

**BACKGROUND STUDY ON WATER AND ENERGY  
ISSUES IN NIGERIA TO INFORM THE NATIONAL  
CONSULTATIVE CONFERENCE ON DAMS AND  
DEVELOPMENT**

By

**J. K. Okoye**  
*B.Sc, M.Sc, PhD*

*And*

**Priscilla M. Achakpa**

*Submitted to the*

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**&**

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## **INTRODUCTION**

### **Preamble**

The aim of the study is to provide a framework for “Setting the Agenda for a National Dialogue Process on Water and Energy Policies in Nigeria with Reference to the Framework of the World Commission on Dams (WCD)”. Formulation of a Realistic Master Plan for National Water and Energy Policies has received increased attention in Nigeria of recent. Combined efforts of the Federal Ministry of Agriculture and Water Resources and other interest groups such as the World Commission on Dams (WCD), Society for Water and Public Health Protection (SWAPHEP) and United Nations Environment Programme - Dams and Development Project (UNEP-DDP) are highlighted in this study.

### **Background**

In Nigeria, a draft bill on Water Resources Management containing aspects of dam and development had been submitted to the National Assembly by the Federal Ministry of Water Resources (FMWR). The bill was however submitted without input from dam-affected communities and Non-Governmental Organizations (NGOs). In order to address this anomaly, SWAPHEP and FMAWR are collaborating to initiate a national dialogue on dams and development in Nigeria.

WCD was organized in 1998 with the mandate of reviewing the development effectiveness of large dams and assessing alternatives in water sources and energy development. It was also intended to develop internationally acceptable criteria, guidelines and standards for dams. In November 2000, the Commission published its report “Dams and Development: A new framework for Decision-making”.

SWAPHEP, on the other hand, is an NGO concerned with dams and related development issues. It has worked with dam affected people in Nigeria. In addition to attending UNEP-DDP issue-based workshops on Gaining Public Acceptance, SWAPHEP, has organized several awareness workshops for civil societies on the WCD report.

SWAPHEP, in collaboration with FMAWR, are seeking UNEP-DDP’s co-operation and support to enhance the maiden multi-stakeholder consultation stages to establish the dialogue forum and produce recommendations on the necessary improvements for legislation. On its part, UNEP-DDP is to promote dialogue to improving decision making, planning and management of dams and their alternatives on the basis of the WCD Core Values and strategic priorities and other relevant reference materials.

In 1984, the Federal Ministry of Water Resources and Rural Development initiated the preparation of a National Water Resources Master Plan with FAO assistance. A draft plan submitted in 1985 did not compile all necessary issues and the FAO assistance could not stretch further to address these issues for lack of fund. Efforts by Government towards securing foreign financial assistance for this purpose have not been fruitful. Realization of this objective has been greatly hampered by

stagnation in government spending which originated from a succession of large fiscal and external payment imbalances combined with global economic recession.

### **Project Objective and Goals**

The principal goal of this study is to evolve decision-making strategies to formulating water and energy policies in Nigeria with inputs from a multi-stakeholder dialogue process drawing from the WCD Report Core Values (CVs) and Strategic Priorities (SPs) and other materials.

The main objectives of the study are

- to set up a stakeholder dialogue process to contribute to the improvement of the water and energy policies in Nigeria drawing from the WCD SPs and CVs as well as other materials, and
- to identify major issues and concerns including areas of potential conflicts amongst stakeholders for the dam and development debate drawing from the WCD CVs and SPs and other experiences for the purposes of improving policies on water and energy.

### **Expected Outcomes**

Among the expected results of the study are the following:

- Background documentation to the consultation conference which shall include broad issues on water and energy in Nigeria.
- Position Statement of Civil Societies on the issues of dams, water and energy resources management, and recommendations on ways to improve the water and energy policies in Nigeria presented to the national consultative conference.
- Resolution on the National Consultative Conference regarding the proposal to establish the multi-stakeholder dialogue process and possible governance structures for the process.
- Scoping Report articulating the water and energy situations in Nigeria, challenges and opportunities in the planning and management of dams, recommendations to improve regulatory frameworks and practice in dams and development, and proposing a detailed work plan for dams and development of dialogue process in Nigeria. This will serve as a knowledge base for the forum to define the roadmap for the multi-stakeholders dialogue process for improvement on Water and Energy Policies in Nigeria.
- A roadmap on the Multi-stakeholders Dialogue Process in Nigeria endorsed by the Dams and Development Forum that aims at contributing to improving Water and Energy Policies in Nigeria.
- A press release highlighting the resolutions of the stakeholders at the forum on the process that will contribute to improving water and energy policies in Nigeria with reference to the framework of the WCD.

## **Purpose and Task of Background Study**

As highlighted in Section 1.2, the goal of the study is to set the stage and provide the information background for the successful implementation of the programme for “Setting the Agenda for a National Dialogue Process on Water and Energy Policies in Nigeria”.

The specific tasks to actualize this goal are:

- (a) To identify **broad major water and energy** issues in Nigeria and articulate **opportunities and challenges** around dams and development.
- (b) To identify major stakeholders in the water and energy sectors and in particular those around dams and development in Nigeria.
- (c) To identify the stake including issues, **potential areas of conflicts and agreements**, and
- (d) To discuss the possibilities of successful conduct of the proposal towards improving the policy and regulatory frameworks for planning and management of water and energy, drawing from the WCD Report on Core Values and Strategic Priorities, and others.

## **Scope and Methods of Study**

### **Scope**

The scope of this study is limited to identification of the broad major issues of social and environmental concern, stakeholders and their stakes on water and energy resource management, focusing on dams and development with reference to Strategic Priorities and Core Values of the WCD and other internationally acceptable policy guidelines. Proposals for modalities for organizing a national consultative conference of identified stakeholders and a governing structure for taking the outcome of the conference forward, form part of the study.

### **Method**

Principally, this study comprises both desk reviews and field visits. Use of questionnaires and personal interviews were employed to some extent. Consultations were made with relevant government agencies, networks, associations and coalitions.



## **TECHNICAL, FINANCIAL AND ECONOMIC PERFORMANCE OF DAMS**

The World Commission on Dams (WCD 2000) report shows that dam promoters systematically exaggerate the benefits of dams. But dams have on average generated less power, irrigated less land and provided fewer water supplies than predicted. These have actually places populations at greater risk of suffering severe social economic, cultural and environmental damages.

### **Performance of Dams on Power Generation**

Hydro Power Dams studied by the WCD showed an overall tendency to fall short of target. 55% of dams with hydro power components generated less power than projected. A ¼% of the 28 dams that met or exceeded targets, did so because their installed capacities were increased, thus requiring larger investment than predicted (WCD2000)

### **Performance of Dams on Irrigation**

Large dams designed to deliver irrigation services have typically fallen short of physical targets. All 52 irrigation dams analyzed by WCD irrigated less land area and supplied less water to fields than predicted. After 15 years only about 75% of irrigated area targets were met on average. The WCD knows therefore that the larger irrigation dams have the world record. The contribution of large dams to world food production indicates that a 1/3 of total food production is made possible by irrigation from dams, thus fallen short of world food requirement.

### **Performance of Dams on Water Supply**

Water supply dams have fared even worst than irrigation dams. On average 70% of water supply dams studied by WCD did not supply water as much as predicted. ¼ of the dams deliver less than half as much as claimed (WCD 2000).

### **Performance of Dams on Flood Control**

While dams have provided important flood control benefits, the WCD states that most dams have increased the vulnerability of riverine communities to flood. Downstream communities have faced significant damage where reservoirs have not been properly operated or equipment has failed. Some have died when peak operations on hydro power plants have caused an unexpected power surge and warning signals were not efficient or heeded.

Dams provide a false sense of security and encourage settlement along flood prone areas. When exceptional flood finally arrives, more people and high valued properties are at risk of destruction than otherwise would have been. Where normal floods have eradicated by dams, there are always higher cost to farmers, fishermen and others dependent on flood plain resources (IRN2002)

## **Cost and Time Overrun of Dams**

Large dams are demonstrated a marked tendency towards scheduled delays and significant cost overruns (WCD2000 and CAPP 2005). On average the construction cost overrun for 81 large dams studied by the WCD was 56%. Half of the dams had construction delays of one year or more.

## **Dams and Economic Return**

Analysis of a few dam projects carried out by the World Bank, Asian Development Bank, and African Development Bank indicate on average that large dams have been at best only marginally economically viable. Of 20 hydro power dams funded by multilateral banks have failed to meet their economic target. 9 of the dams had an economic internal rate of return (EIRR) under 10%. Infrastructural projects in developing countries are typically judged successful, if they attain an EIRR exceeding 10%(IRN 2002).

Irrigation dams did not recover their cost and have often failed to deliver on promised financial and economic profitability. For 14 irrigation dams funded by the WB and ADB, the actual EIRR average 10.5% compel with an estimated 15% when the projects were approved.

Water supply dams also exhibit poor financial cost recovery and economic performance. 3 out of the 4 water supply dams funded by the WB and ADB had EIRR way below 10%. Multipurpose dams tend to fail even further behind their economic targets than single purpose dam projects (IRN2002)

## **Sedimentation of Dams**

The WCD 2000 estimates that 0.5-1% of world reservoir volume is lost from sedimentation annually. Sedimentation can affect a projects physical and economic performance, and will eventually affect project life by filing the reservoirs storage area.

## **Water logging and salinisation of Dams**

1/5 of irrigated land worldwide is affected by water logging and salinity due to dam fed irrigation. These have severe, long-term and often permanent impacts on land, agriculture and livelihoods. Facilities to drain affected lands are often omitted from initial project plans, leading to over estimation of project net benefits. Resolving water logging and salinity problems entails significant rehabilitation cost and loss of productivity (WCD 2000).

## **Environmental impacts of Dams**

### ***Contribution to climate change***

The WCD found that reservoirs are a significant contributor to climate change, and that hydropower schemes sometimes have greater impact on global warming than fossil power station. The WCD (2002) stated that gross emissions from reservoirs may account for between 1% and 28% of all global green house gases (GHG) released due to human activities. The WCD emphasises that all reservoirs emit GHGS and that in the circumstances the gross emissions can be considerable, and possibly greater than the thermal alternatives.

Decomposing vegetation and soils flooded under a reservoir emit carbon dioxide and methane. Organic matter washed into a reservoir from upstream and the decomposition of aquatic plants and algae also generates large amount of these gases. Thus emission may continue for the lifetime of the reservoir long after all vegetation in the reservoir has decomposed.

### **Downstream impacts**

Storage dams have capacity to significantly disrupt the whole flow regime, dramatically altering the riverine environment and changing the water temperature {WCD 2002}. Dams alter natural habitat, often allowing exotic plant and animal species to take over native species. The report states that large dams have led to the loss of aquatic biodiversity, upstream and downstream fisheries and the services of downstream flood plains, wetlands and riverine estuaries and adjacent marine ecosystems.

Both aquatic and floodplain ecosystems are subject to the dynamic flow patterns of the river, both in terms of the annual discharge regime, and the size and longevity of shorter-term flood events, the ground water regime, and the distribution of ground water in space and time that these river flows support. Changes in river flow regimes obviously have very large potential effects on river and floodplain environments, and hence on the people, depending on the resources of these ecosystems.

### **Blocking of sediments and nutrients transport**

The reduction in sediments and nutrient transport in rivers downstream of dams has impacts on channel floodplain and coastal delta morphology and causes the loss of aquatic habitat for fish and other species. Eliminating the natural flood cycles can decrease the fertility of floodplains, lead to dramatic reductions in bird species and severely diminish recharge of groundwater in floodplain areas.

### **Social Impacts of Dams**

The pervasive and systematic failure to assess the range of potential negative impacts and implement adequate mitigation, resettlement and development programmes for the displaced. The failure to account for the consequences of large

dams for downstream livelihoods have led to the impoverishment and suffering of millions without gaining a commensurate share of the economic benefits.

## **Displacement**

The WCD (2000) report estimates that 40-80 million people have been displaced by dams, and often this physical displacement is involuntary and involves coercion and force, and in some cases killing. Those displaced face a broad range of impoverishment risks that include landlessness, joblessness, homelessness, marginalization, food insecurity, increased mobility, loss of common resources, and community disarticulation that results in a loss of socio-cultural resilience.

## **Non-compensation of affected people**

At the planning stage, the numbers of both directly and indirectly affected people have frequently been underestimated. In the report, WCD stated that initial project assessments failed to account for all the affected people, undercounting by 2000 to 40, 000 people. A study of the World Bank projects revealed that the actual number of the people to be resettled was 47% higher than the estimate made at the time of appraisal.

Millions displaced due to canals, powerhouses and project infrastructure are not counted or considered for resettlement, nor are communities living upstream and downstream of dam who suffer livelihood losses. Compensation has usually gone only to those in possession of legal titles, leaving out a large number of people, often the poorest, who depend on common resources such as forests and grazing grounds for subsistence.



Plate 1: A typical classroom in a community in Kainji- pix Hope Ogbeide, SWAPHEP

## **Failure of Resettlement, and Mitigation**

Most dam affected people have rarely had their livelihoods restored as resettlement programmes have focused on physical relocation rather than on the economic and social development of the displaced.

Resettlement has been involuntary and traumatic. Development opportunities have been denied to communities for years and often decades. Little or no meaningful participation of affected people in the planning and implementation of dam project including resettlement and rehabilitation has taken place.

Affected people have often been forced to resettle in resource depleted and environmentally degraded areas around the reservoir. The replacement of agricultural land, basic services, and infrastructure at resettlement sites has often failed to materialize, was inadequate, or was delayed for many years. Without a source of livelihood, affected people have been forced to abandon resettlement sites and migrate.

## **Impact on indigenous people**

Large dams have severe impacts on the lives, livelihoods, cultures and spirited existence of indigenous and tribal peoples. Due to neglect and lack of capacity to secure justices because of structural inequities, cultural dissonance, discrimination, economic and political marginalization, indigenous and tribal people have suffered disproportionately from the negative impacts of large dams, while often been excluded from sharing in the benefit (CAPP 2005)

## **Impact on women**

The WCD (2002) reported that dams have widened gender disparities among affected communities and those women have frequently borne a disproportionate share of the social costs and were often discriminated against in the sharing of benefits. Despite the adoption of policies by governments and funding agencies to address gender issues on development.

## **Impact on Cultural heritage**

WCD states that large dams have had significant adverse effects on cultural heritage through the loss of cultural resources of local communities and the submergence and degradation of plants and animal remains, burial sites and archaeological moments.

## **Impact on Human health**

Dams have significant adverse health outcomes for local populations and downstream communities. Resettled communities face in seasonal risk of diseases like schistosomiasis and malaria. High levels of mercury can accumulate in reservoir fish, poisoning people through the trans- human effect. In recent years, the high incidence of HIV/AIDS in construction and settlement areas are of growing concern.

Further destruction of community productive bases in agriculture and fishes can give rise to food shortages leading to hunger and malnutrition (WHO 1999).

### **Equity and distribution of costs and benefits**

WCD report show that the direct adverse impacts of dams have fallen disproportionately on rural dwellers, subsistence farmers, indigenous people's ethnic minorities and women. In downstream areas, communities suffering formatted river flows are mainly subsistence farmers whose livelihood, are largely dependant resources offered by the natural flow of the river. WCD concluded therefore that by failing to take into account the time, social and environmental costs and benefits of large dams, the true economic efficiency and profitability of these schemes remain largely unknown.

### **Alternatives and opportunities of Dam services**

In assessing the different options available for meeting the services provided by large dams, the WCD assessed possibilities for demand side management, supply side efficiency measures and new supply options in the four areas of agriculture, energy, water supply and flood management.

The WCD state that demand side management (DSM) has significant untapped and universal potential and provides a major opportunity to reduce water stress. DSM options include reduced consumption; recycling and technological policy options that promote efficient use of water and power. Improving efficiency at the supply side can differ in the need for new sources of supply by enhancing supply and convergence efficiency. Needless loss of power and water can be avoided through reductions in water leakages improving system maintenance and upgrading control, transmission and distribution technology in the power sector.

### **Agriculture and irrigation**

In the agriculture and irrigation sector, preference for improving the performance and productivity of existing irrigation systems, and alternative supply-side measures that involve rain-fed, as well as local, small scale and traditional water management and harvesting systems, are including ground water recharge methods. The following options are identified by WCD

- .Improved basin and system level management, including sediment flushing and catchments management to increase the efficiency and life of irrigation systems.
- Controlling salinity and reclaiming saline land as an urgent priority in order to increase productivity of existing land. New drainage and maintenance of existing drainage is one method, though WCD emphasizes an integrated approach combining management of surface water, groundwater and agricultural practices. Salt tolerant crops and vegetation can remove excess surface water and power water tables.

- Controlling the loss of sea page in canals could some up to 14.8billion m3/ year of water. Canal lining is one way to control losses as well as maintenance of irrigation systems.
- Technologies exist for improving the efficiency of surface irrigation, through cultivation of less water intensive crops in dry regions, and micro-irrigation methods such as sprinkler and tip systems.
- Pricing structures for irrigation water which reflect the cost of supplying water and associated externalities to encourage efficient use of water should be designed with stepped rates to provide security for basic livelihood needs.

Some alternative supply-side measures include:

- Enhancing rainfall agriculture and supporting local irrigation technologies. Some 80% of agricultural land world wide generate rainfall cultivation, contributing to 60% of food production. Given the number of low income households that rely on rainfall agriculture throughout the developing world, the enhancement of opportunities in the sector can have major effect on productivity and livelihoods (WCD 2003).
- Range of irrigation drainage water and urban west water.

**Power**

The priority for a sustainable and equitable global energy sector is for all societies to increase the efficiency of energy use and the use of renewable source. High consumption societies must also reduce their use of fossil finds. Decentralized, small scale options based on local renewable source offer the greatest near- term and possibly long-term potentials in rural areas.

WCD estimates that technical potential of demand side management (DSM) in countries with high per capita consumption, such as the United States, may be up to 50%. DSM is about reduced consumption of electricity by consumers and replacement of energy inefficient aphasias. Generally investments in promoting consumers use of efficient, aphasics as much cheaper than new supply options.

Alternative renewable supply options include biomass, wind, solar, geothermal, steam energy sources and cogeneration.

- Wind power is the fastest growing of the renewable energy options and is competitive with other conventional options when a back up generation source is available and when government support is provided as an incentive.
- The cost of solar thermal systems almost competes with conventional thermal power in setting with high solar insulation levels.
- Biomass options are commercial where biomass fuel is readily available; the greatest potential is in decentralized local system.
- Fuel cells show great promise, and are expected to be commercially available for use in vehicles and in grid and off-grid electricity by 2005.

## **Water supply**

Domestic, municipal and industrial consumption account for less than 1/5 of water use world wide and only about 5% in Africa, Central American and Asia (WCD 2000). In the water supply sector, meeting the needs of those currently not served in both urban and rural areas through a range of efficient supply options is the priority. Further efforts to revitalize existing sources introduce appropriate pricing strategies, encourage faire and sustainable water management and transfers, recycling and reuse and local strategies, such as rain water harvesting are sustainable options.

Demand supply measures include the following:

- ❖ Regulatory standards for appliances and equipment manufacturers and subsidies to consumers to install water saving devices such as low flow toilet, showers and washing machines
- ❖ Tariff structures that start low and progressively rise for higher level of consummation
- ❖ A significant proportion of high quality domestic water to be used in sewage systems to transport waste. A number of low cost sanitation systems that have low water requirement are suitable alternatives. This may include pit latrines and septic tanks.

Supply Side Alternatives include:

- ❖ Stabilizing and reducing loses from pipe systems through leakage and other programmes can serve a substantial amount of water
- ❖ Rain water harvesting through rooftops, tanks, and other methods are suitable alternative sources of water supply.
- ❖ Recycling of waste water for agriculture, ground water recharge, landscape management, irrigation, industry and domestic uses.

## **Integrated Flood Management**

In the case of floods, as obsolete control of floods may be neither achievable nor desirable, it is necessary to manage floods so as to minimize damage and maximize ecological benefits. The WCD outlines an integrated approach to flood management and control. This consists of three complimentary approaches namely;

- i. Reducing the scale of flood by managing the quantity and quality of surface water runoff. The following measures may be applied;
  - ❖ Ground water recharge measures such as infiltration trenches, detention basins, infiltration ponds, retention ponds and wetland vegetation to reduce runoff.
  - ❖ Forest protection, limited logging practices, avoidance of clear felling and less intensive agriculture to reduce soil erosion and landslides.
  - ❖ Small scale storage of runoff by use of diversion channels and improvement in drainage.



- ii. Isolating the threat of floods through structural, technological and policy alternatives involves;
- ❖ flood embankment that do not cut off natural drainage patterns
  - ❖ Flood proofing of houses and other structures through water proofing of walls, fitting opening with permanent or temporary doors or gates, raising houses or building boundary wall around the house or structures.
  - ❖ Limiting flood plain development.
- iii. Increasing people coping capacities involves;
- ❖ Integrated catchments and coastal zone management, wise planning and use of flood plains and coastal zones in an environmental friendly manner
  - ❖ Emergency planning such as forecasting, warnings, evacuation plans and post flood recovery, compensation and insurance.

### **Dam decommissioning**

Experts have suggested that dam the commissioning should be undertaken as a necessary strategy to address safety concerns, lower profits or concerns about social and environmental impact. The IRN 2002 report recommended that dams design should include provision for decommissioning and project licenses should defined the responsibility and mechanism for financing decommissioning cost. This is an acceptable practice world wide.

### **Politics of Financing Dam Construction**

#### **The role of Foreign Assistance**

Multilateral development banks and bilateral agencies have played a key strategic role in spreading the technology of dam construction to developing countries, lending legitimately to emerging dam projects, and fostering the technological and human resources required to build and maintain dams.

The World Bank started financing dams in the 1950's, providing on average over \$1billion per year. At the peak of lending in 1980 – 1984 financing for large dams by multilateral development banks and bilateral and agencies was more than \$4.5 billion annually (WCD 2000).

#### **Bias towards large dams**

The WCD (2002) reports that political economy or intellectual barriers often predetermined what options were considered in a given context. Options assessment was typically limited in scope due to political and economic interests driving dam projects, lack of familiarity with other options, the perceived need to quickly proceed with large –scale projects to meet large projection in demand, and the relative ease of developing new supply relative to undertaking policy or institutional reform.

Overstated predictions of future demand for water and power have multilateral against a gradual approach of adopting smaller, non-structural options and has pushed decision –makers into adopting large –scale dam projects because they

seem to be the only adequate response to the large gap between existing supply and forecast demand.

### **Conflicts of Interest**

The end result of the influence exerted by vested interests, and the conflicts of interest that have arisen, have been that many claims were not built based on an objective assessment and evaluation of the technical, financial and economic criteria applicable at the time, much less the social and environmental criteria that apply today.

### **Failure of Environmental Impact Assessment (EIA)**

Environmental Impact Assessment (EIA) still frequently fails to influence decision making. EIA consists mostly of measures to compensate or mitigate the planned impacts and render them acceptable when the decision to proceed has already been taken. Most dam proponents see an EIA as an administrative hurdle to be cleared or a requirement to secure funding. Often large political, technical and financial investment has been made before the EIA is even launched.

### **Lack of Participation on and Transparency**

The WCD found out that there has been a generalized failure to include and recognize affected people and empower them to participate in decision making. Insufficient time, resources and information have been made available for public consultations. Opportunities for participation, when provided often occur late in the process and are limited in scope. This has magnified the negative impacts of such projects and alienated affected communities, leading not only to serious social impacts but also schedule delays, cost overruns and poor financial and economic performance.

### **Lack of Compliance to Guidelines/Commitments**

Poor outcomes and mistrust stem from the failure of dam proponents and financing agencies to fulfill commitments and abide by internal guidelines. Conflicts remain largely unresolved and past impacts largely unmitigated.

### **Corruption**

The opportunity for corruption provided by dams as large scale infrastructure projects further distorted decision – making, planning and implementation. Decision makers are inclined to favour large infrastructure as they provide opportunities for personal enrichment not afforded by smaller or more diffuse alternatives. Allegations of corruption have tainted many large dam projects in the past but have seldom resulted in prosecution in court.

## LEGAL AND INSTITUTIONAL FRAMEWORK FOR WATER RESOURCES MANAGEMENT IN NIGERIA

All the three tiers of government in Nigeria are involved in the administration and management of water resources in the country since the management and development of water resources is in the concurrent legislative list in the Nigerian Constitution. At the Federal level, there is the Federal Ministry of Water Resources with the River Basin Development Authorities. At the State level, we have the administration of water resources being undertaken by various state ministries such as Agriculture, Natural Resources, Works and Public Utilities. At the Local Government level, attention is paid to rural water supplies and sanitation.



Plate 2: A view of the Uusman Lower Dam, FCT

The overall management of water resources is the exclusive responsibility of the Federal Ministry of Water Resources headed by the Minister for Water Resources with the responsibility to enforce all national policies, federal laws and regulations relating to water resources management and development. The FMWR thus has the overall responsibility for policy advice and formulation, data collection, monitoring and planning, management and coordination of water resources.

The Federal Ministry of Water Resources, like the River Basin Development Authorities, was not spared the consequences of policy inconsistencies as it was severally merged and separated from the Federal Ministry of Agriculture and Rural Development in the past. The series of changes affecting the institutional arrangements are as detailed below:

1959 – creation of the Inland Waterways Division of the Federal Ministry of Communications based in Lokoja

- Formation of hydrological unit under the First Republic

- Creation of Water Resources Division in the Ministry of agriculture and formation of the Geological Survey Department of the Federal Ministry of Mines and Power
- 1970 – Creation of State Water Agencies
- 1970s - Creation of Kainji Lake Development Commission and the CBDA and SRRBDA in the Second National Development Plan
- 1975 – Creation of FMWR
- 1976 – Nine (9) other RBDAs were established (3<sup>rd</sup> National Development Plan)
- 1977 FMWR was merged with the Federal Ministry of Agriculture
- 1979 – Re-creation of the FMWR and the establishment of NWRI
- 1984 – FMWR merged with FMA & RD to form Federal Ministry of Agriculture, Water Resources and Rural Development
- 1984- Creation of 18 RBDAs, with one for each state except Ogun, and Lagos that shared one.
- 1988 – Mergers of 18 RBDAs to the former 11 with reduction of functions to only provision of water for multipurpose usage
- 1989 – Re-creation of FMWR and the expansion of the departments from one to eight
- Partial Commercialization of RBDAs by Technical Committee on Privatizations and commercialisation (now Bureau of Public Enterprises BPE))
- 1992 – Re-merger of FMWR with FMARD
- 1<sup>st</sup> Review of Irrigation sub-sector by the FAO
- 1994- Re-creation of FMWR and the rationalization of DFRRI into the Ministry to form the Department of Rural Development, thus changing the name of the Ministry to Federal Ministry of Water Resources and Rural Development.
- Lower and Upper Niger Basin RBDA were created out of the Niger RBDA
- the creation of some state's Ministry of Water Resources
- 1995- Change of the name from River Basin Development Authorities to River Basin and Rural Development Authorities

### **Functions of the Federal Ministry of Water Resources**

The Federal Ministry of Water Resources has the following functions:

- i) To formulate and implement a Water Resources Master Plan for Integrated Water Resources development, including inter-basin water transfers
- ii) To develop and support irrigated agriculture and reduce the nation's dependence on rain-fed agriculture
- iii) To promote and sustain national food security by minimising unexpected and undesirable shortfalls in domestic food production and agro-based raw materials caused by the vagaries of weather
- iv) To collect, store, analyze and disseminate hydrometeorological and hydrological data

- v) To support, monitor and evaluate the programmes and performance of the River Basin Development Authorities and the National Water Resources Institute
- vi) To explore and develop ground water resources
- vii) To formulate and review from time to time the National Water Legislation
- viii) To coordinate the development and utilization of water resources for irrigation and water supply
- ix) To liaise with all relevant national and international agencies on all matters relating to water resources development
- x) To support studies and research on the nation's ground and surface water resources potentials
- xi) To undertake hydrological and hydrogeological investigations
- xii) To formulate and implement national irrigation policy that is consistent with and complementary to the national agricultural policy
- xiii) To formulate and implement programmes and policies towards surface water storage schemes
- xiv) To develop guiding principles for dam construction nation-wide, and
- xv) To develop anti-desertification programs.

### **Institutional Arrangement in the Federal Ministry of Water Resources (FMWR)**

To enable the ministry to carry out these functions, it is structured into seven departments. The main (line) departments are:

- Dept. of Planning, Research and Statistics, charged with Policy development, project planning and monitoring, out-reach, information management, public and external relations, research and data base management;
- Dept. of Hydrology and Hydrogeology, charged with the responsibility for developing, maintaining and operating the hydrological network; groundwater resources mapping and monitoring, including the promotion of groundwater by-laws;
- Dept. of Irrigation and Drainage, supports the RBDA's irrigation related programmes, policy development, and liaising with other water resources organisations;
- Dept. of Water Supply and Quality Control, is charged with planning, monitoring, coordination of water supply matters, water quality control of treated surface and ground water, and establishment of water quality laboratories;
- Dept. of Dams and Reservoir Operations, charged with completion of on-going dams, ensuring safety and operations, capacity building of RBDAs for small dams implementation, formulation of policies and programmes for dam implementation, liaising with ICOLD;

- There are in addition, two service departments namely, Department of Administration and Supplies and Department of Accounts and Finance that give support services to the Ministry.

### **The National Council on Water Resources (NCWR)**

The NCWR is the highest water resources policy formulating body, chaired by the Honourable Minister of Water Resources. Its membership includes representatives from the Federal Ministry of Environment and all State Government Commissioners responsible for Water Resources matters (including the Chairman of the FCT Water Resources Agency). The NCWR was established in 1980.

Under the NCWR resides the National Technical Committee on Water Resources (NTCWR), chaired by the Permanent Secretary of the FMWR.

The NTCWR meets annually and its members include representatives from:

- Departments of the Federal Ministry of Water Resources
- Managing Directors and General Managers of RBDAs;
- NWRI;
- NEPA;
- State Water Boards;
- National Inland Waterways Authority;
- Nigerian Meteorological Services Agency;
- ADP management Unit/Project Manager;
- Representatives of universities;
- National Society of Engineers and other relevant professional bodies;
- Consulting Industry.

The NTCWR advises and prepares decisions to be taken by the NCWR or identifies and develops strategies to adopt and implement policy decisions taken by the NCWR. Six sub-committees of the NTCWR have been established for detailed implementation of NCWR / NTCWR decisions. The sub-committees consist of experts in the respective disciplines of water resources. The sub-committees also constitute the primary fora to discuss and exchange ideas on pressing problems of water resources development and its further promotion. Sub-committees can set-up working groups to carry out detailed field studies on any subject of concern. The sub-committees are:

- Sub-Committee on Hydrology and Hydrogeology;
- Sub-Committee on Irrigation and Drainage;
- Sub-Committee on Manpower;
- Sub-Committee on Dams;
- Sub-Committee on Water Supply and Sanitation;

Policy issues generally originate from the various specialised agencies responsible for water resources development and members of the NCWR, NTCWR and its sub-committees.

Policy suggestions and proposals of the NCWR are put forward to the FMWR to be packaged as a memorandum to the Federal Executive Council where it is subject to discussion for inclusion as national policy. The NCWR will be subjected to further analysis in the detailed institutional analysis phase.

### **River Basin Development Authorities (RBDAs)**

Decree No. 33 of 1973 established the Sokoto Rima Basin Development Authority and the Chad Basin Development Authority. In 1976, the number of River Basin Development Authorities was increased from two to eleven through Decree No. 35 of 1976. These Decrees were amended yet by Decree No. 37 of 1979, by expanding their scope of activities to include the development of water resources, agriculture, transportation, fisheries, livestock, forestry, industrialization, rural development, energy, etc. In 1987, Decree No. 35 was enacted to repeal the 1977 Decree, thus modifying the functions of the River Basin Development Authorities to include the following:

- To undertake comprehensive development of surface and underground water resources for multi-purpose use with particular emphasis on the provision of irrigation infrastructure and the control of floods and erosion and for watershed management
- To construct, operate and maintain dams, dykes, polders, wells, boreholes, irrigation and drainage systems, and other works necessary for the achievement of the Authority's functions and hand over all lands to be cultivated under the irrigation schemes to the farmers
- To supply water from the Authority's completed storage schemes to all users for a fee to be determined by the Authority concerned
- To construct, operate and maintain infrastructural services such as roads and bridges linking project sites, provided that such infrastructural services are included and form an integral part of the list of approved projects
- To develop and keep up-to-date comprehensive water resources master plan, identifying all water resources requirements in the Authority's area of operation, through adequate collection and collation of water resources, water use, socio-economic and environmental data of the River Basin.

### **National Water Resources Institute (NWRI)**

The NWRI, located in Kaduna, is a parastatal under the FMWR designated to provide training and education, data collection and dissemination services in the field of water resources development and management. The functions of the National Water Resources Institute, as specified in Decree No.3, 1985, include:

- Promotion and development of training courses in water resources;
- Train and educate the students of sufficient proficiency in various aspects of water resources disciplines to meet the middle-level manpower needs of water resources development, as well as upgrade the technical knowledge and competence of the professionals in the

water resources sector through short courses and seminars emphasizing new technologies;

- Advise the Honourable Minister on the nation's water resources training needs and priorities;
- Perform the engineering functions related to such major water resources projects as may be required for flood control, river regulation, reclamation, drainage, irrigation, domestic and industrial water supply, sewage treatment;
- Perform such ancillary services on planning of water resources management and river basin development, and produce the necessary codes of practice in water resources engineering related and suitable to Nigerian conditions;
- Promote the establishment of a national water resources data bank;
- Establish and maintain a water resources library, documentation and conference centre;
- Publish or sponsor the publication of water resources journals;
- Promote cooperation with similar bodies in other countries and with international bodies in connection with water resources management and operations.
- Carry out such other activities as are necessary or expedient for the full discharge of its functions.

## **Legal Framework**

The Constitution of the Federal Republic of Nigeria provides that water from such sources as may be declared by the National Assembly affecting more than one State are under the Exclusive Legislative List. Furthermore, the Fundamental Objectives and Directive Principles of State-policy make it a duty of the State to protect and improve the environment and safeguard water resources. The constitution empowers the States to make laws in respect of water, that is to say, legislation with regard to water supplies, irrigation, canals, drainage, embankments, water storage and waterpower subject to the provisions of the Exclusive legislative list.

## **Federal Regulations**

The management of water resources is the exclusive responsibility of the Federal Ministry of Water Resources headed by the Minister for Water Resources with the responsibility to enforce Federal laws relating to water resources management and development. The following Federal laws are relevant in the development and management of water resources.

1. The Water Resources Act 1993 vests control of all surface and groundwater and any water course affecting more than one State in the Government of the Federation for purpose of planning, co-ordination and management. The Act grants citizens the right to take water from any water course for domestic and livestock needs, whereby a watercourse is defined to include stream, wells, springs, lakes, lagoons, swamps or any course of water flows.



The Act empowers the Minister for Water Resources to make regulations particularly for the control of groundwater use, issue licenses for the construction or mode of operation of boreholes and wells. The enforcement of the provisions of the Act is the primary responsibility of the Federal Ministry of Water Resources. The Minister is empowered to make regulations particularly for the control of groundwater use, granting licences for abstraction, construction and mode of operation of bore holes and wells, general planning for development and administration of water resources. The Minister has the power to delegate this function.

2. The second major water resources legislation at the Federal level is the River Basin Development Authorities Act, 1990, which defines the mandate and functioning of the River Basin Development Authorities. They are charged in their catchment areas with the development of surface and groundwater resources with emphasis on provision of irrigation infrastructure, control of floods and erosion and watershed management. They are empowered to construct, operate and maintain dams, dykes, wells, boreholes, and irrigation and drainage systems. They are also charged with the supply of water from storage schemes and the development of comprehensive water resources master plans.

The RBDA Act provides for a generally weak structure for the RBDAs to perform their duties. Their functions are limited to water resources development for irrigation purposes and developing and managing irrigation and water supply schemes. However, there are no cost recovery mechanisms provided for and the RBDAs also have no powers to enforce national legislation as to water quality and management, which is vested within the Ministry of Environment.

The RBDAs are in no position to initiate forms of horizontal co-ordination among themselves. As multiple RBDAs operate in the same catchment, this prohibits catchment management. Also the RBDAs are not capable of initiating co-operative arrangements with relevant State Ministries of Water Resources and Water Boards and Corporations. Co-ordination only takes place on a basis of voluntary and personal contacts between representatives of the institutions involved.

There are other Federal regulations which, by their provision grant power for control and management. Notable among these legislation are:

- The Minerals Act, 1990 which while vesting control of all rivers, streams and water courses throughout Nigeria in the State authorities empowers the Minister for Solid Minerals Development to issue licenses to the holder of a mining lease for construction of a dam, reservoir, pumping station or any construction for the collection, storage, conveyance of water for mining activities.
- The National Electricity Power Authority Act, 1972 in part 11, empowers the Authority to construct buildings and works necessary for the abstraction of water from any lake, river, stream or other natural

sources and the doing of all such things as may be necessary for the purpose of utilising and returning the water so abstracted in a condition no less pure than when it was abstracted.

- The Inland Waterway Authority Act, No 13 of 1997 empowers the authority to grant licenses for water intake in respect of all Federal navigable waterways as contained in the second schedule of the Act in respect of navigation of those waterways.
- Nigeria Ports Authority Decree, 1991 empowers the Nigerian Ports Authority to supply water to shipping vessels and control pollution arising from oil or any other substance from ships using the port limits or their approaches. The authority also has power in section 8 to construct work and develop embankments and jetties.
- Oil In Navigable Water Act Cap 337, 1968, prohibit the discharge of contaminated oil unto prohibited sea greens, and empowers the Minister of Transport to make exceptions from application of this prohibition as appropriate. Furthermore, discharge of oil is prohibited within seaward limits of territorial waters of Nigeria and all other inland waters, which are within. Those limits are navigable by sea-going ships. The Act empowers the harbour authority to appoint a place for the discharge ballast water from vessels, which have carried a cargo of petroleum and such a discharge shall not constitute an offence.
- The Petroleum Act, 1969 gives to the Minister of Petroleum Resources power to make regulation providing generally for matters relating to licenses or leases granted under the Petroleum Act including those for the preventing of pollution of watercourses and the atmospheres.
- Niger Delta Development Commission (Establishment) Act, 2000 empowers the Niger Delta (Joint) Development Commission to conceive, plan and implement development projects for waterways and water supply in the Niger Delta. This includes tackling environmental problems arising from oil exploration, and also to advise States on prevention and control of oil spillage.
- Public Health Act, 1971 which prohibits the fouling of water and the Pollution of the atmosphere.
- Harmful Waste (Special Criminal Provisions, etc.) Act 1988 prescribes Criminal Prosecution for dumping of harmful wastes in Nigerian Territorial Waters or its Inland Waterways.

The existing Federal regulations relating to water resources management are to a large extent not specific as to where final control of water resources resides. This is because the different regulations contain overlapping provisions granting control of the same resources to different authorities. Several Federal regulations impact on water resources management in one way or the other and are not coherent as to the reporting requirements

regarding the use, management and development of water resources. In some cases, the legal provisions grant similar authorities to different institutions without clear rules as to the division of responsibilities and the management of conflict. The provisions in laws or separate regulations fail to recognize the existence of other rules in other regulations on the same issue.

Furthermore, most of the regulations appear to be too general on the issues they cover. For example, there are no unifying provisions for co-ordinating quality, quantity, distribution and rehabilitation of water supply. The regulations provide multiple powers for fixing tariffs and other matters for water use without guiding provisions for determining such tariffs, for domestic and economic use. While offences are prescribed under the provisions of the various regulations, enforcement provisions are sketchy and reporting requirements non-existent. While provisions in the various regulations grant power to fix tariffs for the use of water under the activity, to which such law relates, there are no obligations to account to the Federal Ministry of Water Resources or the River Basin Development Authorities as the case may be or to provide data regarding such use.

A major cause of the lack of a coherent legal framework for water resources management and development is that there are no constitutional and collective-choice rules. Such rules should contain central guiding principles on who has the authority to make and establish regulations on water resources management, by what procedures this has to take place (including who should be involved). Therefore new regulations do not give cognizance to existing institutional arrangement for management of water resources. This could also be a particular role of the Assembly, but it does not have enough resources to check and streamline all relevant regulations determining the roles and responsibilities in the water sector.

There are no provisions what so-ever for allocating water for different uses notwithstanding that the provisions allow water from the same sources to be used for domestic, agricultural and industrial and commercial purposes. Industrial and commercial water users are not under a codified legal obligation to return water in a specified form to watercourses although some regulations require users generally to return water to the watercourse in the same form. The regulatory framework for water quality and drinking water quality is also dispersed and generally weak. Finally, there are only weak procedures and guidelines with provisions related to land-use, physical planning, urban development and waste management, which highly affect water resources management.

## **State Regulations**

The 36 States all have additional and separate laws designed for the management of water in their jurisdictions. For example, the Enugu State Water Corporation Edict 1996 established the Enugu State Water Corporation in Enugu State, which is charged with the responsibility to develop, provide and distribute water in the State for public, domestic and industrial purposes with power to charge adequate fees. In this regard, the corporation has the power to make plans for development and

maintenance of its undertakings including power to construct and maintain waterworks, stations, buildings and other works necessary to discharge its function under the law. The corporation also has the power to abstract water from any lake, river, stream or other natural water sources in the State and examine surface or groundwater within the State for control of pollution.

Plateau State Water Board Edict, 1991 established the Plateau State Water Board charged with the duty to control and manage all water works in the State for purposes of providing water to meet the requirements of the general public and for agriculture and ensure that water is supplied at reasonable cost.

The Board also has power to construct and maintain waterworks and sewage systems and carry out water distribution throughout the State. It also has power to abstract water from any lake, river, and stream or other natural sources, control pollution and withhold, and diminish and divert the supply of water to any tenement within the State.

A review of State management institutions, by in-depth analysis of two institutions and enquiry into availability of by-laws reveal that similar deficiencies as identified in the Federal regulations exist. The State Edicts creating the State Water Agencies in some instance make the operation of these agencies subject to the provisions of Federal regulations in water management. The Federal regulations, however, do not provide for control of the State Water Agencies in the management of water resources, particularly in areas of quality and quantity of water supply in their areas of operation.

There are no reporting requirements and the edicts do not provide rules for standardisation of water quality. Both the Federal and State institutions are empowered to provide irrigation services and build dams without recourse to an overall planning system bearing in mind that demand for water differs in different areas of the country. Federal regulations are more detailed in areas of standards and control in water resources management. Edicts creating the State Water Agencies do not empower them to enforce these regulations for the overall good of water management in the country.

**Synthesis:-** The River Niger is Africa's third longest river and the ninth (9<sup>th</sup>) longest in the world. The Niger Basin connects West African countries with a total land area of 6,070,000 sq km and a combined population of 207,060,000. Nigeria accounts for about 60 percent of the population but only about 15 percent of the land area of the nine (9) riparian countries put together. Of the River Niger's 4,200km length, its length across Nigeria territory is about 1,000 or one quarter of its total length. The Niger Basin within Nigeria connects 20 out of the 36 states of Nigeria and FCT.. There are two major rivers, the Niger and the Benue, which along with their 20 tributaries and tributaries of their tributaries constitute the Niger Basin River network in Nigeria. Twelve (12) belong to the Niger Basin and their length accounts for about 60 percent of the total length of all important length accounts for about 60 percent of the total length of all the important rivers in Nigeria amounts to 629, 545 km or about 69 percent of the total land area of Nigeria and their population accounts for 51 percent of the population of the country.

The sheer length of the Niger Basin which starts from the extreme south on the Atlantic Ocean to the extreme North on the Southern fringes of the Sahara Desert, bestows on the Basin all the vegetational regions of West Africa-excluding that of the desert. This vegetational variability confers the Niger Basin States in Nigeria, the limitless capacity to produce all tropical crops, rear a great variety of bovine animals and birds and produce a large variety of both fresh water and marine fishes. The Niger Basin in Nigeria is large, potentially rich and abound with development potentials.

However, ethnic diversity and complexity tend to cause distrust and friction among the population and these tend to inhibit social and economic progress. On the other hand, the large population, vast land and numerous ethnicities tend to bless the country with positive factors for development-large labour force, large land and a variety of human aptitudes.

## WATER AND ENERGY RESOURCES IN NIGERIA

### *Water Resources in Nigeria*

#### Overview

Nigeria's surface water resources potential is estimated to be some 267.3 billion cubic meters per annum, while groundwater resources are estimated to total 51.9 billion m<sup>3</sup> per annum (see table 1). Despite these abundant resources, a large percentage of the country does not have access to potable water, (see Fig. 1).

Table 1: **Distribution of Groundwater Resources in Nigeria**

Hydrological Area (HA)	Groundwater Resources (m <sup>3</sup> )	Present		Towards Year 2020	
		Demand (m <sup>3</sup> )	Water Use Rate (%)	Demand (m <sup>3</sup> )	Water Use Rate (%)
North West- I	4,340	20	0.4	290	7
Central West- II	8,180	20	0.2	260	3
Central East- III	6,990	15	0.2	300	4
IV	4,390	5	0.1	180	4
South East- V	7,150	30	0.4	730	10
South West- VI	9,020	70	0.8	830	9
VII	6,280	40	0.7	710	12
North East- VIII	5,580	60	1.0	620	11
TOTAL	51,930	260	0.5	3,920	8

The institutional arrangement for water resources development and management is such that all arms of government, that is Federal, State and Local governments are involved. Water resource development is guided by such statutory laws and rules as the Water Resources Act 101 of 1993, NIWA Act 13 of 1997; River Basin Development Authority (RBDA) Act of 1987 and State Water Edicts.

Fig. 1: **Map of Nigeria Showing Major Rivers**



The National Water Resources Decree No. 101 of 1993 was created by the then Federal Military Government of Nigeria as a framework for the development and management of water resources of Nigeria and to make the associated infrastructure sustainable. The policy therefore provided a framework to address the challenges posed by the development and management of water resources through clear and coherent regulation, a definition of the function and relationship among sector institutions, development of reliable and adequate data for planning and projection, decentralization in order to ensure efficiency, performance and sustainability, provision of stable and adequate power supply, as well as technical and financial capacity building and human resource development. The policy is based on Millennium Development Goal (MDG) objectives, New Partnership for Africa Development (NEPAD), and resolution of various conferences and conventions.

Full application of the National Water Resources Policy requires the enforcement of Water Act 101 as it relates to construction, operation and maintenance of dams. Inter basin water transfer studies shall also be considered for possible water transfer schemes from areas of supply to areas of need.

## **Review of National Water Resources Master Plan**

### Background

Nigeria is endowed with comparatively large reserves of water resources. The nationwide water resources development was ushered in during the 1970s as a result of buoyant oil revenues. As earlier noted, the Federal Ministry of Water Resources initiated in 1984 the preparation of a National Water Resources Master Plan with FAO assistance. With inadequacy of funding which militated against the realization of a comprehensive coverage, the Federal Government requested for assistance from the Government of Japan to update the original draft by addressing the shortcomings of the previous effort and draw up a complete plan. The master plan was completed in 1995 by Japan International Cooperation Agency (JICA).

The review indicated that the policy had favoured implementation of large-scale development with little attention to operations over the river system. In addition, the stagnation in Government spending the consequence of large fiscal and external payment imbalances combined with economic recession, made it difficult for Government to give priority to actions which would lead to effective and meaningful water resources management.

### Objective of the Masterplan

It was intended to formulate a National Water Resources Master Plan (WRMP) which would assure optimum water use and provide the appropriate development

scenarios on short (Yr 2000) – and long (Yr 2020) - term basis in meeting the predicted social - economic demand for regions over a wide range of potentials. The Masterplan would cover the development and management of potential projects, irrigation and drainage, water supply and sanitation, and other related components such as hydropower generation, inland navigation and inland fisheries. The integrated management would also include, gully disaster control, the water-related environmental matters and appropriate water administration.

### Coverage Area

The entire Federal Republic of Nigeria, comprising 36 States and the Federal Capital Territory was divided into eight Hydrological Areas and six Regions for the convenience of presenting the items relevant to the plan in terms of watershed integrity as water actions are regional rather than local in scope. The current status of water resources development and associated water use as evaluated is summarized in the attached table “Major Indicators in the plan”

### Basic Strategies of the Plan

Four strategies were formulated to put the plan targets on short-and long-term basis, namely:

#### (1). Enforcement of the 1993 Water Resources Decree:

The establishment of a series of the regulations needed for proper enforcement of the provisions in the Decree, and the organizational strengthening of related administration were set as the Short-term target.

#### (2). Consolidation of the Hydrological Observation Network and Continuous Monitoring:

Consolidating the network for observing surface and groundwater. conditions and related management systems.

#### (3). Proper Operations and Management of existing Water Resources Projects and Facilities:

To overcome a number of problems identified, the short-term target has been provided for preparation of reservoir water operations rules, organizational set-up of water user associations, rehabilitation of defective and deteriorated facilities, and the strengthening of operation and maintenance programs for project works.

#### Completion of the Water Systems Downstream of Existing Reservoirs:

At present, there are many incomplete water use systems and facilities for irrigation and water supply downstream of already constructed dams. The effort to accelerate the development of these projects should be realized as a short-term target.

In Nigeria, 160 dams (large, medium and small) are constructed or under construction. Some existing notable dams are shown in Table 2.



Table 2: **Existing Notable Dams in Nigeria**

H.A	Dam	Active Capacity (mcm)	Dam Height (m)	Objective	Completed Year
1	Zibiya	121	21.5	Irri/W.S	1990
1	Zobe	170	18.9	Irri/W.S	1983
1	Bakolori	403	48.0	Irri/W.P	1982
1	Goronyo	833	20.0	Irri/W.S	1984
1	Kainji	11,500	65.5	H.P	1968
1	Kubli	62	23.0	Irri	1992
2	Kontagora	200	32.0	Irri	U.C
2	Asa	344	27.0	W.S	?
2	Kagara	39	31.0	W.S	U.C
2	Jebba	1,000	40.0	H.P	1983
2	Omi	220	43.0	Irri	U.C
2	Zaria	29.8	15.0	W.S	1974
2	Kangimi	59.3	19.2	Irri/W.S	1975
2	Shiroro	6,050	105.0	H.P	1989
2	Suleja	48.5	27.8	W.S	?
2	Usuma	100	45.0	W.S	1984
3	Balanga	63	41.0	Irri	1987
3	Dadin Kowa	1,770	42.0	Irri/H.P	1988
3	Kiri	325	37.0	Irri	1982
4	Doma	28.5	15.7	Irri	1988
6	Ikere Gorge	565	47.5	Irri/W.S/H.P	U.C
6	Oyan	254	30.4	Irri/W.S/H.P	1983
8	Erinle	92.5	27.0	W.S	1989
8	Gari	203	22.0	Irri	1980
8	Challawa	900	38.0	Irri/W.S	1992
8	Watari	92.7	19.8	Irri	1980
8	Tiga	1,845	47.2	Irri/W.S	1975
8	Kafin Zaki	2,500	40.0	Irri	U.C
8	Tomas	56.6	13.7	Irri	1976
8	Jakar	54.5	14.3	Irri	1976
8	Alau	106	9.5	Irri/W.S	1972

Irri: Irrigation W.S : Water supply H.P : Hydropower U.C : Under Construction H.A : Hydrological Area

(4). Appropriate Implementation of New Water Resources Projects with Priority given to Small and Medium Size:

The Plan has established a target area for irrigated agriculture of  $1.5 \times 10^6$  ha and a target access rate to safe water supply at 80 percent of the predicted population (186

x 10<sup>6</sup>) by Yr 2000. The projected irrigable area as estimated in the master plan is 468x10<sup>3</sup> ha, while only 70 x 10<sup>3</sup> ha have so far been partially or fully developed.

In addition to consolidating existing and on-going projects, the Plan calls for a drastic change from large-scale oriented developments to implementation of a series of small - and medium-scale multipurpose projects to meet the water demand anticipated in various sectors of the economy with emphasis on effective programs of decentralization, privatization and deeper involvement of local interests. Priority should be shifted to the Middle Zone for irrigation, the Southern Zone for water supply and the Northern Zone for promotion of more efficient water management programs. The Japan International Cooperation Agency (JICA) stressed that the experience and knowledge derived from implementation of proposed small and medium projects will be a great asset in future logical development of larger projects in the Country.

### Scope of Projects and Service Levels Involved

In accordance with the Strategies mentioned above, the scope of the projects and related service levels involved in the Plan by 2020 are listed in the Table: "Major Indicators in the Plan" in the JICA Report.

### Financial Requirements for the Plan

Costs associated with implementation of the Plan are listed in Table 3. These costs, set out in five-yr periods from 2000, are developed applying February 1994 price levels.

Table 3: **Cost of Program Implementation (x10<sup>9</sup> Naira)**

S/No	Period	1996-2000	2001-2005	2006-2010	2011-2015	2016-2020	Total
1	Water Resources Monitoring	270	250	230	240	250	1,240
2	Water Source Works	800	7,300	9,400	10,900	13,300	41,700
	Rehabilitation and Improvement	600	-	-	-	-	600
	Proposed Multipurpose Dams	200	7,300	9,400	10,900	13,300	41,100
3	Public Irrigation and Drainage	7,780	7,580	6,450	7,690	8,930	38,430
	Rehabilitation and Improvement	7,680	3,100	-	-	-	10,780
	Proposed	100	4,480	6,450	7,690	8,930	27,650
4	Water Supply	40,780	25,610	59,590	74,260	113,540	313,780
	Rehabilitation	3,400	5,160	21,020	10,050	13,260	52,890
	Proposed	37,380	20,450	35,130	49,050	67,820	209,830
	Reconstruction	-	-	3,430	15,160	32,460	51,050
5	Dadin Kowa Hydro Development under NEPA	600	-	-	-	-	-
6	Gully Restoration Works	-	-	-	-	-	-
	Total (1 + 2 + 3)	8,850	15,130	16,080	18,830	22,480	81,370
	Total (1 – 6)	53,890	40,740	75,690	93,090	136,020	399,410

The financial feasibility for the Plan, which compares required average annual costs and anticipated annual budgets based on an annual real growth rate of three percent against the national budget inclusive of State budgets and external loans, reveals that apart from the sectors of water resources monitoring and irrigation and drainage, a huge budget would be required under water supply component to meet basic human needs of the Country. If the budgetary arrangement during the Plan period is kept at the present level without further expansion (Table 4), it is likely that water supply in 2020 would be in a range of the service population of 60 to 70 percent urban and 30 to 40 percent rural coverage.

Table 4: **Average and Anticipated Annual Costs and Budgetfor Masterplan (10<sup>9</sup> Naira)**

S/No	Period	Average Annual Costs Required for the Plan – A –	Anticipated Annual Budgets During the Plan Period – B –	A/B
1	Water Resources Monitoring	0.005	0.036	0.2
2	Public Irrigation and Drainage	2.737	2.653	1.0
3	Water Supply	12.911	4.167	3.1
	Total (1 + 2)	2.742	2.689	1.1
	Total: (1 + 2 + 3)	15.653	6.856	2.3

#### Economic Justification of the Plan

The standard practice in terms of economic rate of return (ERR) as is internationally applied has been employed by taking only the irrigated farming benefits for evaluation of public irrigation and drainage projects. Computed ERR was found to be about 10 percent for Northern, 10 to 14 percent for Central and more than 14percent for Southern Regions of the Country. Under the least-cost approach, water rates chargeable per cu.m for recovery of OM and replacement costs were found to be 2 to 3 Naira for surface water and 2 to 4.5 Naira for groundwater. These rates are considered acceptable until users attain a higher level of income to bear the full cost recovery.

#### **Energy Resources in Nigeria**

Energy development in Nigeria started in Lagos during the early days of colonial rule. Later, in the provinces, isolated thermal stations operated by Public Works Departments (PWDs) dotted the nation. The first hydro-electric station was established in the Jos Plateau to serve small industries and domestic needs by the mining companies. In 1958, an off-shoot of PWD became the Electricity Company of Nigeria (ECN). A few years later, the Northern Regional Government in association with the ECN commenced the development of the Niger Dam at Kainji via an Act

promulgated in 1962. Thereafter the ECN commissioned a study for large hydro dams at Shiroro and Jebba.

In 1972 the Niger Dam authority and ECN were merged to form the National Electric Power Authority (NEPA). Upon creation in 1972 of the Federal Ministry of Water Resources (FMWR), with statutory responsibility for water resources development, a National Council on Water Resources was promulgated with all State Commissioners for water resources and NEPA as members.

Overall energy resources of the Country is managed by the Energy Commission of Nigeria under the Federal Ministry of Power and Steel. The Commission is responsible for policy formulation and implementation, and coordinates energy development in the Country.

During the 1970s there were major developments in the energy sector. Detailed feasibility studies and investigations were initiated for major hydro and thermal power development together with associated transmission and distribution facilities. The Shiroro and Jebba projects were realized (see table 5), and numerous hydro sites were identified at Lokoja, Makurdi and Ikom on Niger, Benue and Cross Rivers, respectively, and the Gembu, Zungeru, Katsina, Mambilla and Onitsha hydro dams were identified (see table 6). Thermal stations were sited at Sapale, Afam, Egbin, Delta and Ijora-Lagos and additional thermal sites identified at Eket, Lagos-Imore (Nuclear), Onitsha, Makurdi and Ajaokuta.

Table 5: **Major Hydro Power Schemes in Nigeria**

S/No.	Location	Installed Capacity (MW)	Available Capacity (MW)	Availability Factor %
1	Kainji	760	174	22.8
2	Jebba	540	501	86.6
3	Shiroro	600	454	75.7
TOTAL		1,900	1,129	61.3 (Av. Value)

Table 6: **Small Hydro Power (Off-grid) Schemes in Nigeria**

S/No.	Location	Installed Capacity (MW)	Available Capacity (MW)	Availability Factor %
1	Bagel I	1	0.88	88
2	Bagel II	2	1.95	97.5
3	Ouree	2	1.94	97.
4	Kurra	8	7.5	93.75
5	Lere I	4	3.8	95
6	Lere II	4	3.8	95
7	Bakalori	3	2.87	95.67
8	Tiga	6	5.77	96.16
	TOTAL	30	28.51	94.76 (Av. Value)

Currently, there are in Nigeria, over 52 potential small hydro sites, (See Table 7), 12 large hydro power sites and 34 potential thermal stations (Figs. 1 and 2). Many more sites for hydro, thermal and nuclear power stations are available for development in the Country.

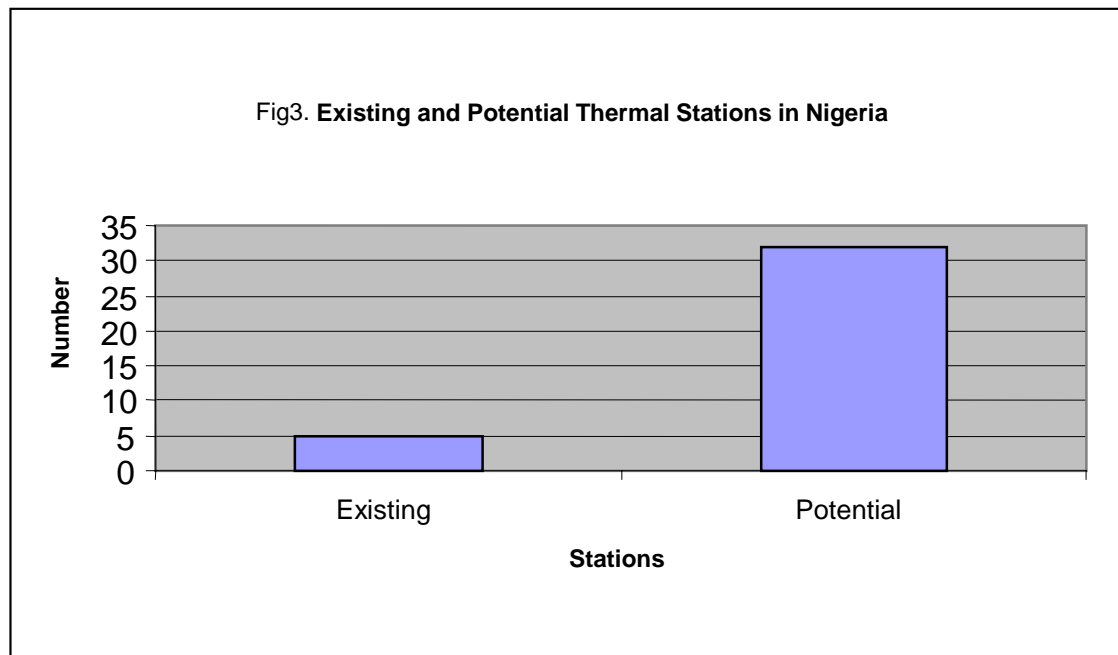
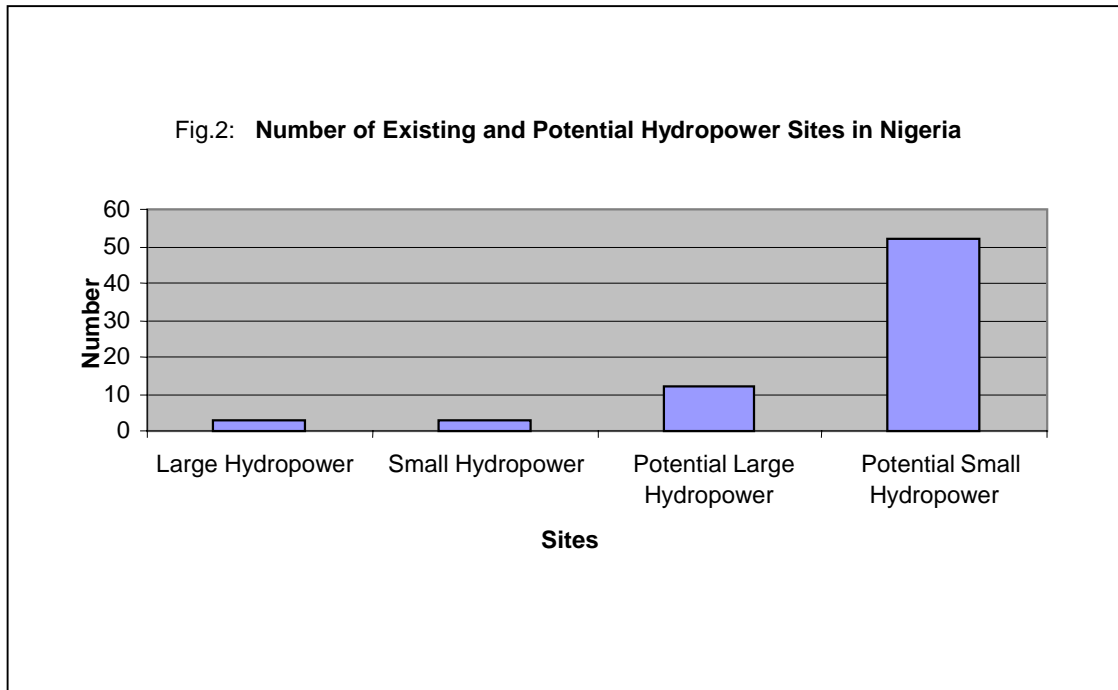


Table 7: **Some Potential Hydro Power Sites in Nigeria (1995)**

<b>S/N TYPE OF APPLICATION</b>	<b>LOCATION DATE OF INST.</b>	<b>POWER RATING IN Kw</b>	<b>TYPE OF INVERTER</b>	<b>SPONSOR</b>
1. Electrification	SERC 1992	4.5	1 Nos of 2.5kW	Energy Commission
2. Electrification	Kwalkwalawa 1994	7.2	4 Nos of 2.5kW	Energy Commission
3. Communication & Electrification	1 Div. Hq. Kaduna 1998	1.5	2 Nos of 1.kW & 500W	Energy Commission
4. Communication & Electrification	3 Mechanized Brid. Kano 1999	1	2 Nos of 500W	Energy Commission
5. Communication & Electrification	Giginya Barracks Sokoto, 1999	1	2 Nos of 500W	Energy Commission
6. Communication & Electrification	Minna Barracks 1999	1	1 No. of 1kW	Energy Commission
7. Electrification	Agbashi Nassarawa. 1999	2.5	1 No. of 3kW	Energy Commission
8. Electrification	UDUS, City Campus, 2002	1.5	1 No. of 1.5kW	Education Tax Fund
9. Electrification	UDUS, NUNET, 2002	2	1 Nos of 2kW	Usmanu Danfodio University, Sokoto
10. Electrification	School for the Deaf, Kaduna, 2003	5	2 Nos of 3kW	Education Tax Fund
11. Electrification (Wind Energy)	Sayya Gidan-Gada 1998	5	2 Nos of 2.5kW	Energy Commission

## MAJOR WATER ISSUES AND CONCERNS

### Concerns of People Affected by Dams

- The issue of social impacts of dams on the health, social system, cultures and livelihood of the people is an integral part of dams performance records.
- In terms of social impacts, it was discovered that the negative effects were frequently neither adequately assessed nor accounted for. The range of these impacts is substantial, affecting the lives, livelihood and health of a wide range of communities particularly those dependent on the riverine environment. Some of the effects are as follows:
- About 40-80 million people have been physically displaced by dams worldwide.
- In 1999, the Kainji dam release flooded the river banks and displaced thousands of people.
- In August 2001, the Tiga dam failed and the ensuing flood displaced over 20,000 people and washed away hundreds of hectares of farmland.
- Thousands of people living on the flood plains downstream of dams have also sustained widespread damage to their livelihoods and resource productivity.
- Many of the displaced were not recognized (or enumerated), and consequently were not resettled or compensated.
- Where compensation was provided it was often inadequate and where the physically displaced were enumerated, many were not included in resettlement programmes.
- Those who were resettled rarely had their livelihoods restored as resettlement programmes focused on physical relocation rather than economic and social development of the displaced.
- The larger the magnitude of displacement, the less likely that livelihoods of affected communities are restored.
- Gurara Dam displaced over 100 settlements within its reservoir. While compensations were made, affected people lost their farmlands, cultural artifacts, ancestral homes and socio-economic mainstays (Fig. 4).



Plate 3: Settlement Displaced Due to Construction of Gurara Dam

Recently (in August, 2006), a run-of the-river flood from the Usuma plain channel displaced many settlements within the satellite town of Kubwa in the FCT, destroying many properties. The affected people were largely not compensated, rather Government evicted many, demolishing their buildings many without compensation or resettlement. This rekindles the contention of NGOs that the rural people should participate in decision-making and their opinion considered during planning and design of dams.

In World Commission on Dams (WCD) Knowledge Base report it was demonstrated that a generalized lack of commitment or lack of capacity to cope with displacement of people is a major challenge. In addition, large dams in the Knowledge Base have had significant adverse effects on cultural heritage through the loss of cultural resources including artifacts of local communities and the submergence and/or degradation of medicinal plants and animal remains, burial sites as well as archaeological monuments. The Knowledge Base indicated that the poor, vulnerable groups and future generations are likely to bear a disproportionate share of the social and environmental costs of large dam projects without gaining a commensurate share of the economic benefits, that is,

- Indigenous and tribal people as well as vulnerable ethnic minorities have suffered disproportionate levels of displacement and negative impacts on livelihood, culture and spiritual existence.
- Rural and directly affected people living near reservoirs as well as displaced people and downstream communities have often contracted



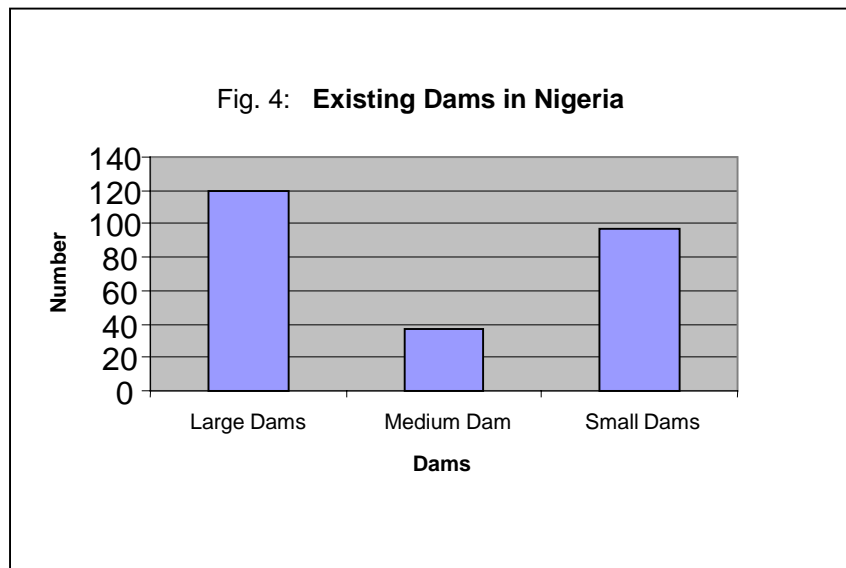
tropical diseases and other health related afflictions, from environmental changes and social disruptions.

- Among affected communities, gender gaps have widened, and women frequently suffer a disproportionate share of the social costs, while often subjected to discrimination in the sharing of benefits.

### Dam and Rural Development

Dams, as major incursions into nature, are supposedly wheels in the progress of rural development. Most often, however, this man-made structure has not lived up to its billing. Construction of Dams has led to the displacement of rural and sometimes urban residents, loss of farmlands, alteration of ecosystems of the host environment and other negative consequences. Dam development impacts river flow, the right of access to water and brings about the disruption of existing human settlement, culture and sources of livelihood. Nevertheless, there is no doubt that large dams have contributed to economic growth of host communities like opening up labour opportunities, improvement of farming and commercial activities, and transformation of the river flow regime.

The distribution of existing Dams in Nigeria is presented in Fig. 4 below.

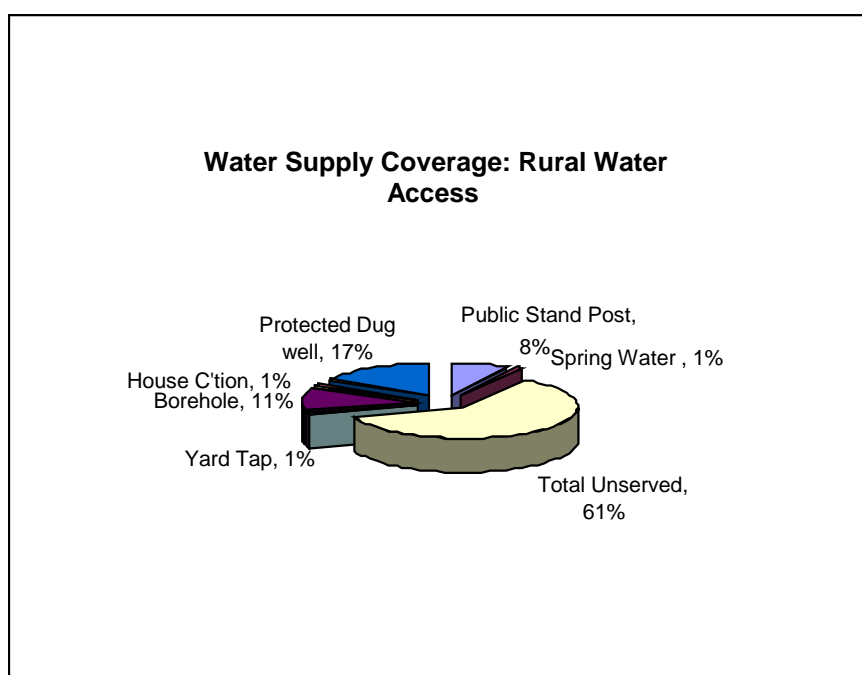


Source: NICOLD/FMWR

## Access to Potable Water

Barely 40% of the population affected by dams has access to safe drinking water (Fig. 6). It has been estimated that better access to potable water could relieve the burden of water borne diseases by as much as would improvements in health care delivery.

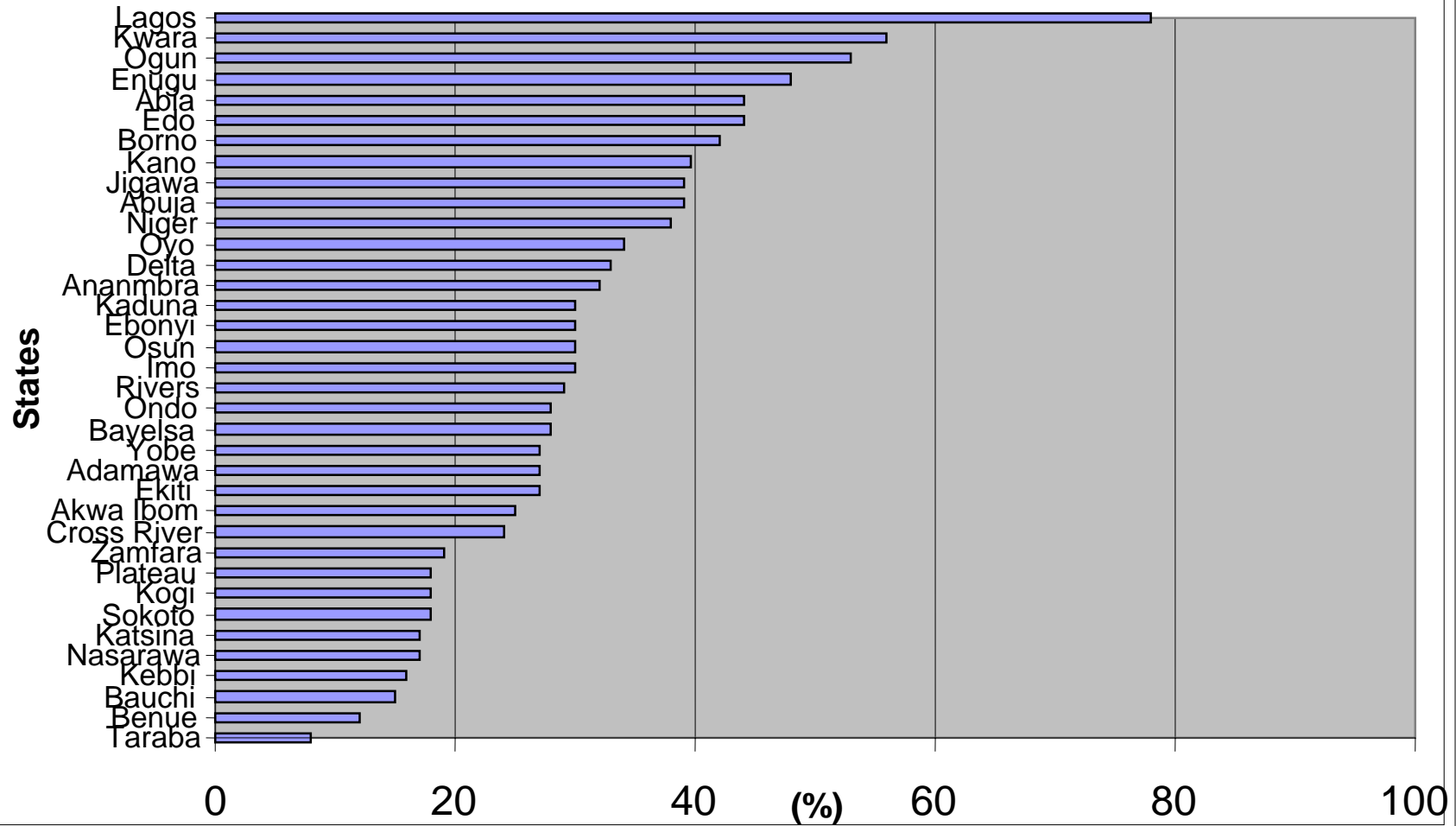
Fig.5: **Water Supply Coverage: Rural Water Access**



Source: **Federal Ministry of Water Resources & Rural Development, 1996**

In a survey published by the Federal Ministry of Water Resources, only 9% of people affected by dams in rural areas have access to water, treated or not. Though the supply of water is inadequate in all parts of the Country, some states have considerably better access as illustrated in Fig. 7, shown on Nigeria's 36 – State structure.

Fig. 6: Percentage Population Having Access to Safe Drinking Water (2001)



In about two-thirds of the States, the population having access to safe water is less than 30%.

### **National Rural Water Supply and Sanitation Policy**

The Federal Ministry of Water Resources in collaboration with State Water Corporations, the National Water Resources Institute, UNICEF, the European Commission and the World Bank are in consultation with key stakeholders to formulate a National Rural Water Supply and Sanitation Program (NRWSSP) in consonance with the objective of the National Water Supply and Sanitation Policy.

The NRWSSP objectives, targets and safe water consumption standards have implications for the NRWSSP. The overall goal of the NRWSSP is to consolidate, increase and sustain universal access to adequate quantities of affordable and safe water by the Yr 2015; as well as consolidate, increase and sustain universal access to hygienic sanitation facilities by the Yr 2020.

Among key objectives of the Program are:

- To promote improved hygiene and sanitation practice by developing and applying appropriate participatory and social marketing methods and techniques that will lead to demand for household and communal sanitary facilities;
- To support, strengthen and enhance community management resulting in sustainability of water supply and sanitation services;
- To increase the capacity of Local, State and Federal Governments to assist communities obtain basic water supply and sanitation services that the communities themselves can maintain with private sector support;
- To increase the capacity of Local, State and Federal Governments, NGOs and Civil Society Organizations to deliver water supply, sanitation and hygiene service to communities experiencing crisis and outbreaks of endemic diseases;
- To increase the capacity of Local, State and Federal government institutions to manage program implementation in support of communities in an efficient and cost-effective manner;
- To enhance the capacity of the private sector to supply goods and services for the sub-sector;
- To support the Country's poverty reduction program by reducing the disease and workload burden so that the poor and disadvantaged, especially women, in rural areas can lead a more productive and fulfilling life;

- To support the Nigerian guinea–worm Eradication Program through provision of adequate safe water to all guinea–worm endemic villages;
- To supplement the National Primary Health Care Program by promoting better health practices, focusing on safe water, good hygiene, diarrhea control and proper waste disposal;
- To supplement the Universal Basic Education (UBE) Program through provision of water and sanitation facilities to make primary schools and junior secondary schools child and especially girl friendly; and
- To monitor the performance of the sub-sector for sound policy and strategy adjustment and development.

It is a major concern that a few years to the end of the target date the objectives of the programme have not been realized, particularly on those affected by dams. The cardinal points of the programme have not even been implemented as the recent Rural Water Supply Programme coverage is still 25% of the entire nation. A recent survey has shown that none of the communities affected by the dams was considered in the citing of the scheme.

### **Issues and Constraints to Expanding Access to Potable Water in General and Dam Affected People in Particular**

1. *Delay in implementing agreed legal and regulation framework.* Generally, the regulatory framework for the water sector is diffused and weak and the roles of the various tiers of government unclear. Agencies of government have continued to see their role as service providers and regulators. The new WRMP and NRWSSP envisage the creation of a National Water Commission - an independent regulator for water supply and water resources management in the Country. Despite the acceptance of the imperative for an independent regulator, the Commission is yet to be created. States were also expected to develop regulatory agencies to facilitate the achievement of sector objectives. So far, no State has an independent water regulator. Inadequate regulatory guidelines ensuring a level playing field for various categories of investors deter investment. Moreover, activities of all tiers of government in water supply significantly overlap and are poorly coordinated and the legal framework setup for dam affected issues has not been implemented.
2. *Inadequate power supply.* UNICEF, in partnership with State Governments, has established a Rural Water Supply and Sanitation Agency (RUWASA) all over the Country. Central to the strategy of RUWASA is the use of hand pumps muscle power in pumping water, which is practical for many dispersed communities where the hydrogeology supports such use. For modern water supply schemes drawing water from deep aquifers and serving moderate to large populations, electricity is required. Power supply from Power Holding Company of Nigeria (PHCN), where such possibilities exist, is unreliable. Consequently, all water works in the Country are planned with diesel generators as the main source of power. Depending on the size of the plant, the cost of diesel and maintenance of the generators constitute 30-40% of

total operating costs. Hence, the viability of modern water supply facilities in Nigeria is substantially dependent on the availability of reliable power supply.

3. *Poorly directed subsidies.* Ten liters of potable borehole water in a typical village cost about ₦5. Meanwhile, the Abuja Municipal Water Board supplies water to high income neighborhoods at the rate of ₦21/m<sup>3</sup> of treated water. This represents less than half the cost of water in many rural areas. People directly affected by dams are generally worse off as there are usually no arrangements on ground to alleviate their water shortage problems even though they have lost their usual sources of water to reservoirs created by dam construction.
4. *Regulatory Actions restrict enterprise size.* The proportion of water supplied by individuals and companies represents a significant share of the total national output. However, there are no major water corporations in the Country. This has restricted water business to small scale enterprises and the informal sector.
5. *Local capacity to deliver rural water supply.* To a large extent, the competence, capital and technology to extract, treat and transport water exist in Nigeria. Several components are imported, including power equipment, rigs, pumps and steel pipe. The services network for water supply is relatively well-established nationwide. Similarly, there are several procurement, construction and engineering consulting firms with strong presence in specific regions of the Country. Due to the absence of major water utility firms, however, ownership and management experiences are limited to small scale firms and the informal water supply sector. While water engineering and procurement are big business in Nigeria, there is little domestic experience in running modern water and wastewater utilities.

### **Technical, Financial and Economic Issues and Concerns**

The benefit of large dams in Nigeria varies widely, with some of the uses falling short of their targets. Some large dams are yet to be effectively harnessed usually due to under or non development of downstream irrigation and other use facilities. For example, the Dadin Kowa Dam constructed in 1987 was not used until 2005 when the Gombe Regional Water Scheme, which would draw less than 10% of the reservoir capacity, was constructed. The irrigation component, the major area of the stored water, is yet to be implemented.

A review of the performance of other large dams reveals strategic issues which need to be addressed in order to realize the target of such structures. Issues relating to their development include the following realities:

- Large dams, such as Omi Dam in Kogi State, designed to support irrigation, have fallen short of their targets, due largely to poor or non development of enough irrigable land for farming, thereby wasting the investment objective.
- Large dams in Nigeria built for power generation have performed below their installed capacities or targets. For instance, the Kainji Dam on

River Niger (760mw), Jebba on River Niger (540mw) and Shiroro on Kaduna River (600mw) hardly deliver 50% of their installed capacity. This has translated into huge economic losses.

- Large dams, built for municipal and industrial water supply, have generally fallen short of their intended targets of delivery of bulk water supply, and thus led to poor financial cost recovery and economic performance.
- Large dams with flood control components have provided important benefits in this regard, but have, at the same time, led to greater vulnerability to flood hazards due to increased settlement and greater damages in the recovered flood plain.
- Impacts on ecosystems are usually more negative than positive, and have led, in many cases, to significant and irreversible loss of species. In some cases, however, enhancement of ecosystem values does occur, through the creation of new wetland habitat as well as fishing and recreational opportunities provided by new reservoirs.

In the EIA studies of the Gurara Water Transfer Project, it was observed that reservoirs and natural lakes would emit greenhouse gases due to rotting of vegetation and carbon inflows from the catchments, especially during the first year of reservoir filling. The scale of such emissions has not been reliably established in Nigeria but an unpublished study at the University of Benin on some medium reservoirs in Southwest Nigeria appears to indicate that the level of these emissions might be significant, relative to emissions from equivalent thermal power plants.

Information on other reservoirs studied (notably those in the Northern States of Nigeria), indicates that gross emissions of greenhouse gases are significantly lower than the thermal alternative. However, this assertion cannot be confirmed as no quantitative measurements have been made to compare or verify these assertions.

The World Commission on Dams (WCD) in its report stated that efforts to counter the ecosystem impacts of large dams have met with limited success due to the lack of attention to anticipating and avoiding such impacts, the poor quality and uncertainty of predictions, the difficulty of coping with all impacts, and the partial implementation and success of mitigation measures. The report further stated that:

- It is not possible to mitigate many of the impacts of reservoir creation on terrestrial ecosystem and biodiversity, and efforts to 'rescue' wildlife have met with little long-term success;
- The use of fish passes to mitigate the blockage of migratory fish has had little success, as the technology has often not been tailored to specific sites and species;

- Good mitigation results from a good information base, early co-operation between ecologists, the dam design team and affected people; and regular monitoring and feedback on the effectiveness of mitigation measures are generally absent.
- Environmental flow requirements (including managed flood releases) are increasingly not implemented to mitigate impacts of changed downstream flow regimes on aquatic, floodplain and downstream ecosystems.

These issues raised by the WCD are of great concern, especially to environmentalists and environmental-biased NGOs; given the usually nonchalant attitude of dam proponents. In view of the lack of enforceable legislation, there is limited success of traditional mitigation measures.

There is need therefore, to promulgate appropriate legislation to minimize ecological impacts through implementation of workable measures and involvement of directly affected stakeholders and people in decision making and implementation of mitigation measures or selection of alternative sites with less ecosystem damage. Consideration should also be given to experimenting on 'compensatory' approach, offsetting the loss of ecosystems and biodiversity through investment in conservation and regeneration measures and through protection of other threatened sites of equivalent ecological value.

### **Socio –economic and Cultural Impacts.**

All communities around dam sites who hitherto depended on the rivers for domestic water, farming, fishing and grazing were dislocated with the promise of resettlement, but this was haphazardly done resulting in the abandonment of most communities, who have lost their farmlands, source of drinking water and livelihood, without adequate compensation, resettlement and rehabilitation.

Several people who could not afford the harsh conditions of new areas were forced to migrate for green pastures to other communities and even the cities causing congestion in urban areas. Those who decided to stay in relocated areas are compelled to live in abject poverty, hunger and disease in the midst of abundance.

The dam affected communities have cost their ancestral graves, shrines, worship centres and other cultural artifacts causing social dislocation. In most cases indigenous people and women suffer most from these social impacts due to deliberate exclusion from benefits and decision making.

For communities around irrigation dams like the Hadejia –Jamere river basin in Kano, Jigawa, and Bauchi States, the experience is that the dams have not fulfilled their expectation of providing channels of irrigation for dry season farming. Rather they relate that the channels of irrigation are either inadequate or ill material such as the water collected at the dams does not spread out to the plains where crops are cultivated. They thus resort to use of mini petrol powered engine water pumps to supply water to their crops. But the pumps are however too expensive for peasant farmers to afford, while petrol is often hard to get or too expensive.



Another expectation of the Hadeja-Jamere river basin communities is that the presence of the dam would help to control the flow of water. They expect that excess flow would accumulate in the reservoirs during the rains, and released when eventually needed. The experience is that often the water is released downstream when the dam overflows causing heavy flooding and destruction to farmlands, buildings, and fishing ponds. Ironically when the water in the river is insufficient to irrigate their crops, the dams swallow up what little water remains in the rivers during the farmland dry.

For communities with hydropower's stations like Kanji, Jebba and Shiroro even though electricity magnets from and passes through their areas, most of them are not beneficiaries of the electricity generated. Damming the river has resulted in reduction in water volume downstream leading to depletion of the fish stock, with some species actually extinct.

To overcome this problem, some desperate fishermen which have resulted to the use of small nets, chemicals and explosives which destroy the fingerling and eggs leading to extraction of some species, destroying the ecosystem and exposing human population to health hazards. This experience is the same for downstream communities along the Benue valley whose river has been demand in Cameroon.



Plate 4: Indigenous people whose lives depends on fishing

## Environmental Issues and Concerns

According to the WCD, ecosystem impacts are classified in the following order;

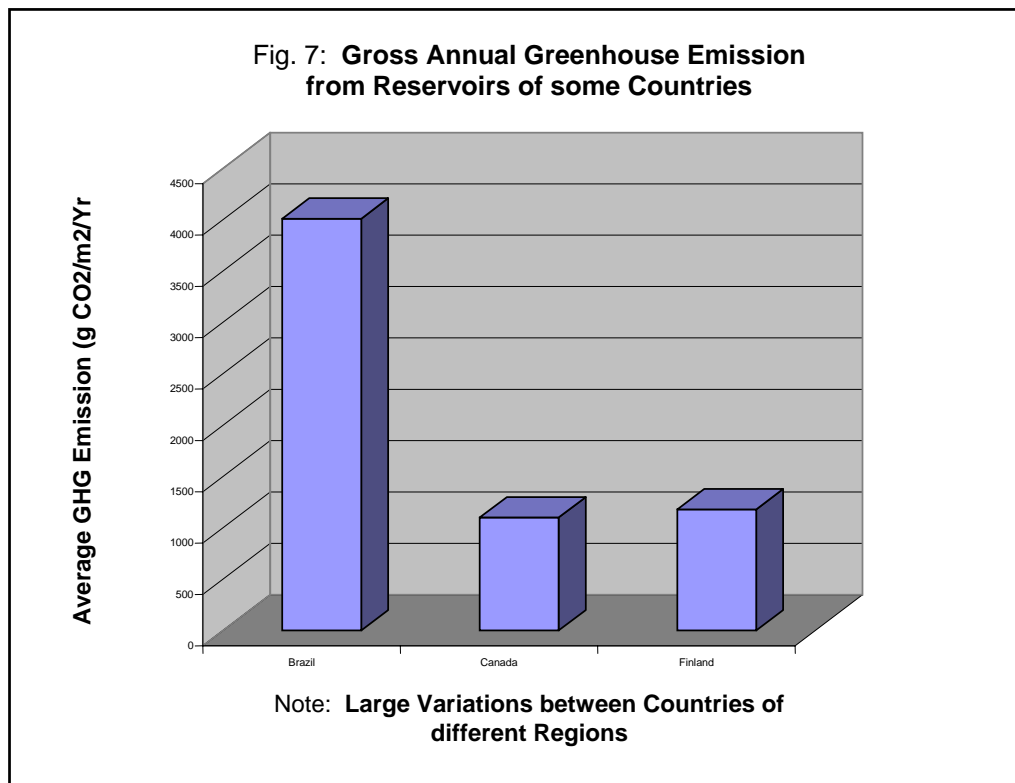
- i. First - order impacts that involve physical, chemical and geomorphologic consequences of blocking a river; altering the natural distribution and timing of the streamflow;

- ii. Second – order: impacts that involve changes by primary biological productivity of ecosystem including effects on riverine and riparian plant life and on such downstream habitat as wetlands;
- iii. Third – order: impacts that involve alterations to fauna (such as fish) caused by first or second - order effects.

Displacement of people, land, cultural artifacts, economic trees and land resources were the immediate casualty of large dams. However, resettlement of the aforementioned had never restored original status. Consequently, people affected by the dam suffer substantial loss.

In Nigeria, large dams have many mostly negative impacts on ecosystems. Terrestrial ecosystems and biodiversity affected during dam construction and subsequent inundation of the reservoir area result in loss of plants and forests. Other impacts include:

- Flooding of the reservoir area which leads to loss of land and settlement in upstream catchments.
- Emission of greenhouse gases (GHG) from reservoirs due to rotting vegetation and carbon inflows from the catchment (Fig. 8). It is believed that globally GHG emission accounts for between 1% and 28% of the global warming gases. The level of such emission in Nigeria is still a subject of research and it is believed it could be a major concern.



- Dams alter the natural distribution and timing of streamflow;
- Storage dams such as Kanji, Shiroro and Jebba, have led to significant loss of water by evaporation.
- As a physical barrier, the dam disrupts the movement of aquatic species leading to changes in upstream and downstream species composition and even species loss. For instance, migrating fishes dominantly found in River Kaduna have been affected by the altering of the main phases of their life cycle, i.e. reproduction, production of juveniles and species maturity, due to the altered flow regime. It is believed that fish species like salmon found in River Kaduna prior to Shiroro dam construction have been completely wiped out:
- Reduction in downstream annual flooding affects the natural productivity of riparian areas, floodplains and deltas. The characteristics of riparian plant communities are controlled by the dynamic interaction of flooding and sedimentation. Many riparian species depend on shallow floodplain aquifers that are recharged during regular flood events. Dams can have significant and complex impacts on downstream riparian plant communities. High discharges can retard the encroachment of true terrestrial species, and negatively impact the riparian plants, which had evolved with and become adapted to the natural flood regime.
- It is a well known scenario that riparian forest tree species are dependent on river flows and a shallow aquifer, and that the community and population structure of riparian forests is related to the spatial and temporal patterns of flooding at a site. For example, scrub forests of the Usuma floodplain, FCT, depend on periodic flooding for seed germination and headwater impoundment has curtailed regeneration. Conversely, artificial pulses generated by dam releases at the wrong time - in ecological terms - are recognized as a cause of forest destruction; such as, the disappearance of *Acacia xanthophloea* at the Goronyo dam area caused by the modified flood regime.
- The control of floodwaters by large dams, which usually reduces flow during natural flood periods and increases flow during dry periods, leads to a discontinuity in the river system. This, together with the associated loss of floodplain habitats, usually has a marked negative impact on fish diversity and productivity. The connection between the river and floodplain or backwater habitats is essential in the life cycle of many riverine fish which evolve over time to take advantage of the seasonal floods for spawning and feeding. Loss of this connection can lead to rapid decline in productivity of the local fishery and to the extinction of some species. Additionally, dewatering of stream channels immediately downstream of dams can constitute a serious impediment to riparian habitat development and sustainability.

- The loss of annual silt and nutrient replenishment, as a consequence of upstream impoundment, contributes to a gradual loss of fertility of formerly productive floodplain soils which support flood - recession agriculture. Dramatic reductions in bird species are also known, especially in downstream floodplains and delta areas, where wetlands may not be replenished with water and nutrients, once a dam is in place. Furthermore, recharge of groundwater in flood-plain areas is severely diminished once floods are eliminated.
- In the Benue Basin, changes in the hydrological regime due to Dadin Kowa Dam construction has adversely affected floodplain agriculture, fisheries, pasture and forests that constituted a significant element of community livelihood and culture.
- As earlier indicated, the blockage of sediment and nutrients, regulation of streamflow and elimination of the natural flood regime engendered by dams can have significant negative effects on downstream fisheries.
- Substantial losses in downstream fishery production as a result of dam construction are reported around the world. Along with subsistence agriculture, fisheries constitute an important dietary element among large rural populations in the developing world. Many of these people depend on fish as a primary or supplementary source of livelihood. The partial closing of the Onyami River channel by Ojirami dam, Edo State, for example, blocked fish migration and diminished upstream fish catch by almost 70%, affecting livelihoods. The WCD reports that in areas of rich fish species diversity, such as the lower Mekong Region of South East Asia, community livelihoods and culture are woven around fisheries. In Pak Mun the drastic decline in upstream fish harvest caused by dam construction effectively blocked fish migration from the Mekong River to tributaries of the large Mun River watershed.

## **Options for Water and Energy Resources Development**

Review of issues for meeting energy, water and food needs in Nigeria and Africa at large and the barriers and enabling conditions that determine the choice or adoption of particular options needs to be examined. The various potential options available in Nigeria include demand-side management (DSM), supply efficiency and new supply. When these options are harnessed or expanded, water and energy services is expected to meet evolving development needs across all segments of the economy. Viewing these options in an integrated fashion, rather than as individual sectors, the WCD identified the following issues:

- DSM options include reduced consumption, recycling, technological and policy options that promote efficiency of water and power utilization at points of end-use. DSM has significant untapped and universal potentials and provides a major opportunity to reduce water stress and

power requirements as well as achieve other benefits such as the reduction of greenhouse gas emissions.

- Improving system management can deter the need for new sources of supply by enhancing supply and conveyance efficiency. Needless loss of power and water can be avoided through reductions in leakages from the system, keeping up with system maintenance and upgrading of control, transmission and distribution technology in the power sector.
- Basin and catchment management through vegetative and structural measures offers opportunities across all sectors to reduce sedimentation of reservoirs and canals and to manage the timing and quantity of peak, seasonal and annual flows, as well as ground water recharge.
- A number of supply options have emerged that are locally and environmentally appropriate, economically viable and acceptable to the public, including recycling, rainwater harvesting and, renewable energy.
- The ability of various options to meet existing and future needs or to replace conventional supplies depends on the specific context, but in general they offer significant potential, individually and collectively.

The review also examined factors related to the physical sustainability of large dams and their benefits, and confirmed that:

- Ensuring the safety of dams requires increasing attention and investment as the stock of dams ages, maintenance costs rise and climate change possibly alters the hydrological regime used as a basis for the design of dam system units and, in particular, spillways.
- Sedimentation and the consequent long-term loss of storage are a serious concern globally, and the associated effects are particularly felt by basins with high geological or human-induced erosion rates, dams in the lower reaches of rivers and dams with smaller storage volumes.
- Waterlogging and salinity affect one-fifth of irrigated land globally-including land irrigated by large dams-and have severe, long-term and often permanent impacts on land, agriculture and livelihoods where rehabilitation is not undertaken.

## **Strategic Priorities for Decision - Making**

### **Gaining Public Acceptance**

As earlier noted, the affected people in Nigeria are not generally contacted before decisions affecting their lives are made, whether such decisions are likely to be publicly accepted or not. Public acceptance of key decisions is essential for equitable and sustainable water and energy resources development. Acceptance emerges from recognizing feelings and rights, addressing risks, and safeguarding the entitlements of all affected groups, particularly indigenous and rural settlements, women and other vulnerable groups.

According to WCD report, decision-making processes and mechanisms should involve all groups and people, and results should be demonstrably accepted by stakeholders as key decisions, and such processes should be guided by their free, prior and informed consent. In particular, the following should be noted:

- Recognition of rights and assessment of risks are the basis for the identification and inclusion of stakeholders in decision -making on energy and water resources development.
- Access to information, legal aids and other support from pressure groups are available to all stakeholders, particularly displaced or affected indigenous residents, women and other vulnerable groups, to enable their informed participation in decision-making processes.
- Public hearings and/or “Town Hall Meetings” are hardly held to solicit the opinion of affected people. Demonstrable public acceptance of key decisions should be achieved through agreements negotiated in an open and transparent process conducted in good faith and with the informed participation of all stakeholders.
- Decisions on projects affecting indigenous and tribal people should be guided by their free, prior and informed consent, achieved through formal and informal contacts with representative bodies.

### **Rights and Risks of Communities**

To size the efficacy of decision taking, rights and risk analyses are necessary ingredients. The bases for assessing and reaching decisions on water and energy resources development are issues of concern in today’s Nigeria.

Along with all development choices, decisions on dams or energy projects and their alternatives must respond to a wide range of needs, expectations, objectives and constraints. They should be a function of public choice and public policy. To resolve underlying conflicts about the effectiveness of dams and their alternatives, a broad consensus is needed on the norms that guide development choice and the criteria that should define the process of negotiation and decision-making.

To improve development outcomes in the future, it is necessary to look at proposed water and energy development projects in Nigeria in a much wider setting—a setting that reflects full knowledge and understanding of the benefits and impacts of the large dam projects and alternative options. It means that new voices, perspectives and criteria should be brought into decision-making, and it is necessary to adopt an approach that will build consensus around the decisions reached. This will result in fundamental changes in the way decisions are made.

According to the WCD, such a process must start with a clear understanding of the shared values, objectives and goals of development. WCD grouped the core values informing its understanding of these issues under five main headings, namely:

- Equity,
- Efficiency,
- Participatory decision-making,
- Sustainability, and
- Accountability

Considerable support exists for rights, particularly basic human rights, to be considered as a fundamental reference point in any debate on dams—starting with the adoption of the Universal Declaration of Human Rights in 1948 and the related covenants adopted thereafter, through to the Declaration on the Development adopted by the General Assembly in 1992.

Given the significance of the rights-related issues as well as the nature and magnitude of potential risks for all parties concerned, the Commission proposes that an approach based on 'recognition of rights' and 'assessment of risks' be developed as a tool for guiding future planning and decision-making. This will also provide a more effective framework for integrating the economic, social and environmental dimensions for options assessment and for planning.

Clarifying the rights context for a project is an essential step in identifying those legitimate claims and entitlements that might be affected by the proposed project or indeed, its alternatives. It is also the basis for effective identification of stakeholder groups that are entitled to a formal role in the consultative process and eventually in negotiating project-specific agreements relating, for example, to benefit sharing, resettlement or compensation.

The notion of risk adds an important dimension to understanding how and to what extent, a project may have an impact on such rights. Traditional practice usually tends to restrict the definition of risk to the developer or corporate investor in terms of capital invested and expected returns. These voluntary risk-takers have the capacity to define the level and type of risk they wish to take and explicitly to define its boundaries and acceptability. In contrast, as the Global Review showed, a far larger group often has risks imposed on them involuntarily and managed by others. Typically, these involuntary risk-bearers have little or no say in overall water and energy policy, in the choice of specific projects or in the project design and implementation. The risks they face directly affect individual well-being, livelihoods, quality of life, even their spiritual world view and very survival.

## **MAJOR ENERGY ISSUES IN NIGERIA**

### **Introduction**

Energy it is an essential ingredient for socio-economic development and economic growth. The objective of the energy system is to provide energy services which are the desired and useful products, processes or indeed services that result from the use of energy, such as for lighting, provision of air-conditioned indoor climate, refrigerated storage, transportation, and appropriate temperatures for cooking.

The energy chain to deliver these services begins with the collection or extraction of primary energy, which is then converted into energy carriers suitable for various end-uses. These carriers are used in energy end-use technologies to provide the desired energy services (Sambo, 1997). Thus, energy is an essential input to all aspects of modern life. It is indeed the livewire of industrial production, the fuel for transportation and for the generation of electricity in conventional power plants.

In Nigeria the major sources of power for domestic and industrial uses are hydro or thermal.

### **Energy Crises in Nigeria**

Inadequate power supply is no longer news in Nigeria. With a population of over 150 million people, the Country cannot boast of steady power supply. Infact, it is estimated that the population is effectively short of power supply over 60 percent of the time.

The installed capacities of the major generating plants in Nigeria are as follows:

- A. Hydro
  - Kainji Hydrodam on Niger River (760 MW)
  - Jebba Hydrodam on Niger River (540MW)
  - Shiroro Hydrodam on Kaduna River (600MW)
  
- B. Thermal
  - Sapele (1020MW)
  - Afam )700MW)
  - Delta (876 MW)
  - Egbin (1320MW)
  - Ijora (60MW)

At a the total installed capacity of 5876 MW, the combined output of the plants hardly over reaches 3000MW; and this has led to major energy crises in the Country. The inability of the National Electric Power Authority (now Power Holding Company of Nigeria) to meet the nation's energy requirement has been attributed to corruption, lack of system maintenance, inadequate funding, long military rule, technical ineptitude, and fluctuation of river flow into the reservoirs.



Energy supply worldwide is drifting away from fossil fuels to renewable energy. Developed nations had become complacent during the 1960s and 1970s when regular and reasonably cheap supplies were available. Then, oil producing countries caused a world-wide reaction by imposing a sharp increase in the price of crude oil in the seventies. Thus, oil-rich countries like Nigeria recorded tremendous economic gains, while non-oil producing developing nations were subjected to serious economic hardships as they suddenly found themselves utilizing, in some cases, up to 50% of their foreign exchange earnings for importing petroleum products or crude oil in order to sustain their oil-based industries and public utilities (Sambo, 1992).

Currently a high proportion of the world's total energy output is generated from fossil fuels such as oil and coal. In general, the quest for an option to conventional power schemes for extension to remote and rural locations of developing countries like Nigeria arises from the high cost associated with such extensions, as well as the maintenance of the power grid system to rural areas. The costs of grid extensions vary widely from country to country and are heavily dependent on the system used, the length of connection required, the topography encountered, the usage pattern and the load factor of the supply point (Charters, 1985). The close relationship between the proximity of energy resources to the potential users coupled with the high cost of conventional energy sources has led to considerable interest in the development and application of renewable energy resources.

Although research and development activities are currently undertaken in various aspects of renewable energy utilization, a number of technologies have since been shown to be feasible and ready for adoption. These technologies are quite suitable for the rural areas of Nigeria (Sambo, 1991). It is now universally accepted that fossil fuels are finite and it is only a matter of time before their reserves are exhausted. Estimates of reserves of fossil fuels all reach the same conclusion. Extended use of these reserves, worldwide, at the current rate, it is estimated, may not last more than a few more decades from now.

## **Energy Issues and Concerns**

The major energy issues in Nigeria can be considered as inefficient energy utilization, inefficient and unreliable energy supply system, environmental concerns, energy financing, inadequate technological capabilities in the energy sector and weak institutional framework (World Energy Council, 1993). However before discussing these issues there is need to consider the current energy consumption patterns in the country.

## **Energy Consumption Patterns**

In 1991, the Sokoto Energy Research Centre, at the instance of the Energy Commission of Nigeria, carried out a survey of 55 Local Government areas in Niger, Kano, Katsina and Sokoto States as well as the Federal Capital Territory, Abuja. The report of that survey (Sambo, 1991) as well as the report of similar surveys carried out in other parts of the country revealed the following:

### **(a). Agricultural sector**

Human and animal power provides the bulk of the energy requirements for agricultural production. An assessment of the energy unit adopted, that is man-hours, showed that sharp variations exist in the magnitudes of the man-hour figures from place to place. Evidence of use of petroleum products for agricultural production was recorded. This, though small compared to human and animal power, is significant because it showed some application of motorized irrigation pumps and diesel powered tractors for mechanized agricultural activities.

### **(b) Household sector**

Fuel wood was found to be the predominant energy source in the household sector in Nigeria with 70 - 80% of households depending on it as their cooking fuel in both remote villages and towns. A consequence of this to the natural environment is that unchecked felling of trees to provide the fuel wood requirements will exacerbate desert encroachment, soil erosion and loss of soil fertility. Right now, it would not be practical to stop the use of fuel wood; rather, in the short term efficient wood-burning stoves, together with widespread establishment of fast growing trees should be adopted. In the long term, there should be a policy to introduce other fuels like LPG, kerosene and smokeless coal briquettes to replace fuel wood.

Kerosene is the predominant energy source used in rural areas for lighting. There is strong evidence of the use of small quantities of kerosene to assist the quick commencement of combustion of fuel wood. This is in addition to its use in urban centers as a cooking fuel. The predominant type of lantern used is the wick-type which does not produce a good level of luminosity.

The third energy type in the household sector in terms of significance is electricity which is mostly limited to state and local government headquarters and some big towns. Most of the electricity in the rural areas is provided by the State Rural Electricity Boards.

### **(c) Industrial sector**

Electricity from PHCN is the main energy supply for the industrial sector. This is supplemented, and in most cases replaced, by electricity generating sets that are fueled by automotive gas oil (diesel), as supplies from PHCN are predominantly unreliable. High and low

pour fuel oils are used in textile, cement, brick and other manufacturing plants, generally for large industries which are mostly located in the big cities and towns. For small towns and villages, most small-scale industries are operated on diesel generators for bakeries, steel, ceramic/pottery works and other establishments. In these localities, other activities like handicraft and weaving are human power based.

**(d) Transport sector**

In the transport sector, the prime motor spirit (PMS) or petrol is the major fuel for cars and the small buses. For lorries, trucks and rail transport, the predominant fuel is automotive gas oil (AGO) or diesel while air transport is powered by aviation kerosene. It has been estimated that 74% of the petroleum products demand in Nigeria is for transportation with only 19% devoted to the industrial sector. Of the amount of fuel consumed in the transport sector, 50% is absorbed in aviation.

**(e) Services sector**

In remote rural areas, human power is used for hand pumps or lifting water from wells, while in the big villages and many towns, diesel powered pumping systems are relied upon for borehole operation. Hospitals and health centers in rural areas rely on both REB-generated electricity and diesel generators for lighting, sterilizing of appliances as well as storage of drugs and vaccines. Use is made of fuel wood and to a lesser extent LPG, for cooking. The situation in the health centers is very much the same in institutions, boarding schools, barracks and the prisons.

### **Inefficient Energy Utilization**

As earlier noted, energy utilization in Nigeria is inefficient. Apart from direct loss due to wastage, this inefficiency has three major implications, namely:

- The investment in energy supply infrastructure is far in excess of the demand requirement;
- The environmental problems associated with energy utilization are aggravated; and
- Excessive energy consumption adds to the costs of goods produced especially in energy intensive industries like cement, steel works and refineries.

The potential for energy savings is substantial in the three dominant energy consuming sectors of the economy, namely: household, industry and transportation. In the household sector, for example, there is considerable energy loss due to the use of inefficient traditional stone stoves with efficiencies of between 5 to 12%. These efficiencies can be improved substantially. In the household sector, large savings can be made by simply switching from incandescent bulbs to fluorescent lamps. In the industrial sector, energy audit studies have shown that up to 25% of

energy consumption can be saved by adopting simple house keeping measures. Such measures include shutting off electrical machinery on no-load condition, plugging steam leaks and avoiding material wastages. In the transport sector, major savings can be realized by emphasizing mass transit schemes.

The major barriers militating against the adoption of more energy efficient practices in the Country include:

- Lack of awareness of the potential and importance of energy efficiency;
- Absence of skilled manpower to undertake energy audit studies; and
- No awareness of potential alternatives such as renewable energy technologies.

### **Inefficient and Unreliable Energy Supply System**

In electric energy supply, efficiencies of existing thermal plants are low. They are as low as 12% whereas efficiencies of up to 40% are attainable with modern technologies. Also, substantial electricity is lost in transmission and distribution. These losses are sometimes more than 30% of the total generated power. Apart from these inefficiencies, the reliability of existing installed electric generation system is low. There is the serious problem of power unreliability over the years such that most industrial establishments and upper income households install expensive generating sets amounting to over half of the total installed grid capacity. This constitutes huge economic losses to the Nigerian economy.

The major factors contributing to unreliability and inefficiency in the power sector are:

- Frequent breakdown of generating plants and equipment due to inadequate maintenance and poor repairs;
- Lack of foreign exchange for timely purchase of needed spare parts;
- Obsolete transmission and distribution equipment which frequently break down
- Lack of skilled manpower; as well as
- Inadequacy of basic industries to service the power sector.

In the petroleum sector, production, marketing and distribution systems are often inadequate, inefficient and costly. On the production side, refinery capacity utilization is generally low largely due to operation and maintenance problems.

### **Environmental Issues**

The major environmental problems associated with energy production, distribution and consumption are deforestation, air and land pollution as well as flooding.

Excessive fuel wood consumption arises due to population growth, low technical efficiency of the traditional stone stoves and the lack of adoption of other sustainable cooking methodologies. These contribute to deforestation, a serious issue considering the important role of forestry resources in the ecosystem. Forests serve as sinks for carbon dioxide, maintain diverse plants and animal life and regulate water flow. Their loss, as earlier noted, leads to soil erosion, desertification and loss of soil fertility. Combustion of fossil fuels, especially in the transport and industry sectors, contributes greatly to air pollution, which constitutes a health hazard to dwellers of both cities and rural areas that are also exposed to smoke from biomass combustion in poorly ventilated kitchens.

Major water and soil contaminations are rampant from oil spillages in oil producing areas of the country. Hydropower Dams, among other problems earlier listed, because flooding of agricultural land upstream and ecosystems downstream.

### **Energy Financing Institution Framework Issues**

Other important issues in energy development include poor financing, low technical capabilities in the sector and weak institutional framework. The energy sector is a large consumer of national resources, demanding large capital expenditures, skilled manpower and steady foreign exchange outflows. Almost invariably, energy financing has been the exclusive prerogative of Government whose capacity to finance new investments is to a large degree inadequate. Low technical capacity is responsible for the nation's inability to manufacture components of power plants as well as maintain the various structures and complexes in the energy sector. A major problem with institutional framework in the energy sector is the weak linkage among the various energy institutions.

### **Priority Issues**

An analysis of the Country's energy resource base shows that the nation stands to benefit immensely by ensuring that petroleum products are made to last for as many years as possible so they continue to serve as revenue earners that would fuel and sustain the industrial sector over many years. This can only be realized with the adoption of many energy types within the energy mix of the Country.

The clear and practical approach is to adopt the renewable energy sources of solar, biomass, wind energy and small-scale hydropower plants for as many applications as possible. This approach is supported by the fact that renewable energy sources are available in all parts of the Country, the technology for their use is mostly simple, their utilization does not require heavy financing and their development is generally not associated with serious environmental implications. These considerations have led the Federal Government to establish amongst others, two centers for research and development in renewable energy (at University of Nigeria Nsukka, and Sokoto Energy Research Centre).

## **Renewable Energy Resource Issues**

For the purpose of this study, renewable energy sources considered are hydro, solar, biomass and wind.

### ***Hydro***

Essentially, hydropower systems rely on the potential energy difference between the levels of water in reservoirs, dams or lakes and their discharge tailwater levels downstream. Water turbines which convert the potential energy of water to power via a shaft rotation are coupled to suitable generators.

The hydropower potential of Nigeria is very high and hydropower currently accounts for about 29% of the total electrical power supply in the Country. The first hydropower station in Nigeria was constructed at Kainji in 1962 on the Niger River. The installed capacity was 760MW with provisions for expansion to 1156MW. A second hydropower station on the Niger was built in 1972 at Jebba with an installed capacity of 540MW. At Shiroro on the Kaduna River, a hydro power facility of 600MW capacity is also under operation, since 1972.

An estimate (Aliyu and Elegba, 1990) for Rivers Kaduna, Benue and Cross River (at Shiroro, Makurdi and Ikom, respectively) indicates their total capacity to stand at about 4,650MW. For rivers on the Mambila Plateau a hydropower system of 2,330MW capacity has been identified and is currently under development. Thus, the overall hydropower resources potentially exploitable in Nigeria is in excess of 11,000MW.

The foregoing assessment is for large hydro systems which have predominantly been the class of schemes in use prior to the oil crisis of 1973. Since that time, however, many developed and developing countries have opted for small-scale hydropower with appreciable savings made over the otherwise alternative of crude oil. It should be noted that hydropower plants that supply electrical energy in the range of 15kW to 15MW are classified as mini-hydro while those generating below 15kW are normally referred to as micro-hydro plants (Sambo and Taylor, 1990, Okoye, 2005). Indeed small-scale (both micro and mini) hydropower systems have the advantage over large hydro systems that problems of topography and environmental stresses are not excessive. In effect, small hydropower systems can be set up in all parts of the Country so that hydro energy in the large network of rivers and streams can be tapped and converted to electrical power. This way the nation's rural electrification projects can be greatly enhanced.

### ***Solar Energy***

Solar energy is the most promising of the renewable energy sources in view of its apparent limitless potential. The sun radiates its energy at the rate of about  $3.8 \times 10^{23}$  kW per second. Most of this energy is transmitted radically as electromagnetic radiation which comes to about  $1.5\text{kW/m}^2$  at the boundary of the atmosphere. After traversing the atmosphere, a square meter of the earth's surface can receive as much as 1kW of Solar power, averaging about 0.5kw over all hours of daylight.

Studies relevant to the availability of solar energy resource in Nigeria (Sambo, 1986; Sambo, 1988; Sambo, Doyle, 1986; Doyle and Sambo, 1988; and Folayan, 1988) have fully indicated its viability for practical use. Although solar radiation intensity appears dilute when compared with the volumetric concentration of energy in fossil fuels, it has been confirmed that Nigeria receives  $5.08 \times 10^{12}$  kWh of energy per day from the sun and if solar energy appliances with just 5% efficiency are used to cover only 1% of the country's surface area then  $2.54 \times 10^6$  MWh of electrical energy can be obtained from solar source. This amount of electrical energy is equivalent to 4.66 million barrels of oil per day.

Solar energy technologies are divided into two broad groups namely: solar-thermal and solar photovoltaics. In solar thermal applications, solar energy, in the form of electromagnetic waves, is first converted into heat, may then be used directly as heat, or converted into 'cold', or even into electrical or mechanical energy forms. Typical of such applications are drying, cooking, heating, distillation, cooling and refrigeration as well as electricity generation in thermal power plants.

In solar photovoltaic applications, solar radiation is converted directly into electricity. The most common method of doing this is through the use of silicon solar cells, a technique first observed in 1939. Its development has been closely tied to the space programme of the western world. The power generating unit is the solar module which comprises several solar cells electrically linked together on a base plate. On the whole, the major components of a photovoltaic system include arrays of the photovoltaic conversion devices, their interconnections and support, power conditioning equipment that converts the dc to ac and provides regulated outputs of voltage and current; the controller, which automatically manages the operation of the total system; as well as the optional storage for standalone (non-grid) systems. In recent times, the commercial viability of photovoltaic systems have been recognized and concerted international efforts in research and development have led to their increased efficiency and reliability as well as reduction in cost.

## **Biomass**

Biomass energy refers to the energy of biological systems such as wood and wastes. Biomass energy is an indirect form of solar energy because it arises due to photosynthesis. The biomass resources of Nigeria can be identified as wood, forage grasses and shrubs, residues and wastes (forestry, agricultural, municipal and industrial) as well as aquatic biomass. Wood, apart from being a major source of energy in the form of fuel wood is also used for commercial purposes in various forms as plywood, sawnwood, paper products and electric poles. For energy purposes, Nigeria is using 80 million cubic meters ( $43.4 \times 10^9$  kg) of fuel wood annually for cooking and other domestic purposes. The energy content of this fuel wood is  $6.0 \times 10^9$  MJ out of which only 5 to 12% is gainfully utilized for cooking and other domestic uses.

Although the biomass availability as at 1973 was put at  $9.1 \times 10^{12}$  MJ, it is expected that overall biomass resource availability at present is lower than the 1973 figure. This is largely due to the demand for wood in construction and the furniture industries in addition to its use as an energy source. As for forage grasses and

shrubs, estimates show that 200 million tones of dry biomass can be obtained from them and this comes up to  $2.28 \times 10^6$  MJ of energy. For crops and wastes, dry biomass produced annually leaves residues of energy content reaching  $5.3 \times 10^{11}$  MJ.

Estimates made in 1985 give the number of cattle, sheep, goats, horses and pigs as well as poultry birds in Nigeria to be 166 million. These produce 227,500 tones of animal wastes daily which comes to  $2.2 \times 10^9$  MJ taking the calorific value of animal dung to average 9,800 MJ/tonne. Animal residue can be converted to biogas and estimates show that this is in the order of  $5.36 \times 10^9$  m<sup>3</sup> which has an energy content amounting to  $2.93 \times 10^9$  kWh.

### **Wind Energy**

Wind is a natural phenomenon related to the movement of air masses caused primarily by the differential solar heating of the earth's surface. Seasonal variations in the energy received from the sun affects the strength and direction of winds. The ease with which aeroturbines transform energy in moving air to rotary mechanical energy suggests the use of electrical devices to convert wind energy to electricity. Wind energy has also been utilised, for decades, for water pumping as well as for milling of grains.

A study on the wind energy potentials for a number of Nigerian cities shows that the annual wind speed ranges from 2.32 m/s for Port Harcourt to 3.89m/s for Sokoto (Sambo, 1987). The maximum extractable power per unit area, for the same two sites was estimated to be 4.51 and 21.97 watts per square meter of blade area, respectively. And when the duration of wind speeds greater than 3 m/s is considered, the energy per unit area works out to be 168.63 and 1,556.35 kWh per square meter of blade area, respectively, for Port-Harcourt and Sokoto. Although use of wind energy for water supply has been known and applied over hundreds of years, in recent times, efforts have been directed largely towards the use of wind power for the generation of electricity. In the past twenty years or so, rapid changes in technology have occurred and major wind powered generating plants have been installed, especially in the rural areas of developed countries.

### **Renewable Energy Needs for Rural Development**

In this section, the energy needs in rural areas as well as the basis for design of solar and wind energy systems, are discussed.

#### **Energy Needs in Rural Areas**

Energy needs in rural and semi-urban areas of Nigeria can be categorized generally as follows:

##### **A. Domestic Needs**

- Cooking
- House lighting
- Domestic water pumping and distribution



- Television and radio operation
- Water heating
- Refrigeration

**B. Agricultural Production**

- Water pumping and distribution for irrigation
- Operation of various agricultural equipment or implements
- Processing and storage of agricultural products
- Drying

**C. Community Needs**

- Hospitals, Clinics
- Schools
- Community Centers
- Barracks, prison houses

**D. Industrial/Commercial Needs**

- Small to medium industries
- Business establishments (shops, banks, restaurants, bakeries, etc).

The issue of improving on renewable energy in Nigeria should be a major task by Government if the energy crises in the Country is to be tackled head on. The draft master plan for renewable energy presented in July, 2005 should be addressed and implemented without delay.

**Application of Renewable Energy Masterplan in Nigeria**

In October, 2005, the Energy Commission of Nigeria presented research and development studies that were undertaken by prominent researchers in various aspects of renewable energy systems and devices for adoption and integration into the national economy. A report compiled by the Commission provided details of available technologies, implementation schedules (short, medium and long term), funding, policies and legislation for adoption into the economy. A comprehensive compilation of the status of renewable energy technologies is in the final report titled "RENEWABLE ENERGY MASTERPLAN, OCTOBER, 2005.

## **Major Applications of Renewable Energy Systems**

### **A. Hydro Energy**

Hydropower has over the years provided major contributions to the growth of the Nigerian economy. These contributions are evident in its application to domestic industrial, manufacturing and construction areas, among others. Despite the importance of hydropower to the economy; Small Hydro Power (SHP) schemes have not been fully developed in the Nigeria. In the Republic of South Africa (RSA), SHP constitutes about 68% of hydropower injection to the Country's national power generation. Studies of potential sites of SHP in Nigeria in 1980 revealed that more than 12 sites with estimated potential capacity of 734MW are available for development. In addition, six SHPs of total capacity of 30MW have been installed, providing power supply to domestic and small-scale industries in rural areas (Okoye, 2005).

### **B. Solar Energy**

Solar thermal systems, especially solar water heaters and solar dryers, are in use in many parts of the Country. Solar cookers, solar stills, solar chicken brooders and solar thermal refrigerators have been developed by research centers and confirmed to be of practical application. Studies revealed, however, that solar photovoltaic applications have not attained a wide coverage over the Country. The issue of how to effectively use solar energy over a significant area of Nigeria should be a major consideration of the planned Consultative Conference. Other issues should include solar photovoltaic water pumping systems, solar powered vaccine refrigerators as well as telecommunication repeater stations that are powered by solar photovoltaics. Currently there are a few solar photovoltaic power plants that are providing electricity to entire villages and others that are operating on stand-alone basis, and on specific projects as rural health and television viewing centers. The impact of these innovations on rural communities should be a subject of further assessment.

### **C. Biomass**

Many versions of efficient wood-burning and charcoal stoves have been developed and are being used in many parts of the Country with the overall objective of curtailing the amount of trees that are perennially cut to provide fuel wood and char-coal. Biogas digesters, which are capable of producing biogas that could be used for domestic and industrial purposes, have been developed in many parts of the Country. Though biomass is now available, its impact on the targeted rural communities is still suspect. Sufficient raw materials growth is far from being realized as animal production is still low.

### **D. Wind Energy**

Wind energy used to be relied upon in the 1950s and 1960s for provision of water in many locations of the northern part of the Country. This practice is now largely abandoned as use of petroleum products

has essentially taken over. The development of the Poldow wind pump in Bauchi using locally available materials is surely a move in the right direction. It should be mentioned that there are a few modern wind water pumps in some parts of the Country. One wind electricity generator is currently supplying electricity at Sayya Gidan Gada in Sokoto State.

### **Renewable Energy Technologies Ready for Adaptation**

Many renewable energy devices have been developed by Nigerian researchers in various parts of the Country (Sambo, 1991). These devices, which are ready for integration into the economy especially for rural areas, include:

**A. Solar Cookers**

These are box-type arrangements where most local dishes can be cooked within one hour under average sunshine conditions.

**B. Solar Water Heaters**

The heaters, which are based on flat-plate collectors with appropriate storage units, can produce water at temperatures of up to 80°C. They can find applications in hospitals, hotels, and industry and private homes and can provide significant reduction of electricity bills.

**C. Solar Dryers**

Both portable cabinet dryers for individual private use and large-scale units for community utilization, have been developed. The dryers, which typically attain temperatures of up to 60-70°C, are suitable for drying a variety of agricultural produce.

**D. Solar Stills**

Solar stills are designed to produce distilled water from brackish water and can be useful at hospitals, industries and laboratories. When sized appropriately, they can provide the needs of comprehensive health centers in semi-urban areas.

**E. Water Pumping**

Photovoltaic solar modules have been used to pump water from wells and boreholes especially in rural areas where they can provide the water requirements of entire communities. Photovoltaic powered pumps can also be employed for irrigation purposes.

**F. Storage of Vaccines and Drugs**

Photovoltaic power components have been shown to adequately provide electricity for refrigerators and deep freezers for safe storage and preservation of vaccines and drugs.

**G. Street Lights and Traffic Controllers**

Photovoltaic modules have been used to provide uninterrupted electricity during the day and night for traffic controllers in city centers.

Operating jointly with storage batteries, they have been shown to power street lights continuously without the power outages commonly associated with the mains supply.

**H. Improved Wood-Burning Stoves**

Clay-based improved cooking stoves of various designs have been developed, and these conserve fuel wood consumption by up to 50%, leading to faster cooking. With chimneys, they allow for organized exhaustion of smoke, consequently reducing smoking in the kitchen environment.

**I. Production of Biogas**

With biogas digesters, which are typically constructed from sheet metal or empty drums and fed with slurries of animal dung, biogas can be produced after 2-3 days. The gas, which has a reasonable content of methane, is combustible and can be relied upon for cooking. It can also be used for powering internal combustion engines for electricity generation in rural areas.

**J. Wind for Electricity Generation**

In Nigeria and for quite some time, only laboratory trials have been made in the use of wind for electricity generation. Such trials have been made with models of three-bladed aeroturbines and the results obtained indicate the potential for stand-alone utilization especially in the Sahelian zone and the coastal areas of the Country. Recently, however, several wind water pumping sets and wind electricity conversion systems have been installed.

**K. Electricity from Microhydro Systems**

The generation of electricity from numerous waterfalls and rivers in the form of microhydro plants for integration into the national grid as well as for stand-alone utilizations, in remote locations, is a system that has been shown to be viable.

***Renewable Energy Systems Installed for Community Utilization***

Over the past 13 years the Energy Commission of Nigeria, some State Governments, the Education Tax Fund and a few other organizations have sponsored the installation of many pilot renewable energy systems for use by various communities. These projects have been executed by the Sokoto Energy Research Centre and quite a number of them are in Niger, Cameroun and Chad Republics. Table 8 lists 11 such projects on electrification while Tables 9 and 10, respectively, provide data on 17 photovoltaic water pumping systems in Nigeria and 14 solar thermal/biogas systems installed by the Sokoto Energy Research Centre.

**Table 8: Photovoltaic Electrification Systems Installed By Sokoto Energy Research Centre in Nigeria**

<b>S/N TYPE OF APPLICATION</b>	<b>LOCATION DATE OF INST.</b>	<b>POWER RATING IN Kw</b>	<b>TYPE OF INVERTER</b>	<b>SPONSOR</b>
1. Electrification	SERC 1992	4.5	1 Nos of 2.5kW	Energy Commission
2. Electrification	Kwalkwalawa 1994	7.2	4 Nos of 2.5kW	Energy Commission
3. Communication & Electrification	1 Div. Hq. Kaduna 1998	1.5	2 Nos of 1.kW & 500W	Energy Commission
4. Communication & Electrification	3 Mechanized Brid. Kano 1999	1	2 Nos of 500W	Energy Commission
5. Communication & Electrification	Giginya Barracks Sokoto, 1999	1	2 Nos of 500W	Energy Commission
6. Communication & Electrification	Minna Barracks 1999	1	1 No. of 1kW	Energy Commission
7. Electrification	Agbashi Nassarawa. 1999	2.5	1 No. of 3kW	Energy Commission
8. Electrification	UDUS, City Campus, 2002	1.5	1 No. of 1.5kW	Education Tax Fund
9. Electrification	UDUS, NUNET, 2002	2	1 Nos of 2kW	Usmanu Danfodio University, Sokoto
10. Electrification	School for the Deaf, Kaduna, 2003	5	2 Nos of 3kW	Education Tax Fund
11. Electrification (Wind Energy)	Sayya Gidan-Gada 1998	5	2 Nos of 2.5kW	Energy Commission

**Table 9: Some Photovoltaic Pumping Systems Installed in Nigeria**

	<b>LOCATION, SPONSOR &amp; DATE</b>	<b>TYPE OF MODULE</b>	<b>TOTAL NO.</b>	<b>HEAD IN METERS (m)</b>	<b>AGENCY</b>
1	Mech. Workshop, UDUS (1992)	SEIMENS M55	42	35	Energy Commission
2	Kalgo ((Binji) 1995	SEIMENS M55	79	18	Sokoto State Govt.
3	Ruggar Kijo (Yabo) 1996	SEIMENS M55	65	20	Sokoto State Govt.
4	Yar Tsakwa (Rabah) 1997	SEIMENS M55	70	20	Sokoto State Govt.
5	Falale (Gummi) 1998	ARCO M90	22	35	Zamfara State Govt.
6	Bukkuyum (Zamfara State)	ARCO M60	75	20	Zamfara State Govt.
7	Danzabuwa (Kano) 1998	SEIMENS M55	71	18	Energy Commission
8	Nangere (Yobe) 1997	SEIMENS M55	70	20	Energy Commission
9	Gumel (Jigawa) 1998	ARCO M90	70	20	Energy Commission
10	Kadar Tsaka (Sokoto) 1999	SEIMENS M55	80	20	Energy Commission
11	Birnin Tsaba (Zamfara)	SEIMENS M55	70	20	Zamfara State Govt.
12	Kuruwa (Sokoto) 1998	SEIMENS M55	69	20	Sokoto State Govt.
13	Achida (Sokoto) 1999	SEIMENS M55	110	20	Sokoto State Govt.
14	Kebbi (Sokoto) 1999	SEIMENS M55	40	18	Sokoto State Govt.
15	Goronyo (Sokoto) 1998	SEIMENS M55	52	20	Sokoto State Govt.
16	F. G. C. Kwali, Abuja (Feb., 2003)	Isofotons M55	52	20	E T F
17	Students' Hostel UDUS (Feb., 2003)	Isofotons M55	60	20	E T F

**Table 10: Solar Thermal & Biogas Systems Installed by Sokoto Energy Research Centre**

<b>PROJECT TYPE</b>	<b>LOCATION &amp; DATE</b>	<b>SIZE OF PROJECT/ CAPACITY</b>	<b>SPONSOR</b>
1 1.Improved Wood Stove	Danjawa (Sokoto), 1988	200 Nos	Fed. Min. of Sci. & Tech.
2 Multi-booster Forage Solar Dryer	NAPRI (Zaria), 1996	2 tonnes/day	Energy Commission
3 Multi-booster Forage Solar Dryer	New-Bussa & Yauri, 1997	1 tonne/day	Energy Commission
4 Biogas Plant	NAPRI (Zaria), 1996	20m <sup>3</sup>	Energy Commission
5 Biogas Plant	Zaria Prison, 1998	20m <sup>3</sup>	Energy Commission
6 Solar Water Heater	UDUTH (Sokoto), 1997	1000 Litres	Energy Commission
7 Improved Wood Stove	Zaria, Sokoto, Kebbi & Zamfara Prisons, 1998	150-200 Nos	Energy Commission
8 Biogas Plant	Mayflower Sch. Ikene (Ogun State), 2001	20m <sup>3</sup>	Energy Commission
9 Biogas Plant	Ojokoro, Lagos, 2001	20m <sup>3</sup>	Energy Commission
10 Biogas Plant 4 Nos.	Mega-chad	20m <sup>3</sup>	
11 Biogas Plant	Maiduguri, 2003	20m <sup>3</sup>	University of Maiduguri
12 Biogas Plant	Maiduguri, 2000	8m <sup>3</sup>	Al Amin Daggash
	Chad Republic, 2003		Mega-Chad Project
13 Biogas Plant	Cameroon, 2003	8m <sup>3</sup>	Mega-Chad Project
14 Biogas Plant	Niger Republic, 2003	8m <sup>3</sup>	Mega-Chad Project

## **Necessary Measures for Promoting Renewable Energy for Rural Development of Nigeria**

With the availability of renewable energy resources in all parts of the Country and the existing level of development of systems and devices in the Nation, there is urgent need to adopt practical measures that will systematically introduce various renewable energy technologies into the economy.

Apart from the policy measures that will promote the introduction of technologies based on individual renewable energy sources there is the need to adopt an integrated approach to sustainable energy development. This is in recognition of the fact that conventional energy sources will continue to serve the transport and industrial sectors of the economy.

### **Issues of Policy Measures for Various Renewable Energy Technologies**

#### **(a) Solar Energy**

There is no policy thrust established for incorporation of solar energy devices into as many spheres of the economy as possible. A policy strategy should be structured to include:

- continuous active support of research and development activities to cater for site specificity of designs for all parts of the Country.
- support of demonstration and pilot projects to ensure that the general public becomes aware of the potentials of solar energy technologies which will as well assist in the creation of markets for solar energy systems.
- provision of financial incentives to encourage the use of solar energy systems particularly in rural areas where the greatest potential exists.
- introduction of regulatory measures to encourage and protect local capabilities.

#### **(b) Biomass**

The policy outlined above for solar energy also applies for Biomass. Further, it should be emphasized that fuelwood consumption rate should be significantly reduced. Policy strategies for Biomass should include:

- the adoption of efficient wood - burning stoves
- systematic cultivation of fast growing trees needed to facilitate regeneration of forests



- active introduction of biogas digesters to cater for the cooking energy needs of especially large households and institutions including boarding schools, hospitals, barracks and prisons.
- development of alternative technologies to supplement wood both as a domestic energy source and as a building/furniture material.

**(c) Wind Energy**

The policy and strategies for solar energy are also applicable for Wind Energy. Additionally, the policy should emphasize the exploitation of wind power for rural water supply and for electricity generation. That is to say, the strategies should further include:

- an aggressive drive to optimize the components of wind water pumping and electricity generation and to de-emphasize diesel powered water pumps wherever the wind speed will allow wind water pumping.

**(d) Hydropower**

The policy under hydropower is for the nation to manage its water resources for the development of its hydro - electric potentials and for other uses. The policy should focus more on microhydro plants. The strategy should include further development and updating of data on the potentials of small - scale hydroplants and inter basin water transfers.

## **Integrated Approach to Sustainable Energy Development**

The agenda for solving the general energy problems should include the promotion of a rational and efficient energy use to guarantee energy security for the rural populace and to create an enabling environment to attract investments in the energy sector. There should also be a concerted and committed policy on liberalization of the energy sector, the integration of environmental considerations into energy development plans and the strengthening of technical capacities in the energy sector.

**(a) Promotion of rational and efficient energy use**

To achieve a more rational and efficient energy utilization, wastages in energy use must be reduced, energy efficiencies of major energy supply systems improved considerably, and a more energy efficient development path pursued. For these to be realized, the following strategies are required:

- creation of awareness for the benefits of energy savings in all sectors of the economy.
- encouraging households to shift to more energy efficient fuels as LPG, and to kerosene in place of fuelwood.

- promoting the use of improved cooking stoves.
- providing incentives for energy intensive industries to invest in industrial energy efficiency measures and human resources development in the area of energy conservation.

**(b) Provision of energy security for rural dwellers**

One of the major needs of rural dwellers is the energy they consume for subsistence. Since they lack access to such commercial fuels as petroleum products and electricity, they depend largely on traditional fuels mainly fuelwood, charcoal and agricultural residues. To provide the energy needs of rural dwellers, especially in the Sahelian zone of the Country, the following measures are necessary:

- continued afforestation programmes
- setting up of community based woodlot programmes
- accelerated rural electrification schemes
- promotion of energy efficiency practices.

**(c) Creation of enabling environment to attract investment in the Energy Sector**

Investment requirements for the conventional energy sector are large and it is clear that Government will not be able to solely finance the sector as has been the case in the past. Hence, private sector participation is necessary. There is also the need to attract foreign investment in the sector. The needed attractions include serious improvements in the financial performance of the conventional energy supply companies as well as the development of a conducive investment environment.

On the whole, attraction of private sector investment will call for:

- reviewing existing energy pricing to allow for good returns on investments;
- easing the difficulties in the procurement of foreign exchange
- promoting energy conservation and efficiency measures in all sectors of the economy;
- maximizing the operating performance of existing energy supply infrastructure.

**(d) Integration of environmental consideration into energy development plan**

To reflect the prevalent strong energy - environment linkage, it is important to integrate the policies affecting the two sectors for sustainable development. This can be done by incorporating environmental considerations during the planning and execution stages of large conventional energy projects. Requirements for this include:

- improving forestry management by strengthening the institution charged with monitoring forestry resources;
- incorporating environmental impact assessment for all major energy projects;
- internalizing the external cost in pricing energy products
- designing and enforcing guidelines for monitoring the environment.

**(e) Strengthening technical capacities in the energy sector**

Two major steps are required here. These include, firstly, the offering of specialized training and development of sound technical education in the sector and, secondly, assurance that the available pool of human resources is given the opportunity to "learn - by - doing". Another requirement for enhancing technical capabilities is the strengthening of research, development and demonstration activities in the energy sector. The acquisition of technologies developed elsewhere and adapting them for use in Nigeria is a key element here. The strategies for strengthening technical capacities include:

- provision of technical support services needed for effective training of personnel;
- subsidizing the cost of technical education;
- mobilizing local expertise and involving them in the planning, designing and construction of energy projects so they can "learn - by - doing".
- provision of adequate funding for energy research, development and demonstration activities.

## Challenges to Renewable Energy Utilization in Nigeria

Key challenges to the deployment of Renewable Energy Technology (RETs) in Nigeria are as follows:

1. **Technological Incapability:** With the exception of solar thermal and biogas technologies, no other RET has been developed in Nigeria. Most of the technologies have to be imported, thereby further escalating the already high investment cost;
2. **High cost of Energy Infrastructure:** Small scale hydro power, central and residential solar technologies, etc., have not penetrated the Nigeria's energy supply system because of their relatively high investment costs. This barrier has also been found to be the major obstacle to widespread adoption of family-sized biogas digesters in the country.
3. **Financial Constraints:** There are limited funds available for the deployment of RETs. In the absence of any serious private sector involvement in the development and the dissemination of the technologies, this posed a serious barrier to the RETs;
4. **Low Level of Public Awareness:** Public awareness of renewable energy sources and technologies in Nigeria and their benefits, both economically and environmentally are generally low. Consequently, the public is not well-equipped to influence the government to begin to take more decisive initiatives in enhancing the development, application, dissemination and diffusion of renewable energy resources and technologies in the national energy market; and
5. **General absence of comprehensive national energy policy:** Nigeria has never formulated a comprehensive energy policy; only sub-sectoral policies have formulated. Since such a policy is pivotal to using energy efficient and RETs, this has to a large extent contributed to the lack of attention for the RETs

## POTENTIAL CONFLICTS

### *Background*

As populations grow and economic development leads to higher consumption, demand for water increases sharply putting intense pressure on available facilities. This can cause growing social tensions, and even lead to outright conflict. While commonly expressed predictions that future wars will largely be fought over water may be exaggerated, nobody doubts that access to both surface and ground water is an increasingly contentious issue. Conflicts over dams are generally of greater intensity than conflicts over water.

Conflicts over dams have heightened in the last two decades due largely to the social and environmental impacts of dams that were either disregarded in the planning process or unanticipated. They also stem from the failure by dam proponents and financing agencies to fulfill commitments made, to observe statutory regulations and to abide by Federal Environmental Protection Sectorial guidelines.

In Europe and America large dam construction has been bedeviled by a history of conflicts, though it is only in recent years that such conflicts have come to command wider attention. Conflicts over water and dams are probably as ancient as dam building itself. For instance, in England, boat owners opposed millers blocking rivers to create millponds to turn their water wheels. Records from the 17th century tell of Scottish fishermen trying to destroy a newly completed weir. In the 1910s, conservationist John Muir unsuccessfully lobbied public opinion and the US Congress against the building of O'Shaughnessy dam in Yosemite National Park in California.

Populations affected or threatened by dams have fiercely resisted their construction. For instance, eight people died and over 30 were injured when colonial government forces fired on Tonga people resisting removal of their villages to make way for the Kariba dam reservoir.

In Mexico, the Papaloapan River Commission set fire to the houses of indigenous Mazatecs who refused to move for the Miguel Aleman dam. In 1978 police killed four people when they fired at an anti-resettlement rally at the Chandil dam site in the State of Bihar in India.

**Plate 5: Protesters Demanding Amenities on the Gurara Dam Project**

In Nigeria, resistance to dams often went unnoticed locally or internationally and, in some cases, Government took advantage of the peoples' docility to intimidate, or use violence to suppress their resistance. In April 1980, police fired at people blocking roads in protest against the Bakolori Dam. Again in 1990 women and children, were brutalized by security operatives in the course of clearing the reservoir area of Suleja dam. In 2004, some youths protested against the compensation aspect of Gurara Dam Construction (Fig.9). As dam building accelerated in Nigeria from the eighties, opposition to dams increased, both vocal and organized.

## **Classification of Conflicts**

Conflicts in dam development can be classified under the following phases:

- Pre-construction
- Construction
- Post-construction, and
- Conflict of Interest

In each phase, conflicts can be among communities, between communities and the government or between construction/engineering companies and the host communities.

### **Pre-Construction Conflicts**

Conflicts can be triggered during pre-construction or feasibility study/design stage of dam development. Names given to dams are one major cause of intra and/or inter communal conflicts and if unresolved could lead to clashes. Sometimes a location chosen during desktop study may turn out from the feasibility studies to be unsuitable for a dam, leading to relocation to another community. Such shift, if not well managed, could trigger accusations and counter accusations leading to recriminations between the communities.

Lack of compensation or disagreement over method of compensation for project affected economic trees and properties could lead to conflicts between communities and executing companies. For instance, in 1983, disagreement between some settlers in Dadin Kowa and Showmont Consultants over destroyed economic trees nearly marred construction of the Dadin Kowa Dam. Only the intervention of village heads saved the situation.

### **Conflicts during Construction**

Compensation and resettlement of people can cause major disagreements during the construction stage of dams. Some of such disagreements lead to unrest and physical assault. Computing entitlements is the single most important factor triggering conflicts and associated disagreements as there is usually no legal framework to determine the computation of compensation. Growing disaffection

between communities, on one hand, and Government and many NGOs, on the other, on ways decisions are taken over compensation and with payment procedure has provoked growing resistance to large dam construction and escalated tension and conflicts around individual dam projects. Conflicts between construction companies and host communities stem from demand for compensation, for environmental pollution (air, land and surface water), employment of local people, and the provision of such social infrastructure as roads, electricity, water, health centers and schools. Some of such conflicts have led to physical confrontation between workers and villagers, public protests and blocking of roads.

### ***Post-Construction Conflicts***

After construction and reservoir area inundation, shortage of arable land becomes clear to the host communities as most of their farm lands are now lost to the lake. The conflict triggered by land shortages between the Buddhist Chakma people and Muslim Bengali settlers cost 10,000 lives since the Bengali Dam was completed in 1962. Though in Nigeria, there are no known records of deaths resulting from conflicts over post dam construction, gradual awareness created by NGOs of the rights of and risks to the people is now growing. Conflicts over transboundary rivers usually result from a power imbalance amongst riparian especially in Nigeria where one State does not sufficiently influence or exert its authority over another. A dam controlled upstream by one State might cause flooding downstream in another State with the release of excess water. Such cases have been reported between Niger and Kogi States along Kaduna River. Similar conflicts may occur internationally where rivers traverse several Countries. Political diplomacy has prevented the flooding emanating from Cameroon along Katsina-Ala River from degenerating into an international conflict between Nigeria and Cameroon.

Resettlement camps and facilities provided to resettle those displaced by dam construction are seldom adequate or of good standards. Such inadequate provisions sometimes result into fierce agitations and conflicts.

### ***Conflict of Interests***

Conflicts between NGOs and government/companies are regarded as conflicts of interests. As Government is interested in providing facilities to the general society, interests of a smaller community should be considered of lower priority. NGOs are interested in the rights and protection of even the small community. By bringing to the table all those whose rights are involved and who bear the risks associated with a project, whether for water or energy resources development, the conflict of interests can lead to litigation and aggressive protests.

The Federal Environmental Protection Act, together with growing public concern about environmental conservation, has opened up a debate on the benefits of dam development vis-à-vis environmental implications. The NGOs and affected groups' associations are now more vigorous and more coordinated in opposing dams worldwide. In many cases, the strength of these coalitions has had a major impact on dam-related planning and policies and on the extent of dam construction.

Providing a legal framework that governs the process of displacement is important for protecting the rights of affected people. For instance, China’s Reservoir Resettlement Act specifies the rights of the affected people and defines the obligations of the State and the procedures for settling conflicts and the redress of complaints. Such laws are necessary if the conflicts are to be curbed or eliminated. Minimizing displacement is another enabling condition to effectively address resettlement needs.

Broadly, major stakeholders in Dams and Development in Nigeria include:

- River Basin Development Authorities and State Water Agencies
- Federal and State Ministries of Water Resources
- Federal and State Ministries of Agriculture
- Federal and State Environmental Agencies
- Contractors and Consultants in Water Resources Development
- Power Holding Company of Nigeria (formerly NEPA)
- Water Resources Development Partners
- Water Resources Institute
- Donor Nations
- Professional Bodies, e.g. the NSE, NMGS, ICOLD, NICOLD, WCD
- NGOs, Civil Societies and Human Right Activists
- Ministries of Sciences and Technology (Federal and State)
- Energy Commission of Nigeria
- Nuclear Energy Agency
- Electricity Regulation Commission of Nigeria
- Universities, Polytechnics and Science-based Institutes
- Foreign Missions and Embassies
- World Bank, IMF, ADB ,
- Legislators-Committees on Water and Energy (Federal, States and LG)
- Rural Communities benefiting or affected by dam development
- National Emergency Management Agencies, including the Red Cross and Crescent

The stakeholders, their stakes and concerns are listed in the Table 11 below.

**Table 11: Stakeholders and their Concerns**

S/NO	STAKEHOLDER	STAKE	CONCERN
<b>River Basin Development Authorities</b>			
1.	Upper Niger, Minna, Niger State	Develop, Control and Monitor all the dams under their basins.	<ul style="list-style-type: none"> <li>• Downstream Flood</li> <li>• Poor Development of downstream irrigation.</li> </ul>
2.	Lower Niger, Ilorin, Kwara State		



Table 11: Stakeholders and their Concerns

S/NO	STAKEHOLDER	STAKE	CONCERN	
3.	Upper Benue, Yola, Adamawa		<ul style="list-style-type: none"> <li>• Climatic charge.</li> </ul>	
4.	Lower Benue, Makurdi, Benue State			
5.	Hadjia-Jama'are, Kano, Kano State			
6.	Chad Basin, Maiduguri, Borno State			
7.	Ogun – Osun,			
8.	Benin – Owena, Benin, Edo State			
9.	Anambra – Imo, Owerri, Imo State			
10.	Niger – Delta, Port Harcourt, Rivers State			
11.	Cross River , Calabar,			
12.	Sokoto – Rima, Sokoto			
13.	Federal Ministry of Water Resources, Area 1, Garki, Abuja, FCT	Dam Development in Nigeria, Policy and Monitoring.		<ul style="list-style-type: none"> <li>• Failure of implementation of decision</li> <li>• Funding</li> <li>• Inconsistency to Policy</li> </ul>
14.	Federal Environmental Protection Agency, Central Business District, Abuja	Environmental Issues of Dam Development and energy		<ul style="list-style-type: none"> <li>• Environment free of pollution</li> <li>• Protection of env. rights of people</li> </ul>
15	Power Holding Company of Nigeria, Maitama District, Abuja	Hydropower Dam Development	<ul style="list-style-type: none"> <li>• Climatic charge.</li> <li>• Black and white Flood</li> <li>• Obsolete equipment</li> <li>• Funding Issues</li> <li>• Tech and Mgt</li> </ul>	
<b>Water Board or Corporation</b>				
16.	Abia State, Umuahia	Rural and Urban Water Resources Management and Development	<ul style="list-style-type: none"> <li>• Large dams not providing water for rural development</li> <li>• Flooding &amp; Erosion</li> <li>• Lack of funding for small dam development</li> <li>• Broken down facilities</li> </ul>	
17.	Adamawa State, Yola			
18.	Anambra State, Awka			
19.	Akwa Ibom , Uyo			
20.	Bayelsa State, Yenagoa			
21.	Bauchi State, Bauchi			
22.	Benue State, Makurdi			
23.	Borno State, Maiduguri			
24.	Cross–River State, Calabar			
25.	Delta State, Asaba			
26.	Ebonyi State, Abakaliki			
27.	Edo State, Benin			
28.	Enugu State, Enugu			

Table 11: Stakeholders and their Concerns

S/NO	STAKEHOLDER	STAKE	CONCERN
29.	Ekiti State , Ado Ekiti		
30.	Gombe State, Gombe		
31.	Imo State, Owerri		
32.	Jigawa State , Dutse		
33.	Kano State, Kano		
34.	Kaduna State , Kaduna		
35.	Katsina State , Katsina		
36.	Kebbi State , Birnin Kebbi		
37.	Kogi State, Lokoja		
38.	Kwara State , Ilorin		
39.	Lagos State ,Lagos		
40.	Niger State ,Minna		
41.	Nasarawa State, Lafia		
42.	Oyo State , Ibadan		
43.	Ogun State, Abeokuta		
44.	Osun State, Osogbo		
45.	Ondo State, Akure		
46.	Plateau State, Jos		
47.	Sokoto State, Sokoto		
<b>State Water Board or Corporation</b>			
48	Taraba State, Jalingo	Rural and Urban Water Resources Management and Development	<ul style="list-style-type: none"> <li>• Large dams not providing water for rural development</li> <li>• Flooding &amp; Erosion</li> <li>• Lack of funding for small dam development</li> <li>• Broken down facilities</li> </ul>
49	Yobe State, Damaturu		
50	Zamfara State, Gusau		
51	Federal Capital Development Authority, Abuja	Rural and Urban Water Resources Management and Development	<ul style="list-style-type: none"> <li>• Construction of small scale dams</li> <li>• Inefficient power supply</li> <li>• Slow pace of urban water development</li> </ul>
<b>Contractors and Consultants</b>			
53	SCC Nigeria Ltd, Abuja	Providing Services for improved Water Supply and Sanitation	Lack of funding for water and energy infrastructure
54	Salini Nigeria, Abuja		
55	Hydroworks Nigeria Ltd., Abuja		
56	Nelson Benjamin, Enugu		
57	Julius Berger Nig. Ltd., Abuja		

Table 11: Stakeholders and their Concerns

S/NO	STAKEHOLDER	STAKE	CONCERN
58	Gilmor Nigeria Ltd., Abuja		
59	RCC Nigeria Ltd., Abuja		
60	CGC Nigeria Ltd., Kaduna		
61	Water and Dam Services Company, Abuja		
62	Aim Consultants, Abuja		
63	De-Crown Nigeria Ltd., Abuja		
65	Del-Handsel Consultant, Kano		
66	Enplan Nigeria, Lagos		
67	Parkman Nigeria, Kaduna		
<b>Donor Nation / Organization</b>			
70	UK Department for International Development (DFID)	Provision of funds prudence and sustainability of action for capacity building and rural development infrastructure and protection of rights of rural people.	
71	Carter Foundation, USA		
72	United Nations for Environmental Protection, UN HQ		
73	African Development Bank, Abijan, Abijan, Ivry Coast	Funding and Monitoring	
74	World Bank,		
75	UNCEF		
76	UNESCO		
77	Japan International Corporation Agency (JICA), Tokyo		
<b>Professional Boards</b>			
78	Nigeria Society of Engineers (NSE), Abuja	Professional development	Water supply and energy sustainability
79	Hydrological Society of Nigeria, Abuja		
80	Geology and Mining Society of Nigeria, Abuja		
81	Rural Communities of Jebbe, Shiroro Goronyo, Tiga, Challawa, Jibya Katsina Ala, Suleja, etc.	Dam affected people who have been displaced and relocated	<ul style="list-style-type: none"> <li>• Displacement</li> <li>• Environmental Pollution</li> <li>• Flooding and Erosion</li> <li>• Infringement into rights</li> </ul>
82	Senate Committees on Water Resources	Legislation and provision of legal framework for water and energy	<ul style="list-style-type: none"> <li>• Poor or lack of implementation of fundamental rights of people.</li> </ul>
83	House Committee on Water Resources		

Table 11: Stakeholders and their Concerns

S/NO	STAKEHOLDER	STAKE	CONCERN
84	University of Nigeria Nsukka		
85	Ahmadu Bello University		
86	University of Benin		
87	University of Lagos		
88	FUT, Owerri		
89	FUT, Minna		
90	University of Ilorin	Studies and research for dam and energy issues	<ul style="list-style-type: none"> <li>Poor or lack of implementation of fundamental rights of people</li> </ul>
91	University of Maduguri		
92	University of Agriculture Makurdi		
93	Energy Commission of Nigeria		
94	Federal Ministry of Agriculture		

## **THE PROPOSED NATIONAL DIALOGUE**

### **Conducting a Stakeholders Dialogue in Nigeria**

This multi-stakeholders' dialogue is structured as a formal discussion or negotiation on water and energy issues amongst stakeholders who had earlier been identified in this report. This dialogue has become necessary especially now that people in Nigeria and elsewhere in the world are increasingly sensitive to the environment and their rights.

Similar dialogues have taken place in some countries in Africa. In October 2004, a multi-stakeholder Forum endorsed the final substantive report of the South African Initiative on the World Commission on Dams based on an extensive review of South African national policies and practices against WCD principles, strategic priorities and guidelines. The Forum also identified three priority recommendations that included addressing unresolved social issues of existing dams, enhancing proper governance for water and energy development and developing a process of gaining public acceptance, building capacity, allocating resources for empowerment and promoting water management through comprehensive options assessment, monitoring and evaluation systems.

In Uganda the first national consultation workshop on the WCD was convened in October 2004. Following this meeting, an inter-sectoral and multi stakeholder body was constituted comprising various governments Ministries and agencies, NGOs, Civil Society Organizations, the private sector and academic institutions to define the way forward and oversee the dialogue process on dams and their alternatives in the Country. The first Steering Committee meeting was subsequently convened in June 2005. At its second meeting held October 2005, the Steering Committee adopted rules and procedures after a thorough discussion of the dialogue governance structures including the WCD Forum. The meeting also reviewed and approved the Terms of Reference for the consultant to undertake the task of elaborating the scoping report.

Other countries in Africa where the processes of organizing the dialogue have been concluded include Ethiopia and Ghana. In South Asia, a successful dialogue has been conducted.

Conducting a successful dialogue in Nigeria is considered expedient considering the interests shown by the Federal Government through the Federal Ministry of Water Resources (FMWR) and the twelve River Basin Development Authorities covering the 36 States of the Country including the Federal Capital Territory, the NGOs, Ministerial and extra-ministerial agencies in charge of energy and agriculture. The dialogue will discuss and adopt the WCD Report, draft the bill on Water Resources Management submitted by FMWR to the National Assembly, consider a number of key issues concerning dam-affected people, environmental issues, including the outcomes of relevant national, regional and international multi-stakeholder dialogue and the compendium on relevant practices for improved decision making, planning and management of dams and energy. In general, consensus are expected to emerge at the meeting on how to achieve sustainable water and energy management in Nigeria.. Participants are expected to agree or recommend key

priority issues to be further elaborated in the subsequent dialogue and elaborate on a meeting of the WCD. Proceedings of the dialogue would be available on the DDP, SWAPHEP, WCD and FMWR websites and in printed copies.

It is expected that over 1,000 participants will grace the occasion. With adequate sensitization and grass-root mobilization now being mounted by SWAPHEP and FMWR, dam affected communities and other identified stakeholders will attend the conference.

First-class facilities like international conference halls, accommodation, transportation, communication and conference materials are available for the Conference in Abuja, Lagos, Port Harcourt, Enugu, Ibadan, Kaduna and other cities in Nigeria. Partners are available for corporate sponsorship and waivers to ensure a successful conference.

### **Challenges and Opportunities of the Dialogue**

Organizing a conference of this magnitude will not go without challenges. Effective and grassroots mobilization of participants shall be a major task to be accomplished in the consultative conference. Epileptic information dissemination mechanism occasioned by a dearth or poor infrastructure which until recently had been a clog in the wheel of national mass mobilization is expected to be a major challenge in this dialogue. Similarly, dam-affected communities' apathy to rights and risks due to their ignorance would provide some level of constraint to mass mobilization of participants.

The harsh economic downturn in Nigeria is expected to affect stakeholders participation, especially self-sponsored participants, and environmentally affected communities. It is estimated that a participant attending from areas within 0-100km would expend over ₦25,000 (\$195) while other participants from 100-500km would require some ₦35,000 (\$273) to attend a one-half day conference in Nigeria where the minimum wage is ₦7,000 (\$58.50)/month. Therefore sponsorship of participants by organizations and corporate bodies would be a major challenge in organizing this conference.

The issue of the dialogue and the outcome/recommendations gaining public and government acceptance, shall be a major task which needs to be tackled before the conference, since similar conferences on other national issues had in the past been a talk shop without follow-up action.

However, the dialogue would provide opportunities for local technocrats to broaden their knowledge-base in areas of dam and development as well as water and energy resources management. As some participants are expected from some of the Nigerian universities and research institutes, the dialogue will also provide opportunities for the academia to exchange literary ideas with participants from WCD, UNEP, colleges and research centers expected from the U.S. and Europe. The dialogue would further provide input into the draft bill of Water Resources Management drawing from experiences of other participating countries including their regulations, policies and laws on water resources management for local

adaptation. With participants from various parts of the world, it is expected that the Nigerian tourism industries would use the conference to showcase the nation as a tourist destination country. .

### **Terms of Reference (TOR) for the Scoping Report**

The scoping report to be developed will be multidisciplinary in nature. Hence, a team of experts with different academic and professional backgrounds will be required to undertake the study. The scoping study report will thereafter be reviewed by the Steering Committee (SC) and a draft final copy submitted to the first Dams and Development Forum for deliberation and ratification.

Among others, the Report is expected to highlight such major areas as:

- Detailed discussion on the development context of water and energy in Nigeria against the background of the national plan considering global commitments to poverty reduction and the Millennium Development Goals (MDGs).
- Identification and detailed documentation of the major features together with key issues and concerns regarding sustainable water and energy planning and management in Nigeria using the WCD Report Core Values and Strategic Priorities as an analytical framework.
- Discussion and presentation of well articulated recommendations of actions to be undertaken for the improvement of regulatory frameworks and practices on dams and development in Nigeria.
- Preparation of a detailed work plan for the improvement of regulatory frameworks in Nigeria within a multistakeholder dialogue process.

It is expected that the Dams and Development Forum that will endorse this report will be maintained as a standing forum that is envisaged to be dissolved only after the roadmap has been ratified and implemented, with the outcomes of its implementing submitted to the Presidency and National Assembly for consideration. There will be periodic submission of interim outcomes of the dialogue process such as the roadmap and other reports to the government for consideration in decision making.

### **Governance Structure of the Dialogue**

For the purpose of executing this conference, the governance structure detailed hereunder shall be put in place.

#### **The Forum**

The name of the National Forum of multi -stakeholder is proposed as **National Forum on DAMS and Development (NFDD)**.

## **Terms of Reference (TOR) for the Forum**

1. To coordinate activities of all member organizations working on dams
2. To liaise with Donor agencies, Governments and private organization to raise funds for execution of projects
3. To participate in all decisions/policy issues concerning dam establishment in Nigeria
4. To create awareness, sensitization of the public on fundamental human rights of people around dam communities.
5. To participate in EIA projects relating to dam establishment
6. To build capacity of members and of the stakeholders on dam related issues
7. To develop specific programs on gender issues relating to dam establishment
8. To monitor compliance to guidelines by project promoters

## **The Secretariat**

The dialogue process shall be managed by a Secretariat to be headed by one of the Co-Directors of SWAPHEP and assisted by an Assistant/Deputy Director of the FMWR. Other technical members of the Secretariat shall be drawn one from each of the following bodies:

- Civil Society Organization
- Federal Ministry of Power and Steel
- River Basin Development Authorities
- Dam affected communities
- Women Organizations
- Private Sector (Contractor/Consultant)

Secretariat staff shall include the following support staff drawn from both SWAPHEP and FMWR:

- Two Protocol Officers
- One Confidential Secretary
- Computer Expert/System Analyst
- Office Clerk
- Cleaners

The secretariat shall basically be responsible for the day-to-day running of all activities that would culminate into a successful organization and hosting of the conference in Nigeria. Publicity, coordination of other committees, general management of the conference as well as printing and documentation of all materials excluding those of the participants and resources persons shall be done by the Secretariat.

## **Steering Committee**

The Steering Committee shall comprise members drawn from the following entities:



- Federal Ministries of Water Resources, Finance, Power & Steel, Agriculture and the River Basins
- SWAPHEP
- Other Civil Society Organization
- Federal Environmental Protection Agency
- Universities of Lagos, Benin and Nsukka
- Dam-affected communities of Shiroro, Tiga, Gurara, Ife, Obudu

The Steering Committee shall be responsible for the general organization of the Conference with subcommittees covering the following areas:

- Conference venue, decoration and multimedia
- Publication, Documentation, Invitation, souvenir and Protocols
- Accommodation, Refreshment and leisure
- Resource Personnel and Repertoires
- Scoping Study Report Review

The Conference venue subcommittee shall arrange for location and venue for the conference. It shall also procure multimedia equipment for speech and audiovisual systems for presentations. The publicity subcommittee shall carry out information dissemination (radio, TV and print) and distribute invitations to all cadre of participants, and be responsible for all protocol both within and outside the conference venue. Documentation for the conference, including materials and provision of automation, shall be undertaken out by the publicity subcommittee.

Information about hotels and pre-conference booking, provision of refreshments (tea and snacks), available tourist locations and leisure are to be arranged by this subcommittee.

The next subcommittee is the resource persons and repertoires subcommittee which will be responsible for arranging for resource persons and roundtable discussions, management of breakout sessions, presentation of position papers/communiqué and press coverage. The scoping study report subcommittee will review the study report and set up the structure, agenda and modus operandi for the Forum.

## **Agenda for the National Consultative Conference**

### **Timelines and Milestones**

In order to have a public oriented multi-stakeholder dialogue, the following Agenda is proposed as timelines and milestones:

- Nationwide public awareness through print and electronic media (announcement and jingles):  
February, 2007 – April, 2007
- Preparatory processes including fund raising, consultative meetings, mobilization of participants and other preparations:  
March, 2007 – May, 2007

- Background Study to prepare for the Consultative Conference including sensitizing and contacting stakeholders. Collation and streamlining concerns and stakes of dam-affected people and other participants:  
May, 2007 – June, 2007
- Civil Society Consensus Building Conference will, specific reference to the collated issues, concerns and stakes, addressing specific needs of dam-affected communities, farmers, pastoralists, women, and persons with disabilities, NGOs, media, traditional institutions and other civil society actors. This is to be a one-day event.  
July, 2007
- National Consultative Conference. This one and half-day conference will address issues and concerns around dams and development in Nigeria, and identify potential areas of conflicts and common understanding/agreements on dams, water and energy resources management.  
August, 2007
- Scoping Study defining the Roadmap for the Dialogue. Draft Final Report to be submitted to the first Dam and Development Forum meeting for consideration.  
August, 2007 – September, 2007
- One day Nigeria Dams and Development Forum meeting for endorsement.  
October, 2007
- Publishing and dissemination of the Study Report with Roadmap including submission to Presidency and National Assembly for consideration in decision making.  
November, 2007
- Implementation of the Roadmap and progress reporting.  
January, 2008 onwards

### **Potential Participants**

Representatives from the underlisted organizations are proposed to be participants at the conference

- River Basin Development Authorities and State Water Agencies
- Federal and State Ministries of Water Resources
- Federal and State Ministries of Agriculture
- Federal and State Environmental Agencies
- Contractors and Consultants in Water Resources Development
- Power Holding Company of Nigeria (formerly NEPA)

- Water Resources Development Partners
- Water Resources Institute
- Donor Nations
- Professional Bodies, e.g. the NSE, NMGs, ICOLD, NICOLD, WCD, SWAPHEP
- NGOs, Civil Societies and Human Right Groups
- Ministries of Sciences and Technology (Federal and State)
- Energy Commission of Nigeria
- Nuclear Energy Agency
- Electricity Regulation Commission of Nigeria
- Universities, Polytechnics and Science-based Institutes
- Foreign Missions and Embassies
- World Bank, IMF, ADB
- Legislators-Committees on Water and Energy (Federal, States and LG)
- Rural Communities benefiting or affected by dam development
- National Emergency Management Agencies, including the Red Cross and Crescent
- Presidency
- Consultancy Firms and Contractors on Dam Projects nationwide

The above listed organizations will be expected to send representatives not below the rank of Principal/Senior Management Officer.

## CONCLUSION

From this study it can be concluded as follows:

- that large dams such as Kainji, Shiroro, Tiga, Usuma, Jebba have performed short of their objectives by creating greater vulnerability to flood, exhibiting poor financial cost recovery, delivering below installed capacities for hydropower dams and virtually no implementation of designed irrigation programs.
- that dam development in Nigeria, as in other Countries, has led to environmental distortion and ecosystem imbalance through displacement of aquatic and terrestrial organisms and loss of flora and fauna. Also found of concern are greenhouse gas emission from reservoirs, climatic changes, river channel sedimentation, flooding, among other effects.
- that dam development has led to displacement of people from their ancestral homes resulting in loss of cultural artifacts, heritage and sacred places of worship , which are issues of concern to proponents and stakeholders in dam and hydro energy development.
- that in Nigeria people are not fully mobilized in decisions affecting their lives. This therefore means that the decision-making process and mechanism are not followed to ensure participation of all stakeholders to enable them recognize their rights and play a role in the assessment of risks involved.
- that affected people/communities displaced by dams have sometimes been treated with levity by implementing authorities as most residents are not compensated through resettlement, allocation of land titles to enable them continue life in their new abode and compensation was of economic trees and properties.
- that there are structural gaps in the laws covering water and energy development and management. Existing laws have not invited or recognized private sector participation in water or energy resource management.

## RECOMMENDATIONS

Considering the important conclusions drawn from this background study on water and energy issues, recommendations are made towards implementation of a national multistakeholders dialogue project: "Setting the Agenda for a National Dialogue Process on Water and Energy Policies in Nigeria with Reference to the Framework of the World Commission on Dams (WCD)". It is recommended first and foremost that a national dialogue process be put in place in order to formulate a suitable framework to realizing the following recommendations and others to be suggested:

- Existing dams and reservoirs should be properly harnessed so as to effectively utilize available water resources to justify the huge cost involved in their development and the attendant hazards to communities impacted the projects.
- Emphasis should be directed towards development of small/medium dams considering their comparative operational advantages over large dams especially regarding the period of construction and relatively low resettlement costs and environmental consequences.
- Comprehensive review of existing National Water Resources Master Plan is recommended. The new plan should seriously consider phased development and management of identifiable potential projects.
- A financial plan should be adopted setting out annual budgetary allocations to relevant water development and energy projects. Development of such infrastructure is recommended to support the growth of other sectors of the economy.
- Appropriate legislation should be passed setting up monitoring agencies for potential projects to provide the basis for a legal framework for implementation of the projects.

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## **ACRONYMS AND ABBREVIATIONS**

AGO	Automotive Gas Oil
DSM	Demand-Side Management
ECN	Energy Commission of Nigeria
EIA	Environmental Impact Assessment
ERR	Economic Rate of Return
FAO	Food and Agricultural Organization
FCT	Federal Capital Territory
FMWR	Federal Ministry of Water Resources
GHG	Greenhouse Gases
ICOLD	International Commission on Large Dams
IGBP	The International Geosphere - Biosphere Program
JICA	The Japan International Cooperation Agency
LPG	Liquefied Petroleum Gas
MDG	Millennium Development Goal
NEPA	National Electric Power Authority
NEPAD	New Partnership for Africa Development
NGO	Non Governmental Organization
NICOLD	Nigeria Committee on Large Dams
NIWA	National Inland Water Authority
NMGS	Nigerian Mining and Geosciences Society
NRWSSP	National Rural Water Supply and Sanitation Program
NSE	Nigerian Society of Engineers
NWRMP	National Water Resource Master Plan
O&M	Operation and Maintenance



PHCN	Power Holding Company of Nigeria
PMS	Prime Motor Spirit
PWD	Public Works Department
RBDA	River Basin Development Authority
REB	Rural Electricity Board
RSA	Republic of South Africa
RUWASA	Rural Water Supply and Sanitation Agency
SHP	Small Hydro Power
SWAPHEP	Society for Water and Public Health Protection
UBE	Universal Basic Education
UNEP - DDP	United Nations Environmental Programme - Dams and Development Project
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WCD	World Commission on Dams