPA and SWAs, the Directors of FIWD and FDMS, and the representatives of universities, academic societies and private consulting firms. The NTCWR has six specialist sub-committees. Since the management information system in Nigeria tends to be rudimentary, these types of arrangement are important.

It is suggested that the activities of NCWR/NTCWR will be more strengthened in all aspects including the FEPA, the FMWH, the FMOH and the NPC in compliance with the recommendations in the NWRMP, and the NTCWR sub-committees will be reorganized into seven including hydrology, water administration, dams, irrigation, water supply/sanitation, erosion/flood control and manpower, and their working parties will function more well to a greater extent to which the NCWR/NTCWR will influence the Nigeria's water resources policy. Another alternative would be to strengthen the function of existing National Council for Water Resources (NCWR) who could have the responsibility for reviewing and recommending changes in investments and management to promote the overall water resources strategy and achieve the consistency within each river basin. To coordinate the activities at the national level, the NCWR may have to belong to the National Planning Commission and have adequate authority to monitor and review the water activities and to enforce the consistency with the national strategies taking into account an

important principle in assigning responsibility that the policy, planning, and regulatory functions should be separated from the operational functions at each level of the Government.

(2) Departments, FMWRRD

The Water Resources Sector of FMWRRD in the apex Federal Government institution vested with the responsibility of water resources policy formulation and management consisting of three service Departments ((1) Planning, Research and Statistics, (2) Finance and Supplies, and (3) Personnel Management) and five operational Departments ((1) Hydrology and Hydrogeology, (2) Irrigation and Drainage, (3) Water Supply and Quality Control, (4) Dams and Reservoirs, and (5) Soil Erosion and Flood Control)

It should be properly understood in line with the promulgation of the Water Resources Decree in 1993 that major responsibility to be given to the Water Resources Sector of FMWRRD is to coordinate with the central authorization the development and management of both of the available surface and groundwater in a well-defined manner including various watershed management programs which are mostly undertaken by the outside agencies. Taking into account the future role and work load with a sense that enforcing the Decree is of a quite different matter from its promulgating, it is duly suggested to create newly a competent Department of Water Administration.

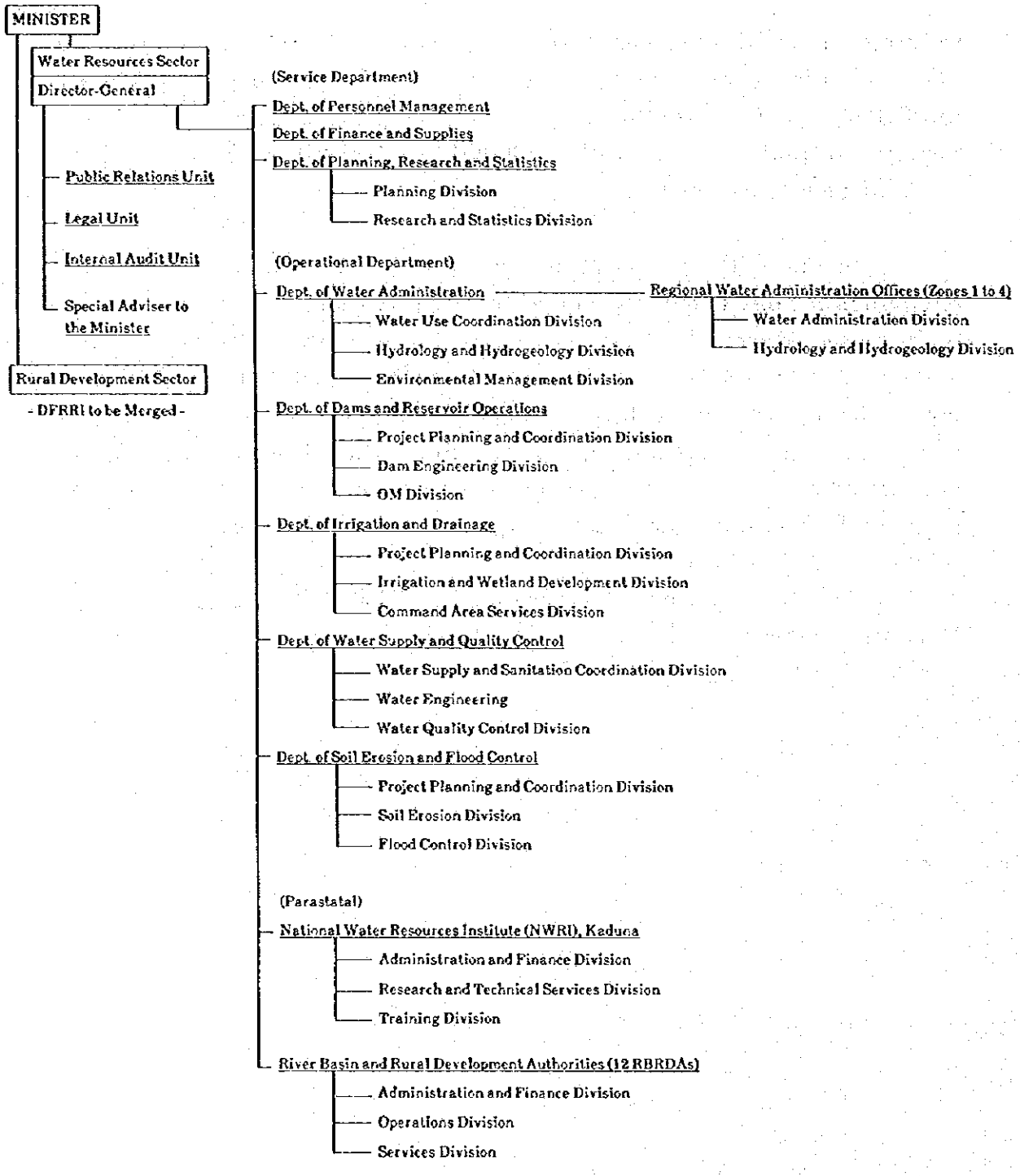
It may be considered that the Department of Water Administration should be positioned as a cornerstone of other operational Departments which is created in a form of enlarging and amalgamating the functions of existing Department of Hydrology and Hydrogeology that are not directly related to the public administration but to merely the technical-oriented. It is also suggested to provide this Department with three Divisions to be managed by Deputy Directors such as (1) Water Use Coordination, (2) Hydrology and Hydrogeology and (3) Environmental Management (EIA and watershed management).

Serious attention has been paid at the policy level to forge the strong collaborative links between various organizations involved in one way or another in the development of all aspects in the field of irrigation and water supply. The Department of Irrigation and Drainage should develop the strong

working links with the Department of Agriculture, FMANR in terms of the implementation of private irrigation schemes and of supporting services for the the RBDA's public irrigation projects, and also the Department of Water Supply and Quality Control with the FMOH and FMWH at Federal level and SWAs and EPCs at State level.

In line with the above-mentioned arrangement, it is proposed to strengthen the day-to-day regional water resources administration which will be increased in work load to a large extent with the establishment of four Regional Water Administration Offices to be managed at Deputy-Director level. The responsibility to be given would include (1) undertaking of regional water administration, including liaison with the State Government agencies, and (2) undertaking of hydrological and hydrogeological monitoring. With this proposal, 13 Area offices as presently organized will be abolished.

An organizational structure of the FMWRRD as proposed in the NWRMP is summarized below:



(3) Two Parastatals

(a) NWRI

The NWRI, Kaduna established in 1979 is a publicly owned and financed organization accountable to the Water Resources Sector, FMWRRD under the direct supervision of the Director General. Aside from public

administration to be positively implemented by the FMWRRD in line with the recommendations involved in the NWRMP, the NWRI will be substantially strengthened and upgraded as a main body for technical research and services with the full responsibility to operate the data collection/analysis/banking, hydrological observation/analytical study and training for design/OM of hydraulic structures.

In this respect, the main functions in existing Department of Hydrology and Hydrogeology will be transferred to the NWRI, and the present function of Water Resource Databank Centre, Abuja will also be shifted to the NWRI for more technical-oriented considerations while the Abuja Centre will be directed for the function of a water resources management information system needed for public administration. It is also stressed that more positive effort should be made to upgrade the water resources staff through in-service and on-the-job training. In order to achieve a proper implementation of the NWRMP, the FMWRRD should identify the skill gaps to be filled through such training in the NWRI and other local establishments.

(b) 12 RBDAs

The RBDAs, FGN parastatals under the FMWRRD were created in 1976 by the Decree, No. 25 to ensure that a nationwide systematic and consistent program of the water resources development is achieved. Over the years, 11 RBDAs have gone through some operational and structural changes to improve their relevance and efficiency as spelt out in the Decree, No..35 of 1986. In January 1994, an additional RBDA has been created in Ilorin with the concurrent reversion of RBDAs to their former designation of "River Basin and Rural Development Authorities".

It is clear from the ambitious aims specified for the RBDAs that they were looked upon the solution to the inefficiency of development planning of the Federal and State Ministries; however, each of the RBDAs have developed large and inefficient bureaucracies, and the perennial conflicts with the FGN and State Governments have made the RBDAs to achieve very little progress. It appears that the general performance of the RBDAs has been much mixed, few of which would be either financially or economically sound. Since the year 1988, the reform package program on Partial Commercialization of the RBDAs

to remedy several shortcomings is being in progress under the positive guidance of the TCPC.

In accordance with the decision to restrict the RBDA operations to the water resources development and subsequent OM, the following future directions have been delineated to carry out the field work to be incorporated under the NWRMP:

- The RBDAs will be responsible for developing multipurpose water storages and conveying raw water for the purpose of irrigation, water supply, hydropower, fisheries and others with the amount and timing as required by the downstream users at designated points with appropriate costing arrangement.
- Since the State Governments are not equipped with sufficient manpower to manage their water resources projects, all of the projects even for small-scaled should be carried out by the RBDAs after substantial upgrading of their engineering and management capability and in compliance with the consistent policy and guidelines under the FMWRRD.
- It would be difficult to evaluate how the programs of four RBDAs (A-I, B-O, C and ND) justify their existence as independent agencies, and there would be a strong case of reducing the number of RBDAs through amalgamation in the interests of both administrative and technical efficiency. In addition, the moves to achieve proper joint operations between the H-J RBDA and the CBRA would make significant positive changes to the currently imbalanced water situations within the Lake Chad Basin (HA-VIII).

3. 5. 3 Manpower

(1) National Manpower Inventory Survey

Because of no statistics on nationwide manpower of the water resources sector in the FMWRRD, a comprehensive manpower inventory survey has been carried out by the FMWRRD in 1993 by entrusting to Skoup & Co. Ltd, Enugu. This survey was designed by using the questionnaire to all the relevant public and private organizations numbered at 220, but only 119 sets of them were retrieved due to the lack of enthusiasm and the unwillingness for

cooperation. The survey has revealed that some 23,996 staff are presently available in the nationwide water resources sector, of which there are 2,133 or 8.9 percent in the senior-level engineering related disciplines, 2,727 senior technological/technical officers and 4,105 of other unclassified staff in senior technical cadre. And, the FMWRRD has the largest number of staff recording 2,351 out of a total of 23,996, and this is followed by Imo State with 1,762.

(2) Current Public Administration

It appears at a glance that the institutions in water resources sector typically suffer from serious shortages of skilled and experienced staff, an excessive number of untrained staff, overloaded services and facilities, inadequate wages and salaries, and a counterproductive policy environment. In particular, at the heart of the public administration performance lies the issues concerning the efficiency, competence and morale of civil servants. It is common in Nigeria to find the public service grossly overstaffed at junior level, while salaries and benefits at senior level are inadequate to attract, retain and motivate competent professional staff; as a matter of fact, real wages in the public sector have fallen over the last decade(s) with particularly the manager's salaries falling sharply compared with what the private sector pays.

(3) Improvement of the Public Administration

There would be the needs to improve these aspects of public administration including:

- Strengthening the personnel management by conducting diagnostic studies, by training the staff of the agency that has oversight responsibility for the civil service, and by reforming the rules and regulations.
- Reducing staff on the Government payroll by identifying the redundant workers and helping to retain and relocate them, and by designing the programs to control public employment.
- Selectively raising the civil service compensation when this is necessary to bring it more closely in line with that of competing positions in the private sector.

- Changing the organization and procedures of public agencies to improve efficiency, generate more timely and accurate information and make the agencies more responsive to their public.
- Improving the training programs for Government personnel.

It is stressed that deficiencies of the Government agencies in managing the investment programs frequently are an impediment on public sector activities, hence an important area in need of attention. Programs and activities to ensure the most economic use of public resources and improve the speed and efficiency with which the decisions are made should be sought to improve the decision-making process so as to curb inappropriate or excessive investment. To accomplish this, the programs should support better coordination between the NPC and other agencies concerned and a clear definition of the responsibility for evaluating and monitoring investment's being combined with the improvement in Government's ability to identify new investments and to set priorities among them.

It is hoped that the substantial change along these lines will be achieved by the FMWRRD during the earlier course of the NWRMP period with a possible reform that will proceed step by step through the introduction of such procedures as the painstaking in investment decision-making system after eliminating several factors as poor interministerial coordination and inadequate information on which to base decisions or guide actions have slowed progress.

Generally speaking, the managers and staff respond to work incentives as well as material incentives: to being given responsibility, to being judged fairly on their performance, and to working in a better institution. In that sense, staff development is circular as staff are highly motivated in part because their institution performs well. Nevertheless, the decision-makers can encourage positive trends by involving staff in designing tasks and organizational solutions and by instituting performance appraisal and promotion systems.

(4) Proposed National Water Resources Manpower Training Program

In conclusion, severe shortage of the trained manpower may be a major constraint of implementing the NWRMP in an appropriate manner. At this

stage, virtually all the work for feasibility study, design and construction supervision of the water projects are entrusted to the local or expatriate consultants. Because of an emphasis upon medium and small-sized projects as recommended in the NWRMP, effort should be made to train more skilled in-house manpower and to give enough incentives to keep them. Although a temporary solution may be to engage the local or expatriate consultants, the FMWRRD should arrange for intensive training of water resources staff to take over from them, as well as for long-term training of younger agency staff and university graduates. When the consultants are employed, an additional but important task for training the Government officials as counterparts to the consulting experts should be assigned to them.

The NWRMP has identified that the transfer and development of appropriate water resources and environmental technologies are a long and painstaking venture for proper implementation of the NWRMP by the FMWRRD which calls for the National Water Resources Manpower Training Program from external multinational or bilateral agencies to assist the NWRI in all aspects. This proposed Program should be, if possible, carried out during the early period of the NWRMP at least by 2000 in line with the strategic implementation schedule to be involved in the NWRMP layout. A major requirement is to initiate the necessary machinery in a manner with "action-learning" or "action-research" approach for training to translate or adapt the proven technologies in the donor or related countries to those appropriate for use in Nigeria. The proposed technical assistance program can be seen more as long-term institutional development and capacity building venture than as the traditional short-term intervention aimed at the strengthening of virtually non-existent capabilities in Nigeria, and this TA should also be self-perpetuating in that the water resources sector in Nigeria enables the recipient of the TA to develop its own capabilities.

The proposed TA Program would be mainly stationed at the NWRI, Kaduna for intensive group trainings with local stays at RBDAs and State Governments to break down the artificial barriers between training and work by giving the trainees practical problems to solve, review and discuss collegially. The Program may include such expertise as water administration, dam, irrigation, water supply, gully erosion and flood control, hydrology and hydrogeology, and part-time specialists to be led by a team leader and supported by a coordinator.

CHAPTER 4. NWRMP IMPLEMENTATION PROGRAM

4.1 IMPLEMENTATION STRATEGY

A long-range scenario of the National Water Resources Master Plan towards the year 2020 covering a total land area of 923,800 sq.km in Nigeria as established in the previous Chapter is discussed for implementing arrangements and procedures. Apart from adequate improvement of the water resources management in line with strict enforcement of the Water Resources Decree, No.101 of 1993, two specific strategies such as (1) proper operations and management of existing and on-going water resources projects and facilities and (2) appropriate implementation of the proposed medium-and small-sized water resources projects along tributary basins have been incorporated into proper layout of the proposed NWRMP in view of the past unfavorable water resources operations with the priority placed upon large-scale projects and inappropriate technology in relation to the project objectives or to local capabilities.

Taking into additional account the current FGN constraint on financial management that may be continued by the end of this century, the proposed implementation mode for the NWRMP has been delineated largely dividing into two: (1) the rehabilitation of existing projects and perfect completion of on-going development programs and the establishment of basic foundations for proposed projects, which should be executed during the first five-year period, say, within the National Water Master Action Plan toward the year 2000, and (2) the full implementation of proposed medium and small water resources development programs. In order to achieve this implementation strategy, a centre of the great attention has been focussed on the strengthening of the FMWRRD institutions concerned with planning, implementing and operating the projects including the training of Government managers and staff; to this end, the National Water Resources Manpower Training Program to be assisted by the external agency or institution has been suggested for implementation at the earliest practicable date.

In this Chapter, some relevant matters concerned with the NWRMP implementation program are examined including the requirements for costs, project economic considerations, funding issues, priority and model basins for

development, and the programs and projects for consideration by external agency, with particular emphasis upon those of the National Water Master Action Plan by the year 2000.

4. 2 FINANCIAL REQUIREMENTS

4. 2. 1 Capital and Recurrent Costs

(1) Water Resources Monitoring Program

(a) Climate and Surface Water

The proposed work includes the strengthening of gaging stations, provision of additional observation equipment and logistics, and continuous operations for observation. For the urgent action program towards 2000, a plan may put in workable conditions the strategic gages at BRCPs over major rivers, existing large water storages more than 50×10^6 cu.m and SHAs for the proposed water resources development.

(b) Groundwater

The installation of local groundwater monitoring system and subsequent surveillance work with respect to aquifer hydraulic parameters for deep wells and shallow-groundwater behaviors for private irrigation schemes over the wetlands have been incorporated in the NWRMP. For the action program towards 2000, the former includes the areas of Sokoto, Maiduguri, Nguru-Gashua, and Lagos, and the latter for the northern wetlands.

(c) Capital and Recurrent Costs

The direct costs for the above work being exclusive of those for administration to be incurred during the NWRMP period have been approximated at the price level of February 1994 and summarized on six Regional basis and at an interval of five years by 2020:

(unit: 10^6 Naira)

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VII	Total
1. Climate and Surface Water	125.6	129.0	171.8	200.8	195.8	250.9	1,073.9
Gaging Stations	52.6	53.7	70.7	73.1	77.7	74.3	402.1
Observation Equipment	14.3	15.7	21.5	29.0	23.7	46.6	50.8
Observation Work	58.7	59.6	79.6	98.7	94.4	130.0	521.0
2. Groundwater	29.7	59.9	15.2	14.6	28.7	22.6	170.7
For Deep Wells	13.0	31.5	-	-	17.7	11.9	74.1
Above Monitoring	4.4	7.4	-	-	7.1	2.9	21.8
For Shallow Wells	6.9	13.8	10.3	11.2	3.4	6.0	51.6
Above Monitoring	5.4	7.2	4.9	3.4	0.5	1.8	23.2
3. Total: (1. + 2.)	155.3	188.9	187.0	215.4	224.5	273.5	1,224.6

(unit: 10^6 Naira)

	1996~ 2000	2001~ 2005	2006~ 2010	2011~ 2015	2016~ 2020	Total
1. Climate and Surface Water	208.2	226.8	202.0	208.7	228.2	1,073.9
Gaging Stations	136.5	94.8	58.1	57.9	54.8	402.1
Observation Equipment	20.9	39.3	39.8	23.1	27.7	150.8
Observation Work	50.8	92.7	104.1	127.7	145.7	521.0
2. Groundwater	63.1	24.9	30.7	27.4	24.6	170.7
For Deep Wells	42.9	7.6	10.8	8.6	4.2	74.1
Above Monitoring	1.6	3.7	4.7	5.7	6.1	21.8
For Shallow Wells	17.2	10.3	10.3	6.9	6.9	51.6
Above Monitoring	1.4	3.3	4.9	6.2	7.4	23.2
3. Total: (1. + 2.)	271.3	251.7	232.7	236.1	252.8	1,244.6

(2) Water Source Works

(a) BMR Works

The BMR works for existing dams and reservoirs may be divided into two: (1) integrated water resources management programs for effective use of upstream storages and appropriate release to downstream needs in the Upper Hadejia and Upper Rima Basins, and (2) the establishment of proper reservoir operations rules and rehabilitation of dam structures for almost all of existing storages. All of these works will be completed by 2000.

(b) Proposed Multipurpose Dams

The pre-feasibility and feasibility study for each of nine Priority Basins tentatively selected and the environmental study for dam projects will be completed by 2000, and the subsequent implementation of small and medium projects with high priority will be commenced in the beginning of the 2000s. Following these model program, a series of the studies for other basins will be carried out. In principle, the construction of small and medium dams will take the lead, and after strengthening of the RBDA's in-house engineering capability, the large dams will enter into the implementation stage. It is anticipated that 40 small dams on force account basis and 10 to 15 medium and large dams on contract basis will be built each year during the NWRMP period on an average.

(c) Capital and Recurrent Costs

The direct capital costs as approximated at the 1994-February price level are summarized on six Regional basis and at an interval of five years during the NWRMP period. Since the multipurpose dams proposed have various service components, the related costs have been preliminarily allocated to irrigation, water supply and others including hydro and fisheries, and such costs are given to the following table of cost scheduling. The recurrent costs concerned are negligibly small as compared with the capital costs.

(unit: 10^6 Naira)

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VI	Total
1. BMR for Existing Dams	300	170	50	50	20	10	600
Integrated Water Resources Management	50	50	-	-	-	-	100
Rehabilitation	250	120	50	50	20	10	500
2. Construction for Proposed Multipurpose Dams	2,700	300	11,900	14,600	5,300	6,300	41,100
For Large/Medium	1,870	0	8,120	10,140	3,640	3,810	27,580
For Small	830	300	3,780	4,460	1,660	2,490	13,520
3. Total: (1. + 2.)	3,000	490	11,950	14,650	5,320	6,310	41,700

(unit: 10^6 Naira)

	1996~ 2000	2001~ 2005	2006~ 2010	2011~ 2015	2016~ 2020	Total
1.BMR for Existing Dams	600	-	-	-	-	600
2. Construction for Proposed Dams	200	7,300	9,400	10,900	13,300	41,100
Construction Works	-	6,500	8,500	10,000	12,300	37,300
Engineering & Compensation	200	800	900	900	1,000	3,800
3. Total: (1. + 2.)	800	7,300	9,400	10,900	13,300	41,700
Of Which Cost Allocated for Proposed Multipurpose Dams:						
Irrigation	150	5,340	6,840	7,950	9,720	30,000
Water Supply	40	1,600	2,050	2,390	2,920	9,000
Hydro/Fisheries	10	360	510	560	660	2,100

(3) Irrigation and Drainage

(a) Existing Public Schemes

While the BMR works for complete schemes are scheduled to finish by 2000, the development of all incomplete schemes amounting to 250×10^3 ha would be in a difficult situation for commissioning by 2000 particularly for large irrigation projects with the area of more than 50×10^3 ha which require a full-scaled feasibility study and appear to finish by 2005.

(b) Proposed Public Schemes

Almost all of these schemes belong to multipurpose dams newly proposed, and the planning and implementing procedures will be taken in parallel with those for the water source works. It is generally scheduled that the medium and small-sized schemes with the area less than 3×10^3 ha will be constructed for their systems during the period of 2000 to 2010, and other larger schemes after 2010. In this manner, annual development area for the proposed schemes would be at 40×10^3 ha per year throughout the country.

(c) Proposed Private Schemes

These schemes over the wetlands under the FMANR - State ADPs have been scheduled in such manner that those are always practiced being

ahead of the public scheme's implementation which will be carried out on a full-scale in 2005.

(d) Development Plan of Irrigable Area

In view of the above-mentioned implementing arrangement, the irrigable area will be developed year by year and summarized below:

(unit: 10^3 ha)

	1996~ 2000	2001~ 2005	2006~ 2010	2011~ 2015	2016~ 2020	Total
1. Public Schemes	220	100	180	220	260	1,120
1.1 Existing Schemes	220	100	-	-	-	320
- BMR Works	70	-	-	-	-	70
- Additional Development	150	100	-	-	-	250
1.2 Proposed Schemes	-	140	180	220	260	800
2. Private Schemes	250	150	150	100	100	750
2.1 Existing Plan	150	-	-	-	-	150
2.2 Proposed Plan	100	150	150	100	100	600

(e) Capital and Recurrent Costs

The direct capital costs have been approximated in such similar way as are explained in para. 4.2.1 (2) (c). The costs allocated from multipurpose dams to this sector have been added to the direct costs on the following table of cost scheduling. It may be noted that the annual OM costs for gravity system and primary pump system would generally take one percent and 1.5 percent for the capital costs at present value, respectively.

(unit: 10^6 Naira)

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VII	Total
1. Public Schemes	3,850	2,900	10,115	9,995	3,940	7,630	38,430
1.1 Existing Schemes	1,840	2,745	2,065	1,330	1,470	1,300	10,780
- BMR Works	48	162	72	72	18	18	420
- Additional Development	1,792	2,583	1,993	1,258	1,452	1,282	10,360
1.2 Proposed Schemes	2,010	155	8,050	8,665	2,470	6,300	27,650
- By Water Storages	1,860	155	7,750	8,215	2,170	4,650	24,800
- By Pumps and Creeks	150	0	300	450	300	1,650	2,850
2. Private Schemes	884	1,222	1,898	2,132	559	1,105	7,800
3. Total: (1. + 2.)	4,734	4,112	12,013	12,127	4,499	8,735	46,230

(unit: 10^6 Naira)

	1996~ 2000	2001~ 2005	2006~ 2010	2011~ 2015	2016~ 2020	Total
1. Public Schemes	7,780	7,580	6,450	7,690	8,930	38,430
1.1 Existing Schemes	7,680	3,100	-	-	-	10,780
- BMR Works	420	-	-	-	-	420
- Additional Development	7,260	3,100	-	-	-	10,360
1.2 Proposed Schemes	100	4,480	6,450	7,690	8,930	27,650
- Construction Works	-	4,080	5,890	7,020	8,150	25,140
- Engineering and Compensation	100	400	560	670	780	2,510
2. Private Schemes	1,300	1,950	1,950	1,300	1,300	7,800
3. Total: (1. + 2.)	9,080	9,530	8,400	8,990	10,230	46,230
4. Costs Allocated from Multipurpose Dams	150	5,340	6,840	7,950	9,720	30,000
5. Total: (3. + 4.)	9,230	14,870	15,240	16,940	19,950	76,230

(4) Water Supply and Sanitation

(a) BMR Works

It has been made clear under the NWRMP Study that the actual water supply capability in comparison with the designed capacity for existing schemes is quite low mostly due to poor maintenance, viz. 69 percent for surface water and 57 percent for groundwater on nationwide basis. The urgent BMR works to remedy these shortcomings should be implemented in a coordinated manner by 2000.

Attention has been paid to another BMR works for replacement of minor equipment during the operational stages including some parts for treatment plants once in 15 years and pumps for deep wells once in ten years.

(b) Proposed Water Supply Schemes

Reference is made to para. (3) of 3.2.4 where the water supply capacity proposed by 2020 is discussed. This capacity has been interpreted at the interval of five years during the NWRMP period, so that the proposed water supply schemes will be provided to meet the following capacity:

(unit: 10^3 cu.m)

	1996~ 2000	2001~ 2005	2006~ 2010	2011~ 2015	2016~ 2020	Total
1. Urban Water Supply	600	400	790	1,120	1,550	4,460
Surface Water	280	240	470	660	890	2,540
Groundwater	320	160	320	460	660	1,920
2. Rural Water Supply	410	180	240	330	430	1,590
Surface Water	10	0	0	10	10	30
Groundwater	400	180	240	320	420	1,560

(c) Reconstruction Schemes

It is common that the treatment plants and boreholes should be reconstructed after a certain period for operations due to their capacity deterioration from the economic point of view. This period has been taken at 30 years for the former case and 20 years for the latter after the initial construction of these facilities.

(d) Capital and Recurrent Costs

The direct capital costs have been estimated at a master plan level by applying the 1994 - February price level without taking into account any inflation factor. Such costs are summarized on six Regional level and at the interval of five years during the NWRMP period, in which the additional costs to be allocated from the construction of multipurpose dams are incorporated for the latter table. Annual OM costs which are not included in the above cost estimates and are financed by users due to Partial Commercialization policy would take 15 percent for surface water schemes and 5 to 25 percent for boreholes of the initial capital costs at present value.

Reference is made to para. (1) of 3.2.4 where the preliminary guidelines to provide a public sewerage system during the course of the NWRMP are introduced. It would be rather difficult to identify these public sewerage schemes due to the lack of detailed demographic statistics during the NWRMP Study; thus, the costs to be incurred for these schemes are not compiled.

(unit: 10^6 Naira)

	NW HA-I	NE HA-VII	CW HA-II	CE HA-III/IV	SW HA-VI	SE HA-V/VIII	Total
1. BMR Works	5,230	8,450	7,080	5,960	16,690	9,590	52,890
(1) Urban Water Supply Schemes	2,410	3,890	4,370	2,380	13,470	5,290	31,810
Surface Water	1,240	1,680	2,960	1,670	8,950	1,580	18,080
Groundwater	1,170	2,210	1,410	710	4,520	3,710	13,720
(2) Rural Water Supply Schemes	2,820	4,560	2,710	3,580	3,120	4,300	21,080
Surface Water	0	0	20	0	80	10	110
Groundwater	2,820	4,560	2,690	3,580	3,040	4,280	20,970
2. Proposed Schemes	15,800	27,180	26,880	25,020	71,400	43,550	209,830
(1) Urban Water Supply Schemes	6,630	11,740	16,800	11,710	60,280	27,950	135,110
Surface Water	2,870	6,080	12,900	8,020	43,310	6,690	79,870
Groundwater	3,760	5,660	3,900	3,690	16,970	21,260	55,240
(2) Rural Water Supply Schemes	9,170	15,440	10,080	13,310	11,120	15,600	74,720
Surface Water	0	0	130	0	460	40	630
Groundwater	9,170	15,440	9,950	13,310	10,660	15,560	74,090
3. Reconstruction Schemes of Water Supply Facilities	4,910	9,740	5,750	5,750	12,910	12,000	51,060
(1) Urban Water Supply Facilities	1,790	4,680	3,020	2,100	9,680	7,430	28,700
Surface Water	480	1,180	1,740	1,110	2,540	800	7,850
Groundwater	1,310	3,500	1,280	990	7,140	6,630	20,850
(2) Rural Water Supply Facilities	3,120	5,060	2,730	3,650	3,230	4,570	22,360
Surface Water	0	0	0	0	10	0	10
Groundwater	3,120	5,060	2,730	3,650	3,220	4,570	22,350
4. Total: (1. + 2. + 3.)	25,940	45,370	39,710	36,730	100,900	65,140	313,780

(unit: 10^6 Naira)

	1996~ 2000	2001~ 2005	2006~ 2010	2011~ 2015	2016~ 2020	Total
1. BMR Works	3,400	5,150	21,020	10,050	13,260	52,890
(1) Urban Water Supply Schemes	2,960	4,040	11,630	5,900	7,280	31,810
Surface Water	2,060	1,190	7,650	4,100	3,080	18,080
Groundwater	900	2,850	3,980	1,800	4,200	13,730
(2) Rural Water Supply Schemes	0	1,120	9,390	4,150	5,980	21,080
Surface Water	0	0	20	60	30	110
Groundwater	0	1,120	9,370	4,090	5,950	20,970
2. Proposed Schemes	37,380	20,450	35,130	49,050	67,820	209,830
(1) Urban Water Supply Schemes	18,020	12,000	23,740	33,870	47,480	135,110
Surface Water	8,920	7,340	14,750	20,840	28,020	79,870
Groundwater	9,100	4,600	8,990	13,030	19,460	55,240
(2) Rural Water Supply Schemes	19,360	8,450	11,390	15,180	20,340	74,720
Surface Water	140	70	100	130	180	620
Groundwater	19,220	8,380	11,290	15,050	20,160	74,100
3. Reconstruction schemes of Water Supply Facilities	0	0	3,430	15,160	32,460	51,060
(1) Urban Water Supply Facilities	0	0	2,550	12,900	13,240	28,700
Surface Water	0	0	0	4,900	2,950	7,850
Groundwater	0	0	2,550	8,000	10,290	20,850
(2) Rural Water Supply Facilities	0	0	880	2,260	19,220	22,360
Surface Water	0	0	0	10	0	10
Groundwater	0	0	880	2,250	19,220	22,350
4. Total: (1. + 2. + 3.)	40,780	25,610	69,580	74,260	113,540	313,780
5. Costs Allocated from Multipurpose Dams	40	1,600	2,050	2,390	2,920	9,000
6. total: (4. + 5.)	40,820	27,210	61,630	76,650	116,460	322,780

(5) Gully Erosion and Flood Control

Virtually, these items would be classified at the water-related disasters; therefore, it would be quite impossible to forecast the occurrence of future gully disasters which are largely man-made and of future flood disasters at spot level due to local scour and deposit on the rivers by the eroded sediments and partly being subject to urban planning. In the NWRMP Study, only the order-of-magnitude cost to be needed for restoration works for the 1,045 gullies as identified at this stage is approximated at 7.61×10^9 Naira with the following Regional breakdown:

(unit: 10^6 Naira)

NW	NE	CW	CE	SW	SE
HA-I	HA-VII	HA-II	HA-III/IV	HA-VI	HA-V/VI
6	87	35	621	687	6,171

It may be noted that the gullying inevitably increases with time in number and size so that the urgent restoration works which are not productive in the cost should be undertaken as quickly as possible. The financing for gully erosion and flood control measures will be made under the Federal Ecological Funds and State Government budgets, and the major restoration works in civil engineering mode will be better entrusted for planning, design and construction to RBDAs concerned, and the completed works will be promptly handed over to the State Governments concerned for maintenance.

4.2.2 Project Economic Justification

The potential projects and programs to be included in the NWRMP have been examined and evaluated in an integrated manner from the technical, economic, financial and environmental aspects with a particular emphasis upon smaller-scale and decentralized schemes with more participation of local people concerned. Needless to say, these schemes would be more successful in all aspects than larger schemes. This paragraph explains some of the economic considerations on representative projects for irrigation and drainage and water supply within the constraints of currently available database and time availability for the Study at a master plan level.

Aside from the BMR works and additional development for existing public irrigation schemes, newly proposed public irrigation projects have been designed to take the per ha cost on the premise that civil works construction would in principle be made on the basis of domestic contracting for medium-size and of force account by the RBDAs for small-scale, as shown below:

Region	With Storage		Pump & Creek	
	₦ × 10^3	US$	₦ × 10^3	US$
Central/North	73.9	3,360	61.0	2,780
South	72.3	3,290	61.0	2,780

The standard practice in terms of the economic rate of return (ERR) as is commonly employed by the World Bank has been applied by taking only the irrigated farming benefits with some of the shortcuts and simplifications to keep this evaluation process manageable. It has also been considered that while rice could compete with imports with marginal protection, a higher tariff would be needed to retain the viability of wheat production.

Region	Annual Cropping Intensity	ERR (%)
North	10% for rice and 140% for maize and vegetables	10 ±
Central	55% for rice and 125%for maize and vegetables	10 to 4
South	160% for rice and 20% for maize and vegetables	14>

These ERRs thus computed may be referred to the World Bank's general guide of 12 percent. It may be noted that a relatively small component of high value crops such as vegetables and fruits would sharply increase the ERR and farmers' profits while the integration of livestock and crop production would be another way to increase returns.

The past neglect on the investment in safe water and sanitary waste disposal may reflect in part the incorrect perception that the investment in this component is not a productive use of the resources, and this would have been reinforced by the practical difficulties of measuring the economic returns. An accurate method of carrying out a full-scale rate of return analysis is still evolving; in the absence, the economic returns on this type of projects are customarily measured by the consumers' willingness to pay as reflected by the prices charged for the public services. Because of the lack of data for measuring the increase in consumers' surplus under the project and also for valuing the

benefits related to lower morbidity and mortality from the improvements in health standards, the least-cost approach to issues of technical design on the waterworks has been applied taking into account the predetermined physical or cost standards for the services to be provided. The chargeable water rates per cu.m for the cases of (1) OM & replacement recovery and (2) full cost recovery have been computed. For the former, 2 to 3 Naira for surface water and 2 to 4.5 Naira for groundwater would be in an acceptable range until the users would attain a satisfactory level of the income to bear the water rate for the full cost recovery, viz. 5 ~ 8 Naira for surface water and 9 to 11 Naira for groundwater.

4. 2. 3 Sector Funding

This paragraph gives a brief discussion on the financing potential of the costs approximated for materialization of the NWRMP as compiled in previous para. 4.2.1. First of all, the recapitulation of the public sector costs for each component is made as follows:

(unit: 10^9 Naira)

	1996~ 2000	2001~ 2005	2206~ 2010	2011~ 2015	2016~ 2200	Total
1. Water Resources Monitoring	0.27	0.25	0.23	0.24	0.25	1.24
2. Multipurpose Dams	- costs allocated to service components -					
3. Irrigation and Drainage (excluding the costs for private schemes)	7.93	12.92	13.29	15.64	18.65	68.43
4. Water Supply (FMWRRD for coordination)	40.82	27.21	61.63	76.65	116.46	322.78
Total: (1. to 3.)	8.20	13.17	13.52	15.88	18.9	69.67
Total: (1. to 4.)	49.27	40.38	75.15	92.53	135.36	392.45

Note: At the 1994 February price level without any inflation factor.

As far as the FMWRRD budget is concerned, it has been rather in a difficult situation by the JICA Team to grasp its current situation because of complex budgetary system. Effort has been made to collect the available information, out of which the 1993 - 95 Rolling Plan as proposed by the FMWRRD has been employed to grasp the annual budget including the State budgets concerned and external loans, although it should be kept in mind that actual disbursement would be less than the budget. In order to estimate an average annual budget during the NWRMP period, an assumption has been made on the anticipated annual growth rate of FGN budget at three percent.

The anticipated annual budget during the NWRMP period, thus, computed is shown below in comparison with the average annual costs for the NWRMP, while reference is made to a detailed computation on the anticipated average annual budget in Chapter 2 of the Sector Report:

(unit: 10^6 Naira)

	NWRMP Average Annual Costs	Anticipated Annual Budget during NWRMP Period	A/B
	- A -	- B -	
1. Water Resources Monitoring	5.0	36.0	0.2
2. Irrigation and Drainage	2,737.2	2,653.0	1.0
3. Water Supply	12,911.2	4,167.0	3.1
Total: (1. + 2.)	2,742.2	2,689.0	1.1
Total: (1. + 2. + 3.)	15,653.4	6,856.0	2.3

It may be seen that apart from the costs both for water resources monitoring and irrigation and drainage, a huge budget would be needed for the water supply component to strengthen the nationwide service population rate of 31 percent at present to 80 percent in 2020. Under this situation, a sensitivity testing between various water supply targets and related capital costs required for the water supply component has been conducted as is detailed in Chapter 6 of the Sector Report. When the budgetary arrangement during the NWRMP period is kept at the present level without any extra expansion, it may be understood that the following conditions for water supply would be achieved at 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

It may be mentioned that as is observed in para. 1.2, the present FGN budgetary arrangement is in a critical situation with the large stock of external debt in spite of the huge reserves of petroleum and natural gas, and the need for further restraints on the FGN spending in connection with the economic reform

program including the SAP as well as subsequent application of the ESAF and so forth will be continued in the foreseeable future. Taking into account this circumstance, rather moderate outlook in the FGN budgetary situation including the resource inflow could be expected beyond 2000, and this perspective has corresponded to the specific strategies of NWRMP as are compiled in para. 3.1.2.

During the period of the Master Action Plan towards 2000, there may be the scope for the great involvement of World Bank and AfDB in assisting in the financing of existing public irrigation schemes for completion if the Banks' tests of viability is met through the feasibility studies. For the urban water supply and sanitation, the overall responsibility should continue to be that of the State Governments, and each State will have to reinstitute his budgetary and development priorities including manpower training if significant progress is to be made in this component. In this respect, the FMWRRD would continue to guarantee and coordinate the loans and grants on genuine basis and also to receive additional financial support for the States from external agencies where such financial requirements cannot be generated domestically. For the rural water supply, the current cost sharing mechanisms would continue to be adopted and strengthened to achieve the great target in the NWRMP. For reference, the present trend indicates that 20 percent of the program can be financed from external agencies, 35 percent by the FGN, 30 percent by States, 10 percent by LGs and 5 percent by the impact communities themselves.

4.3 NATIONAL WATER MASTER ACTION PLAN TOWARDS THE YEAR 2000

4.3.1 Scope of Work

(1) General Overview

The NWRMP Study towards 2020 after evaluating and assessing each of the identified water resources management and development options as explained previously has formulated a comprehensive, long-term plan which is outlined by the timeframe-specific (phased) water resources management options including development and conservation in line with the guidelines and criteria in various fields and best permits the well-balanced development and

sustainable growth of the water resources in Nigeria within the FGN's constraints for financial resource and their technical and management capability for implementation and OM.

In this sub-Chapter, the National Water Master Action Plan towards 2000, viz. during a five-year period of 1996 to 2000 is worked out in more implementable and operational mode comprising a series of the water resources management projects and programs with the most urgent priority within the NWRMP framework. Major components to be carried out during this period include (1) the accomplishment of proper operations and management of existing and on-going water resources projects and facilities, and (2) the preparation of water resources projects with an emphasis upon medium and small-size over the nine Priority Basins as specially designated in para. 4.3.2 to establish the solid foundation for successful implementation, in addition to the institutional building to enforce the Water Resources Decree, No.101 of 1993.

In view of severe shortage of the trained manpower in the FMWRRD and other water resources sector agencies that may be a major constraint of implementing the NWRMP in an appropriate manner, a special proposal has been incorporated into the Master Action Plan on the aspect of institutional development and manpower capacity building through the introduction of a technical assistance by external agency(s) "National Water Resources Manpower Training Program". This program executing body to be stationed at the NWRI, Kaduna being composed of some 15 expatriate experts for eight different fields over a five-year period is intended to assist the FMWRRD, NWRI, RBDAs and State Governments in training their in-house manpowers in order to achieve the aobve-mentioned objectives. Details of this program are explained in para. (3) of 3.5.3.

In addition to this program in general, particular considerations have been made to ensure satisfactory operations of the projects and programs to be involved in the National Water Master Action Plan. These include a series of the technical assistance programs by external agencies for five items with the dispatch of survey teams and a financial assistance program by external agencies for Dadin Kowa hydro scheme. The former includes (1) Water Resources Management Program in Upper Hadejia, (2) EIA Study and Environmental Monitoring Program, and (3) Preparation of Medium/Small Dams Package Program (one survey team for each of three Priority Basins).

(2) Project and Programs to be Involved

Aside from those of the water supply sector that will be undertaken in an extension line of existing situations during the period by 2000 in line with the strengthening of manpower and institutions under the proposed National Water Resources Manpower Training Program, the projects and programs concerned with the water resources monitoring, water source works and public irrigation schemes which should be directly managed by the FMWRRD in collaboration with other agencies are summarized below:

(a) Water Resources Monitoring Program

a. 1 Climate and Surface Water

These programs toward 2000 will be carried out at 23 BRCPs for major river management, 20 existing large dams with the storage capacity of more than 5×10^6 cu.m for proper reservoir operations and 20 SHAs with the priority to be developed by proposed dams for evaluation of potential surface water resources.

The monitoring programs consist of the following items:

- Installation of new gaging stations to observe rainfall and evaporation and to measure water level at rivers and reservoirs, including the reconstruction of existing deteriorated stations and the replacement of staff gages to automatic ones.
- Provision of the monitoring equipment such as vehicles, boats, current meters for discharge measurement, etc.
- Topographical survey for river profile and cross sections at each station.
- Continuous monitoring work for rainfall, evaporation, water level, and periodical measurement of water discharge, water quality and sediment discharge.
- Preparation of an accurate rating curve at each station based on frequent discharge measurement.
- Processing and storage of the monitored data as well as publication of the hydrological annual reports at the Databank Center, NWRI.

Particular attention should be paid to the followings:

- Transfer of the important river gages presently managed by the FIWD to the FMWRRD as BRCPs.
- Inventory survey for existing stations, site selection for new stations and provision of observation equipment by the proposed four Regional Water Administration Offices under the FMWRRD.

a. 2 Groundwater

Monitoring and surveillance programs of the aquifers for borehole development will be launched at four local areas covering Maiduguri, mid-Lake Chad Basin, Sokoto and Lagos which have probable problems such as lowering of water level, decreasing of withdrawal amount and/or water quality pollution due to overdrafting for water supply. In addition, the monitoring work for shallow groundwater to ensure the implementation of private irrigation schemes by the FMANR-State ADPs will cover the wetlands in the HAs-I and-VIII.

The number of monitoring wells proposed for the above work is as follows:

	Depth of Monitoring Wells	Lake Chad Basin	Sokoto-Rima Basin	Lagos Area	Total
Aquifers	100 ~ 150 m	23	10	5	38
Shallow Groundwater	10 ~ 15 m	80	40	-	120

Monitoring work for aquifers will be carried out by installing automatic water level meters while the work for shallow groundwater by periodical water level measurement, and all of the observation will be done by the Regional Water Administration Offices concerned for analysis by the NWRI.

(b) Water Source Works

These include implementation of the BMR works for existing storages and preparation of the proposed water resources development projects with new dams over nine Priority Basins.

b. 1 BMR Works for Existing Storages

- Formulation of Integrated Water Management Programs:

The integrated water management programs will be formulated over Upper Hadejia and Upper Rima basins in the North Region where many existing reservoirs are facing the difficulty to carry out the proper reservoir operations. The management programs will take the following components:

- Installation of the gaging stations at the river upstream of the reservoir to observe the inflow, in the reservoir to monitor the water level and downstream river to measure the discharge released from the reservoir.
- Installation of the shallow groundwater monitoring wells over the downstream wetlands to monitor water level fluctuation.
- Survey and review for the accurate data of existing reservoirs such as inflow, evaporation loss, reservoir dimensions, designed outflow, water allocated to the downstream wetlands, etc.
- Alternative reservoir operations study based on the above data taking into account the proper water allocation for downstream service areas and wetlands in order to establish an optimum reservoir operations rule.
- Reservoir operations practices in monitoring the reservoir inflow and controlling the outflow from reservoir, based on the optimum reservoir operations rule.
- Simultaneous monitoring work at gaging stations along the rivers for discharge to be released from the reservoir in order to verify water conveyance loss.

- Formulation of the integrated water management programs for all existing dams including reservoir operations rule, standard outflow criteria to downstream service areas and wetlands, river management to convey the reservoir outflow properly to the wetlands, etc.

- Rehabilitation Works:

Rehabilitation works for the existing dams will be implemented by classifying the works into the ordinary and particular:

The ordinary works include the following items to be implemented by the RBDAs on force account basis due to simple works:

- Measures against the small leakages through dam foundation and outlet structures.
- Measures against the scouring in downstream of spillway and outlet structures.
- Expansion of the overflow weir type spillway with insufficient flood release capacity.
- Removal of the dense vegetation and treatment of the gully so far developed on dam slope.
- OM road and facility including equipment.

These works will take the following procedures:

- Detailed inventory survey for each dam.
- Preparation of detailed design and construction plan.

Particular rehabilitation will be required for the Goronyo dam with severe leakage problem through dam foundation and for the Bakolori dam for the power intake chamber together with leakage problem. These rehabilitation works will be carefully surveyed and studied by expatriate expert and then implemented by domestic contractor.

b. 2 Hydropower Development at Dadin Kowa Dam

Reference is made to para. (1) of 3.2.6.

b. 3 Preparatory Work for Medium/Small Dams Package Programs in Multipurpose Nature

Reference is made to para. (3) of 3.2.2 and 4.3.2.

(c) Irrigation and Drainage

This sector is composed of the following:

- BMR workers for current irrigation systems covering the service area of 70×10^3 ha under public irrigation schemes.
- Development works for incomplete public irrigation schemes for the area of 250×10^3 ha.
- Preparatory work for proposed irrigation projects under the water storages covering nine Priority Basins.
- Implementation of private irrigation schemes by the FMANR - State ADPs.

c. 1 BMR Works for Complete Public Schemes

- Irrigation Water Management Programs:
  Proper irrigation water management programs will be formulated to deliver the irrigation water from the water sources to the WUA units and to use it effectively on farm level. The following water management procedures will be consolidated:

  - Water allocation and distribution plan for each irrigation zone, block and unit will be prepared by the OM office one or two months before irrigation season in accordance with the cropping pattern and irrigation schedule requested by the WUA.
  - Water distribution management along canal system and at regulators and farm turnouts so as to divert water to meet the irrigation schedule.

- Effective water use management such as control of night storages and rotational irrigation on farm level.

- Rehabilitation Works:
  The rehabilitation works for the following will be completed urgently to supply in more stable mode the irrigation water required for the WUA-managed areas and increase their agricultural productivity:

  - Canal systems with narrow section, siltation, disordered slope, broken turnouts, etc.
  - Defective and deteriorated pumping stations.
  - Improper on-farm works such as farm ditches and farm roads.

c. 2 Development of Incomplete Public Schemes

The following incomplete public schemes for the potential service area of 250×10^3 ha will be designed and constructed in order to expand the irrigable areas under the existing water sources.

- Small and Medium-Scale Irrigation Projects:
  Irrigation canal systems and pumping facilities under small and medium irrigation projects covering the potential area of 150×10^3 ha have been partially constructed, so that these will be completed within a short period by strengthening the implementing capability of RBDAs for design and construction and of State ADPs for irrigated agriculture.

- Large-Sccale Irrigation Projects:
  Large irrigation projects covering a total potential area of 100×10^3 ha will require the full-scale feasibility study prior to their implementation. These projects will be completed beyond 2000 taking into account rather long

period required for feasibility study, detailed design and construction works.

4.3.2 Priority Basins for Water Resources Development

(1) General Overview

The NWRMP has identified 260 potential sites for medium-sized dams and 820 sites for small dams to be built along the tributaries throughout Nigeria during the NWRMP period in line with the office work on the 1:50,000 FSN topographical maps along with short field visits to some potential sites; therefore, subsequent pre-feasibility study for site identification and full-scale feasibility study for preparation will be required for orderly implementation. When executing a series of these procedures, a basinwide approach is a pre-requisite to prepare an appropriate medium and small dams package program in order to verify well-balanced allocation of the water resources in a particular basin with the priority sub-project rating.

The first step to be taken for this long-range implementation program during the NWRMP period is to carry out a pilot study and preparation of the medium and small dams package programs for some basins where the fundamental technology for selection and planning of potential sub-projects should be developed as model. To select these model basins, the following criteria have been provided:

- Potential water resources : High in amount
- Existing water resources development : Few in number
- Potential medium and small dams proposed : More in number
- Population density : High
- Per capita farmland : High
- Irrigable area proposed : More in scope
- Increase of demand for water supply : High rate at 2020/1991
- Surface water withdrawal rate in 2020 : High
- Convenience for the management by RBDA and the demonstration effect for other basins in similar nature from the locational point of view : Favorable

- Access to the site : Easy
- 1:50,000 FSN Maps : Available
- Basin area size for the Study : Moderate

First, 17 basins were screened out, and with a principle of one basin per RBDA, the following nine model basins which are designated at "Priority Basins" have been identified:

No.	SHA	Basin	RBDA	Basin Area (10^3 sq.km)	Population 2020 (10^6)	Surface Water (10^9 cu.m)	No. of Proposed Dams	Proposed Irrigable Area (10^3 ha)	Water Supply Demand in 2020 (10^3 cu.m)
P.1	110	Danzaki	Sokoto-Rima	0.81	0.75	1.01	14	11	10
P.2	214	Gbako	Upper Niger	7.67	1.25	1.69	24	43	52
P.3	204	Awun	Lower Niger	7.15	1.45	1.07	29	30	118
P.4	301	Kilange	Upper Benue	9.45	1.18	1.43	27	16	6
P.5	4052 to 3	Lower Katsina-Ala	Lower Benue	8.55	1.68	12.80	37	19	17
P.6	504	Mamu	Anambra-Imo	4.27	5.66	0.73	23	8	50
P.7	6022 to 3	Upper Ogun	Ogun-Oshun	20.14	2.54	2.60	36	19	50
P.8	608	Osse	Benin-Owena	13.73	4.00	1.20	22	9	89
P.9	702	Aya	Cross	8.66	2.00	2.41	37	16	11

It is scheduled that all of the studies for nine Priority Basins will be carried out by the FMWRRD during the National Water Master Action Plan period by 2000 with the positive participation of SWAs for domestic water supply, the NEPA and State Rural Electricity Boards for mini-hydro, the Federal Department of Fisheries and State agencies concerned for fisheries, and others. In principle, all of these activities will be supported under the proposed National Water Resources Manpower Training Program to be assisted by the external agencies; however, in view of the work load under this Program, the study and preparation for three Priority Basins of P.3 (Awun), P.4 (Kilange) and P.9 (Aya) which are most representative from the locational point of view would be duly requested possibly to three external agencies for more elaboration. It is also recommended that in view of the past neglect in the environmental factors, a special technical assistance program by an external agency that is called at "EIA Study and Environmental Monitoring Program for Dam Projects" as is outlined in para. (3) of 3.2.2 is carried out to support the preparation of medium and small dams package programs.