THE PROSPECT OF SMALL HYDRO SCHEMES FOR SUSTAINABLE POWER GENERATION IN NIGERIA

Engr. M. G. Samaila and Engr. S. B. Mabadeje

Abstract

The fuel driving the engine of growth and sustainable development of any nation is the nation's access to reliable and adequate electricity. Hydropower projects throughout the world provide about 19% of our electricity. While large-scale hydropower development is becoming a challenge due to environmental and socio-economic concerns, small hydropower (SHP) development continues to be an attractive resource, especially in remote parts of Africa. It is a proven technology that can be connected to the main grid, isolated grids or as a stand-alone option. Nigeria has many permanent rivers and streams providing excellent opportunities for small hydropower development. This paper therefore, presents the significant role small hydro schemes can play towards alleviating the electricity problems of Nigeria if the nation must attain rapid sustainable socio-economic development.

Introduction

Without modern energy services the existence of basic community services and infrastructures is questionable. One necessary input for human development anywhere in the world is the provision of economic and reliable modern energy (electric power). However, the low level of electricity generation in Nigeria has become a great constraint to rapid economic development of the country. About sixty-five percent (65%) of the 140 million population of Nigeria are rural dwellers with majority of them farmers pitching their tents far off-grid areas to stay near their agricultural firms. It is pathetic to note that despite bumper harvest by some of these farmers they still live in abject poverty. This is due to lack of electricity powered modern storage and processing facilities hence, large-scale wastes. Electricity is also needed for basic house-hold equipment such as refrigerator, fan, and lighting and small rating induction grinding machines. Adejumboi, Esan and Okunuga (2007) observed that many areas in Nigeria, especially the rural environments are blessed with rivers, streams and run-off-waters of depths ranging from about 1 metre to 25 metres, which are suitable for small-scale hydro schemes.

Overview of Small Hydropower

Although there is still no internationally agreed definition of "small" hydro power (SHP), the upper limit is usually taken as 10MW, and for large countries such as India and China, this rises to 25 and 50MW respectively. Also within the range of small hydro power, mini hydro typically refer to schemes below 1MW, micro hydro below 100kW and Pico hydro below 5kW.

In general terms the environmental impacts of hydropower plants are minimal through the use of "run-of- river" schemes in which no dam or reservoir storage is involved.

All over the world there are thousands of good sites for small hydropower development. Although small hydropower alone cannot contribute significantly to the ever increasing need of more electricity, it is a very valuable part of the world's energy mix. Small hydro locations are available in most countries, and many of them can be developed with minimal or no negative social or environmental impacts. The financial requirements are normally manageable also for local investors, and a small hydro development can play an important role in industrial and economical progress in local regions. Micro and mini hydro are in addition instrumental in clean rural electrification.

Eastern, southern, central and parts of western Africa have many permanent rivers and streams providing excellent opportunities for hydropower development. According to [Klunne, 2007], several initiatives are ongoing to help in developing small hydropower in Africa. A number of NGOs are active in support programmes to remove barriers to the harnessing of the large small hydro-potential, small hydro support centres are established or in the process of being established in a number of countries.

The contribution of SHP to the worldwide electrical capacity is about 47GW and about 25GW (53%) of this capacity is in developing countries [Taylor and Upadhyay, 2005].

Table 1: Installed SHP Capacity by Region

Region	Installed Capacity	Percentage
Asia	32,642	68.0
Africa	228	0.5
South America	1280	2.7
North & Central America	2,929	6.1
Europe	10,723	22.3
Australasia/Oceania	198	0.4
TOTAL	47,997	100%

(Source: Klunne, 2007)

In the SHP sector, China is the major player, driven by long-standing rural electrification programmes from the Government. China alone has developed more than half of the world's small hydro capacity, and most of the capacity in developing countries. Other developing countries with significant SHP capacity are India, Brazil, Peru, Malaysia and Pakistan.

The Electrical Power in Nigeria Today

Few countries in the world stand more threatened by the energy crisis (especially, electric power) than the Oil producing Nigeria. The power sector in Nigeria had suffered and is still suffering from terrible neglect by government despite its strategic importance to the nation's economy.

Bangoshe (2007, p.1), lamented that:

> the incessant hum of generators belching fumes into the air day and night; the look of helplessness of the artisan as he sits idle outside his stall and the frustration of the housewife as she sees the food that she has spent days painstakingly preparing turn bad because it can not be preserved are the signature stories of what many people would regard as the Obasanjo administration's biggest failure - the inability after nearly eight years in office to make any difference in Nigeria's long running power supply problem.

In Nigeria, electricity is seen as an essential infrastructure in the category as roads, telecommunication, and water. In fact, it is the life-blood of national development and industrial growth. Although electricity is treated as an essential social service, the present supply is characterised by erratic power supply to industries, inadequate coverage in terms of geographic spread, leaving out large number of villages and covering less than 40% of the population.

The Need for Small Hydropower Development in Nigeria

Small hydropower plants can be set up in virtually all parts of Nigeria. Their suitability for stand-alone utilization in the rural parts of Nigeria can be further justified by noting that many viable small hydro-scale plants are actually "run-of-river" schemes based on water wheels that require minimal amount of civil works.

Most small-scale schemes, for generating hydropower, are around Jos Plateau State, where there is a 2MW station at Kwall falls on N'Gell River (or River Kaduna) and one 8MW station at Kura falls. The State can boast of being the first to enjoy hygro-electricity in Nigeria, because from 1929 to the end of the Nigerian civil war, jos and the surrounding mine fields were supplied with electricity generated from these sites, by the National Electricity Supply Company (NESCO). This private company was originally set up to supply tin mines. It latter extended its services to Bukuru, jos township and Kafanchan in Kaduna State.

Nigeria has 278 yet undeveloped sites for small hydropower production, with the total capacity of 734MW. The country has now on-going, different phases of rural electrification to link so many villages to the national grid. This is an enormous task because the sole utility in the country (PHCN) does not have the capacity to extend their lines far and wide to large numbers of isolated communities. Whereas, small hydro schemes can easily meet the energy needs of these communities, economically. PHCN and Rural Electrification Boards (REBs) now use only the national grid and diesel generators for their rural electrification programmes. Small hydropower is essentially non-polluting and it releases no heat. Adverse environment impacts are negligible and for small installations, it is totally absent. With the development of compact and efficient machines, the investment per installed kW is not very high. SHP projects do not require large capital investment. Compared to other conventional energy

generation schemes, these projects have low gestation period ranging from 8 to 24 months. Operating costs are low and the equipment does not, to some extent, need trained and skilled personal. With the introduction of microprocessors in the SHP stations, it may run virtually unattended (automated schemes). Thus SHP is an ideal decentralized energy generation source. It can supply energy to rural feeders, cutting distribution losses to a large extent. SHP can also be synchronized with the national grid.

Potential Sites for Small Hydropower Development in Nigeria

The major rivers of Nigeria, such as the Niger, Benue, Cross river and Kano and their tributaries along with some smaller rivers, provide an enviable potential for the exploitation of hydro energy in Nigeria. SHP potential sites exist in virtually all parts of Nigeria. As stated earlier, there are over 278 unexploited sites with total potentials of 734.3 MW. So far about eight (8) SHP stations with aggregate capacity of 37.0MW has been installed in Nigeria by private company and the Government as
shown in table 2.

Table 2: Existing Small Hydro Schemes in Nigeria

S/No.	River	State	Installed Capacity (Mw)
1.	Kwall	Plateau	2.0
2.	Kurra	Plateau	8.0
3.	Lere (I) (II)	Plateau	4.0 4.0
4.	Bakalori	Sokoto	3.0
5.	Tiga	Kano	6.0
6.	Oyan	Ogun	9.0

(Source: Akanmu and Ezeh, 2007)

The technically exploitable small hydro capability in Nigeria is high but under utilized. According to Akanmu and Ezeh (2007), some potential sites have been assessed for development as shown in table 3.

Table 3: Small Hydro Potentials in 12 Surveyed States in Nigeria

S/NO.	STATE	RIVER BASIN	TOTAL 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	Hadeja-Jama'are	28	46.2
7.	Borno	Chad	29	20.8
8.	Bauchi	Upper-Benue	20	42.6

9.	Adamawa	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

(Source: Akanmu and Ezeh, 2007)

The Benefits/Challenges of Developing Small Hydropower in Nigeria

At a time when Nigeria and other developing countries urgently need a comprehensive sustainable development strategy in all sector of her economy (especially in the power sector), the promotion and popularisation of small hydropower systems deserve priority in policy considerations. As it is recognised throughout the world, SHP development is econo-ecologically sustainable and, operationally flexible with opportunity for people's

Participation in its total life cycle process. It is most suitable for flexible peak load support to grid power systems as well as for independent and stand-alone applications in isolated remote areas. It is also realised in many parts of the world, where SHP systems are developed and put to use in isolated and inaccessible areas that the total multiplier and value added effects, including employment generation and poverty reduction/alleviation, are very high and so these can become effective catalysts in promoting sustainable development. In spite of the fact that Nigeria has a history of over 70 years in the development and utilisation of private sector SHP systems, it has so far exploited only 33MW out of the currently estimated potential of over 730MW.

Therefore, it is necessary that comprehensive infrastructure (encompassing academic research, training and consultancy including linkage with equipment manufacture) be created in Nigeria to exploit the SHP potential to the fullest. Further, considering the global environment and sustainability needs, the successful implementation of SHP projects will definitely help in mitigating the green house gases, as it is estimated that each kWh of electrical energy produced through thermal sources and used will contribute to the production of additional 1kg of carbon dioxide emission. Under these circumstances, it is becoming an urgent necessity to initiate institutional efforts to exploit the SHP resources on a priority basis.

Conclusion

Nigeria as a developing country, can not afford to continue ignoring the enviable potential for the exploitation of SHP. This is because SHP has already proved itself, even in Nigeria, as a major contributor to electrification in developing countries. With effective policy formulation by the Government and the private partnership involvement in renewable energy particularly small hydropower, there is guarantee of sustainable national development.

References

Adejumboi, I.A.; Esan, A.A.and Okunuga, A.B.(2007). Discovering potential Sites for small hydropower (SHP) in Nigeria. Advanced materials research Vols. 18-19. Trans tech Publications, Switzerland. P.93.

Akanmu, J.O. and Ezeh, E.M. (2007). Small hydropower development to achieve millennium development goals. University of Lagos, Nigeria. P.1.

Bangoshe, S. L.(2007). Nigeria's electric power sector reform: Matters arising. Volta. river Authority. P.1

Klunne, W.J. (2007). Small hydropower development in Africa. hydropower, ESI AFRICA ISSUE 2. P. 1.

Taylor, S. and Upadhyay, D. (2005). Small Hydro in Europe and beyond. Renewable Energy World, September, 2005.