WATER AND AGRICULTURE IN THE RENEWABLE ENERGY EQUATION IN NIGERIA*

By

Professor E. J. Bala

Director General

Energy Commission of Nigeria, Abuja.

dg@energy.gov.ng

Presentation made at the 2013 International Engineering Conference and Exhibition of the Nigerian Society of Engineers, Abuja. 10th December, 2013

Contents

- **Introduction**
- **Energy Resources and Final Energies in Nigeria**
- **Hydropower and Biomass Policy and Targets in Nigeria**
- **Prospects, Challenges and Way Forward**
- **Conclusion**

1. Introduction

- Renewable energy is energy derived from a source that does regenerate itself within a relatively short time through natural process, unlike fossil energy sources that take hundreds of millions of years to form. These sources include solar, wind, ocean waves and tides, hydropower, biomass etc. These sources of energy can be transformed into three basic final forms of energy required for driving national economy. These forms are:
  - electricity,
  - fuel, and
  - process heat.
- Subsequent discussion on Water and Agriculture in the Renewable Energy equation in Nigeria will therefore be focused on Water and Agricultural feed stock as sources of final energies of electricity, fuels and process heat.

1. Introduction Cont'd…

- Electricity from water (hydropower) is derived from the conversion of potential and kinetic energy in stationary or moving water into mechanical energy for electricity production. A water resource is basically obtained from atmospheric, surface and underground water. However, hydropower is derived basically from surface water resource, that is replenished through annual rainfall. Nigeria has total water resources of about $3.05 \times 10^{11} m^3$/annum (underground and surface) with annual rainfall ranging between 3250mm at coastal region and 250mm in the far northern part. An average annual value of about 1350mm rainfall is usually quoted for Nigeria.

1. Introduction Cont'd…

- Biomass is referred to organic matter of non-fossil type that has energy stored in it in the form of chemical energy. Biomass resource is mainly source from agricultural feedstock such as sugar cane, corn, sorghum, cassava, jatropha, rape seed etc and agric waste. Agriculture, which includes crop production, animal production, fisheries and forestry, is an economic activity that makes the highest contribution to GDP at appropriately 40%; with crop production making the greatest effect at 36% in 2011. Agriculture is by nature linked to water resources. All agricultural produce require water. Crop production requires water and sunlight in photosynthesis for its nutrition; animals require water for survival, whereas, forestry like crop production also require water in photosynthesis.

1. Introduction Cont'd…

- Thus, while water and particularly surface water resource from rainfall can be utilized to produce electrical energy and is thus a renewable energy resource; it also serves as an input to agriculture for the production of biomass, which is also a renewable energy resource. It is, however, to be noted that both water and agriculture are closely affected by climate change.
- Adequate management of our water resources, both surface and underground, as well as agriculture are therefore necessary in solving the renewable energy equation in Nigeria for achieving the Transformation Agenda of Mr. President, *Dr. Goodluck Ebele Jonathan*, GCON, GCFR.

2. Energy Resources and Final Energies in Nigeria

- Nigeria, with its enormous energy resources as depicted in Tables 1 and 2 has about 4000MW only available from the grid out of an installed generation capacity of about 9,955MW in 2012. This translates to an incredible and inadequate power supply per capita of about 27W/capita. Renewable energy, mainly from large hydropower accounted for about 22%, while the rest is from natural gas powered plants. National electricity access is about 60%, average of the households; with 87% access in the urban areas and about 40% access in the rural areas. Majority of the household in the southern zones have higher access than the northern part; with south-west zone having the highest access, while the north east has the least access.

2. Energy Resources and Final Energies in Nigeria Cont'd…

- Nigeria produced an average of about 2.45 million barrels/day(mb/day) of crude oil and about 2.4 billion cubic feet/year(Bcf/year) of natural gas in 2010; while it consumes about 33 million litres of PMS per day, 18million litres of AGO per day and 2.4 million litres of HHK. Ironically, greater proportions of the consumed products are imported from outside the country because of low local refining capacity, which was about 21% in 2010. Biofuels in the forms of bioethanol and biodiesel can be blended up to 10% and 20% by volume with PMS and AGO(E10 & B20), respectively for automotive use in Nigeria.

2. Energy Resources and Final Energies in Nigeria Cont'd…

- Solar PV is the fast growing new renewable energy into the nation's energy supply mix. Over 15MW of dispersed isolated stand alone systems have been installed in the country for water supply from boreholes using solar driven submersible pumps, solar street lights, solar PV mini-grids for communities, vaccine refrigerators etc. However, no grid-connected solar electricity system, either solar PV or solar thermal, is yet put in place despite the huge solar energy resource in the country.
- A 10MW wind farm to be grid-connected is being constructed in the Northern part of the country by Federal Ministry of Power.

2. Energy Resources and Final Energies in Nigeria Cont'd…

Table 1. Fossil and Nuclear Energy Sources

S/N	Resources	Reserves	Production (2010)	Domestic Utilization (2010)
1.	Crude Oil	37billion barrels	0.896billion barrels	0.164billion barrels
1.	Natural Gas	187 Tscf	2.392Tscf	75.7% - Fuel, Industries, re-injection and gas lift. 24.3% - gas flare
1.	Coal	2.7 billion tonnes	0	Negligible
1.	Tar Sands	31 billion barrels of oil equivalent	0	0.224 million tonnes
1.	Nuclear	Yet to be quantified	0	30kW experimental nuclear reactor

2. Energy Resources and Final Energies in Nigeria Cont'd…

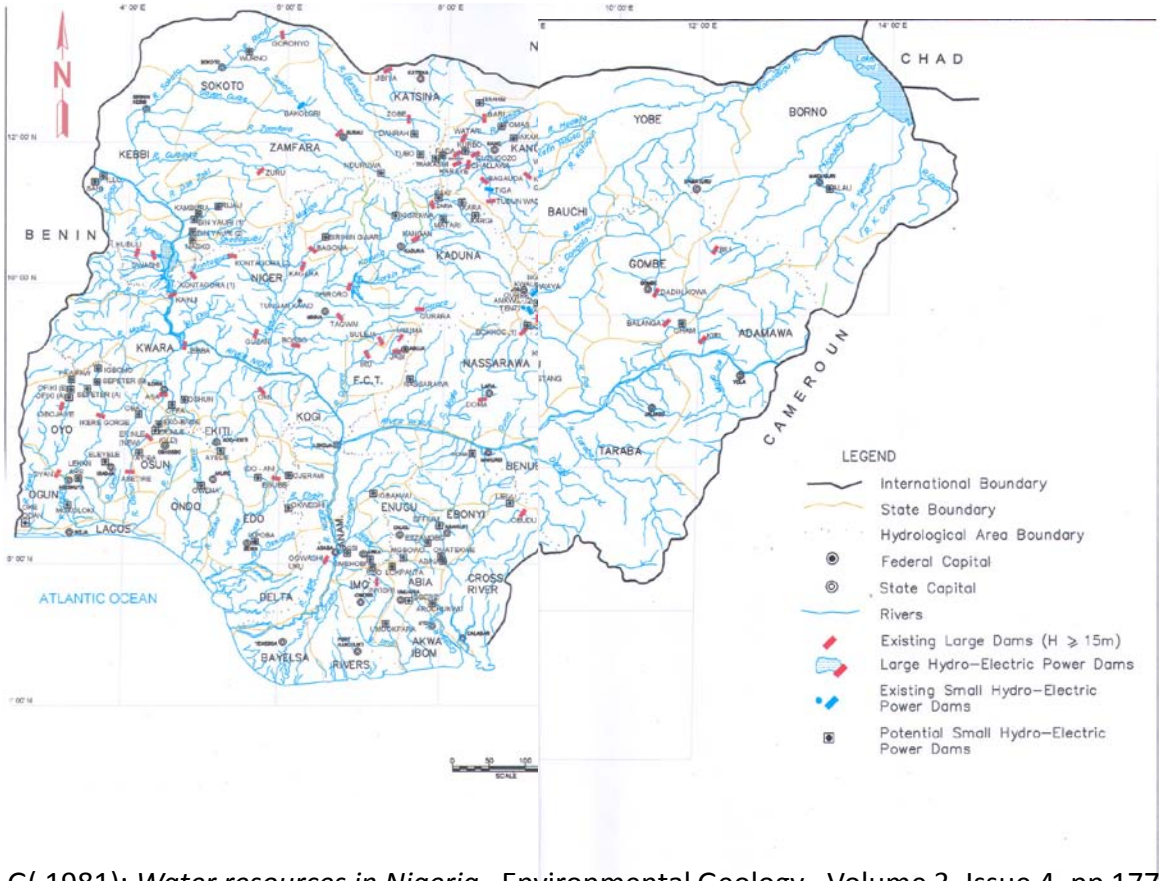
Table 2. Renewable Energy Resources

S/N	Resource		Reserve	Utilization Level
1.	Large hydro power		11,250MW	1,972MW
1.	Small Hydro power		3,500MW	64.2MW
1.	Solar Energy		4.0kW/M2/day 6.5kW/M2/day	15MW solar PV stand-alone No solar thermal electricity
1.	Wind		2-4m/s at 10m height	2x2.5KW electricity generator; 10MW wind farm in Katsina
1.	Biomass	Fuel wood	11 million hectares of forest and woodlands	43.4 million tonnes of firewood/yr
		Municipal waste	- 18.3 million tonnes in 2005* & about 30 million tonnes/yr now	-
		Animal waste	- 243 million assorted animals in 2001	-
		Energy Crops and agric waste	- 28.2 million hectares of Arable land	8.5% cultivated

3. Hydropower and Biomass Policy and Targets in Nigeria

- **Hydropower**:
- Hydropower is one of the major sources of base load electricity generation. Despite its high initial capital cost, hydropower provides one of the cheapest and cleanest sources of electricity. The country is well endowed with large rivers and some few natural falls which are together responsible for the high hydropower potential of the country. The Rivers Niger and Benue and their several tributaries constitute the core of the Nigerian river system, which offers a renewable source of energy for small scale (≤ 30MW) & large scale (> 30MW) hydropower development, estimated at 14,750MW potential. Figure 1 shows the river systems and dams in Nigeria.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…



Source:- Oteze, G(1981): *Water resources in Nigeria,* Environmental Geology , Volume 3, Issue 4, pp 177-184.

Figure 1. River systems and dams in Nigeria

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

- The National Energy Policy (NEP) provides for the following policy statements, objectives and strategies for hydropower development in Nigeria:
- ***Policies***

  i. The nation shall fully harness the hydropower potential available in the country for electricity generation.

  ii. The nation shall pay particular attention to the development of the mini and micro hydropower schemes.

  iii. The exploitation of the hydropower resources shall be done in an environmentally sustainable manner.

  iv. Private sector and indigenous participation in hydropower development shall be actively promoted.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

- ***Objectives***

  i. To increase the percentage contribution of hydro electricity to the total energy mix.

  ii. To extend electricity to rural and remote areas, through the use of mini and micro hydro power schemes.

  iii. To conserve non-renewable resources used in the generation of electricity.

  iv. To diversify the energy resource base.

  v. To ensure minimum damage to the ecosystem arising from hydropower development.

  vi. To attract private sector investments into the hydropower sub-sector.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

- ***Strategies***

  i. Establishing and maintaining multilateral agreements to monitor and regulate the use of water in international rivers flowing through the country.

  ii. Ensuring increased indigenous participation in the planning, design and construction of hydropower stations.

  iii. Providing basic engineering infrastructure for the production of hydropower plants, equipment and accessories.

  iv. Encouraging the private sector, both indigenous and foreign, in the establishment and operation of hydropower plants.

  v. Encouraging the private sector, both indigenous and foreign, for the local production of hydropower plants and accessories.

  vi. Ensuring that rural electricity boards incorporate small-scale hydropower plants in their development plans.

  vii. Promoting and supporting R & D activities for the local adaptation of hydropower plant technologies.

  viii. Initiating and updating data on the hydro potential of our rivers and identifying all the possible locations for dams.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

Targets

Table 3: Hydropower Programme/Targets

S/N	Activity/Item	Timeline/Quantity		
		Short (up to - 2015)	Medium(up to - 2020)	**Long(up to - 2030)**
1.	Large Hydropower (MW)	4,000	9,000	**11,250**
1.	Small Hydropower (MW)	100	760	**3,500**
1.	**Total (MW)**	**4,100**	**9,760**	**14,750**

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

- **Biomass**
- Organic, non-fossil material of biological origin is called biomass. The biomass resources of Nigeria can be identified as wood, forage grasses and shrubs, animal wastes and wastes arising from forestry, agricultural, municipal and industrial activities, as well as aquatic biomass. The biomass energy resources of the nation have been estimated to be significant.
- Plant biomass can be used as fuel in thermal power plants or converted to produce solid briquettes, which can then be utilized as fuel for small-scale industries. Biogas digesters of various designs are capable of sustaining household, industrial and institutional energy needs. It has indeed been shown that the remaining biomass material after digestion is a better fertilizer than the original waste. The intensive application of this will reduce the existing heavy reliance on chemical fertilizers.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

- ***Policy***
  i. The nation shall effectively harness non-fuelwood biomass energy resources and integrate them with other energy resources.
  ii. The nation shall promote the use of efficient biomass conversion technologies.
- ***Objectives***
  i. To promote biomass as an alternative energy resource especially in the rural areas.
  ii. To promote efficient use of agricultural residues, animal and human wastes as energy sources.
  iii. To reduce health hazards arising from combustion of biomass fuel.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

- ***Strategies***

  i. Developing extension programmes to facilitate the general use of new biomass energy technologies.

  ii. Promoting R & D in biomass energy technology.

  iii. Establishing pilot projects for the production of biomass energy conversion devices and systems.

  iv. Providing adequate incentives to local entrepreneurs for the production of biomass energy conversion systems.

  v. Training of skilled manpower for the maintenance of biomass energy conversion systems.

  vi. Developing skilled manpower and providing basic engineering infrastructure for the local production of components and spare parts for biomass systems.

3. Hydropower and Biomass Policy and Targets in Nigeria Cont'd…

Targets

Table 4: Biomass Programme /Targets:

S/N	Activity/Item	Timeline/Quantity		
		Short (2012-2015)	Medium (2016-2020)	Long (2020-2030)
1.	Biomass Electricity (MW)	5	30	100
1.	Improved Woodstoves (No.)	300,000	500,000	1,000,000
1.	Biogas Digesters (No.)	500	6,000	8,000
1.	Biomass Briquetting Machine (No.)	30	50	80
1.	**Biofuel (ML/year)* - Bio ethanol (B10) - Biodiesel (B20)**	**1951 730**	**3559 1254**	**8837 4270**

* Based on 13% Growth rate Supply Projections of PMS and AGO(ECN, 2012)

4. Prospects, Challenges and Way Forward

- **Prospects:**
- 87% of the hydropower potentials still untapped
- Liberalized electricity sector with cost reflective Tariff
- FGN guaranteed Power Purchase Agreement for Grid-Connected Systems
- Large market
- Approved biofuel policy

4. Prospects, Challenges and Way Forward Cont'd…

- **Challenges:**
- Inadequate human capacity
- Low manufacturing capacity
- Relatively higher initial investment cost
- Poor access to finance
- Unclear distributed generation programme

4. Prospects, Challenges and Way Forward Cont'd…

- **Way Forward:**
- Improve on access to finance
- Encourage public-private partnerships
- Continuous human capacity building

5. Conclusion

- Nigeria has varied energy resources that include hydro and biomass. These renewable energy sources can be transformed into final energies of electricity, fuels and heat using appropriate technologies to drive the economy in a sustainable manner through the active participation of the private sector.
- High level human capacity development, skills acquisition on these technologies and infrastructural development need to be deepened.
- The nexus between water and agriculture in the renewable energy equation is significant in the development of sustainable energy for driving the transformation agenda of Mr. President, *Dr. Goodluck Ebele Johnathan* *GCON, GCFR*.