# NIGERIA COUNTRY PAPER: OVERVIEW OF HYDROPOWER RESOURCES AND POTENTIALS FOR RENEWABLE ELECTRICITY

# By

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# COUNTRY PROFILE

- **Location:** Nigeria is located within Lat. 4deg N and Long. 2.72deg E and 14.64deg E with.32deg. N and 14deg. Land area of approx. 924,000 sq km.
- **Population:** 158.2 million (UN 2010) with annual growth rate of 2.7% (2007)
- **Climate:** Nigeria have average 20$^{o}$C- 25$^{o}$C (Min.) and 25$^{o}$C- 37$^{o}$C (Max.)
- **Annual Rainfall:** 500- 1800 mm
- **Geography:** Nigeria has four distinct geographical regions namely: coastal, forest, savannah and Sahel zones

# COUNTRY PROFILE cont.

- **GDP**: US$267.779b
- **Real GDP Growth Rate**: 7.72% (2nd quarter of 2011 driven by oil and non oil production GDP: USD 1,670 (2006) Incidence activities
- **Per Capital of Poverty**: 54.4%
- **Life Expectancy**: 47 yrs (2007)
- **Electricity Access**: 40%
- **Electricity consumption/capital** (kWh/capital):0.028kW/capital

# Energy Resources in Nigeria

- **Crude Oil:** Over 35 billion
- **Natural Gas:** Over 183 trillion std. cubic ft.
- **Coal:** Over 2.75 billion metric tons deposit
- **Hydropower:** 14,750 MW
- **Solar Radiation:** Over 3.5-7.0 KWH/m2- day
  485m MWh/d,using0.1% land
- **Wind Energy:** Over 2.0-4.0m/s ( at 10m height)
- **Biomass:** Over 144 m tonnes/year
- Wave/Tidal Energy above 150,000 TJ/yr(16.6 × 10 toe/yr
- **Geothermal Energy :** 37 and above 100$^{o}$C (Not yet expl.)
- **Nuclear:** (Not yet quantified)
- **Tar Sands:** 30 billion barrels of oil equivalent.

# Promoting SHP in Nigeria

- Energy Commission of Nigeria (ECN) prioritise renewable energy dev., 2 Research Centres
- National Energy Policy approved and launched in 2003
- National Energy Masterplan in Final draft
- ECN collaborating with UNIDO to promote SHP
- Establishment of UNIDO Africa Regional Centre for SHP in Abuja
- Promote and support the establishment of a National NGO for SHP (Association of Member of International Network for Small Hydropower (AM-INSHP)
- Pilot SHP schemes at Waya Dam, Bauchi State and Ezioha-Ngbowo village , Enugu State

# sting Small Hydropower Schemes in Nigeria

| S/N | River | State | Installed Capacity (MW) |
|---|---|---|---|
| 1 | Bagel (I) | Plateau | 1.0 |
| 2 | Bagel (II) | " | 2.0 |
| 3 | Kurra | " | 8.0 |
| 4 | Lere (I) | " | 4.0 |
| 5 | Lere (II) | " | 4.0 |
| 6 | Bakalori* | Zamfara | 3.0 |
| 7 | Oyan* | Ogun | 9.0 |

Source: UNIDO/ECN (2003). Renewable Energy for Rural Industrialization and Dev. In Nig. p81.

# Distribution of Potential Small Hydro Sites

| S/N | State | RBDA | No. of Sites | Potential Capacity (MW) |
|---|---|---|---|---|
| 1 | Sokoto | Sokoto-Rima | 22 | 30.6 |
| 2 | Katsina | Sokoto-Rima | 11 | 8.0 |
| 3 | Niger | Niger | 30 | 117.6 |
| 4 | Kaduna | Niger | 19 | 59.2 |
| 5 | Kwara | Niger | 12 | 38.8 |
| 6 | Kano | Hadejia-Jama'are | 28 | 46.2 |
| 7 | Borno | Chad | 29 | 20.8 |
| 8 | Bauchi | Upper Benue | 20 | 42.6 |
| 9 | Gongola | Upper Benue | 38 | 162.7 |
| 10 | Plateau | Lower Benue | 32 | 110.4 |
| 11 | Benue | Lower Benue | 19 | 69.2 |
| 12 | Cross River | Cross River | 18 | 28.1 |
| Total | | | 278 | 734.2 |

# GENERAL POLICY LEGAL FRAMEWORK

**Policy Framework**: The strong link between energy and socio-economic development made the Federal Government of Nigeria to approve in 2003 an overall National Energy Policy (NEP) and Enacted Electric Power Sector Reform Act ( ESPR Act 2005), which encourages the optimum utilization of the country's energy resources including renewables for sustainable national development with the active participation of the private sector.

# GENERAL POLICY/ LEGAL FRAMEWORK cont.

The road map to Power Sector Reform: 1.4.2 FGN Policy : Any medium to long term investments by the FGN in power plants should be highly selective

Over the medium to long term, the Government acknowledges that there is a case for some limited involvement by the FGN in financing of renewable forms of power generation e.g. Hydro ( or other renewables) and in stimulating production of power from coal. However, it also acknowledges that the support for such power generation technologies should, where appropriate , be in form of feed-in tariffs rather than direct capital injections by the FGN.

# REGULATION AND LEGISLATION

- The FGN signed into law the power sector reform bill 2005, hence it becomes an Act of the Legislator known as Electric Power Sector Reform Act, 2005, with subsequent establishment of a strong regulatory institution. The Nigerian Electricity Regulatory Commission (NERC) by the National Assembly.
- NERC has the general mandate to regulate the entire electricity sector in the country with regard to tariff setting and regulation, supervision of market rules, performance monitoring and overseeing the orderly transformation of the power sector to a more competitive environment.
- Licences are required for power generation of 30 MW aggregate and above at a site.

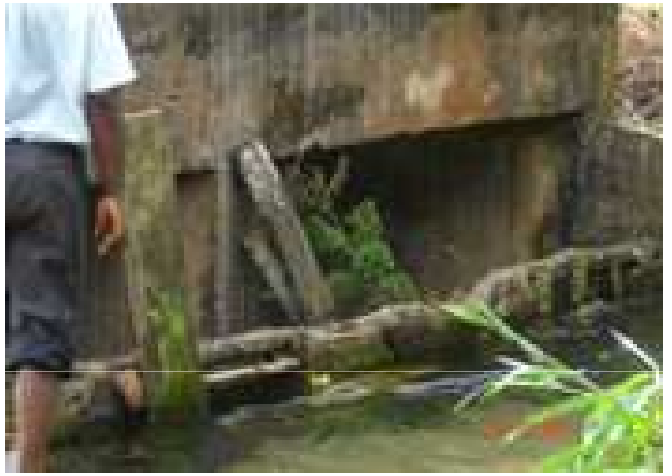
# Case Study-Background

**Source: Ukabiala, C.O. (2006). Ebvaro II Small hydropower in Nigeria: A challenge to developing countries. In Esan, A.A. (Ed.) Small Hydropower for Productive Use in Rural Areas. UNIDO-RC-SHP in Africa. pp 32-38.**

- **A micro hydropower scheme (3 kW)**
- **A private initiative – Mr. Christian Oyenekwe, 42 yrs old, a 1986 School Cert. holder, a farmer and village electrician**
- **Located in Evboro II village, Ovia N.E. LGA, Edo State, 45 km west of Benin City**
- **A small farming village, population 400, 55 households**
- **River Ogbovben, a tributary of Osse (Ovia), divides the village into 2, provides the water for the scheme**

# Case Study-The Dam

**The dam is made of wood**

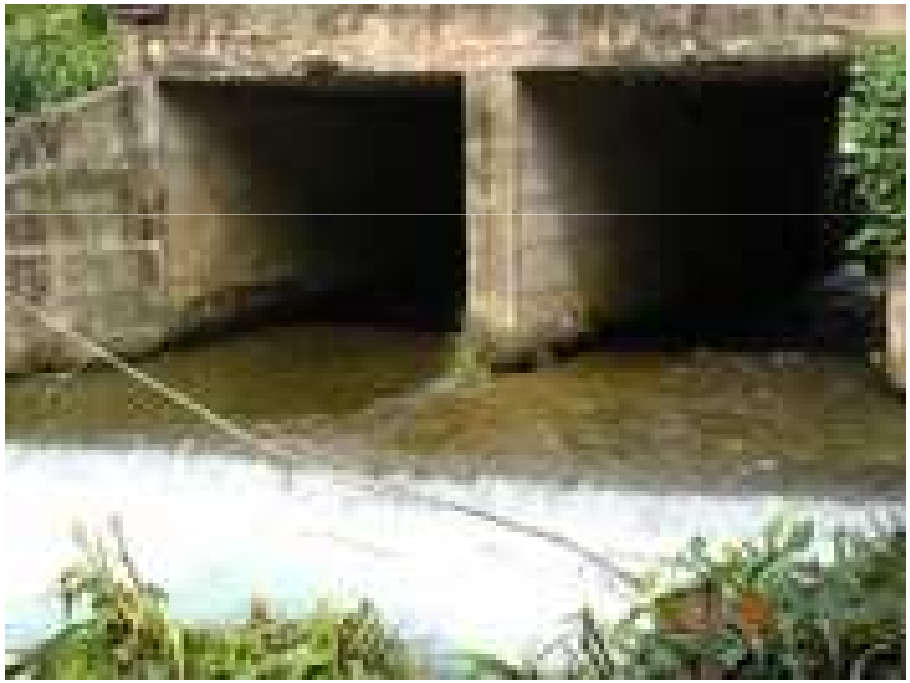


**Supported by the concrete culvert (bridge)**

**The weir was also made with wood**

# Case Study-The Powerhouse

**The powerhouse is housed in one of the twin ducted concrete water channels**



**The water channel is the bridge on Ogbovben river which links the two part s of Evboro II village**

# Case Study-The Mechanical System

The turbine is a cross flow type with 7 blades, locally manufactured from a normal flat mild steel


It is coupled to a locally manufactured wooden pulley which drives the generator via a belt drive.

# Case Study-The Electrical System

the generator was a converted electric

# Case Study- Transmission/ Distribution Lines

The transmission towers were made from bamboo sticks (Pole) while the lines consist of conventional copper conductors

The two lines (live and neutral) drawn from the generator were separated by short pieces of sticks

# Case Study-Project Specifications

- **Mr. Oyenekwe took 11 yrs (1986-1997) to complete the project**
- **The scheme in operation for 9 yrs (1997 – date)**
- **Minimum annual flow rate (Q) is 1.72$m^3$/s, corresponding stage height (h) is 1.2m**
- **Insignificant flow variations**
- **Project cost estimated at N60,000**

# Case Study-Project Operations

- **Only 15 out of the 55 houses connected, pressure to expand**
- **200 watts for each house, 2-point (60w each) lighting and a plug-point (80w) for radio/tv/fan**
- **No tariff collection, consumers just contribute N2,000 monthly for maintenance (barely sufficient)**
- **O&M cost of scheme only N0.92/kwh month**

# Case Study-Lessons Learnt

- **The need for electricity in rural areas is real (it propelled Mr. Oyenekwe to develop the scheme)**
- **Materials for development of SHP can be sourced locally and are affordable**
- **SHP schemes are not very capital intensive**
- **O & M are relatively cheap and require low technical skills available in rural areas**
- **Great potential to raise the quality of life in the rural areas**

# Targets for Growth of Renewable Energy Sub-sector

| Target | ST 2007 | MT 2015 | LT 2025 | Total |
|---|---|---|---|---|
| Installed electr. cap. (MW) for total renewable sources (TRS ) | 56 | 746 | 2,945 | |
| Installed electr. cap. (MW) for small hydropower (SHP) | 50 | 600 | 2,000 | |
| % (SHP to TR) | 89 | 80 | 68 | |
| Est. cost of investment (Nm) for TRS | | | | |
| Est. cost of investment (Nm) for SHP | 134 | 1,244 | 1,726 | 3,104 |
| | | | | |

Source: ECN (2005). Draft Renewable Energy Master Plan

# Conclusions

- Reliable and affordable energy supply is pre-requisite for sustainable development
- Efficient exploitation of renewable energy resources is a priority at national and international agenda
- Hydropower is recognised as the most important renewable energy source
- There is great potentials for SHP in Nigeria
- SHP schemes are most appropriate for rural energy supply
- States and Local Governments would need to accord it top priority

# THANKS FOR LISTENING