FEDERAL REPUBLIC OF NIGERIA

DRAFT

RURAL WATER SUPPLY AND SANITATION SECTOR STRATEGY AND ACTION PLAN

prepared by

The Federal Ministry of Water Resources

with the assistance of

The UNDP/World Bank Water Supply and Sanitation Program

in association with

The Directorate of Food, Roads and Rural Infrastructures
The Federal Ministry of Health
UNICEF

JULY 1991

Preface

This document is the first draft of a National Sector Strategy and Action Plan for Rural Water Supply and Sanitation. The policies and implementation strategy proposed herein are based on current government directives concerning rural development and to a large extent reflect the thinking of sector professionals. It is an attempt to rationalize the institutional, financial and technical aspects of rural water supply and sanitation, and to provide a basis for increased financing in the sector. The report will be updated periodically in order to provide continuing guidance for sector development.

This document will be reviewed by relevant government agencies and discussed at a national workshop on rural water supply and sanitation. It is expected that many refinements will be made in the process and that this Sector Strategy and Action Plan will become a guide for all those involved in the sector.

Table of Contents

List of Acronyms

ADP	Agricultural Development Project
CIDA	Canadian International Development Agency
CUSO	Canadian University Services Overseas
DFRRI	Directorate of Food Roads Rural Infrastructures
ESA	External Support Agency
FACU	Federal Agricultural Coordinating Unit
FG	Federal Government
FGN	Federal Government of Nigeria
FMFED	Federal Ministry of Finance and Economic Development
FMOH	Federal Ministry of Health
FMWR	Federal Ministry of Water Resources
JICA	Japanese Development Agency
LG	Local Government
LGA	Local Government Area
NEPA	National Electric Power Authority
NWRI	National Water Resources Institute
NGO	Non-Governmental Organization
PHC	Primary Health Care
PVC	Polyvinyl chloride
RBDA	River Basin Development Authority
RWS	Rural Water Supply
RWS/S	Rural Water Supply and Sanitation
SWA	State Water Agency
SMOE	State Ministry of Education
SMOF	State Ministry of Finance
SMOH	State Ministry of Health
SMWR	State Ministry of Water Resources
TNC	Training Network Center for Low-cost Water Supply and Sanitation
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit Latrine
VLOM	Village Level Operation and Maintenance
WATSAN	Water and Sanitation Units
WB	World Bank
WHO	World Health Organization

I. SECTOR BACKGROUND

A. Rural Nigeria

1. Current estimates place Nigeria's population at 110 million,[1] and by the year 2005 it is expected to reach 165 million. About half of the country's population (55 million people) live in rural communities of less than 5,000. The main economic activities in rural areas are agriculture and livestock rearing, with about two-thirds of the population engaged in small holdings. Residents are usually willing to contribute money for community-based projects, but cash flows are often tied to harvests and may not be dependable throughout the year.

2. The infant mortality rate is about 105 per 1,000 live births, and is generally higher in rural (130 per 1,000 births) than urban areas. Malaria is the major cause of child mortality, and gastro-intestinal diseases rank second. An estimated 150,000 to 200,000 diarrhea-related deaths occur among children each year. Prevalence rates of guinea worm as high as 70 to 80% have been recorded in some areas, and an estimated 15 million people are reported to be at risk from the disease. In 1990 the Federal Government launched a nationwide campaign to eradicate the disease. Presence of guinea worm is a top criterion for selection of sites for water points, and the Federal Government has agreed to help those states that demonstrate their intention to fight the disease.

B. Government Decentralization Programme

3. The Governments's decentralization programme is designed to make LGAs more autonomous, more responsive to local needs, and technically and financially capable of providing services. The programme is intended to end dependency on the central government and "top down" planning. This is being achieved by giving the country's 453 LGAs primary responsibility for planning and administering their own development programmes, increasing their budget allocations, and requiring communities to take the lead in decision making and implementing development projects based on their particular needs. It is intended that the localization of development planning and decision-making in matters of most direct and immediate concern to the people will result in more relevant, better-focussed, and better-managed development. The community-owned and managed water and sanitation programme presented in this document, not only fits neatly into the FGN decentralization programme, but is also its logical culmination.

C. Water Resources

4. Nigeria can be divided geographically into five main regions: in the far south are low-lying swamp forests, followed in a northerly direction by generally flat dense rain forests, hilly shrub-lands in the middle belt, relatively flat savannah grasslands, and semi-arid areas in the far north. The central part of the country is marked by crystalline rock outcroppings and gently rolling hills. The average rainfall is about 500 mm/year in the north (occurring April through September), increasing to about 3,000 mm/year in the south (occurring March through October). Surface runoff is high in most parts of the country and increases turbidity of the rivers and streams during the rainy season.

5. The country is noted for its two major river systems: the Niger entering the country from the northwest and the Benue entering from the northeast which together with their many tributaries drain half the land area of the country; after meeting at Lokoja, they pass through an extensive delta before discharging into the Atlantic Ocean. Other rivers flow directly into the Ocean or into Lake Chad. Most perennial rivers are important sources of drinking and irrigation water. Many rivers in the

---

1 The last official census was conducted in 1963 and has remained the basis of official population projections.

north are intermittent, having water in them only in the rainy season, but the majority of the rivers in the south are perennial, flowing all year round.

6. About 60% of the country is underlain by crystalline rocks, 20% by consolidated sedimentary materials, and 20% unconsolidated sedimentary materials. Static water levels range between zero in the coastal alluvium to 200 meters in some sedimentary areas. In crystalline rock areas well yields are unpredictable; where sufficient depth of weathering exists the area may be suitable for handpump operation (minimum yield of 10 litres per minute), but only at specific localities where deep weathering and underlying fractures coincide are yields likely to be sufficient for motorized schemes.

7. Groundwater quality in the country is good. Only in some areas are iron, nitrate or fluoride concentrations above recommended WHO levels. The corrosiveness of groundwater is also an important consideration in choosing materials for water supply equipment. Using pH as an index of corrosion potential, about 20% of the country is underlain by highly corrosive groundwater (pH < 6.5), 40% by moderately corrosive groundwater (pH 6.5 to 6.8), and the remaining 40% by non-corrosive groundwater (pH > 6.8).

D. Water Supply and Sanitation

8. More than 75% of those living in rural communities, or roughly 45 million people, do not have access to safe water supplies or adequate sanitation. Many entities are involved in rural water supply, including: FMWR, DFRRI, FMOH, SWAs, ADPs, RBDAs, LGs, and external support agencies including UNICEF, UNDP, World Bank, JICA, CIDA/CUSO, and ZONTA International. These institutions employ their own implementation strategies and involve individual communities and LGAs to varying degrees. In most cases, however, services have been introduced with little or no community involvement. There is no single policy to coordinate and lend focus to the various efforts.

9. In recent times, DFRRI, through direct and substantial funding by the FG, has financed new RWS supply facilities, working through State DFRRI offices or other state RWS agencies. States which achieved their phase I targets (250 water points with financing of Naira 5 million or Naira 20,000 per water point) are eligible to participate in Phase II whose goal is the construction of an additional 10,000 water points nationwide with at least 250 in each state. State DFRRI has contracted out the construction of these water points, and in many cases states did not provide adequate counterpart funding or did not have adequate supervisory capacity to ensure high quality work. The trend in some states has been toward the installation of less costly facilities such as hand dug wells, even when they don't always provide a year round supply and later may not be accepted by DFRRI.

10. The ADPs and the FMOH/UNICEF Assisted Projects have constructed well designed boreholes, but like other projects have not established sustainable maintenance systems. Handpump maintenance for the most part is performed by specialized crews based either in state capitals or in zonal offices within the state and spare parts are provided free of charge. The private sector is not involved in repairing pumps through private mechanics or in supplying spare parts through local retailers. The decline in the value of the Naira and high inflation rates have sharply increased the cost of spare parts and vehicles necessary to transport maintenance teams to widely dispersed settlements; as a result, state agencies are not able to finance operation and maintenance costs, and about 40% of the pumps in the country are out of service at any one time. To resolve this problem, several UNICEF-assisted and ADP Projects as well as the UNDP assisted RUSAFIYA Project have begun to move toward maintenance by rural communities assisted by private mechanics. Others would prefer to immediately transfer maintenance to local government; as LGAs do not have the experience or capacity to do this, state RWS authorities should continue to maintain existing systems until individual communities, assisted by local government, are able to take responsibility.

11. Rural mechanized schemes are usually the responsibility of the State Water Agencies, which in the past have provided fuel, operators, watchmen and repair services, but which increasingly are relying on the beneficiary communities to supply these. Tariffs normally are not charged because the cost of revenue collection exceeds the revenues that can be collected and logistical problems associated with revenue collection are generally too great to try to overcome. Because these rural systems can not be operated on a commercial basis, water supply agencies minimize their financial losses by limiting their services.

E. National Primary Health Care Programme

12. To address the gap between provision of health care services in urban and rural areas, the government has made primary health care a national priority; and to ensure the delivery of services to often neglected rural areas, the government has shifted responsibility for primary health care to the LGAs through the creation of the National Primary Health Care (PHC) Programme. The programme, implemented under the guidance of the Federal and State Ministries of Health, was launched as a pilot project in one or two LGAs in each state in 1986, and is now active in nearly all LGAs throughout the country.

13. The PHC Programme focuses on EPI/ORT treatment, immunization against major infectious diseases and provision of essential drugs. The PHC Programme is also involved in training of Village-Based Workers in health and hygiene education, appropriate treatment of common diseases, and the prevention and control of endemic diseases. These outreach activities are limited due to resource constraints.

14. Funds for the PHC Programme are provided by the Federal Government through the Federal Ministry of Health. After an LGA's implementation plan is approved by a state-level committee, a lump sum grant (Naira 500,000) is released from the Federal Government to a central account at the state level. Disbursements from the account to individual LGAs are approved by a state-level committee (comprising LGA chairmen, local and state PHC coordinators, the State Commissioner of Health, and the State Coordinator of the PHC Programme) and made for each budgeted activity. In the future it is likely that Federal Government funds will be disbursed directly to LGAs.

Table 1 Population Projections and Water Supply Facility Requirements

State	Pop. Density	Population 1990 (millions)				Population 2005[1] (millions)				Pop. of Rural Communities (millions)			No. Needed[3]		No. Existing		Investment Required[6]			
		Total	Urban	Semi-Urban	Rural	Total	Urban	Semi-Urban	Rural	Small[2]	Medium	Large	HP[4]	Piped[5]	HP	Piped	HP (N)	Piped (N)	Total (N)	Total (US$)
Akwa Ibom	M	5.2	1.8	1.7	1.7	7.6	2.8	2.5	2.3	0.12	0.81	1.39	3,483	464	350	0	184	279	463	58
Anambra	H	7.4	3.3	2.6	1.5	10.7	5.2	3.7	2.0	0.06	0.54	1.39	2,185	464	266	0	113	278	392	49
Bauchi	L	5.0	1.3	1.5	2.3	7.2	1.9	2.2	3.0	0.30	1.21	1.51	6,060	505	1,815	0	264	303	567	71
Bendel	H	5.0	2.3	1.8	1.0	7.3	3.5	2.5	1.4	0.04	0.37	0.95	1,487	315	210	0	76	189	265	33
Benue	M	5.0	1.7	1.7	1.7	7.3	2.7	2.4	2.2	0.11	0.78	1.34	3,346	446	350	0	176	268	444	56
Borno	L	6.1	1.5	1.8	2.7	8.8	2.4	2.6	3.7	0.37	1.48	1.85	7,388	616	550	0	400	369	769	96
Cross R.	M	1.9	0.7	0.6	0.6	2.8	1.0	0.9	0.9	0.04	0.30	0.52	1,297	173	389	0	57	104	161	20
FCT	M	0.7	0.2	0.2	0.2	1.0	0.4	0.3	0.3	0.02	0.11	0.19	478	64	200	0	18	38	56	7
Gongola	M	5.3	1.8	1.8	1.8	7.7	2.8	2.5	2.4	0.12	0.83	1.42	3,551	473	1,585	0	130	284	414	52
Imo	H	7.6	3.4	2.7	1.5	11.0	5.3	3.8	2.0	0.06	0.55	1.43	2,246	476	650	0	99	286	385	48
Kaduna	L	3.4	0.8	1.0	1.6	4.9	1.3	1.5	2.1	0.21	0.62	1.03	4,104	342	1,033	0	188	205	393	49
Kano	L	11.9	3.0	3.6	5.4	17.3	4.6	5.2	7.2	0.72	2.89	3.61	14,436	1,203	2,650	0	707	722	1429	179
Katsina	L	6.0	1.3	1.5	2.3	7.3	2.0	2.2	3.0	0.30	1.22	1.52	6,089	507	1,377	0	296	304	591	74
Kwara	M	3.5	1.2	1.2	1.2	5.1	1.9	1.7	1.6	0.08	0.54	0.93	2,328	310	1,617	0	63	186	249	31
Lagos	H	3.0	1.3	1.0	0.6	4.3	2.1	1.5	0.8	0.02	0.22	0.68	880	187	0	0	51	112	163	20
Niger	L	2.5	0.6	0.7	1.1	3.6	1.0	1.1	1.5	0.15	0.60	0.74	2,960	248	508	0	148	149	297	37
Ogun	H	3.2	1.4	1.1	0.6	4.6	2.2	1.6	0.9	0.03	0.23	0.60	941	200	214	0	44	120	164	20
Ondo	H	5.6	2.5	2.0	1.1	8.2	4.0	2.9	1.5	0.05	0.41	1.06	1,669	354	150	0	89	212	302	38
Oyo	H	10.7	4.8	3.7	2.1	15.4	7.5	5.4	2.9	0.09	0.77	2.01	3,156	670	150	0	175	402	576	72
Plateau	M	4.2	1.4	1.4	1.4	6.0	2.2	2.0	1.9	0.09	0.65	1.11	2,776	370	570	0	133	222	355	44
Rivers	H	3.5	1.8	1.2	0.7	5.0	2.4	1.8	0.9	0.03	0.25	0.66	1,032	219	150	0	52	131	184	23
Sokoto	L	9.3	2.3	2.8	4.2	13.5	3.6	4.1	5.6	0.56	2.26	2.82	11,298	942	2,150	0	550	565	1115	139
Total		115	40	38	37	167	63	54	50	4	18	29	83,209	9,546	16,814	0	4,006	5,729	9,735	1,217
Percent			35	33	32		38	33	30	7	36	57					41	59		
Average/State		5.2	1.8	1.7	1.7	7.6	2.9	2.5	2.3	0.2	0.8	1.3	3,782	434	764	0	182	260	442	55

Year 1990 Pop. Density	Proportion of Population Low	Medium	High	Growth Rate
Urban	0.25	0.34	0.45	0.030
Semi-Urban	0.30	0.33	0.35	0.025
Rural	0.45	0.33	0.20	0.020
Small	0.10	0.05	0.03	
Medium	0.40	0.35	0.27	
Large	0.50	0.60	0.70	

(1) Population projections based on growth rates listed in table at left.
(2) Refer to the community sizes listed in the table below.
(3) Number of water points needed for full coverage of communities with greater than 150 people (95% coverage).
(4) The number of handpumps needed is based on an average of 300 persons per handpump for medium size communities and 150 persons per handpumps for small communities.
(5) The number of small piped systems is based on an average size of 3,000 persons per community.
(6) Costs based on Naira 200 per person for small piped systems, Naira 6000 for low-lift and Naira 12,000 high-lift handpumps, Naira 24,000 for hand-dug wells fitted with handpumps, and Naira 64,000 for new boreholes fitted with handpumps. It is assumed that all existing handpumps will require replacement in the next 10 years.

■ Small = Communities <300 persons ■ Medium = Communities 300-1500 ■ Large = Communities 1500-5000.

II. SECTOR STRATEGY

A. National RWS/S Programme

Objectives of the National RWS/S Programme

- To assist all rural communities to obtain basic water supply facilities, while ensuring that assistance is directed to communities that are prepared to maintain their facilities. Priority will be given to those rural communities that have populations over 150 and that are prepared to pay at least 10 percent of the capital cost in cash and kind and all of the operations and maintenance costs of their water supply facilities. Special consideration will also be given to communities where guinea worm is prevalent. Basic service means a protected, year-round supply of 30 liters per capita per day within 250 meters of the community and not exceeding 500 meters serving about 250 persons per outlet. Higher levels of service up to of 60 lpcd are encouraged, but communities must pay the added cost.

- To increase the capacity of local, state and federal government to assist communities to obtain basic water supply facilities that the communities themselves can maintain with private-sector support.

- To increase the capacity of the private sector at the state and local level to construct high quality hand-dug wells, boreholes and latrines and to repair water supply equipment.

- To supplement the National Primary Health Care Programme by promoting better health practices, focusing on clean water, good hygiene, diarrhea control and proper excreta disposal.

Definition of RWS

A water supply will be classified as rural if the population of the community is less than 5,000 persons, unless it is contiguous with an urban area and can be served by an urban water authority.

15. **In general, communities are classified as being rural, semi-urban or urban depending on** their size and level of infrastructure: urban communities have populations greater than 20,000 persons who live in contiguous built-up areas and usually have electricity, piped water, and tarred roads; semi-urban communities have populations between 5,000 and 20,000; and rural communities have populations of less than 5,000 which usually do not have all of these amenities. Similarly, a water supply will be classified as rural if the community has less than 5,000 residents, unless it is contiguous with an urban area and can be served by an urban water authority.

16. In line with the government's desire to have communities taking the lead in determining their development activities and it's stress on building a maintenance culture to ensure that infrastructure will be sustained, the National RWS/S Programme will pursue a strategy based on community management with government promoting improved services and the private sector supplying goods and services. Under this strategy (i) individual communities will make all decisions about their water supply and sanitation facilities (including the type of system, its layout and management) and assume responsibility for operating and maintaining it; (ii) LGA personnel will assist the communities to plan for their facilities and its management; (iii) state-level personnel will assist LGAs to establish RWS/S Units and provide training and technical support to them; and (iv) the private sector will provide most construction, operations and maintenance services. Specifically, the National RWS/S Programme will

assist those rural communities that are prepared to pay 10% of the construction cost of improved water supply facilities and to assume full responsibility for managing them, including operation, maintenance, and collection of revenues to cover recurrent and normal replacement costs.

17. Health can be improved and mortality rates reduced significantly through a combination of safe water supply and sanitation, good water use and hygiene practices, oral rehydration (in cases of dehydration due to diarrhea), and immunizations. The National RWS/S Programme will support the Ministry of Health's Primary Health Care Programme by carrying out well-defined health education activities in the course of its work with communities, focusing on personal hygiene, excreta disposal, and diarrhea control. The Ministry of Education could play a similar role through the country's primary and secondary school system. In addition, the National RWS/S Programme will establish and develop private-sector capacity to promote and construct a range of household and public latrines including the VIP latrine in rural areas.

18. If all communities participate, the National RWS/S Programme would require an investment of about Naira 8,500 million or Naira 565 million per year over a 15-year implementation period to provide 30 lpcd. This would require eventual replacement of the existing 17,000 handpumps, 65,000 new wells fitted with handpumps, and 9,000 small piped systems. The cost of water for those who require an improved supply is very high, and attainment of programme goals will require the active participation and financial resources of all agencies currently involved in the sector, as well as additional assistance from external sources. This Strategy and Action Plan is intended to provide a sound framework that will support existing programmes and promote external financing.

B. Institutional Arrangements

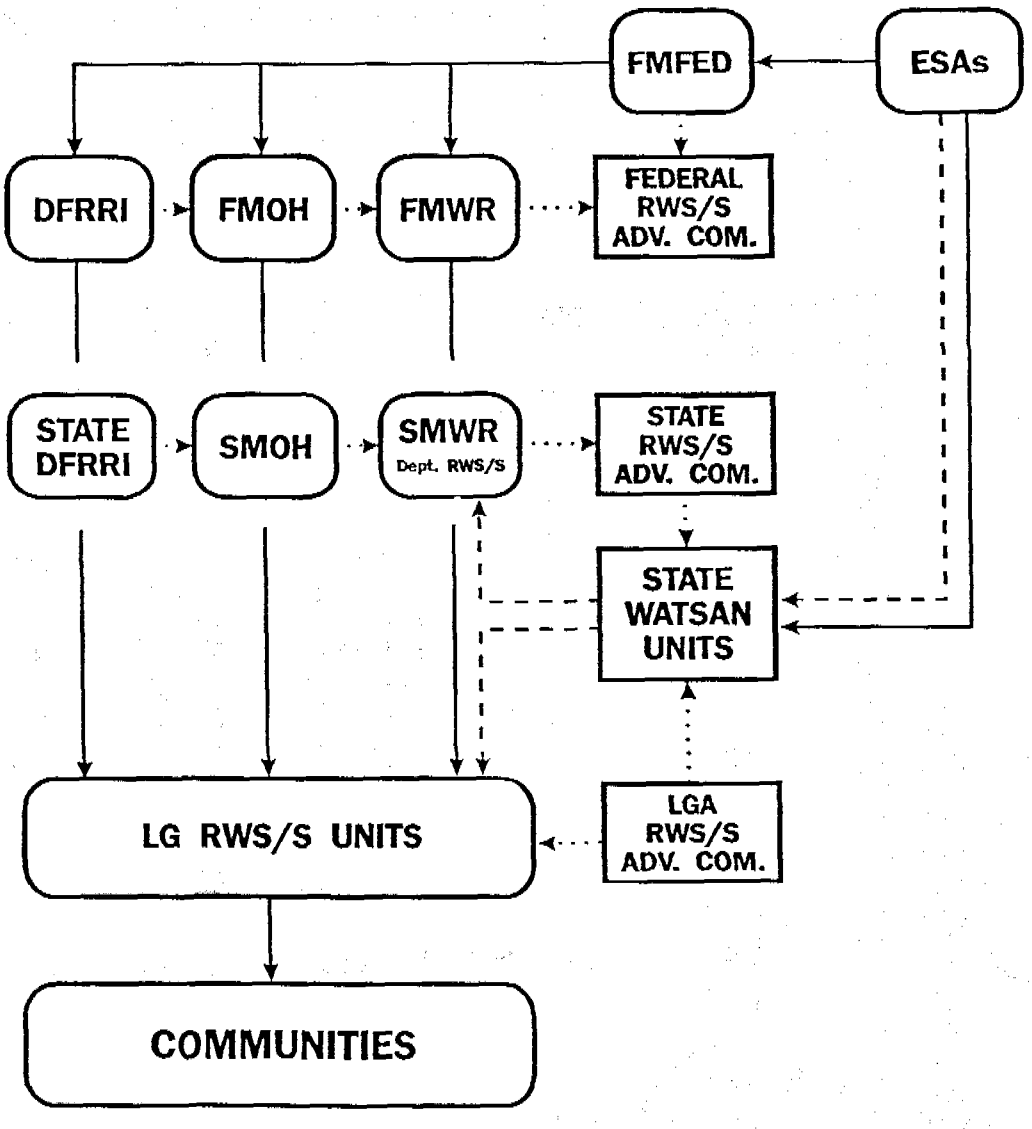
Community, Local, State and Federal Responsibilities

Components of the proposed National RWS/S Programme will be implemented at the community, local, state and federal levels, with each having clearly defined responsibilities. Over time it is expected that state level support for local government will decrease as local government personnel gain experience and their capacity to implement RWS/S programmes independently grows stronger. The main functions at each level will be as follows:

- Communities will plan, manage and maintain their water supplies.
- Local government RWS/S Units will assist communities to plan their water supply facilities, advise them on how to manage them, and promote improved health and sanitation. Those LGAs that have sufficient technical and institutional capacity, will also assume responsibility for issuing contracts for water supply facilities.
- At state level, State Ministries of RWS with Departments of RWS should be established to plan and monitor implementation of the National RWS/S Program in each state. State RWS/S Advisory Committees composed of all state agencies involved in rural water and sanitation should be established to advise on the development and implementation of the State RWS/S Program. And WATSAN Units (independent NGO/consultant groups of specialists in planning, community development, sanitation, RWS technologies, and hydrogeology) should be established to provide technical and training support to local governments to enable them to implement RWS/S activities in their areas and to ensure that they can assume full responsibility for RWS/S as soon as possible.
- At the national level the FMWR will plan and coordinate the National RWS/S Programme; mobilize national and international funding and support; monitor water resources and service coverage; prepare and update national policies, guidelines and technical specifications; and ensure that training is organized for state personnel. They will also provide technical, institutional, and promotional support to increase private-sector involvement.
- External support agencies will provide financial assistance to construct water supply and sanitation facilities and technical assistance to strengthen sector institutions at all levels. From the start reliance will be placed on national personnel, primarily through state WATSAN Units; external consultants with specialized skills will be used only for short term, specific activities. As LGA RWS/S Units become stronger this assistance will decrease.
- Training Network Centers at NWRI and UN Nsukka, specializing in water supply and sanitation for low-income groups, together with associated sector specialists, will develop and refine training methods and materials, train state and key LGA RWS/S personnel, strengthen RWS/S curricula at universities and polytechnics, and provide consultant services to state programmes.
- A National Water Well Drillers Association will be formed to support the local well drilling industry.

19. The following pages detail the ultimate responsibilities at each level. These are given to provide long term direction, as it is recognized that all levels must be strengthened if they are to successfully carry out their functions.

INSTITUTIONAL ARRANGEMENTS



Community Level

Community Responsibilities

- Request the LGA for a National RWS Construction Grant and planning assistance.
- Plan the design and management of its water supply and sanitation facilities with LGA assistance.
- Form a water committee or include its functions in an existing committee.
- Meet pre-project understandings (organizational and financial).
- Participate in health education training as part of project activities.
- Improve environmental sanitation, including construction of household and community latrines, if affordable.
- Meet construction commitments (e.g. site preparation and labor).
- Manage and maintain the water supply facilities, including operation, security, collection of operations and maintenance funds, and keeping records of accounts and decisions.
- Repair pump and equipment, or hire a private mechanic or firm to undertake the repairs.

20. **Village chiefs and elders, ward counselors, and influential individuals and groups are the key** decision makers in a community. Accordingly, they must be fully involved in all development activities from their inception. Extension agents should not interfere with the political or ethnic situation within communities; instead they should take them into account when advising the community on the design and management of their water supply system.

21. The acquisition of an improved water supply should start with a community requesting a RWS grant through its LGA. If a grant is approved, the community (assisted by LGA extension staff and state WATSAN advisors) must choose the type of system that it wants and how to manage its operation, maintenance, and revenue collection. From the earliest stage, the community must clearly understand the financial and organizational implications of managing, operating and maintaining its water supply, including the collection of revenues. Where practicable, a Memorandum of Understanding should be agreed upon to ensure that the responsibilities of each party are clear. In this process, a water committee should be formed, a special bank account set up under the exclusive control of the community with the community's share of the capital cost deposited in the account, and other pre-project obligations met. When the government-financed portion of the works is complete, the community should purchase those components that it previously agreed to contribute. An integral part of this programme is health education and improvement of environmental sanitation, which are necessary if the full benefits of improved water supplies are to be realized. During discussions with the community, extension agents will pay particular attention to delivery of health messages related to personal hygiene, water use practices, diarrhea control, excreta disposal and environmental sanitation. Communities should be required to actively participate in health education discussions and to take concrete actions to improve environmental sanitation as a condition for continuing LGA assistance in improving their water supply.

22. **Once a community has been awarded a grant or wishes to proceed on its own, the LGA will** assist the community to plan its facilities and to develop on effective management system. A key feature of this is the formation of a Water and Sanitation Committee, or in cases where an appropriate association already exists, adding the functions of the committee to the association. The

committee's main functions would be to: ▪ organize meetings, training sessions, and communal works, ▪ ensure proper use of facilities, ▪ arrange for operators, ▪ arrange for security, ▪ collect revenues, ▪ arrange repairs, and ▪ keep records of accounts and management decisions. Wherever women are responsible for ensuring that their homes are supplied with water, they should be involved in any decisions concerning the management of the community's water supply facilities; in such situations it is essential that women are well represented on the Water Committee and are able to repair their water supply equipment.

23. In addition to the Water and Sanitation Committee, it may also be useful to establish an advisory committee within the community, or to form a water and sanitation subcommittee within the Community Development Association. The composition of the committee will vary from community to community, but a working checklist of possible members include: the district and/or village head (as patron or chairman), the councillor for the ward (for effective political liaison with the LGA), representatives/heads of various religious groups/organizations, resident civil servants (especially teachers and health officials), sons and daughters of the community who reside in other communities but who play key roles in community development and are major donors to their home communities, leaders of various groups and organizations (e.g. youth, political parties, farmers' unions, trade associations), traditional healers, and, most importantly, women, if they are responsible for supplying water to the home.

24. The selection of communities that are to receive water supply grants is a sensitive issue and one which requires a defined and transparent procedures. Because so little is known about rural water supplies, preliminary community surveying is required. It is recommended that this be kept simple and done quickly though a "rapid reconnaissance" technique and that LGA RWS/S staff do this under the direction of state WATSAN personnel. This acquaints them with the water supply situation in each community in their LGA, and with a preliminary assessment of the importance that each community places on an improved water supply. The survey team should gain an overall impression of the physical environment and socio-cultural make-up of a community with an emphasis on water resources.

25. All community contacts should be kept as informal as possible, paying attention to normal courtesy and decorum, with information gathered by observation with limited questioning. The survey team should include an extension agent who is known by the communities, so that introductions can be kept simple, and should be multidisciplinary, so that engineering/geology/works staff learn about the ethnic mix and settlement pattern while the community development/health staff learn to appreciate the hydrogeological conditions of the area. Important outputs of the community survey should include a report including the details of the survey and a map of the LGA (1:50,000 or 1:100,000); and a list of all the communities according to the population grouping (<150, 150-1500 and >1500). The following information should be collected and used to prioritize communities on the basis of need: ▪ name of community, ▪ name of district, ▪ population, ▪ community type (scattered, nucleated), ▪ guinea worm (extent), ▪ main water source: type, distance to it, and water quality (dry season and wet season), ▪ geology, ▪ hand dug wells (presence and suitability for upgrading), ▪ possible new water supply installations, ▪ indications of need, and ▪ location map.

26. At any time a community may submit a request for a construction grant to its LGA. As funds become available individual communities will be informed that they have become eligible to receive a grant. At that time LGA RWS/S personnel will discuss technical options with them and the community will be requested to collect and put aside funds covering at least 10% of the expected cost of a basic service as well as the marginal cost of higher levels of service. Some LGA's may choose to give higher priority to communities that are prepared to pay part of the LGA's 15% share (para 51).

Community Management: Principles and Rationale

In recent years many countries in the region have attempted to provide operation and maintenance services for rural water supplies. In all cases these efforts have failed because of the difficulty of collecting water rates from dispersed rural communities and the overwhelming financial and logistical problems associated with purchasing spare parts and maintaining vehicles. However, whereever it has been tried, individual communities have proved quite capable of maintaining their water supply facilities, provided they can purchase spare parts locally and can get assistance from trained private mechanics for difficult repairs. Community management is also more equitable, as scarce or dwindling government resources can be used to construct new systems rather than to maintain existing ones.

To ensure that all communities obtain water supply facilities that will provide many years of reliable service, a policy of community-based operation and maintenance is essential. This shift to community management, however, is premised on government assurance that reasonably priced spare parts will be available at local retail outlets throughout the country, that handpumps and small motorized systems are of a type that can be repaired by local communities and private mechanics, and that community members and local private mechanics will be trained to operate and maintain the facilities.

Community management and the ownership of water supply facilities must go together, for all too often systems fall into disrepair because communities are reticent to repair government-owned facilities or sometimes are totally disinterested. To ensure community ownership, communities should make all decisions regarding the design of their facilities (including the type of system and its layout) and its management (including operations, maintenance, and revenue collection). The community must also fully understand and agree to pay its share of the capital costs and operation and maintenance costs. In addition to giving communities ownership, cost sharing better ensures that the sector will become demand driven, with the result that government subsidies are directed to communities who most want improved services and who value those services sufficiently to maintain them. This policy is consistent with government efforts to make communities partners in development, with each community determining its development projects and paying part of the capital cost, and is similar to cost sharing for other infrastructure such as electricity and telephone services. Cost sharing should be transparent, with communities being responsible for procuring an identifiable component, rather than contributing to a construction fund. For point sources communities should purchase their handpump or at least pay a major portion of the cost. The advantages of this are that (1) a market will be created that can support local handpump manufacture, (2) pumps will be selected on the basis of cost, performance, and availability rather than on criteria imposed by funding agencies, and a (3) precedent will be set for later replacing major pump components. For piped systems, communities would best profit from paying for the piped distribution network, as this involves them directly in planning the level of service they can afford and prepares them for expanding services later. Also, communities can provide the labor for digging trenches.

Women are significant contributors to the economy and to development. They are involved in the production of local food crops through subsistence farming and in the production of cash crops, including their processing and marketing, and they are responsible for a major part of the trade in consumer goods. They also run the home; ensure it is supplied with adequate water for drinking and domestic use and firewood for cooking; and are responsible for clothing, feeding, nurturing, and keeping their children healthy. The lack of basic domestic facilities for supplying reliable sources of water and the safe disposal of human waste have put a great strain on women. Very often they must spend much time and effort on collecting water and firewood and caring for their sick children. Because of their lead role in household management, any decisions and activities concerning the installation and maintenance of water supply and waste disposal facilities should have extensive input from women, and wherever culturally appropriate women in the community should be able to repair their water supply equipment.

Process of Establishing Community Management

It is recommended that LGA RWS/S extension teams work in pairs of men and women so that they can effectively communicate with all members of the community. Each team should be able to assist about 15 communities per year to plan their water supply system and to train communities to manage them. To provide adequate time for the community to plan its water supply system and to meet its financial obligations, as well as to provide time for geophysical surveys and design work, it is recommended that local LGA extension teams begin work with communities about 18 months in advance of construction. During this period attention should be paid to keeping the community's interest, through discussions about the design of their new system, activities to improve their existing source, and health and environmental sanitation planning.

In most cases the demand for improved facilities will exceed government financial resources. Consequently, participating LGAs should establish a construction grants list based on predetermined criteria (para 25). The support phases are based on a community's position in the LGA grants list. Initial activities are related to the establishment and maintenance of a grants list. More active involvement in a community begins when a community receives provisional approval (i.e. is eligible for a grant provided it sets aside funds sufficient to meet its financial contribution). Once its financial commitments are met the community will receive final grant approval, at which time detailed planning activities can commence and construction can be arranged.

It is recommended that LGA extension staff undertake the following series of activities.

Maintenance of a Grants List

- Collect and review maps of the LGA.
- Conduct rapid reconnaissance survey of LGA.
- Familiarize themselves with those communities that have a high priority rating by meeting with leaders, groups, and individuals. Discuss the community's overall needs, including water and sanitation, and assess their interest in an improved water supply.
- Familiarize the community with what they must do to obtain a RWS grant, including their financial contribution and management responsibilities, and, if they choose, assist them to make a formal request to the LGC.
- Maintain a grants list based on pre-determined criteria so that communities will know when they are likely to be eligible for assistance and can plan accordingly.

Activities following Provisional Grant Approval

- Discuss water supply options and costs, and agree on the amount of money that community must set aside prior to receiving a grant. The amount that a community ultimately will have to pay will be determined when the detailed design of their facility is completed.

Activities following Final Grant Approval

- Assist community to establish a water and sanitation committee or add water supply management responsibilities to an existing committee. Advise the community of the required skills of the secretary, treasurer, mechanics, and village health workers and train them. Women should be encouraged to hold responsible positions, such as treasurers and mechanics. The final decision must be left to the community.
- Assist the community to plan its water supply system, including technology selection; system layout; and management of operation, maintenance, and revenue collection. This should not proceed until after a water and sanitation committee has been established.
- Promote household latrines and construct demonstration models at schools or clinics.
- Present health messages and train village health workers.
- Ensure that the community, geophysical survey team, and hydrogeologist coordinate well siting. The extension agent should discuss well siting with the community before the geophysical investigation and should be present in the community when the geophysical work is done.
- Liaise between contractors and the community during construction.
- Provide follow-up training and support to the community.

LGA RWS/S Unit Responsibilities

Administration

- Day to day coordination and supervision of activities.
- Liaise with State WATSAN RWS/S Unit and State Department of RWS.
- Supervise community development, health and technical personnel assigned to the unit.
- Coordinate community work with well siting and construction, including improvement of existing systems.
- Prepare and manage contracts for water supply facilities with assistance of State WATSAN Units.
- Budgeting and financial management of the Unit.
- Prepare annual workplan and budget for RWS and update priority listings for new facilities to be adopted by the council.
- Prepare monthly and annual progress reports for LG chairman, secretary and council.
- Monitor progress of LGA RWS/S Program.
- Keep records of service coverage.
- Prepare information/publicity programs.

Water Supply

- Provide information to communities on technology choice and design and assist them to resolve technical problems.
- Train private mechanics.
- Coordinate training of hand dug well and latrine contractors.
- Inspect construction of hand dug wells, keeping well logs.
- Liaise with state hydrogeology personnel.

Sanitation

- Identify and train local latrine artisans.
- Supervise construction of demonstration latrines.
- Keep record of demonstration latrines and monitor coverage.

Community Mobilization and Health Education

- Assist community with needs assessment.
- Assist with formation of water and sanitation committees.
- Assist community to plan its water supply and santation failities.
- Train water committees.
- Promote good health practices and latrines.
- Provide continuing support to communities.

27. **There are a number of advantages to LGAs being responsible for rural water supply and** sanitation. First, their close physical and political proximity to the people ensures better and faster response to community needs, in large part because communities know the responsible LG personnel and communications and transport problems are not as acute at the local level. There is also the historically justifiable worry that if the state governments are responsible for rural water supply, funds will be diverted to the small to medium sized towns (5,000 to 25,000) for which the state is responsible, leaving the rural settlements no better off.

28. Several recent developments are helping LGAs to assume their increasing responsibilities: (i) the Federal Government Rural Development Policy update is expected to provide a major capital

injection into the water supply sector; (ii) the recently implemented Scheme of Service of Local Government Staff will allow LGAs to attract and keep qualified staff at all levels and in all areas of specialization; and (iii) direct LGA funding is increasing (the LGA share of the Federation Account has been raised from 10% to 15%).

29. While the numbers and level of proficiency may vary from LGA to LGA, a RWS/S Unit must be formed and staff must be in place as evidence of the LG's absorptive capacity and intent to support the programme. RWS/S Units will be responsible for assisting communities with a needs assessment and in planning their water supply systems; they will also help communities to form and train the water committees, promote good health practices and, after the systems have been built, provide ongoing support. In addition, they should provide information on technology choice and design, and coordinate the training of private area mechanics and local contractors for hand-dug wells and latrines. LGA RWS/S Units should prepare annual RWS/S work plans and budgets to be incorporated in the LGAs' annual budget. They should also be responsible for the planning and implementing a local latrine promotion programme, including the training of local artisans/contractors to promote and construct latrines.

30. There are three major areas into which the work may be divided: (i) community development including health and hygiene education; (ii) hand dug well and latrine construction; and (iii) the design and contract management of machine drilled boreholes and small piped systems. It is advisable that the LGAs concentrate on the first two, and that State WATSAN Units undertake the third. This division of responsibility is based on the required level of training and experience required to site boreholes, to prepare designs and bidding documents, to effectively inspect construction of machine drilled boreholes and small pipe systems, to achieve cost savings by letting larger contracts for works in more than one LG at a time, and to minimize the logistics of construction inspection by working with fewer contractors at any one time. Also, the number of boreholes (about 15 per year) and small piped systems (2 per year) that are envisioned to be constructed in an LGA does not warrant a full time hydrogeologist and support crew and design engineers in an LGA. It is more effective to have 3 or 4 hydrogeologists and one or two design engineers in the State RWS/S Unit. Whether or not the LGA lets construction contracts, State WATSAN Units should prepare the technical specifications of all RWS facilities and package them for contracts.

31. The provision of water supply and sanitation in rural communities spans three separate but inter-related areas: community development, works and health. It is recommended that participating LGAs consider the importance of water supply and sanitation compared to other LGA services like agriculture, health and education; then decide how to best organize themselves to deliver RWS/S support services to their communities. Having a Department of RWS/S would elevate it to a level commensurate with the felt needs of many rural communities who consider water, health services and education to be their top three development priorities. A department would also sidestep inter-department politics that arise if a multi-facetted programme is placed in one of its related departments. If an LGA already has the maximum number of departments allowed, it could be reorganized along the lines of the LGA's declared priorities - by combining other portfolios. Alternatively, it could transfer the functions required for water and sanitation to a division within the administration department. This would place the unit under the senior civil service officer in the LGA and minimize inter-department conflicts. The Local Government Service Commission in cooperation with the Department of Local Government should address this issue on a state by state basis.

32. As an independent department with career prospects (under the new service scheme that emphasizes professional departments) there will be departmental discipline, reliability, and effective coordination of the assembled skills. Problems of divided loyalty, lack of commitment or enthusiasm, and inability to focus on tasks at hand will abate. It must be emphasized that much depends on the head of department's management ability, and his/her relationship with the secretary, chairman and

council. In any case, the department should be made up of existing staff possessing relevant skills, without crippling their former departments, supplemented by newly recruited staff.

33. The speed with which the above programme can be put in place and the LGa can take increasing responsibility for implementation will vary from state to state and less so from LGA to LGA within a state -- the major parameters being LGA staff strength (number and capability), the quality of the labour pool locally available, and the political support at the state and local levels. The two tier arrangement in which the LGA's are developed as the lead agent for RWS/S with the State WATSAN Unit providing technical and training support (until the LGAs can stand on their own) will conserve and efficiently utilize resources and build donor and lender confidence to attract capital.

34. A broad based RWS/S steering committee at LGA level (involving the LGA chairman and heads of relevant departments, state RWS/S personnel, LGA counsellors, traditional rulers, retired public officers, and women's groups who are involved in water and sanitation) will enhance general support for the RWS/S programme.

State Level

35. At the state level a State Department of RWS should be established to oversee implementation of the State RWS/S Programme. The Department would be responsible for planning and monitoring, resource mobilization, coordination with other agencies within the state, and ensuring that the LGAs are adequately supported. They will be assisted in this by a State WATSAN Unit that will be contracted to provide training and technical assistance to LGA RWS/S Units. Specific plans should be made to transfer as much responsibility as possible to LGAs as quickly as possible. However, state government will be expected to continue to make substantial financial contributions and to provide effective coordination within the state.

36. The State WATSAN Unit would be a consultant/NGO group with support links to ESAs and staffed with specialists in training, community mobilization, sanitation, hydrogeology, RWS technologies, and administration. The unit would be contracted to prepare the State RWS/S Plan, to help all the LGAs in the state to establish RWS/S Units, and to provide ongoing training and technical support to them. The Units would also be responsible for supervising well siting and construction, training local contractors to construct hand-dug and hand-drilled wells, and preparing technical specifications for all RWS facilities, and where appropriate, letting contracts for water supply facilities.

37. In determining the institution in which the State RWS/S Unit should be located, a number of issues and factors must be taken into consideration:

- The unit should be included in the annual state budget and should be self-accounting. Its manager should have no more than one other officer between him/her and the state chief executive.

- The organization should be solely responsible for RWS and should be independent of ministries/agencies that have more general responsibilities in rural areas (such as health, community development and agriculture), but should be advised by an inter-agency committee to ensure complementary policies and activities.

- Urban water supply agencies are commercial enterprises who give priority to urban areas where advocacy groups are stronger and greater revenues can be generated; whereas rural water supply agencies must focus on mobilizing and strengthening communities and the private sector to operate and maintain facilities. The differences in technologies, community involvement, cost recovery, and personnel skills and management approaches necessitate that urban and rural water supply programmes be implemented by different agencies.

State Department of RWS/S Responsibilities

Planning, Monitoring, and Evaluation

- Mobilize financial resources.
- Plan and supervise the State RWS/S Program, preparing annual program and budget.
- Coordinate with local, state, and federal authorities.
- Supervise contract with WATSAN Units.
- Keep an inventory of facilities and monitor their operational status.
- Track program activities and progress.
- License pump mechanics.
- Pre-qualify contractors of hand dug wells and machine drilled boreholes.

State WATSAN Unit Responsibilities

Administration and Finance

- Personnel management and budgeting.
- Accounting and disbursal.
- Contract administration.

Planning, Monitoring, and Evaluation

- Assist LGAs to prepare annual workplans.
- Keep an inventory of facilities and monitor their operational status.
- Track program activities and progress.
- Training of pump mechanics.

Community Mobilization and Health Education

- Assist LGAs to establish RWS/S Units.
- Train and provide professional support to LGA RWS/S staff including communications and community participation, technical and financial issues, and work planning, monitoring and evaluation.
- Adapt and refine training materials for local use.

Water Supply

- Train LGA technical staff and private mechanics.
- Advise communities on technology selection.
- Assist LGAs to conduct geophysical surveys for well siting and/or supervise contractors.
- Supervise contractor drilling including interpretation of pumping tests and sizing and placement of pumps.
- Train local hand-dug well contractors.
- Prepare technical specifications for machine drilled wells and pumps.
- Design, prepare contract documents, and inspect piped and other water supply systems.
- Test water quality before and after construction.
- Monitor and facilitate spare parts distribution.

Health and Sanitation

- Train LGA sanitation staff to train artisans to promote and construct latrines.
- Coordinate health education component, training LGA staff.

38. A number of states have recently formed State Ministries of Water Resources; others are encouraged to do the same and to establish RWS Departments in them. It is expected that all agencies involved in rural water supply would work closely with State Departments of RWS and

would take advantage of LGA and State WATSAN Units' capacity to prepare communities to take responsibility for their water supply systems. An inter-agency State RWS/S Advisory Committee should be established in each state so that relevant government agencies can coordinate their activities, and to ensure that decision makers in the state are kept informed about the RWS/S Programme and that they support it. Members might include the SMWR, State DFRRI, SMOH, SMOE, SMOF, SWBs, RBDAs, ADPs, and UNICEF.

Federal Level

Federal RWS/S Unit Responsibilities (FMWR)

Planning

- Formulate and periodically update National RWS/S Plan and policies.
- Monitor and evaluate sector needs and progress.
- Set national standards, specifications and guidelines in collaboration with DFRRI, FMOH and the Standards Organization of Nigeria.
- Oversee applied research carried out by consultants and research institutions.
- Maintain a database on water resources and water supply facilities.

Management and Administration

- Coordinate National RWS/S program.
- Coordinate with other ministries and organizations, NGOs and ESAs.
- Mobilize national and international funding and support.
- Monitor state budgets, accounts and disbursements of funds channeled through the FMWR.
- Coordinate applied research and training.

Support to State RWS/S Units

- Ensure state and federal RWS/S personnel are fully trained in community mobilization, health education, design and technical specifications for RWS/S facilities, contract management, water quality and facilities monitoring, and spare parts distribution.

Support to Private Sector

- Facilitate the creation of a National Well Drillers Association.
- Keep record of well drillers and their construction work.
- Keep records of well drilling logs.
- Provide technical assistance to handpump manufacturers.
- Provide technical and financial assistance to hand dug well contractors.
- Promote spare parts distribution through private retailers.

Support to Training Institutions

- Secure financing for training network centers.
- Supervise development of training materials needed for the National RWS/S Program.
- Distribute training materials.

39. Implementation of the National RWS/S Programme will take the combined efforts of all agencies involved in the sector and flexibility on their part to work towards a common implementation strategy. The following roles are recommended for FMWR, DFRRI, MOH, UNICEF, ADPs and NGOs.[2]

2 These recommendations are subject to review, refinement and agreement by each agency. They are presented to facilitate discussion.

40. The FMWR will be responsible for planning and coordinating the National RWS/S Programme, monitoring progress, and periodically evaluating and updating policies, standards and guidelines. The FMWR will also be responsible for mobilizing national and international funding and support for the programme, tracking disbursements of funds channeled through them, liaising with other ministries and ESAs. The Ministry will also coordinate applied research and training and maintain a water resources and water supply facilities data base. During the initial stages of the National RWS/S Programme, the FMWR will assist states to prepare State RWS/S Plans and to establish State RWS/S Units, ensure that states receive adequate technical assistance and management support, and coordinate the training of sector personnel. A RWS Unit within the FMWR's Department of Water Supply and Quality Control will be responsible for these activities. The Unit will be staffed by permanent personnel as well as consultants, providing both the staffing needed to initiate the programme and the core personnel needed to sustain it. Administrative and data management support functions will be handled by relevant departments within the Ministry. The FMWR will also post personnel to State RWS/S Units to enhance coordination.

41. Working with the FMFED and others that are active in the sector, the FMWR will seek the financing needed to implement the National RWS/S Programme through federal budget allocations, grants from external assistance agencies, and discretionary loans from international financing agencies. Financing will be sought both for specific components that are needed by the sector as a whole (such as preparation of training materials and support to local manufacturers) and for state specific activities (such as preparation of State RWS/S Plans and construction of water supply facilities). Through the preparation of State RWS/S Plans that rationalize institutional, financial and technical strategies and through the establishment of State and LGA RWS/S Units, existing funds can be used more effectively and additional national and international funds can be attracted to the sector.

42. DFRRI will continue to support and if possible increase funding for RWS/S. Its funds will be part of the overall federal funding for the sector and subject to the cost sharing provisions of para 51. This will provide a more stable financing base for the sector and help ensure that sufficient state, LGA and community counterpart funds are available to install facilities that are well planned and constructed. State DFRRI offices will rely on LGA RWS/S Units to assist communities to plan their new water supply facilities and will rely on State WATSAN Units to prepare technical specifications and to manage construction supervision.

43. The FMOH will continue its role as the supervisory ministry for the UNICEF Assisted State WATSAN Projects; and SMOHs should work closely with LGAs and State WATSAN Units to ensure that their hygiene education and sanitation activities complement the MOH's programme in these areas. UNICEF Assisted State WATSAN Projects could evolve into State WATSAN Units, with UNICEF maintaining a close link to them. UNICEF assisted drilling operations should be placed under separate management from State WATSAN Units, made autonomous with a view to eventually privatizing them, and required to compete for work with other contractors in the state. In addition, technical and financial assistance should be given to private drilling contractors, and spare parts should be supplied through local retail outlets.

44. Through the Federal Ministry of Agriculture, the State ADPs should support the establishment of State WATSAN Units and LGA RWS/S Units, and use them to train communities to take responsibility for managing the maintenance of their water supply facilities. In those states where the ADPs have already installed large numbers of pumps, special consideration will be given to establishing community based maintenance and spare parts distribution through private retail outlets.

45. Non government organizations and consultants also have an important role to play in developing the sector. State WATSAN Units (NGO/consultant groups) with links to ESAs should be established to provide training and technical support to State Departments of RWS and LGA RWS/S Units. For example, the RUSAFIYA advisors could evolve into such an NGO/consultant group at the national level, and as suggested above UNICEF Assisted WATSAN Projects could evolve into State

WATSAN Units. Training Network Centers that specialize in water and sanitation services for low-income groups should be established at the NWRI and UN Nsukka to develop and refine training methods and materials, to assist states to prepare their State RWS/S Plans and to train sector professionals. Also, a National Water Well Drillers' Association should be established to support the local drilling industry.

Private Sector

Private Sector Responsibilities

The main areas in which local manufacturers, distributors, and contractors can play important role are:

Local manufacturing and marketing

- Handpumps and spare parts.
- Hand dug well equipment.
- Pipes and water appurtenances (tanks, taps, valves, etc.).

Construction

- Hand-dug and hand-drilled wells.
- Improved Latrines.
- Machine drilled wells.
- Pump installations.
- Small piped systems.

Operation and maintenance

- Pumps of all types.
- Hand-dug wells and boreholes.
- Small piped systems.

46. As part of the structural adjustment programme, the Federal Government has adopted a general policy of minimizing dependence on external sources for hardware, especially for critical sectors such as water supply. In addition, sustainability requires local availability of equipment and spare parts, which is greatly facilitated if they are made locally. Unfortunately the domestic private sector's participation in and impact on water supply in terms of manufacturing, construction, and maintenance is still very low.

47. As far as possible, the private sector (manufacturers, contractors, and distributors) should be developed and relied upon to undertake all construction and maintenance work and to distribute all water supply equipment. Government intervention should only be to supplement private-sector activities where the private sector is not yet providing effective support.

C. Financing the National RWS/S Programme

Cost Sharing

To be eligible for federal financing, states, local governments and individual communities must share in the cost of the National RWS/S Construction Grant Programme for new facilities and major replacements on the following basis: federal government (40%), states (35%), LGAs (15%) and communities (10%). The full cost of operations and maintenance will be borne by individual communities. Personnel and operational costs of the RWS/S Programme will be borne by local, state and federal government.

In the case of handpumps, communities should purchase their pump at a local retail outlet, the price of which will be shared with the State RWS/S Programme. And in the case of piped systems, the community should purchase their piping network, as this is the component for which it can provide in-kind labor, which most directly affects the level of service and which the community can later add to at its discretion. Payment should be required only after the water source has been tested for water capacity and quality and accepted by the community.

Individual families are solely responsible for paying for the construction of household latrines. However, government will construct demonstration latrines, train artisans, and promote improved hygiene and sanitation practices. To facilitate startup, the government will contribute to the cost of demonstration sanitation facilities according to the standard cost sharing formula used for water supply facilities.

Channeling Funds

Federal funds and external loans for RWS/S may be channeled (i) directly to LGA RWS/S accounts or (ii) through state RWS/S accounts with the disbursal of funds controlled by the local government chairmen through the mechanism of the Joint Local Government Account Committee. Grant assistance can be channeled through one of these mechanisms or through contracting units at the state level, possibly attached to State WATSAN Units. Similarly, contracts for the construction of water supply facilities can be let by LGAs or in some cases by State WATSAN Units. External loans for RWS/S will be negotiated at the federal level and on lent to state governments, with the FMWR acting as the central recipient agency for lending in the sector and charged with supervising disbursements. Disbursement and contracting procedures must be explicitly identified in all State RWS/S Plans.

Background

48. Although the Federal Government will have the chief responsibility for funding the National RWS/S Programme, financing strategies at the state level will in large part be determined by the strengths of the LGAs and the extent to which each is able to bear technical and financial responsibility for the programme's implementation. The cornerstone of the strategy, however, is the participation of communities, both in contributing to initial capital costs and in paying for the operation and maintenance of their water supply facilities.

49. Government has been reluctant to request rural communities to contribute to the cost of water supply because of communities' limited resources and other political considerations. It is important to recognize, however, that this issue is not merely one of transferring all or part of the burden of provision from the government to the communities. Obtaining community contributions can yield a number of other important advantages:

previous year (based on LGA and State RWS/S Unit work plans and audited accounts). These will submitted to the FMFED to guide them in allocating funds for RWS and in determining the amount of financing required for the sector. In addition, the FMWR will keep track of the cumulative total of expenditures made by LGAs and the state for RWS/S and will inspect all facilities when competed for adherence to specifications. Disbursal from the state will stop if an LGA is more than 25% behind in its contributions for more than 6 months in succession, and disbursal from the Federal Government will stop if either the state or an LGA is similarly behind in its contributions. Furthermore, LGA revolving funds will not be replenished for those facilities that are not constructed to specification or are not constructed by contractors pre-qualified on a state wide basis.

58. RWS/S Construction Grants Funds should be channeled directly to individual LGA RWS/S Revolving Accounts by the federal and state government, and whenever possible LGAs should let contracts for water supply facilities. However, LGAs may find it advantageous to have State WATSAN Units manage their machine drilled well contracts for them. The reason for this is that there are a limited number of fully qualified drilling contractors in the country, and not very many hydrogeologists with sufficient experience to supervise fast paced drilling work requiring on the spot decisions that can affect hundreds of thousands of naira. If each LGA lets a contract for 10 to 15 wells each year and some 20 such contracts are let every year in a typical state: (i) the scheduling of drilling work becomes complex, (ii) proper construction supervision is difficult if not impossible to arrange, and (iii) economies of scale (requiring 50 to 100 wells per contract) are not possible. However, as the number of viable drilling contractors and experienced hydrogeologists increases, smaller contracts will be able to be let and LGAs will be able to manage them.

59. For contracts managed by State WATSAN Units, LGAs should deposit funds equivalent to the estimated cost of machine drilled boreholes to be constructed in their area in the next drilling season (including 15% for contingencies) in a State RWS/S Construction Grants Account. The disbursal of funds from this account will be controlled by the LGA chairmen through the mechanism of the Joint Local Government Account Committee (JLGAC). About once a quarter (and more often if required) the committee will review the progress of drilling contracts, advise on policy issues, and approve issuance of contracts and disbursal of funds for payment of contracts issued by the State WATSAN Unit. No contracts will be issued until the full amount of funds are deposited in the State RWS/S Account. Contracts for other facilities such as hand dug wells and small piped systems can also be managed in this way, if LGAs so choose. Regardless of who lets the contracts, the State WATSAN Units should prepare technical specifications for all water supply facilities and should package them for individual contracts.

Channeling of External Grant Assistance

60. External grant assistance will be needed to supplement local, state, and federal funding for the implementation of the RWS/S Programme, and can be channeled via a federal ministry or directly to the state government. To ensure overall coordination of external inputs at the state level, ESAs should plan their assistance through the FMWR. Much of such external assistance can be expected to be paid for directly by the donor organization or through State WATSAN Units and thus will not involve the transfer of funds to LGA RWS/S Revolving Accounts. However, in the event that a cash contribution is made, funds should be paid directly into the National Programme Account and be disbursed by the FMWR for purposes previously agreed to by the donor and the federal, state, or local governments. The State RWS/S Director and the FMWR would be expected to report periodically on the status of disbursements of these funds to the ESA and the JLGAC.

Channeling of External Loans

61. External loans for RWS/S will be negotiated at the federal level and on lent to state governments. The FMWR should act as the central recipient agency for lending in the sector. As ESAs will generally require specific accounting, disbursement, and auditing procedures to enable them to monitor the use of loan funds, a separate domiciliary account should be opened for this purpose.

D. Technology Choice

Water Source

Groundwater has a number of advantages over surface water for the provision of water supply and should be used as the source of supply whenever possible: it is available within the community, is more reliable throughout the year and in periods of drought, and does not require treatment.

Service Level

The community perception of an improved water supply will largely be determined by the service level provided, where service level is determined by a number of factors, including the quantity and quality of the water, the amount of time needed to collect water, and the reliability of the system. It is particularly important that a higher level of service accompany any increase in consumer costs.

Water Supply Systems

Hand dug wells should be used whenever the water table is not too deep (less than 20 meters) and they can provide a year round supply of water. Open wells are more suitable for household than community use, so wells should be fitted with handpumps if the community is able to maintain them. Machine drilled boreholes are suited to virtually all hydrogeological conditions, and should be used whenever less expensive technologies cannot be applied or where a community wishes to install a motorized pump. Springs, wherever they are available, are well suited to rural water supply and should be protected and used when they provide an adequate year round supply and are not so distant from the community that piping costs become excessive.

Handpumps are generally the best option for providing water supplies to small rural communities for pumping lifts up to 45 meters. Galvanized rising mains and pump rods should be used only if the groundwater is non-corrosive (pH > 6.8), otherwise stainless steel or PVC should be used. Ease of repair is also an important consideration, particularly if communities are responsible for maintaining their pumps. Based on the Bauchi Handpump Testing Project, the RUWATSAN I (India Mark III) and RUWATSAN II (Afridev) pumps have been recommended for pumping lifts between 15 and 45 meters. For lifts exceeding 45 meters the Extra Deep Well India Mark II is recommended; and for lifts below 15 meters the Nira AF-85 direct action pumps is recommended.

Whenever a community is served by an electric grid that is not subject to frequent power failures, electric pumps are likely to be the technology of choice. When electricity is not available, the current trend is to install diesel generators to provide an electric submersible pump with power; however, where the water table is shallow, inexpensive, gas-powered centrifugal pumps should be considered. In either case the availability of fuel and local capability to repair the pumps should be considered. As the cost of photovoltaic panels decreases and as confidence in their reliability increases, solar pumps will play an increasingly important role in rural water supply. Considerable cost savings would be achieved by use of locally available water storage tanks and raised platforms that correspond to the distribution requirements. Water treatment plants for small and medium sized communities should rely on slow sand filtration preceded by roughing filters, and use of hydraulic process control mechanisms rather than electro-mechanical equipment.

Latrines

The single pit VIP latrine or pour flush toilet are likely to be well suited for rural areas; while multiple pit, alternating VIP latrines or pour flush toilets are best suited for school, health center, and community facilities.

- for investment costs, it is the sole objective indicator of interest and need, particularly in relatively water abundant areas, and thus can help ensure that investments are based on community demand;

- communities will sufficiently value their systems to maintain them, since they will have a stake in ensuring that their own initial investment does not go to waste;

- if communities pay for and manage operation and maintenance, they can ensure more systematic preventive maintenance, more timely repair of malfunctioning water points, and generally more reliable service.

50. In general, therefore, requiring community contributions can ensure that scarce resources are used where they are really needed and that services provided will be both more reliable and sustainable. Even under present widespread policies of "free water", many communities are contributing labor for construction of hand-dug wells or purchasing materials such as sand or cement for construction of boreholes. Moreover, in many states it is quite common to find people paying as much as 15 to 20 Naira per cubic meter for water from privately operated water tankers or vendors. Villages are already contributing in large measure to operation and maintenance costs, either through purchasing fuel and spare parts or through making supplementary payments to repairmen from central agencies.

Financing the Capital Costs of Water Supply Facilities

51. To ensure that substantial funds are available to implement a nationwide rural water supply investment programme, the Federal Government will take the lead in mobilizing domestic funds and external assistance for implementation of the programme. To be eligible for federal financing, states, LGAs and individual communities must share in the capital cost of new facilities and major replacements on the following basis: Federal Government (40%), states (35%), LGAs (15%) and communities (10%). However, some LGAs may choose to allow communities to contribute a part of the LGA contribution in return for a higher place in the grants list, as a way of making the programme more demand driven and increasing local financing and accordingly state and federal subsidies. Whenever possible communities should procure a specific component such as a handpump or materials for a piped distribution system, both of which will generally represent about 10% of the total investment. In the case of handpumps, communities should purchase their pump at a local retail outlet, the price of which will be shared with the State RWS/S Programme through a voucher system, whereby communities receive a voucher reclaimable by the supplier from the State RWS/S Programme for a set amount, equal to about half the price of the pump. Community cash contributions will be in the form of direct procurement of handpumps, or materials and in-kind labor for piped distribution systems. In either case, payment will be made only after the water source has been tested for water capacity and quality, and accepted by the community. In this way the government assumes the risk of unsuccessful wells and the communities do not have to fear that their money will be taken without receiving an acceptable water supply.

52. Prior to initiating any investment programme, the LGAs will inform communities of the availability of funds and of the conditions necessary for them to be eligible to receive funds. Communities will then apply to their LGA for assistance. All communities that apply will be placed on a grants list and prioritized on the basis of criteria previously agreed to on a statewide basis (para 25). As funds become available, construction grants will provisionally be given to the highest priority communities, at which time LGA RWS/S personnel will discuss with them the full range of technical options available given prevailing hydrogeological conditions, as well as the probable capital and O & M costs of each option. On the basis of this information, communities will select the system of their choice and begin to mobilize the resources required from their side towards the investment. Once a community has set aside its share of the capital costs, their construction grants will be given final approval, a detailed design will be prepared and construction will be arranged. Communities will be encouraged to deposit the funds in a local bank account for safekeeping.

Financing Operation and Maintenance of Water Supplies

53. Financing operations and maintenance will be the responsibility of individual communities. Members of the water and sanitation committee will be responsible for estimating monthly and annual costs and devising a system of revenue collection appropriate to the particular community. The secretary of the committee would be responsible for recording funds collected and disbursed, while another member will ensure their safekeeping. All disbursements will be approved by the committee, and periodic reports on the status of the fund will be given to the community.

Financing the Capital Costs of Sanitation Facilities

54. The financing strategy for sanitation will be based on the premise that individuals are solely responsible for paying for the construction of household latrines. The focus of the RWS/S Programme will be generating demand for improved environmental sanitation and thus creating a self-sustaining market for widespread construction of latrines. To this end, each LGA must set funds aside for the construction of demonstration latrines, training of artisans, and promotion of improved hygiene and sanitation practices. Since one of the key elements influencing demand is cost, the FMWR and/or the FMOH will allocate funds for the development of lower-cost technologies that can eventually be marketed throughout the country, including the conversion/upgrading of existing latrines.

55. Funding for promotional activities related to sanitation can largely be subsumed under other ongoing community development and primary health care programmes being implemented within the LGAs. Additional funding will be required for materials for constructing demonstration latrines as well as for vehicles and other equipment needed to implement the sanitation component. To facilitate startup, state and federal governments will initially contribute to these costs according to the standard cost sharing formula used for water supply facilities. Communities will be required to pay for the full cost of any latrines they construct for their private use. While institutions such as primary schools and hospitals will be responsible for installing their own latrines, LGAs may subsidize part of the cost of construction so as to encourage more widespread demonstration activities. Users of public facilities should be charged a small amount to pay for an attendant and other operational expenses of public facilities to ensure that they are properly cleaned, maintained and used.

Financing of Local, State, and Federal Support

56. The technical and administrative support costs of the RWS/S Programme, including personnel and general operational costs, will be borne by the local, state, and federal governments, respectively. Each level of government will be required to include a provision in their annual budgets to cover the salaries of staff and consultants working on the programme, including travel allowances and transportation costs. Provision will also need to be made for office space and activities such as training, promotion, and publicity. During the early stages of the programme, federal funds will be made available for the purchase of items such as furniture or vehicles and for special training activities. To facilitate startup, the Federal Government will contribute up to 80% of such costs, and states and LGAs will pay the remaining 20%, after which the standard cost sharing formula will be used. Special provision will also be made for the preparation of State RWS/S Plans. It is important that the basic support costs necessary to run the programme be financed entirely from the regular budget of local, state and federal government to ensure long-term sustainability. Care will need to be taken to ensure that in receiving additional funds for the programme through ESA assistance, adequate budgetary provision is made for personnel and other resources needed to guarantee proper supervision of the use of those funds.

Channeling Funds to the State and Local Government Levels

57. Each year the FMWR will compile a summary of LGA/State budget proposals for the upcoming year, together with a summary of the expenditures that each made for RWS/S during the

62. The technology chosen should give the community the highest service level that it is willing and able to pay for, will benefit from and has the institutional capacity to sustain. Technology selection should be guided by the communities, since they will be the ones responsible for paying for much of the systems and for maintaining them. However, communities will need technical assistance, so that they can make informed decisions based on the costs, service level and O&M requirements of the options and on local hydrogeological constraints. They should also determine the location of water points and the layout of water distribution systems, again with the advice of RWS technology specialists. The following sections summarize considerations that affect technology choice.

Water Source

63. In rural areas of the country, groundwater has a number of advantages over surface water for the provision of water supply and in general should be used as the source of supply whenever possible. Groundwater is available within the community, is more reliable throughout the year and in periods of drought, and does not require treatment which complicates and increases the cost of operation and maintenance. Household treatment of surface water (by filtration and chlorination) is technically feasible but would have to be preceded by intensive health education. The treatment of surface water is also feasible, but will at least double the investment and the operations and maintenance costs.

64. Hand-dug wells are by far the most widespread source of water throughout rural areas. They are often affordable to communities and to many households, and can be produced locally by private artisans. Nonetheless, these traditional wells suffer from several deficiencies: (i) they often do not provide year round service, due either to unsuitable hydrogeological conditions or insufficient penetration below the water table, and (ii) they are likely to be heavily contaminated, first because they are open, and second because their well platform and apron are poorly designed.

65. Properly designed, hand dug wells are the technology of choice for rural communities where the hydrogeology is suitable (either where a shallow perennial aquifer in the overburden surmounting crystalline rocks or where the water level is less than 20 m in unconsolidated or semi-consolidated sediments). Hand drilled boreholes could also be constructed in areas where a shallow aquifer is sufficiently permeable (i.e. does not require the larger storage volumes provided by hand dug wells) and where construction is possible. The construction of hand-dug wells could be greatly improved if the contractors used dewatering techniques during construction, allowing them to excavate and line the well below the water table. Open wells are more suitable for household than community use (because of the greater likelihood of pathogens being spread through the community when many households share the same source), and should be discouraged for community use. Handpumps, and, if possible direct-action handpumps, should be installed in all other instances. It is estimated that in the crystalline area 10% of small communities needs could be met by such hand drilled boreholes or hand-dug wells whilst in areas of unconsolidated sandy sediments with a shallow water table this may rise to over 80% of small communities. The relatively low cost of these options being less than Naira 20,000 including direct-action pumps makes them very attractive but their applicability should not be overestimated.

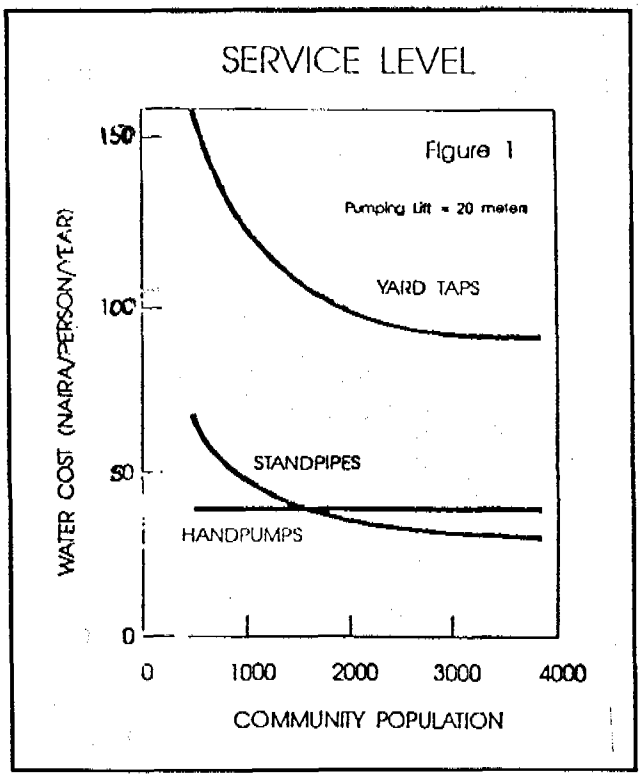
66. Machine drilled boreholes are suited to virtually all hydrogeological conditions, provided that the proper drilling and prior-siting investigation techniques are used; they are the basic option where simpler and less expensive technologies cannot be applied or where a community wishes to install a motorized pump. To ensure high-quality construction and durability of drilled boreholes, it is recommended that contractors: (i) whenever possible tap water present in the overburden above basement, (ii) systematically perform pumping tests, and (iii) use high-quality materials. Close supervision of the work, generally including the separation of consultants' and contractors' tasks through issuance of separate contracts, is essential to achieving high-quality drilled wells.

67. Springs, wherever they are available, are well suited to rural water supply and should be protected and used when they provide an adequate year round supply and are not so distant from the

community that piping costs become excessive. Treated water from rivers and lakes also provide good service if reliable operators, spare parts and uninterrupted supplies of fuel and chemicals are available. However, even temporary failure of the treatment system can result in serious outbreak of water-borne disease.

Service Level

68. The community perception of an improved water supply will largely be determined by the service level provided, where service level is determined by a number of factors, including the quantity and quality of the water, the amount of time needed to collect water, and the reliability of the system. If water quality and reliability are similar for different systems, then service levels fall into two groups, point sources from which households must carry water home (handpumps and standpipes) and yard taps which deliver water to the home. Handpumps and standpipes provide roughly the same level of service while yard tap systems potentially offer better service if they are reliable. As shown in Figure 1 the cost of water increases substantially when the service level shifts from point sources (about Naira 35 per person per year) to yard taps (about Naira 100 per person per year). The increased cost of yard taps is due to higher water consumption and piping costs. It is particularly important that a higher level of service accompany any increase in consumer costs. It is likely that in the southern part of the country a higher level of service must be achieved to satisfy users than is required in the north, as water is generally more readily available in the south. Refer to the end of Annex 1 for a summary of the design parameters and a breakdown of component costs used for these charts.



Pumping Equipment

69. Handpumps: Handpumps are generally the best option for providing water supplies to small rural communities in the country for pumping lifts up to 45 meters. Above this, manual pumps require more energy than people can comfortably generate. Very often insufficient attention has been given to the issue of corrosion resistance. At most locations in the country groundwater Ph is below 6.8 (moderately corrosive) and often below 6.5 (very corrosive); in these instances use of galvanized rising mains and pump rods should be avoided and either stainless steel or PVC should be used. Ease of repair is also an important consideration, particularly if communities are responsible for maintaining their pumps. Based on the Bauchi Handpump Testing Project, the RUWATSAN I (India Mark II/III) and RUWATSAN II (Afridev) pumps have been recommended for high-lift (greater than 15 meter) applications. The advisory committee for the Handpump Testing Project has also tentatively recommended the Nira AF85 for low-lift applications of less than 15 meters, based on its performance in others countries in Africa; its performance in Nigeria will be monitored.

Handpump Selection Based on Pumping Lift and Groundwater pII

	Pumping Lift		
Groundwater	< 15 meters	15 - 45 meters	> 45 meters
pH > 6.8	Direct-action	RUWATSAN I (2½ inch GI)[1] RUWATSAN II[2]	RUWATSAN I (1¼ inch GI)
pH < 6.8	Direct-action	RUWATSAN II	India Mark II (1¼ inch SS)

1) 2½ GI = galvanized iron rising main (2½ inch) and pump rods.
1¼ GI = galvanized iron rising main (1¼ inch) and pump rods.
1¼ SS = stainless steel rising main (1¼ inch) and pump rods.

2) RUWATSAN II has uPVC rising main and stainless steel pump rods.

70. Electric Pumps: Electric pumps are a proven technology that can reliably provide large quantities of water. Whenever a community is served by an electric grid that is not subject to frequent power failures, electric pumps are likely to be the technology of choice. Due to the unreliability of the power supply in rural areas, it is advisable to (i) monitor the electricity supply at the design stage to determine its actual reliability, (ii) adequately size storage capacities and assess costs for the desired level of service, and (iii) protect the pump against voltage fluctuations. If the electric grid must be extended to reach the community, the additional costs are likely to exceed the cost of other pumping options.

71. Diesel Pumps: When electricity is not available, the current trend is to install diesel generators to provide an electric submersible pump with power when water requirements exceed that provided by several handpumps. Other solutions include: (i) direct-drive centrifugal pumps, which are more efficient than the coupling generator-submersible pump; though they require precisely vertical boreholes and careful installation, their maintenance is easier for rural mechanics since they do not include any electrical system, and (ii) small, gas powered, centrifugal suction pumps (when the water table is very shallow, less than 6 m), which are cheap and easy to maintain, even if their life expectancy does not exceed two or three years. In either case, the availability of fuel and the local capability to repair the pumps should be considered.

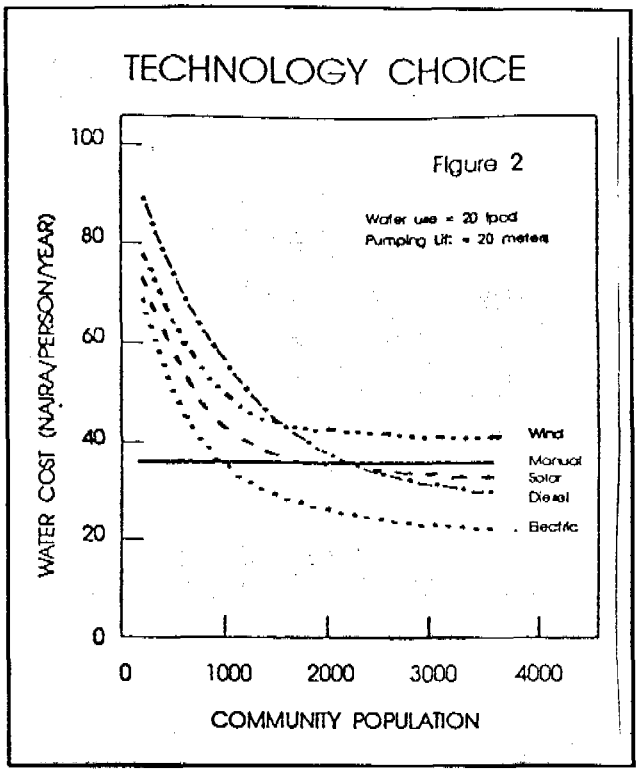
72. Solar Pumps: Solar pumps, which have now reached a high level of reliability, are potentially well suited to the central and northern belts of the country because of the availability of solar radiation. The main problem with solar pumps is the rigorous community organization they require: although breakdowns are very scarce, the repairs are quite costly when they do occur, and the community may find it difficult to gather the necessary funds for repair if a savings and credit system is not implemented beforehand. As the cost of photovoltaic panels decreases and as confidence in their reliability increases, solar pumps will play an increasingly important role in rural water supply.

73. Wind Pumps: Wind pumps will continue to have limited application because winds of sufficient speed and reliability to make them economical occur only in a few locations in the country.

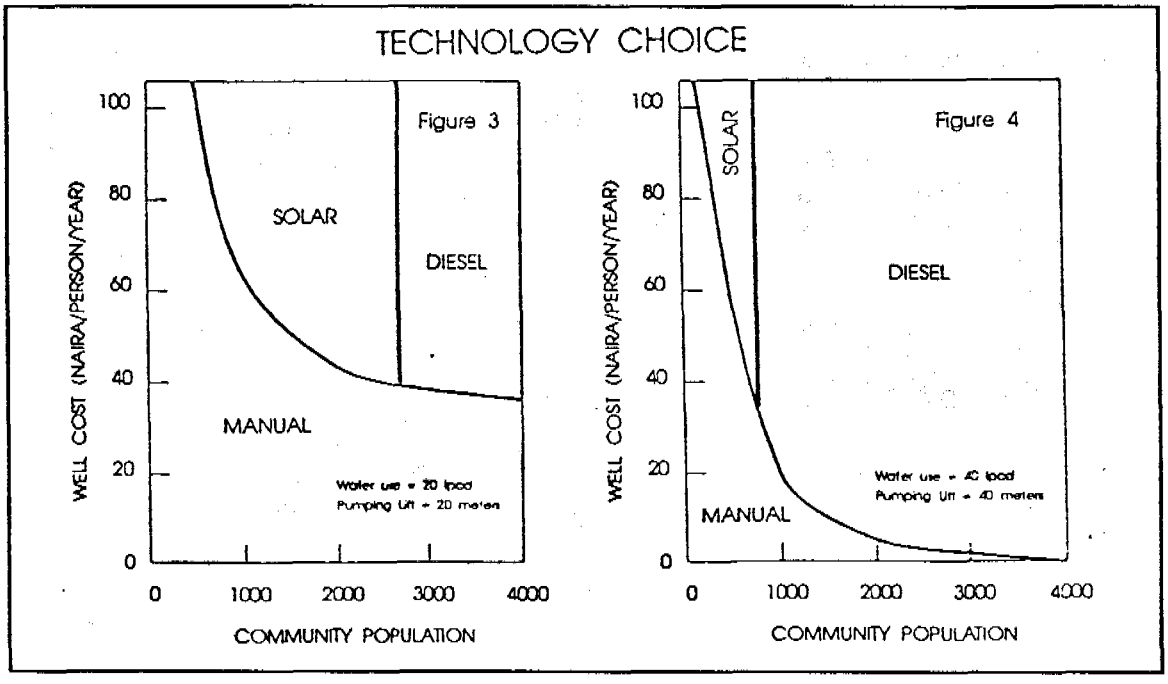
Comparison of Pumping Technologies Based on Cost

74. The curves in Figure 2 show the annualized pumping cost of water (Naira/capita/year) for manual, electric, diesel, solar, and wind pumps as a function of community population. Because handpumps have a limited capacity (about 5 m3/day), additional wells must be added to keep the service level constant, in this case at 250 persons per handpump, so on a per capita basis the cost of manual pumping does not vary with population. Other types of pumps are not

limited by the rate of energy a person can produce and so require only a single well (assuming well capacity is sufficient) and exhibit significant economies of scale. Diesel pumps have the greatest economies of scale because the engine is expensive and its price varies little with capacity in the output ranges required for a small community water supply. Wind and solar pumps on the other hand can be sized in proportion to the power that is required so exhibit somewhat less economies of scale.



75. Where water use is about 20 liters/capita/day and a machine drilled borehole cost more than US$5,000, handpumps will provide water at least cost for communities with populations under about 1,000, solar for populations between 1,000 and 2,500, and diesel for populations above 2,500. Where less expensive hand-dug or hand-drilled wells can be constructed, handpumps can serve virtually any sized community. In general, where water consumption and well costs are low, handpumps will tend to be the most appropriate technology and where water use and well costs are high, solar and then diesel pumps will be better. This trend is depicted in Figures 3 and 4 that show combinations of well cost and community population which correspond to least cost pumping technologies, and which provide about the same level of service. A summary of the design parameters and costs used to generate these charts is given at the end of Annex 1.



Storage and Distribution Systems

76. Many rural piped systems are excessively expensive due to the over-design of both storage capacity and elevation. Considerable cost savings would be achieved by use of locally available water storage tanks and raised platforms that correspond to the distribution requirements. Local welders in all state capitals can supply galvanized iron sheet tanks of acceptable quality that have capacities as large as 10 m^3 that are suitable for smaller systems and that cost less than Naira 10,000. Several tanks can be combined, but for much larger volumes, communities will usually have to install either bolted or fiberglass tanks, the latter also are now being successfully manufactured and installed in the country.

Water Treatment

77. Designers of water treatment plants for small and medium sized communities are now returning to tried and tested methods of water treatment, particularly slow sand filtration preceded by roughing filters, and are minimizing the electro-mechanical equipment, preferring to use hydraulic processes. The result is considerable cost savings and improved reliability, with typical 95% solids removals and 10,000 fold reductions in pathogenic organisms without the use of chemicals. Nonetheless, chlorination is recommended, although a major outbreak of disease is unlikely even if chemicals should run short. Infiltration galleries can provide even better and more reliable treatment at lower costs and should be used whenever technically feasible.

Latrines

78. The single pit VIP latrine or pour flush toilet are likely to be well suited for rural areas; while multiple-pit, alternating VIP latrines or pour flush toilets are best suited for school, health center, and community facilities. The generation of a demand for latrines has in the past been a problem because of their high cost; it is therefore important that a range of different cost designs for improved sanitation (from a simple upgrade of traditional latrines to various types of VIP and pour flush latrines) be promoted through the National RWS/S Programme both for household and public use.

E. Construction

Competitive Bidding

79. All construction should be awarded through competitive bidding on at least a statewide basis, following pre-qualification to identify contractors known to do high-quality, professional work. It is suggested that both State and FMWR RWS/S Units conduct pre-qualification procedures each year to update the list of eligible contractors. Both local and state agencies must send bidding documents to all pre-qualified contractors for all contracts to be issued during the year. In general, contracts should be sized to fit the LGA and State capacity to plan, construct, and manage.

Hand Dug and Hand Drilled Wells

80. Because of the importance of hand-dug wells in meeting the goals of the National RWS/S Programme, it is essential that local contractors be trained to construct them according to standard specifications and that they receive assistance to procure essential equipment. Such a programme will be financed through the National RWS/S Programme, possibly through a grant from an interested external assistance agency. In those states where hand dug or hand drilled wells are important options, sets of equipment (in proportion to the potential number of wells to be constructed in the next few years) will be procured and leased for one year to selected contractors who will be paid to construct a number of wells at the market price. If performance is good, the contractor will be allowed to procure the equipment through a lease purchase arrangement and will be pre-qualified to bid on government contracts.

Means of Strengthening the Construction Industry

All construction should be awarded through competitive bidding on at least a statewide basis, following pre-qualification to identify contractors known to do high-quality, professional work. Well contracts should be preceded by a hydrogeological assessment, including if necessary geophysical surveying and in all cases day to day supervision of borehole construction should be done by geologists experienced in construction inspection (either employees of the client or a consulting firm hired by the client). Contracts for 50 to 200 boreholes at a time should be let; this will provide economies of scale while making it possible for local contractors to qualify.

Because of the importance of hand-dug wells in meeting the goals of the National RWS/S Programme, it is essential that local contractors be trained to construct them according to standard specifications and that they receive assistance to procure essential equipment. Government owned and operated drilling units should be wholly self-sustaining, and whenever possible be privatized or their equipment sold to private contractors.

The drilling industry can help itself by forming a National Water Well Drilling Association. Membership would be open to reputable contractors with proven resources and capability. The Association would help members by providing news about drilling work, technical and logistical support, and advocacy for its members. The Association would help ground-water developers by offering a pool of reliable contractors, a means of recourse for inadequate services, and a source of information on the current costs of boreholes.

Handpump installation should be paid for by the community, who may hire the services of the pump suppliers or private mechanics. Small piped systems should be constructed by private civil works contractors. Latrine construction should be done by local artisans and small private contractors; their training should include both the technical and promotional aspects of the latrine business.

Machine Drilled Wells

81. Most public drilling units are hampered by lack of sound financial management, and excessive staff who cannot be motivated with appropriate bonuses, overtime, and field allowances. Acquisition of spare parts and drilling materials is also problematic, and largely unavoidable due to controls on procurement and operations needed by a public agency or parastatal. In general, public-sector drilling agencies have little accountability, and where they are operating at all, they are doing so on a semi-commercial basis, but without regard for profitability. Because government should rapidly move away from its current role of "provider of services" to one of "promoter" of services, there is little justification to maintain such drilling units. It is recommended that government owned and operated drilling equipment be kept to a minimum and made to be wholly self-sustaining; and whenever possible privatized or sold to local private contractors. Reliance on private drilling contractors will save the government money both by eliminating unprofitable operations and by increasing competition. State RWS/S Units should not be involved in the management of government owned drilling operations.

82. It is estimated that there are a dozen drilling companies in Nigeria that are well managed and technically capable of constructing high quality boreholes, and an equal number that could be made so with appropriate technical and financial support.[3] Given an expanding market, these companies

---

3 Borehole Drilling in Africa: A Case Study in Nigeria, O.A. Adenle and G. Beale. World Bank August 1989. Also, RUSAFIYA drilling contract experience.

could provide the basis for a reliable and efficient drilling service to all agencies and potential groundwater users in the country. Other well qualified companies undoubtedly also exist. At present these companies face the problem that they must compete for the limited drilling work against unrealistic competition offered by middlemen or inexperienced contractors. Contracts issued to such agents results in shoddy and incomplete work. It is essential that contractors that do proper work are identified, hired directly, and paid a fair price for their work.

83. The drilling industry can help itself by forming a National Water Well Drilling Association. Membership would be open to reputable contractors with proven resources and capability. While self regulatory, the professionalism with which the association conducts its affairs will determine its reputation and impact. Such an agency would help members by providing a focal point for news about drilling work, as a lobby for the services of its members, as a source of both technical and logistical support, and as an advocate if a member is cheated. The Association would help groundwater developers, and would offer a pool of reliable contractors, an organization that is answerable in that it can affect the good standing and reputation of its members, and a source of information on the current costs of boreholes. The main functions of the Association in the short term would be to compile a directory of all competent drilling organizations, to establish a code of practice and standards including a self monitoring system, to refine and advocate standard procedures for contract operation, to compile an inventory of materials, equipment and spares in the country - making this known to its members, and to maintain a data base of well drilling records. External financing will be sought for the first three years of operation, after which it will have to become self financing.

Contracting and Construction Supervision for Wells

84. The following actions should be taken to support the drilling industry and to ensure that good quality wells are constructed. These apply to all types of wells whether hand dug or machine drilled.

85. Project Planning: Well contracts awarded by government agencies should be preceded by a hydrogeological assessment, including if necessary geophysical surveying. This will both increase the success rate and provide a basis for estimating the materials quantities and drilling costs needed for planning purposes and for bidding documents.

86. Contracting Procedures: Contracts for 50 to 200 boreholes at a time should be let; this will provide economies of scale while making it possible for local contractors to be able to qualify. All contracts should be let through competitive bidding following annual state wide pre-qualification that verifies the past performance and present technical capabilities of interested drillers. Bids should be prepared using a Bill of Quantities with the responsibilities of the client and contractor clearly stated. A schedule of work prepared by the contractor should accompany tenders. Contracts should not be let until funds to pay for the entire works have been deposited in a construction account; and prompt payment should be made for completed work, with interest paid at the existing bank rates on bona fide unpaid contractors' invoices. The government official responsible for payment must be identifiable, and may delay payment only if the project supervisor refuses to sign the completion certificate because he can show that the contract has not been completed as specified.

87. Supervision: Proper supervision of projects by the executing agency is vital. Consequently, drilling contracts should be of a size which will allow for supervision of the design and construction of each individual borehole. In all cases the day to day supervision of borehole construction should be done by geologists experienced in construction inspection (either employees of the client or a consulting firm hired by the client). In all cases a daily drilling activity summary should be co-signed by supervisory staff and the driller at the close of business each day. Completion reports, jointly signed by supervisory staff and the driller, should be prepared in triplicate - one to be retained by the contractor, another by the client, and a third sent to the SMWR. These should include a location map, a drilling log with completion details, and pump-test results. The supervision of hand dug wells

can be done by experienced RWS technology specialists. They should keep similar records but need not do so on a daily basis.

88. To ensure high quality construction and durability of drilled boreholes it is recommended that contractors:

- Carefully log the boreholes as they are drilled.
- Record all lithologies by sampling at least every meter.
- Record depth of water struck and take interim yield tests plotting incremental increases with increasing depth.
- Design boreholes to take account of all perennially productive zones paying particular attention in weathered crystalline rock to productive zones in the overburden.
- Systematically carry out test-pumping including step tests of at least four steps of 100 minutes duration each.
- Use casing and screen appropriate to the geological and hydrogeological conditions.
- Take account of current/future population size in each settlement when fixing casing diameter.
- Ensure sanitary completion.

Handpump Installation

89. Handpump installation should be paid for by the community, who may hire the services of the pump suppliers or private mechanics after proper training. A certification programme for handpump mechanics will be offered in each LGA, so that communities can have some assurance that the mechanic is properly trained.

Small Piped Systems

Construction of facilities and installation of equipment for small piped systems should also be done by private civil works contractors. As with well construction, all selection should be through competitive bidding following pre-qualification.

Latrine Construction

90. Latrine construction should be done by local artisans and small private contractors. They should also be trained in the use of local building materials. In many cases their services will be limited to supervision and masonry work, as costs can be minimized if individual households dig the pit and construct the superstructure themselves. Artisans and contractors should also have an entrepreneurial spirit and be able to sell their product to households. Their training should include both the technical and promotional aspects of the latrine business.

F. Operations, Maintenance, and Revenue Collection

Recommended Strategies for the Maintenance of Handpumps

91. The full turning over of handpump maintenance to communities and the subsequent withdrawal of government agencies has proved to be a successful approach in many countries in West Africa. Based on experience in these countries and in Nigeria, the following actions are recommended: (i) establishment of a water and sanitation committees in each community that are responsible for day to day management of the pump including the supervision of pump use, the maintenance of the pump surrounds, the collection of repair and replacement funds from the users, the purchase of spare parts from local retailers or private mechanics, and the hiring of local handpump mechanics or borehole maintenance contractors when their services are required; (ii) the

Maintenance of Handpumps

The operations and maintenace of handpumps should be the responsibility of the community. The community should establish a water and sanitation committee that is responsible for supervising use of the pump, collecting revenues for repairs and replacements, and making repairs or arranging for a private mechanic to make them. Several water and sanitation committee members in each community (preferably women, depending on the social context) should be trained to perform all normal repairs on VLOM pumps.

Private mechanics (1 per 15 to 50 handpumps) should be trained to make all types of repairs, including the extraction of downhole components that have fallen to the bottom of the well, and local hand dug well contractors should be assisted to procure compressors that can be used to operate pneumatic equipment both for well construction and borehole maintenance. Local government personnel should monitor the maintenance system and provide technical "back-up" services.

Operations and Maintenance of Small Piped Systems

Mechanized systems require operators, guards, mechanics and a system of revenue collection. Communities may choose to carry out these functions themselves, or hire the services of a private company or an urban water supply agency to undertake one or more of them.

appointment of several water and sanitation committee members in each community (preferably women, depending on the social context) who are trained to perform all normal repairs on VLOM pumps and to undertake preventative maintenance on pumps that are more difficult to repair or that require expensive tools, (iii) the selection of private mechanics (1 per 15 to 50 handpumps) who are trained to make all types of repairs, including the extraction of downhole components that have fallen to the bottom of the well, and (iv) financing local hand dug well contractors, including compressors that can be used either to operate pneumatic equipment both for digging and borehole maintenance.

92. It is essential that communities have access to spare parts. Common wearing parts should be available at local markets, all components at retail outlets in LGA centers, and entire pumps in major cities. It is advisable that each community stores a set of wearing parts, particularly in the wet season when travel may be restricted. Spare parts distribution is discussed further in paras 101-103.

93. Given the involvement of both communities and the private sector described above, government agencies should (i) advise and train communities to manage their water supply facilities, (ii) monitor the maintenance system, correcting possible problems (such as replacement or retraining of mechanics and assistance to manufacturers or retailers to correct deficiencies in spare parts quality or availability, and (iii) provide technical "back-up" services for borehole maintenance or in case of repairs that are out of the reach of area mechanics.

Recommended Strategies for the Operation and Maintenance of Mechanized Systems

94. Mechanized systems require operators, guards, mechanics and a system of revenue collection. Communities may choose to carry out these functions themselves, or hire the services of a private company or an urban water supply agency to undertake one or more of them. Most communities will require the services of a qualified mechanic to make repairs, and large communities or communities that have water treatment facilities will generally need the services of a company or agency to operate their system. Also, as communities become larger and accounting becomes more complex, communities will need to involve the operator in revenue collection. For example, a community may

choose to have women's groups collect revenues from families that use standpipes and in turn have the operator collect revenues (based on the amount of water that was used) from these groups and from households that have individual yard taps. Such a system could also work in semi-urban areas where the water agency would act as a bulk water supplier to communities that would collect revenue in their locality. What is important is that each community decides the type of revenue collection system that works best for it and that communities pay only for water that is delivered and/or for services that are actually provided.

95. RWS/S Units must work with communities to train them to manage their system and to undertake the responsibilities that communities set out for themselves. Commitments of both the contractor/agency and communities should be made clear in writing, and agreement should be reached before starting of the works. Also, private mechanics should be given the opportunity to receive training and to become certified in the repair of water supply equipment, and spare parts suppliers should be advertised.

G. Local Manufacture and Distribution

Local Handpump Manufacture

The metals fabrication, plastics and rubber industries in the country are sufficient for handpump production. It is essential that the most serious potential manufacturers receive orders for substantial numbers of pumps so that they can finance start-up of handpump production lines. When initiating manufacture it is essential thet they receive technical advice from experienced handpump production engineers in both fabrication techniques and in quality control procedures. Each pump should be given in-line quality control by the manufacturer, and should be inspected by an independent external inspection agency like Crown Agents or SGS before being dispatched.

Spare Parts Distribution

To maintain their pumps communities must have access to spare parts. Common wearing parts should be available at local markets, all components at retail outlets in LGA centers, and entire pumps in major cities. The best way to ensure this is to manufacture pumps and spare parts locally and to distribute them through the private sector. However the production and distribution of pumps and spares can only be solidly established if the producer and distributor can make a reasonable living from their undertaking. Thus, they must be able to charge normal markups for these goods.

96. Communities can maintain their water supply facilities only if spare parts are locally available. The best way to ensure this is to manufacture pumps and spare parts locally and to distribute them through the private sector. However the production and distribution of pumps and spares can only be firmly established if the producer and distributor can make a reasonable living from their undertaking. Government will assist in this process by providing assistance to manufacturers and distributors during the initial stages of such a programme.

Potential for Local Manufacture

97. Handpump Market: The ongoing and planned water supply projects in the country total approximately 5,000 new boreholes with handpumps per year. To this figure should be added the replacement of approximately 17,000 boreholes that have already been drilled in the country. The eventual total number of handpumps for 100% coverage will be in a region of over 80,000 pumps. With an estimated life of 10 years per pump the replacement market will be over 8,000 pumps per

annum. Thus, the annual demand for handpumps will be big enough to support several local manufacturers.

98. Local Capacity: A number of companies are well equipped for pump fabrication with lathes, drilling machines, milling machines, guillotines, rolling machines, welding machines, etc. Their product line typically consists of various types of food processing and agricultural equipment. Several have experience making handpumps and light weight drilling equipment; one has produced about 5,000 pumps of three different types, some of which were distributed through a private company. Several companies also produce the 2½ inch GI pipes required for the RUWATSAN I pump. The plastics industry in the country is sufficient for handpump production. PVC pipes are available in reasonable quality, however it is necessary to apply stringent quality control as the products are subject to considerable quality fluctuations. Injection molding and tool making facilities for molds are also available. With some technical assistance the engineering plastic components for the RUWATSAN II could be made and the relatively large domestic market will make the investment for tooling viable. There are also a number of producers of rubber products that can meet the quality requirements for handpump components.

99. Import Duties: Handpumps are mainly made out of ferrous and non-ferrous metals, rubber and plastic. Semi-processed materials need to be imported for the manufacture of pumps. These include iron billets for the manufacture of steel rods, angle iron and sheets; and UPVC polymers and chemicals necessary for rubber compounding. The customs duty for imported goods is calculated on their CIF value to which an additional surcharge of 7% is added. Customs duties on materials used in the production of handpumps vary between 10 and 45 percent, becoming higher for those materials that can be provided in the country. Thus flat rolled steel (10%) and PVC polymer (15%) are relatively low while steel sections (30 to 40%), nuts and bolts (35%) and PVC pipe (40%) are higher. For a typically made handpump, import duty and taxes on raw materials add about 20% on to the cost of the pump. In comparison, imported pumps attract a 10.7% duty.

100. Manufacturing Cost: Based on raw material costs including import duties and tax, tooling costs, labor, working capital requirements, and profits the cost of complete pumps was estimated. They are Naira 7,200 for the RUWATSAN I with galvanized 2½ inch galvanized iron rising mains and Naira 5,400 for the RUWATSAN II with grade 304 stainless pump rods. In comparison these pumps can be imported from India at Naira 5,700 for the RUWATSAN I and Naira 7,600 for the RUWATSAN II.[4] From the point of view of a manufacturer, it may be possible to make the RUWATSAN II as it can sell it to a local distributor for somewhat less than an Indian manufacturer, and can sell it directly to individual projects for substantially less than can local distributors.

Spare Parts Distribution

101. Current Practices: Presently nearly all handpumps and spare parts are purchased by the ADPs, DFRRI and UNICEF, which either purchase them in foreign currency from offshore suppliers or in Naira from local resellers, and then give them to their constituent communities. As a result local retailers are not able to enter the business. Those that sell related agricultural equipment and spare parts generally are not able to sell on consignment, so require advance payment on most orders; only fast moving parts are stocked and then only during the part of the year in which demand is greatest.

---

4 Prices are based on a production of 1000 pumps per year and a cylinder setting of 30 meters. Costs include a customs duty of 11.5% for the RUWATSAN I and 18.5% for the RUWATSAN II and 7% surcharge on raw materials for both. The price of imported pumps includes a 10% customs duty, 7% surcharge and 8% clearing and forwarding charge.

102. Distribution Cost: The costs of handpump distribution and installation are normally not calculated since the pumps are either installed and distributed through projects or through NGOs. In the few cases where handpumps are sold through private sales channels, the sales prices for the pumps are much higher than the landed cost. Costs that must be added to the ex-factory or (if imported) landed cost include: ▪ inspection of pumps by a quality assurance agency, ▪ storage at national and regional outlets, ▪ packing and transport to regional outlets, ▪ marketing, ▪ training of sales and installation crews and production of installation and O&M manuals, ▪ financing of investment, ▪ profit on investment, ▪ sales commission, and ▪ installation including labor, materials, depreciation of the tools and vehicles and transport. Depending on the ex-factory or landed cost, the rate of turnover and the marketing effort required, these distribution costs can add 50 to 100% to the price of a pump.

Actions to Improve Manufacturing Capacity

103. In order to establish local production and distribution of handpumps and spare parts, the local market must be sufficiently large to make them profitable. This can be achieved, but only if (i) the number of different types of pumps is limited, (ii) the sale of spare parts is coupled with the sale of pumps, (iii) agencies do not purchase pumps and spare parts directly from the manufacturers, and (iv) communities purchase their pumps and spare parts from local retailers. Furthermore, retailers must be able to order small quantities of spares at short notice, and must be able to purchase them with local currency.

Procurement

104. The adoption of international handpump specifications will lower barriers to market entry (local manufacturers will not have to design a new pump), increase the market size, intensify competition, and lower prices. This will provide a sufficiently large market to make local manufacture viable and will ensure that communities pay a fair price for their pumps. The Government of Nigeria has or will undertake the following actions to support local manufacture of handpumps.

- Recommended three types of handpumps that provide service over the full range of manual pumping lifts (0 to 75 meters).[5]

- Prepare standard specifications for recommended pumps, making them identical to current international specifications (Standards Organization of Nigeria - SON).

- Pre-qualify local manufacturers of recommended pumps.

- Require that all procurement of pumps be done by individual communities or at least through competitive bidding with all pre-qualified manufacturers being given the opportunity to quote. If competitive bidding is employed, a margin of preference of 15% should be given for local manufacture and the price quotation should include distribution and sales at state and LGA outlets.[6] Also, require that all pumps brought into the country be subject to the normal customs duties and surcharges.

- Purchase substantial numbers of pumps from local manufacturers to initiate production (DFRRI).

---

5 Made by the Steering Committee of the Handpumps Testing Project conducted in Bauchi State, including the Federal Ministry of Water Resources, the Directorate of Food, Roads and Rural Infrastructures, the Federal Agricultural Coordinating Committee, and the Bauchi State Integrated Rural Development Authority.

6 Applies to all rural water supply programs that receive federal grants.

Quality Control

105. Pre-qualification: A pre-qualification system under which manufacturers are certified as being capable of making the product as specified will be introduced. Manufacturers who apply for certification will be assessed on the basis of (i) availability of required fabrication equipment including jigs and fixtures, (ii) successful production of pumps that meet specifications, and (iii) demonstration of internal quality control procedures. If the company has the necessary equipment, a trial order of 100 pumps will be placed. Initially 10 prototype pumps must be made, and, if these meet specifications, the balance of the order can be fabricated. The manufacturer will be paid only for pumps that are made to specification. During the start up period, technical assistance will be provided to the manufacturer. After satisfactory completion of the trial order and demonstration of internal quality control procedures, the manufacturer will be pre-qualified. In addition to pre-qualifying manufacturers, SON will periodically inspect pumps and may rescind one's pre-qualification status if the manufacturer does not rectify the problem.

106. Quality Assurance: Each pump should be given in-line quality control by the manufacturer, and be inspected by an independent external inspection agency like Crown Agents or SGS before being dispatched. Only pumps which have the inspection marks of a qualified independent inspection agency can be sold to the government or purchased by communities that receive government RWS subsidies.

H. Human Resources Development

Human Resources Development

The National RWS/S Programme could be characterized as a training programme for all participants. Communities, RWS/S personnel at the local, state and federal levels, trainers, private contractors and mechanics need to be trained, and decision makers at all levels need to be informed and involved.

RWS/S personnel need to (1) learn new communications skills that encourage dialogue and participation rather than rely on directives, (2) learn effective work planning skills including monitoring, evaluation, and problem resolution, (3) gain a thorough knowledge of the policies and the technical details of the programme and (4) obtain practical experience. To achieve this, a national training programme, requiring a major effort by all concerned agencies and special ESA support, is essential.

It is proposed that a RWS/S Training and Technical Group be formed, comprising staff of interested state RWS/S Units, the FMWR RWS/S Unit, and Training Network Centers. The purpose of the Group will be (1) to maintain links between state projects, (2) to refine implementation strategies while maintaining as much uniformity as local conditions allow, and (3) to coordinate training and training material development.

Training Network Center

The National Water Resources Institute at Kaduna and the University of Nigeria at Nsukka have been identified as suitable institutions to establish centers that will focus on water an sanitation. The NWRI would focus on training sector personnel and disseminating information related to implementing water and sanitation programmes, and UN Nsukka would focus more on development of training materials and methods, applied research in low-cost water and sanitation technologies and implementation strategies, and assisting other institutions to strengthen their water and sanitation curricula. The preparation of training materials and development of training methods will go hand in hand with the implementation of the initial state RWS/S projects. The TNC together with associated consultants will work closely with State WATSAN Units to develop the needed training materials and methods and to refine the implementation strategy.

107. The shift to greater responsibilities for the communities and private sector, with government acting as facilitator, will require a concerted human resources development effort. To a large extent the programme could be characterized as a training programme for all participants: communities, RWS/S personnel and their supervisors at the local, state and federal levels, trainers, and private contractors and mechanics. In addition, administrators and other decision makers at the LGA, state, and national levels need to be informed and involved. While up to 80% of the financing will go towards capital expenditures for new water supply facilities, up to 80% of the effort will go towards training and management.

108. A large number of persons need to work together and, because the approach is new, they require new knowledge and skills. Programme personnel need to (i) learn new communications skills that encourage dialogue and participation rather than rely on directives, (ii) learn effective work planning skills including monitoring, evaluation, and problem resolution, (iii) gain a thorough knowledge of the policies and the technical details of the programme and (iv) obtain practical experience. To achieve this, a national training programme, requiring a major effort by all concerned agencies and special ESA support, is essential.

109. The proposed National RWS/S Programme calls for the following types and numbers of personnel; most of whom require specialized training:

Federal RWS/S Personnel and Consultants
- 2 planning, monitoring and evaluation specialists
- 2 hydrogeologists/hydrologists
- 2 water resources and water supply facilities monitoring specialist
- 2 water supply system design engineers
- 1 handpump manufacturing specialist
- 2 water well drilling specialists
- 3 community development specialists
- 1 health specialists
- 2 training specialists
- 3 accountants and auditors

State RWS/S (number per state)
- 6 community development specialists
- 4 rural water supply technology specialists
- 3 sanitation/health specialists
- 4 hydrologists/hydrologists (2 senior)
- 1 planning specialists
- 2 administrative officers
- 1 manager

LGA RWS/S Personnel (number per LGA)
- 4 community development agents
- 1 sanitation specialist
- 1 RWS technology specialist
- 2 Manager and administrative officer

Private Sector (number per state)
- 50-150 pump mechanics
- 4-6 hand-dug well contractors
- 100-200 latrine artisans

Communities (number per state)
- 4,000 water committees

110. It is proposed that a RWS/S Coordinating Group be formed, comprising staff of interested State RWS/S Units, the FMWR RWS/S Unit, and Training Network Centers. The purpose of the RWS/S Coordinating Group will be (i) to maintain links between state projects, (ii) to refine implementation strategies while maintaining as much uniformity as local conditions allow, and (iii) to coordinate training and training material development.

111. The National Water Resources Institute at Kaduna and the Faculty of Engineering at Nsukka have been identified as suitable institutions to establish units that will focus on water and sanitation for low-income groups. The existing strengths of each institution and the needs of the sector suggest that each institution should address somewhat different aspects of the water and sanitation sector. The NWRI would focus on training sector personnel and disseminating information related to implementing water and sanitation programmes, and UN Nsukka would focus more on development of training materials and methods, applied research in low-cost water and sanitation technologies and implementation strategies, and assisting other institutions to strengthen their water and sanitation curricula. Linkages between the two institutions would be important as each must rely on the experience of the other and both will be working to develop practical training materials. The role of the proposed Training Network Centers for Water Supply and Sanitation (TNCs) will be to assist in the implementation of the National RWS/S Programme by working with State and FMWR RWS/S Units to prepare the training materials needed to implement the National RWS/S Programme and to assist with the training of state RWS/S personnel and to a more limited extent LGA RWS/S personnel.

III. ACTION PLAN

A. Implementation of the National RWS/S Programme

112. The National RWS/S Programme will be supervised by the FMWR with the advice of a National RWS/S Advisory Committee, whose members include the FMWR, DFRRI, FMOH, FACU, UNICEF, and the UNDP/WB Water Supply and Sanitation Program. Programmes will first be prepared in 3 to 5 states and then extended to other states as planning capacity and financing become available. Capacity building at the state and national level will be an important part of programme preparation. At the national level the FMWR will establish a RWS Unit within its Department of Water Supply and Quality Control to supervise the preparation of State Programmes and to coordinate inputs from the Training Network Centers (TNCs) and private consultants. In individual states a WATSAN Unit (a consultant/NGO group), usually linked to the RWS Department of the State Ministry of Water Resources, will be employed to prepare the State RWS/S Plans. This Unit will continue to support the State RWS/S Programme by providing training and technical support to the LGAs, both in preparing and executing the LGA RWS/S Programme. They will be assisted in this by the TNCs and associated local consultants. Assistance will also be provided to the FMWR, State WATSAN Units and the TNCs by UNICEF, the UNDP/WB Water and Sanitation Program and consultants. The operational division of the World Bank and other interested ESAs will work with the FMFED, FMWR and individual state to secure external financing. The involvement of the State WATSAN Units and the TNCs in project preparation and implementation is considered essential to capacity building and replicability in other states.

113. The major components of the National RWS/S Programme are listed below. Financing for each of these must be secured, as part of the National and/or individual State RWS/S Programmes.

Federal, State and Local RWS/S Programmes

Establishment of LGA RWS/S Units, State RWS Departments, and FMWR RWS Unit.

Construction and rehabilitation of water supply facilities, primarily using local contractors.

Privatization of the maintenance of handpumps and small piped systems.

Local manufacture of handpumps and establishment of spare parts distribution through private retail outlets in all states.

Human Resources Development

Establishment of Training Network Centers for Water Supply and Sanitation, including a network of sector specialists who will be associated with the TNCs.[7]

Development of training methods and materials needed to implement State RWS/S Programmes.[8]

Establishment of State WATSAN Units that will be contracted to prepare State RWS/S Plans and to provide training and technical assistance to LGA RWS/S Units.

---

7 To be prepared at the National level for use by individual state.

Establishment of training courses at TNCs for state and key LGA RWS/S personnel, and courses in some local polytechnics for other LGA RWS/S personnel as well as private artisans and contractors.

Private Sector Support

Establishment of a Water Well Drillers Association; also, technical and financial assistance to well drillers to improve their equipment and management.[8]

Technical assistance to hand dug and hand drilled well contractors in individual states and financing of essential equipment.

Technical assistance to local handpump manufacturers, placing of initial orders for pumps, financing dyes for plastic molded components, and establishing third party quality control.[8]

Training of private mechanics for handpumps and small piped systems.

Training of latrine artisans and construction of demonstration latrines.

Preparation of guidelines, technical specifications, engineering drawings bidding documents, contracts, etc.[8]

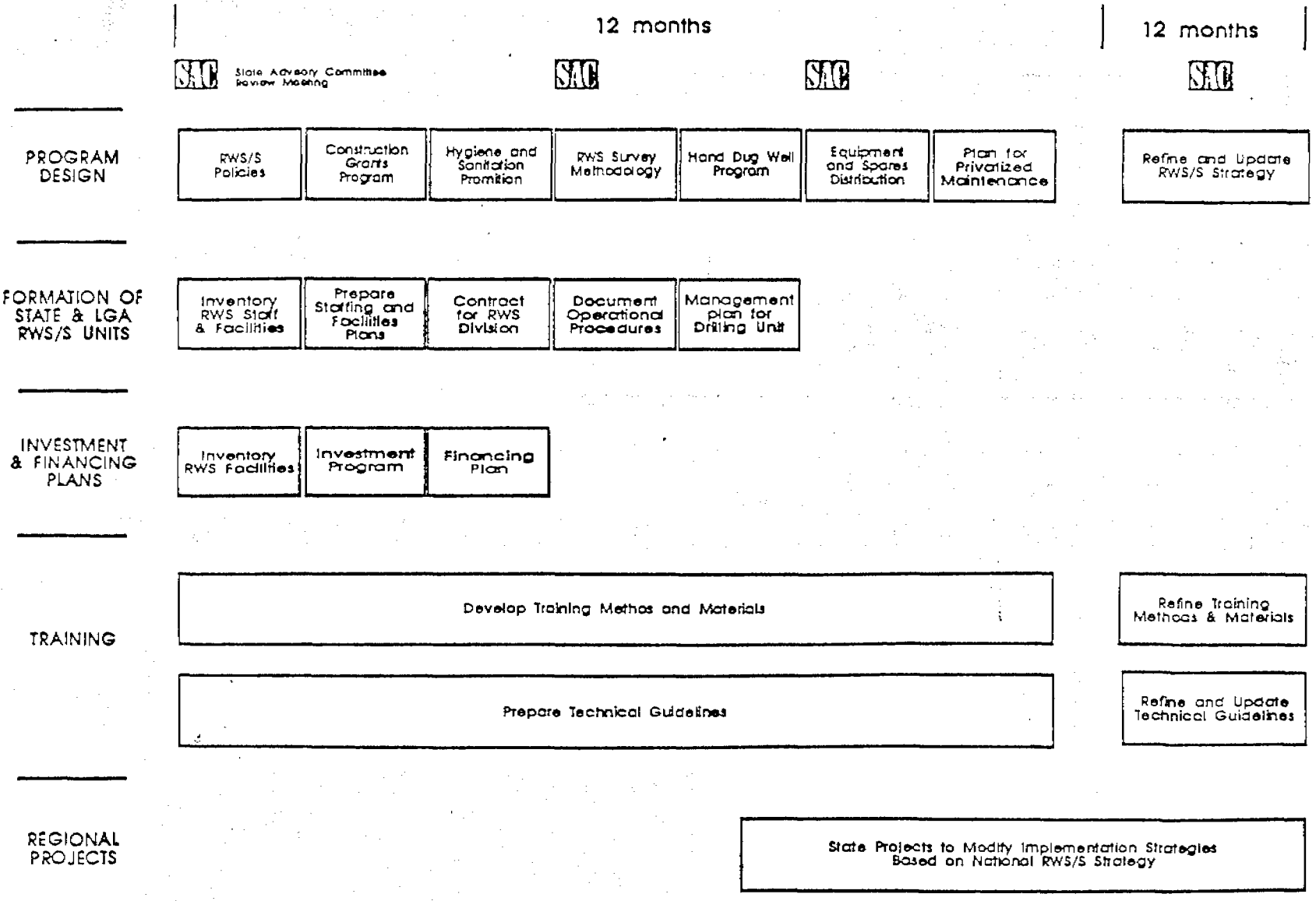
B. Preparation of State RWS/S Plans

114. A "typical" state has a population of about 5 million (more or less equally divided between urban, semi-urban, and rural communities) and 20 LGAs. Of those living in rural communities (i.e. populations of less than 5,000), about 40% live in small communities of less than 1,500 persons where handpumps are likely to be the most suitable technology, and 60% live in larger communities of between 1,500 and 5,000 persons where small piped systems are likely to be better. Assuming that all communities choose to participate in the State RWS/S Programme, by the year 2005 a "typical" state would require about 4,000 handpumps and 400 small piped systems to serve its rural communities; while at present there are about 750 handpumps and few if any small piped systems serving these communities. An investment of about Naira 450 million will be needed to provide these facilities (35% in small communities and 65% in large communities). Using a 15 year implementation period about 250 handpumps and 25 small piped systems would need to be constructed each year in a state. When fully operational the State RWS/S Programme would cost about US$ 4 million per year for facilities and about US $1 million per year for the operational costs of LGA and State RWS/S Units.

115. Plan preparation: Individual states and LGAs will need to prepare an RWS/S Plan for implementing the National RWS/S Programme, establish and staff State and local RWS/S Units based on the guidelines specified in this report (section II B), finance their share of the programme (section II C), and implement the programme according to their State RWS/S Plan. The State Programme should be introduced into LGAs in a state over a period of a few years. When starting the programme in a particular state, it is suggested that activities begin in no more than 4 LGAs in the first two years. In this period the implementation strategy will be tailored to local conditions and core staff will gain the experience they need to extend the programme to the other LGAs. The State Programme should be scaled up over a 5 year period to serve all LGAs.

116. The strategy for preparing and initiating individual State Programmes consists of four components (i) programme design, (ii) establishment of LGA and State RWS/S Units, (iii) investment and finance planning. In addition, training materials and methods need to be developed by the TNCs

SCHEDULE FOR PREPARING A STATE RWS/S PLAN



and then tailored to the needs of each state. State WATSAN Units will be responsible for preparing details of (i-iii) and for presenting these to the State RWS/S Advisory Committee for their review and approval. A more detailed description of each of these components is presented in paras 123 to 130 in the form of terms of reference for preparing State RWS/S Plans. Of particular importance are ▪ staffing and facilities plans, ▪ investment and finance plans, ▪ construction grants programme, ▪ contracting and construction management procedures, ▪ operations and maintenance programme, and ▪ training.

117. The TNCs and their affiliated consultants will have a key role to play in the implementation of the National RWS/S Plans and will be essential to its success. The TNCs will be contracted to (i) prepare a generic State RWS/S Plan that can be used as a model for individual State Plans, (ii) prepare training materials that can be used by individual states to implement their RWS/S Programme, and (iii) prepare an introductory RWS/S training course for LGA and state RWS/S personnel to be given at the TNCs and state polytechnics. The TNC and its affiliated consultants will also be contracted by individual states to assist the State WATSAN Units to prepare their State RWS/S Programmes. To foster an exchange of information a RWS/S Training and Technical Group should be formed, comprising staff of State WATSAN Units, the FMWR RWS/S Unit, and Training Network Centers. The purpose of the Group will be (i) to maintain links between State Programmes, (ii) to refine implementation strategies while maintaining as much uniformity as local conditions allow, and (iii) to coordinate training and training material development. As part of their longer term activities the TNC at UN Nsukka may develop a masters programme that provides specialized training on low-cost water and sanitation for persons interested in specializing in the sector.

118. To ensure that the TNC can meet the challenge, a special support programme will be implemented by the UNDP/WB Water Supply and Sanitation Programme, for which funding will be sought. A nationwide search will be made for the most qualified and committed specialists both in academia and the private sector who would be prepared to develop individual programme components and to provide consultant services to individual states. Persons specializing in the following areas will be required: ▪ hygiene and sanitation, ▪ RWS survey methods, ▪ hand dug well contracting, ▪ equipment and spare parts distribution, ▪ community based operations and maintenance, ▪ design and specifications for RWS and sanitation facilities, ▪ staffing and facilities planning, ▪ investment and finance planning, ▪ water resources and service coverage monitoring, ▪ well siting and construction supervision, ▪ revenue collection and willingness-to-pay for RWS/S in rural communities, ▪ construction grants programme, ▪ participatory communications/training techniques, ▪ work planning, monitoring and evaluation for LGA and State RWS/S Unit personnel, ▪ process of establishing community management, and ▪ administration of LGA and State RWS/S Units.

119. The number of communities that can be served with improved water supplies will depend to a large extent on the cost of boreholes. Costs can best be reduced and coverage maximized by contracting most drilling to private drillers using pre-qualification and local competitive bidding. Prices can also be reduced by providing technical support to serious local drilling contractors. It is recommended that this be done through a National Water Well Drilling Association and that the startup costs and the first three years of operation of the Association be financed as part of the National RWS/S Programme.

120. Initial State Programmes: The National RWS/S Programme should be initiated in selected states. Choice should be based on ensuring both geographic coverage and the involvement of key sector agencies. States that have ongoing RWS programmes along the lines of the proposed strategy or that can quickly secure external financing would be advantageous. To the extent possible these projects should conform to the policies and institutional arrangements that are outlined in this sector strategy and that will be developed further through preparation of the National Programme. Important components of all regional projects include:

(a) Multi-disciplinary RWS/S Units at LGA and state levels.
(b) Programme of support for private mechanics, hand dug well contractors and latrine artisans.
(c) Equipment and spare parts distribution through local retail outlets with the community paying a substantial part of the cost.
(d) Hygiene and sanitation promotion.

121. In the process of implementing these State Programmes (i) the implementation strategy will be refined and tailored to the needs of the particular state, (ii) training methods and materials will be tailored to local conditions, (iii) detailed arrangements for involving the private sector in project execution will be worked out, and (iv) core RWS/S Unit staff and trainers in related institutions will get the experience they need to expand the programme into other areas. The first LGAs that become involved in the National Programme would later become centers at which staff from other states and adjoining states could obtain the field experience they need to implement the programme in their areas.

122. After the programme has been initiated in a few states and TNC staff have completed the outputs described in para 134, future state and key LGA personnel entering the National RWS/S Programme will receive a combination of classroom instruction and field experience through courses offered by the TNCs. Other LGA RWS/S personnel will be given on the job training by state WATSAN staff. They might also receive initial instruction at local polytechnics and field experience in LGAs that have already initiated their RWS/S Programme. The details of individual state training programmes must be worked out as part of preparing the State RWS/S Programme and financing must be obtained for adequate training of staff.

C. Terms of Reference for Preparing State RWS/S Plans

Programme Design

123. RWS/S Policy: Policy statements on a number of important issues need to be adopted by state governments in order to guide sector development. Using the National RWS/S Strategy as a guide, State WATSAN Units will draft policy statements on (i) the objectives of the State RWS/S Programme; (ii) cost sharing arrangements between the State, LGAs and communities. These will be presented to the State RWS/S Advisory Committee (para 38) for their approval; and (iii) the responsibilities of communities, LGAs, SMWR, State DFRRI, SMOH, State WATSAN Units and the private sector in implementing the State RWS/S Programme.

124. Construction Grants Programme: Guidelines for the proposed construction grants programme should be developed, including:

(a) Decision making: Community management means that communities are directly responsible for and must make all decisions regarding the planning, operation, maintenance, and collection of revenues to pay recurrent and replacement costs of their water supply facilities. Communities may choose to contract operations, maintenance and/or revenue collection functions to an outside entity. Options for each of these responsibilities need to be developed and tested both for communities with handpumps and communities with small piped systems. The decision making process that communities must go through in applying for and planning a new or improved water supply system, and the planning assistance and training programme that is to be offered by district and regional RWS Units also need to be developed in detail and refined through LGA based projects.

(b) Construction grants list: Selection of communities that are to receive improved water supply facilities is a sensitive issue and one which requires a defined and transparent methodology. Procedures for preparing and maintaining LGA and state construction grants lists should be developed and the specific mechanisms by which construction grants are allocated between LGAs should be worked out in detail, with the roles of the LGAs and state authorities clearly delineated.

(c) Financing mechanisms: Procedures for channeling government construction funds to beneficiary communities and procedures for communities to pay their share must be developed. Certain flexibility in this is required in order to meet the needs of the various support agencies and to obtain economies of scale in letting machine drilled borehole contracts and effectively supervising their construction.

(d) Construction management: Guidelines for managing construction contracts including pre-qualification, preparation of bidding documents, advertising and awarding contracts, construction supervision, and payment should be prepared, and procedures for supervising the construction of boreholes and hand dug wells by RWS/S Unit personnel and private firms should be developed and tested through LGA based projects.

125. Health Promotion: A component of the National RWS/S Programme that supports the Ministry of Health's programme in this area by carrying out well defined health education activities in the course of RWS/S Units' work with communities that focuses on promotion of personal hygiene, excreta disposal and diarrhea control should be prepared. Special consideration should be given to generating demand for improved water supply and sanitation in communities which do not appreciate the need for them or where unprotected water sources are used in the wet season. In addition, the State RWS/S Programme should take responsibility for establishing private sector capacity at the LGA level to promote and construct a range of household and public latrines. A strategy for identifying and training local artisans to promote and construct latrines should be developed with instruction to include not only technical aspects of construction but also promotional and business aspects, as artisans will need to generate work for themselves through personal contacts with individual households in their area.

126. RWS Survey Methodology: A RWS survey methodology should be developed that can be used by LGA staff to familiarize themselves with the communities in their area including their size, location, existing water supply facilities, prevalence of water related diseases, and need for improved services, and to prepare a construction grants list. The following types of information should be collected and used as the basis for selection criteria to prioritize communities: ▪ population, ▪ community type (scattered, nucleated), ▪ guinea worm (extent), ▪ main water source (type, distance to it, and water quality in the dry season and wet season), ▪ geology, ▪ hand dug wells (presence and suitability for upgrading), ▪ possible new water supply installations, ▪ comments including indications of need, and ▪ location map.

127. Hand Dug Well Programme: A programme should be designed to increase the number of private contractors within each state to construct high-quality hand dug wells. Procedures for identifying, training, financing and supervising viable local contractors and providing work for them should be developed. Provision should also be made for community self-help labor.

128. Equipment and Spare Parts Distribution: A programme to promote the distribution of water supply equipment and spare parts through private retail outlets should be designed and implemented through LGA projects. Equipment should include pumps (manual, solar, diesel and electric), piping, storage tanks, and valves; and services might include installation by a representative of the retailer and a limited warranty.

129. Privatized Maintenance System: Where existing water supply facilities are maintained by government, a strategy and schedule for converting to privatized maintenance for handpumps and small piped systems, utilizing existing staff to the extent possible and ensuring uninterrupted operation of existing facilities, should be prepared. Many states already have trained handpump mechanics who are employed by state agencies; a specific support programme, including both training and financial assistance, to help current staff to make the transition to privatized maintenance is essential. Instruction on repairing new types of pumps and, more importantly, learning to operate a private business should be planned.

130. Borehole Rehabilitation: Long term sustainability of the RWS sector will require that boreholes be rehabilitated perhaps once every ten years. A programme to provide borehole rehabilitation services through the private sector should be developed, possibly linking it to the hand dug well programme, as contractors will require compressors in both instances.

Formation of State and LGA RWS/S Units

131. A comprehensive strategy for establishing a State Department of RWS/S and a WATSAN Unit should be prepared. Activities should include:

(a) Existing Organization and Resources: Review the organization of existing RWS operations and inventory staff (numbers and skills), facilities, and equipment.

(b) Staffing and Facilities Plan: Staffing and facilities plans for LGA RWS/S Units, State Department of RWS/S, and State WATSAN Units are required, including an operational budget for the first five years of the State Programme during its expansion phase and one for a full scale state programme. Also, incentive programme for RWS/S Unit personnel at the state and LGA levels to encourage installation of new or rehabilitation of existing water supply facilities and their proper management, linking renumeration to actual achievements (e.g. annual bonuses) should be developed.

(c) Operations and Personnel Manuals: Prepare operations and personnel manuals for the State and LGA RWS/S Units. The operations manual should contain procedures for (i) budgeting, accounting and disbursal, (ii) procurement, (iii) inventory control, and (iv) contract management including pre-qualification, preparation of bidding documents, advertising and awarding contracts, construction supervision, and payment.

(d) Contract for National RWS/S Programme: Draft a contract under which WATSAN Units would provide training and technical support to LGAs.

(e) State Drilling Units: Develop a management plan for state owned and operated drilling units, including their organization, staffing, and financing. The unit should be autonomous and self-financing, and should be structured with a view toward privatization.

Investment and Finance Planning

132. Investment Programme: Prepare an investment programme for the State RWS/S Programme.

(a) Demand for RWS facilities: Estimate (i) the number of small piped systems and point sources (handpumps and open wells) in each LGA that exist; (ii) the number

of new and rehabilitated systems that will be needed to serve the target population, and (iii) the demand for improved supplies (i.e. the number of communities that will be prepared to request a grant and pay their portion of the costs). Particular attention should be paid to those LGAs that will first participate in the National RWS/S Programme.

(b) Planned investments: Review the planned investments going into each LGA.

(c) Investment plan: Prepare an investment plan for the water supply facilities to be constructed in each state and for the operational costs of LGA and State RWS/S Units, including physical works, facilities and equipment, staffing and operations, training, and technical assistance. The implementation schedule should be based on reasonable assumptions for funds availability, absorptive capacity, and necessary community promotion and involvement.

133. Financing Plan: Prepare a financing plan for the state indicating the types (new and rehabilitated hand dug wells, machine drilled wells, and piped systems) and approximate numbers of facilities that are needed to reach 90% coverage of the rural population.

D. Human Resources Development

134. Implementation of the National RWS/S Programme will require a concerted human resources development effort. All RWS/S personnel (LGA, state and national levels), Training Network Center staff, decision makers (community, district, regional and national levels), and selected members of each community must be trained. In preparing for the National RWS/S Programme the following work is required: (i) develop and refine the training materials and training methods needed to implement State RWS/S Programmes, (ii) train LGA, state and national staff, and (iii) develop and strengthen RWS/S curricula at Universities and some state polytechnics. The TNCs will be contracted to do this work.

135. Key areas in which sector personnel need to be skilled include (i) participatory communications techniques, (ii) work planning, monitoring and evaluation, and (iii) strategy for establishing community management. In addition, technical guidelines for the construction, operation and maintenance of water supply and sanitation facilities are required. The training materials to be prepared should be grouped into training packages and should be tailored to the different groups that will be using them. Trainers of personnel at each of the different levels will also need, in addition to the training package for that group, trainers' guides containing additional information on the subject and on the training methodologies to be used. The particular types of training materials and training techniques that are used will vary. Materials may be written reports or manuals, slides, video, flip charts, posters, etc. Didactic and participatory techniques as well as practical and theoretical methods should also be used as appropriate.

136. Participatory communications techniques: Participatory communication techniques are essential for the establishment of community management, for water supply facilities will be sustained only if communities decide the type of systems that they want and how they will manage them. All project personnel must be trained to communicate effectively with their clients in the communities in a way that ensures that they understand the issues and options, that draws out their thinking on these, and that leaves decision making to them. Participatory communications techniques are also effective in project management, particularly in projects such as RWS/S that require a multi-disciplinary approach which is tailored to and evolves with the needs of each community. Techniques and materials must be developed that can be used to improve project personnel's ability to communicate effectively with communities and to conduct planning meetings that are participatory

in nature. Participatory training techniques for (i) conducting community meetings, (ii) conducting water committee meetings, (iii) training WATSAN committee members, (iv) training and supervision of district personnel, and (v) day to day work planning of LGA and State RWS/S Units should be prepared and field tested.

137. Work Planning, Monitoring and Evaluation: Work planning, monitoring and evaluation are interrelated and essential to successful implementation of LGA RWS/S Programmes. Specific materials on the following elements should be prepared and field tested.

(a) Work planning: In working with individual communities problems are likely to arise because of unique social or physical conditions, consequently community support activities must be tailored to the needs of each community and work plans need to be updated from visit-to-visit. LGA staff, assisted as required by State WATSAN personnel, will need to strategize to tailor their support to each community and to overcome problems that may arise. Guidelines for preparing annual work plans for LGAs and states need to be prepared, as does a record keeping system through which LGA and state staff can track the progress of individual communities and design and schedule upcoming activities.

(b) Monitoring and evaluating sustainability: The main purpose of monitoring and evaluation is to assess the sustainability of water and sanitation facilities and to find ways of improving policies and implementation strategies. Guidelines should be prepared for state and LGA personnel to measure the level of community involvement/support for their water supply facilities. Techniques that require the active participation of the beneficiary communities and that promote inter-staff communications should be employed. At the national level, the TNC should set up a monitoring system to evaluate the sustainability of the water supply facilities including the management capability of WATSAN committees. Research will be directed at identifying constraints to the establishment of community management and ways of refining implementation strategies and training materials to better effect sustainable water supply facilities. Also, procedures for identifying the training needs of LGA and State RWS/S Unit personnel should be developed.

(c) Monitoring of service coverage and water resources: Procedures for monitoring service coverage and water resources (surface and groundwater occurrence and quality) should be developed, including water quality sampling procedures and record keeping. An appropriate database should be established and maintained at State Departments of RWS with the information passed on to the FMWR.

138. Establishment of Community Management: Establishment of community management requires training materials that are tailored to implementing each step of the process. Manuals and training procedures for each of the subject areas listed below should be prepared. In general, for each category there will be (i) manuals for sector specialists so that they will have the detailed information they need to carry out their work, (ii) training aids for communities to help them plan and manage their water supply facilities, and (iii) basic information for personnel specializing in other areas of the programme so that they can reinforce components for which they are not directly responsible.

(a) Programme information: Overviews of all aspects of the State RWS/S Programme are required so that (i) all staff are conversant with all aspects of the State Programme, not just their areas of specialization; and (ii) decision makers, private artisans, contractors, and the general public can have access to the information they need to interact with the Programme. Subjects should include basic RWS/S policies; construction grants programme (RWS survey methods, selection criteria for

communities, processing procedures, contract management and construction process); roles and responsibilities of communities, private sector and government agencies; community decision making process and training programme; participatory communications techniques; design and siting of water supply and sanitation facilities; maintenance procedures (fault detection and repair of handpumps, spare parts distribution, and private repair services); and promotion of hygiene and sanitation.

(b) RWS surveys: Guidelines and materials for conducting RWS surveys should be prepared and field tested.

(c) Grants lists: Procedures for preparing and up-dating construction grants lists should be prepared and field tested.

(d) Community support: Materials for assisting communities to plan and manage their water supply systems should be prepared and field tested, including:

(i) Training WATSAN committee members
(ii) Revenue collection, accounting, savings, and record keeping
(iii) Operations and maintenance
(iv) Health and hygiene education
(v) Monitoring and evaluation (follow-up - problem resolution)
(vi) Promotion of hygiene and sanitation
Environmental quality in communities: general sanitation and drainage at water points.
Collection, storage and use of household water.
General health promotion (diarrhea control, immunizations, nutrition)

139. Technical Guidelines: Practical technical guidelines, designed for field use, are needed to ensure a consistent, high quality programme. Detailed materials for the following are required:

(a) Guidelines for siting hand dug and machine drilled wells and supervising their construction.

(b) Standard drawings and specifications, indicative installed costs, sample bidding documents, construction inspection guidelines, and O&M manuals for hand dug wells, machine drilled boreholes, handpumps, small piped systems (solar, diesel and electric pumps, storage tanks, piping, outlets), surface water treatment facilities, and latrines (household and public). The demand for latrines in the past has been limited by their high cost; it is therefore important that a range of different cost designs for improved sanitation (from a simple trench to various types of VIP and pour flush latrines) be available.

ANNEXES

Hand-Dug Wells

Suitability

140. Hand dug wells are preferred because they are relatively inexpensive and can be maintained by the community. They should be constructed where the following conditions are met:

- Shallow aquifer (less than 25m) providing a year round supply of water, either in sedimentary formations (generally best) or in the overburden in the basement, with yields at least 0.5 m3/hr.
- Hard rock materials can be excavated with hand tools or light pneumatic equipment.

Guidelines for Construction

- Geophysical surveys should be conducted in basement to determine areas of deepest fracture.
- In stable soils first excavate to the water table; line the well in-situ; and then excavate below the water table within a perforated caisson (smaller diameter concrete rings that are placed one on top of the other). This makes it easier to excavate below the water table, to go to greater depths, and to deepen the well at a later time should the groundwater level drop. In unstable soils the well may be dug inside precast concrete rings as described above for working below the water table. A brick or shot concrete lining can be used in stable soils, but reinforced concrete provides better durability, and must be used in unstable soils. Iron rods not less than 6mm in diameter and proper cement mix (350 to 400 kg/m^3) should be used. The diameter of well should not be less than 1.2m, to ensure access for maintenance and adequate yields.
- In order to provide a year round supply of water, the well must be generally extended about 3 meters below the water table. This requires the use of a de-watering pump powered by a compressor, unless yield is low and de-watering can be performed with buckets.
- Proper design of the platform is essential to minimize contamination. It should be at least 0.8 meters off the ground and include a collar and concrete apron sloped to drain away from the well. When the well is fitted with a handpump, it is advisable that an access port be provided so that users can draw water by traditional means should the pump break down.

Maintenance Requirements

- Hand-dug wells tend to fill up with silt, so they periodically must be cleaned out. This can be done by community members (as much as once a year in sandy soils).
- The concrete lining may periodically require patching by a local mason.

Cost (Exclusive of Pump)

- Hand-dug wells (1.2 m diameter) based on above specifications: Naira 800 per meter.
- The main factors affecting the cost per meter are the well diameter and the general organization of the works. It is essential that materials and equipment, particularly expensive compressors, be available when needed at construction sites.

Drilled Boreholes

Suitability

- Drilled boreholes are suitable in any hydrogeological context provided that an aquifer with a minimum discharge of 0.25 l/s is present and the proper drilling technique is used.
- Drilled borcholes are required whenever a discharge higher than 3 m3/hr is needed, i.e. if a submersible pump is going to be installed.
- A drilled borehole should be used only if the community is prepared to manage its pump.

General Guidelines for Construction

Basement

Target zones for water:
Weathered profile (below 10m)
Bedrock/overburden interface
Shallow fractures within the bedrock

Well siting: Well siting should begin by the community deciding where it would prefer the well to be located, resulting in a proposal to the hydrogeological survey team. However, extension agents should explain to the community that it is difficult to obtain reliable water supplies in areas underlain by basement, and that it may be necessary to drill at a point that may not precisely accord with community preference, and even then water may not be found. The hydrogeologist should consult with the water committee during site selection.

Boreholes should not be sited without a hydrogeological assessment. This may vary from a field reconnaissance (paying particular attention to geomorphology), through an analysis of aerial photographs, to a full scale background data and surface geophysical survey. At present the preferred methods of geophysical surveying for water point siting are electro magnetic (EM) traverses, resistivity profiling, and vertical electrical sounding (VES). In basement areas a combination of EM traverses and VESs are increasingly being recognized as having the greatest value. Also, where perennial hand dug wells have been successfully constructed, new sites can be assessed by observing conditions in other wells.

Drilling method: Direct circulation rotary is to be used in the overburden and down-the-hole hammer in the bedrock. In all cases air is the preferred drilling fluid, with air-mist or light foam if necessary in the overburden. In exceptional cases drilling mud (polymer mud, never bentonite) may be required.

Well depth: The target yield for a 'successful' borehole to be equipped with a handpump should be 0.25 l/sec. Interim yield tests should be conducted throughout drilling. Borehole depths should be estimated from successful boreholes where depth of water struck and incremental increase in yield have been recorded. In the absence of such records a general target depth for borcholes in basement to be equipped with handpumps should not exceed 50 metres. The overburden should never be cased off if it contains any perennial water.

Casing: The Drilling and casing diameters should be compatible with the planned and realistic future pump installations and should allow installation of formation stabilizer where necessary. The final casing should never be less than 100 mm (4 inches), and preferably should be 150 mm (6 inches) for communities up to 5000. Screen to be installed should have an open area of

around 10% and should generally be in the form of uniformly slotted pipe; use of either roughly slotted pipe or expensive stainless steel wire wound screen should be avoided.

Gravel pack: Filter packing is required is all cases except where it can be naturally developed from aquifer material in cases of loose sediments.

Development: Completed boreholes should be developed using jetting and air lifting for a minimum of five hours, the solid content of the discharge should be monitored and a sand free sample should be obtained. Yield and drawdown should be monitored during development.

Consolidated Sedimentaries

Target zones for water:
Permeable layers within the formation
Fractures

Drilling method: Direct circulation rotary drilling using drag or rock roller bits should be used, and DTH hammer should be avoided unless absolutely necessary. In all cases air, air-mist, or light or stiff foam is the preferred drilling fluid. This is often the only satisfactory way to determine: (i) the depth of the producing zones of the aquifer and hence the correct screen placement, (ii) the required depth of drilling, and (iii) the potential final yield of the hole. If at all possible the use of mud should be avoided and if judged essential it should first be used as an additive to foam to increase lift capacity. Only degradable high quality polymer should be used.

Well depth: Interim yield tests should be conducted throughout drilling. Target borehole depths should be determined from successful boreholes where depth of water struck and incremental increases in yield have been recorded. In the absence of such records the final depth of a borehole should be determined on the basis of the yield tests.

Casing: Drilling and casing diameters, together with yield targets should be the same as for basement boreholes (see above). Screen should have a minimum open area of 10% and should generally be in the form of uniformly slotted pipe; use of either roughly slotted pipe or expensive stainless steel wire wound screen should be avoided. Where equipment is available the boreholes should be geophysically logged and screen should be placed on the basis of incremental yield increases with geophysical logging information used as back up.

Gravel pack: Full gravel packing is rarely required in consolidated sedimentaries but formation stabilizer should be installed.

Development: Completed boreholes should be developed using jetting and air lifting for a minimum of ten hours, the solids content of the discharge should be monitored and a sand free sample should be obtained. Where necessary development periods should be extended.

Unconsolidated sedimentaries

Target zones for water:
Permeable layers within the formation

Drilling method: For small scale water supplies mechanized drilling is only appropriate if water is found at a depth which makes hand drilling or hand dug wells impossible. Reverse circulation rotary, cable tool or direct circulation rotary drilling can be used. Rotary or cable tool are preferred as they do not require drilling mud.

Drilling depth: Target depths should be based on well records for the area, on the result of interim bailer tests or on analysis of the drill samples. Once the aquifer has been penetrated, samples should be sieved to complete a full borehole design.

Well casing and gravel pack: Borehole design and decisions on gravel packing, etc. should be based on established practice as detailed in standard texts.

Development: When drilling mud has not been used, completed boreholes should be developed using jetting and air lifting or surge blocks for a minimum of five hours, the solids content of the discharge should be monitored and a sand free sample should be obtained. When drilling mud has been used, completed boreholes should be developed using jetting and air lifting or surge blocks for a minimum of 10 hours; this period should be considerably extended if necessary (up to 24 hours would not be unusual).

In all cases (basement as well as sedimentary) test pumping should be carried out using a five phase 500 minute step test (100 minute steps). In the case of boreholes to be fitted with motorized pumps, the step test should be followed by a continuous discharge test of a minimum of 1,500 minutes duration. In all cases boreholes should be sealed with cement to a depth of 3 meters below the surface.

Cost (exclusive of pump, siting and overhead)

- In the basement, 50m deep, 4 1/2 inch PVC-casing, based on a contract for 100 wells: Naira 75,000 including development, pumping-test, grouting and platform, but exclusive of cost of abortive wells.
- In sedimentary formations, 80m deep, 6 inch PVC-casing with stainless steel screens, based on a contract for 50 wells: Naira 100,000 including logging, development, pumping-test, grouting and platform.
- Cost of works supervision by technical office with land-rover: Naira 800 per borehole.

Open Wells Without Pumps

Suitability

- An open well may be the sole option if a community is not able to manage the maintenance of a handpump and may be preferred where large quantities of water for cattle are required.

- In general, community open wells should be avoided because of the risk of disease transmission when large numbers of families share a single water source. Whenever possible handpumps should be installed on community hand dug wells.

Maintenance Requirements

- Periodic replacement of ropes and buckets.

Cost

- While the maintenance cost (periodic regrouting and cleaning) is inexpensive, the operational cost of open wells usually exceeds the cost of maintaining a handpump. This is because each household must purchase and periodically replace the ropes and buckets that are used to draw water.

Direct-Action Handpumps

Suitability

- Direct-action pumps have no lever handle or bearings; they are operated by vertical up and down movement of a T-bar handle that is directly connected to the rising main/piston assembly. Having no mechanical advantage, direct-action pumps are suitable for static water levels up to 12 to 15 meters. Their low cost, high water yields, corrosion resistance, and ease of repair make them an excellent option. With delivery rates of up to 2 m^3/hr (30 liters/min), direct-action pumps can serve 200 to 500 inhabitants depending on the housing density.

Maintenance Requirements

- Currently available direct-action pumps such as Naira AF 85 are corrosion-fee. Wearing parts are inexpensive and pump rods and pistons can be extracted without removing the rising main. Installation is simple and repairs can be made with only three tools by community members, including women with little mechanical experience.

Cost

- The cost of an imported Nira AF 85 direct-action pump is about Naira 4,000. If manufactured locally (which is likely to occur since required technology is available in Nigeria), the cost could be reduced to about Naira 3,000.

High-lift Handpumps

Suitability

- High lift handpumps are suitable for pumping lifts up to 45 meters and are recommended for lifts between 15 and 45. Below this direct-action pumps are generally better and above this they should be used only if motorized schemes are not feasible.

- Since discharge is in the range 0.7 to 1.2 m3/h (12 to 20 1/mn), they can serve 200 to 400 users. Due to queuing times, service level will be good at 200 persons per pump and poor at 400 persons per pump.

Maintenance Requirements

The two main factors affecting maintenance are:

- Ease of extraction of the down-the-hole components, (i.e. pump rods, piston, rising main and cylinder) and replacement of wearing parts (seals, fulcrum bearings, handle bearings, pistons and footvalves).

- Corrosion resistance, since more or less aggressive water is found throughout Nigeria.

Both these factors have been taken into account, among others, in the definition of the "VLOM" handpump concept. Among those likely to be manufactured in Nigerian in the very next future, the Afridev and India Mark III are the closest to this concept, although the Afridev is recommended for corrosive groundwater conditions (Ph below 6.5) and in general for moderately corrosive waters (Ph between 6.5 and 6.8).

Cost

- Depending on installation depth, the cost of a high-lift handpump is in the range Naira 6,000 to 8,000.

- When performed at community level, the maintenance of high-lift handpumps costs about Naira 600 to Naira 1,200 per year, including periodic replacement of major parts and payment to local private mechanics.

Comparison of Handpumps Currently Used in Nigeria

1. The most important criteria used to assess handpumps are presented below together with an assessment of the pumps recommended for use in Nigeria.

2. International Specification: If pumps are made to an international specification and are produced by a number of manufacturers in different countries, a spare parts supply is better ensured and the resulting competition between manufacturers prevents a sole supplier from charging excessive prices.

3. VLOM Potential, Ease of Installation and Repair: A VLOM pump is one that is suitable for village level operations and maintenance. VLOM means (i) the community can make repairs itself or hire local private mechanic, (ii) the community can finance repairs and eventually replace the pump, (iii) the pump can be manufactured in the country to ensure availability of spares, and (iv) the pump is robust and reliable under field conditions. Pumps that can be installed and repaired without heavy lifting equipment and with a minimum of tools are particularly advantageous, as they make it possible for local private mechanics and community members to undertake the work. This saves money and minimizes down times. In particular wearing parts should be able to be repaired by community members, including women with little mechanical experience.

6. Reliability: Reliability of mechanical equipment is commonly measured in "mean time before failure". In rural water supply, however, "mean down time" is equally as important. Pumps that can be repaired by village mechanics are advantageous as this avoids the long down times that occur with central maintenance systems.

7. Corrosion Resistance: The groundwater quality in Nigeria necessitates the use of fully corrosion resistent pumps. Nearly all RWS projects using India Mark II or Moyno pumps are faced with corrosion problems, rising mains and rods must be replaced every few years and corrosion results in unacceptable drinking water quality because of the high iron content.

8. Suitability for Local Manufacture: Pumps that require less sophisticated production processes and allow for greater dimensional tolerances are more suitable for local production.

9. Price of the Pump and Spare Parts: The price of the pump and especially its spare parts should be as low as possible. This will allow communities to raise enough money to purchase the necessary spares without difficulty and to eventually replace the pump.

Table 2 Comparison of Handpumps

Criteria	India Mark II	RUWATSAN I India Mark III	RUWATSAN II Afridev	Nira AF-85
International Specifications	The pump is produced in many countries to Indian Standards. Specifications are in the public domain.	The pump is produced in many countries to Indian Standards. Specifications are in the public domain.	The pump is produced in many countries to an International Standard. Specifications are in the public domain.	The pump is designed by private company, but available to local manufacturers. It is made in Finland and Tanzania.
Ease of Installation	25 tools are needed forinstallation, 10 of which are specialty made for the pump.	Same tool requirements as IMII. Small clearence between casing and 2.5 inch rising main can impede installation. Wide diameter rising main makes pumping elements easy to install.	8 tools are needed for installation. Solvent cementin grising main in the field can be a problem. Hooked rods and wide diameter rising main make pumping elements easy to install.	Pump can be installed with few tools. All components are light weight.
Ease of Repair	Community cannot repair pump. Tripod needed below 30m, rising main and rod disassembly needed to withdraw cylinder parts. 16 different tools are required.	Community can make most repairs but private mechanic needed to replace bearings. 10 different tools are required tomake repairs.	All routine repairs can be done by community with a spanner and a fishing tool. Hooked rodsand plastic bearings simplify repairs.	All repairs can be done by community with 3 simple tools.
VLOM Potential	Community mechanics cannot repair pump. Tools are expensive and not readily available.	Community mechanics can makemost repairs but tools are expensive.	Community mechanic can maintain pump with minimum support from a private mechanic.	Community mechanic can easily maintain pump. Spares are cheap and have long shelf life.
Reliability	Pump is reliable with fewbreakdowns. Can have long downtimes because of dependency oncentral crews.	The pump is reliable with few breakdowns. If water has sand or if cylinder not smooth, leather cups wear quickly.	Few breakdowns, which can be repaired by community mechanic. It has not been proven that community will replace plastic bearings annually.	Pump has few breakdowns andcan be quickly repaired bycommunity mechanic.
Corrosion Resistance	Galvanized rising mains and piston rods are not corrosion resistant in West Africa groundwaters. Stainless steel isvery expensive but needed for half of all installations in Nigeria.	Galvanized rising mains and pump rods are not corrosion resistent in West Africa groundwaters. Stainless steel isvery expensive but needed for half of all installations in Nigeria.	All below ground parts are corrosion resistant. When pH is below 6.8 stainless steel rods are recommended and below 6.5 are essential.	All below ground parts are highly corrosion resistant.
Pumping Lift	Can be used up to 80m, but maximum recommended for any handpump is 50m.	Can be used up to 45m. Above this the weight of the rising main makes handling dangerous.	Pump can be used up to 45m.	Pumping lift is a maximum of 15m. Application of pump is to shallow wells.
Suitability for local manufacture	Pump is manufactured in several Asian and African countries. High investment required for toolingand for stainless steel stock.	Pump is made in several Asian and African countries. High investment required for toolingand for stainless steel stock.	Relatively high costs for jigs, fixtures and molds for plastic components. Working capital requirements are relatively low.	The pumphead can be easil yproduced. If local HDPE pipes areavailable, whole pump can bemade locally.
Cost of Pump and Spares	Prices of pump and spares arelow due to competition in India and local availability of steel. Nigerian manufactureres will have difficult time competing.	Prices of pump and spares are low due to competition in India and local availability of steel. Nigerian manufacturers will have difficult time competing.	Initial pump cost is somewhat high, but spares are inexpensive and operational costs low. Withmargin of preference local manufacturers can compete.	Initial cost of pump is moderate. Spares are inexpensive.

(1) Pump prices do not include markups for local distributors or profit for local manufacturers.

Electric Submersible Pump Connected to National Grid

Suitability

- Electric submersible pumps should be used whenever reliable electricity from the national grid is already available within a community. The cost of extending the transmission lines must also be considered. It is advisable that a study of the reliability of the electricity supply (both cuts and voltage fluctuations) be carried out before a decision is made to install an electric submersible pump. If a diesel generator is required, the scheme should be reconsidered as handpumps may be a better option.

Maintenance Requirements

Maintenance requirements are quite low on electric submersible pumps.

- If waters are turbid, it may be necessary to extract the pump every 1 or 2 years in order to clean the impellers and check the condition of the rising main.
- Bearings are usually sealed and do not require greasing.
- Problems may occur with GI rising mains in corrosive waters. "Wellmaster" semi-rigid pipes are a good alternative as they are corrosion-free, easy to install and extract, and somewhat less expensive than stainless steel.
- Burnt motors should be rewound at a reliable electrical workshop or better yet exchanged for a new or rebuilt motor at an authorized dealer.

Cost

- Capital cost: Including stainless steel or semi-rigid riser pipes, electric cable, switches, well head with meter, but excluding a transformer (11,000 v - 380 v).

  5 m^3/hr, 20 m TDH, and 4" riser: Naira 25,000

  20 m^3/h, 20 m TDH, and 6" riser: Naira 55,000

- Maintenance cost: Naira 8,000 per year
- Operation cost: the very low cost of electricity delivered by NEPA (8 kobo/kwh) makes it possible to produce 1 m^3 of water for less than 1 kobo of power.

Electric Submersible Pump with Diesel Generator

Suitability

- Where a submersible pump is needed to meet relatively high water demand, if electricity is not available.
- Where technical ability is available locally for maintenance of the generator and engine.

Maintenance Requirements

Submersible pump (see previous section)

Engine and generator:

- The requirements of the engine are those usual with diesel engines: oil changes and replacement of oil, fuel and air filters, valve adjustment, etc. Breakdowns are most likely to be due to the fuel injection system (injectors, injection pump), which will require well equipped and experienced mechanics.
- Electric starters should be avoided whenever manual starters can be used, for both batteries and starters can cause trouble.
- The requirements of the generator itself imply electro-mechanical abilities which are not readily available in some rural areas.

Cost

Operation: Naira 5,000 to 10,000 for power in the range 9 to 25 KVA per year for fuel and lubricants.

Maintenance: 5% of initial cost in the first two years and 10% thereafter.

BASE CONDITIONS FOR COMMUNITY WATER SUPPLY SYSTEMS

Demographic Characteristics			
Total Population	1000		
Number of households	125		
Housing density (households/hectare)	15		
Economic Conditions			
Discount rate (%)	10		
Useful life of mechanical eauipment	10		
Useful life on non-mechanical equipment	20		
Annual O&M of mechanical equipment (% of cap cost)	10		
Annual O&M of non-mechanical equipment (% of cap cost)	1		
Electric power cost (Naira/KWHR)	1		
Diesel fuel cost (Naira/liter)	5		
Solar insolation (KWHR/M^2/Day)	5		
Average wind speed (meters/second)	3		
Water Supply System			
Distance to new source (m)	75	75	-
Collection time (min/trip)	20	5	-
Water use (liters/cap/day)	20	20	75
Number of wells	4	1	1
Number of water points	4	4	125
Cost per well (Naira)	50,000	50,000	50,000
Pumping and storage lift (m)	20	30	30
Storage volume (V/Q)	-	1	1

THE COST OF WATER SUPPLY FACILITIES FOR THE PROTOTYPE COMMUNITY

CAPITAL COST (Naira)

Component	Point Sources					Yard Taps	
	Manual	Electric	Diesel	Solar	Wind	Diesel	Solar
Wells	200	50	50	50	50	50	50
Pump	36	34	84	110	125	95	360
Storage	-	45	45	45	45	87	87
Piping	-	65	65	65	65	270	270
Total	236	194	244	290	285	502	760

ANNUALAIZED PER CAPITA COST (Naira/capita/year)

Component	Point Sources					Yard Taps	
	Manual	Electric	Diesel	Solar	Wind	Diesel	Solar
Capital	29.5	25.0	33.5	34.0	40.0	74.0	102.5
O&M	6.5	8.0	21.0	7.5	8.5	31.5	24.5
Power	-	1.5	3.5	-	-	13.0	-
Total	36.0	34.5	58.0	41.5	48.5	118.5	127.0