HARNESSING HYDROPOWER POTENTIAL IN EKITI STATE, NIGERIA

Supported by tetfund TERTIARY EDUCATION TRUST FUND

S. O. Adejuwon[1], Ademola A. Dare[2] and O. A. Ojaomo[2]

[1]Department of Mechanical Engineering, the Ibarapa Polytechnic, Eruwa, Oyo State, Nigeria

[2]Department of Mechanical Engineering, University of Ibadan, Oyo State, Nigeria
Corresponding author: sam.adejuwon@yahoo.com

Received: October 03, 2017 **Accepted:** January 15, 2018

Abstract: The present electricity demand in Nigeria has been estimated as 20000 MW; only about 4000 MW could be generated despite all efforts. This has subsequently led to serious energy crisis in Nigeria. This study was carried out to assess the hydropower potential of the Ekiti State. Ten rivers and nine water supply schemes with dams built were visited and then assessed in terms of hydropower cost and likely revenue. A detailed financial analysis was carried out for the proposed hydropower in each of the location. Thereafter the viability of each proposed hydropower was determined based on the expected payback years using RETSCREEN software. From the study, the rivers average flow rates in Ekiti state were in the range of 25 – 70 m^3/s while the head range from 2.5 – 6 m. Thus all the existing rivers in the State can only sustain mini/pico hydropower scheme ranging from 42 - 190 kW. However five of the nine existing water supply schemes can produce about 270MW which is enough for the state at its present energy demand. Financial analysis showed that only eight of the existing small rivers can sustain viable hydropower project, whereas all the existing water supply schemes are viable with payback on the average about 4 years. However the investment outlay is enormous. The study therefore concludes that in the light of the available information, hydropower can be fully exploited in the State. While tapping from the existing water supply appears promising, exploiting from the small rivers should not be ignored as many communities are located in the rural areas that may not be easily connected via transmission lines from a far- reached hydropower plant.

Keywords: Hydropower, Ekiti state, RETSCREEN software, rivers

Introduction

The present electricity demand in Nigeria has been estimated as 20000 MW, only about 4000 MW could be generated despite all efforts (All Africa Global Media, 2011). For the past three decades, inadequate quantity and quality and access to electricity services has been a regular feature in Nigeria, a country with 140 million people with a majority living on less than US$2 a day (Iwayemi, 2008). This has subsequently led to serious energy crisis in Nigeria. Governments at various levels have been putting up aggressive efforts to tackle this great challenge which has pruned down the industrial activities in the nation. The Federal Government of Nigeria recently set 6000MW electricity generation target by December 2009. Although this might not have been realized, it was generally accepted that exploitation of small rivers and dams for power generation will assist in meeting this target at the nearest future. Hydropower reserves in Nigeria are estimated at about 18,600MW (Sambo, 2006). Presently, Ekiti State with an estimated population of 2.5 million people requires about 250MW of electricity to sustain and stimulate development in the State. Surely a renewable and cheaper hydro source of power in the State will go a long way in ameliorating its power problem. The current National Energy Policy requires that the nation shall fully harness the hydropower potential available in the country for electricity generation paying attention to the development of the mini and micro hydropower schemes (Sambo, 2008; National Energy Policy, 2003).

Ekiti means mountains (in the Yoruba language). The mountainous land formation and hilly topography is a first-hand potential of hydropower site. Also the vast presence of streams and dams if well exploited could be a relief for the yearning for power all over the country. The type of settlement in Ekiti State is basically villages. Almost all the villages in Ekiti have one stream or the other that could at least generate pico, nano, or micro- hydropower for domestic use in these villages.

In the light of this, a study was conducted to assess the possibility of setting up small hydropower in the state which can serve different villages and settlements and subsequently stimulate growth in the State. The various findings are hereby presented for the consideration of the government.

Materials and Methods

Description of study area

Ekiti State, Nigeria. The state lies between longitudes 4º 5" and 5º 45" east of the Greenwich meridian and on latitude 7º 15" north of the equator. The state consists of 16 local Government Areas and covers a total land area of 23, 212, 64 square kilometers. Ekiti state vegetation is derived savannah in the north and forest savannah in the south. Since the State appears to have been located on a tropical island, hydroelectric generation may be attractive because of the following reasons

(1) The price of oil has been rising.
(2) There is abundant annual rainfall and, consequently, stream flow is always available.
(3) There are many waterfalls on the island that would provide the required head.
(4) Many villages are too remote from the urban centers to have a municipal power delivered to them in the foreseeable future.
(5) The electrical demand of these villages is modest, involving mainly lighting needs of the village and perhaps some refrigeration.
(6) Hydropower is independent of fuel cost and virtually maintenance free.

Mode of study

This study was carried out by visiting various sites where there are streams, rivers and dams in the State. Extensive data were collected and collated for the various sites. Validation of some of the data such as flow rates were carried out. In all, three major dams and ten streams/rivers/run offs were investigated and assessed for their flow parameters (mainly Head and flow rate) for period between June and November, signifying the range of peak flow and beginning of low flows in November/December.

Basic features of rivers and dam sites visited

Ero dams and lake are man-made tourist attraction in the State. This dam is located at Ikun- Ekiti in Moba lacal Government of Ekiti State. The lake covers about ten kilometers. These dams supplies three local government areas with drinkable water and the local government that benefit from this are; Oye, Ido/Osi and Moba. In order words, the dam supplies over one hundred towns and villages with pipe born water. It is believed that the dam is capable of supplying Ekiti State as a whole with potable water. The indigenes of the town and neighbors fish on this lake.

Egbe dam was constructed on Ose River at Egbe-Ekiti in Ekiti East local government area of the state. This dam supplies the whole local government and some parts of Akoko in Ondo State with pipe borne water.

Erita waterfalls at Ipole-Iloro is located at about 6 km North-west of Ikogosi. It could be reached only through a secondary road from Ikogosi. The road leading to the fall passes through. Tourists feel the chilly effect of this fall about 10 meters away. It has three pronounced escarpment. This fall is a good site for hydroelectricity.

Data analysis

Rivers hydropower assessment

In analyzing the various sites for hydropower potential, the rivers were first designated as shown in Table 1. The flow rate as well as the gross head for the various sites are contained in Tables 2 and 3. It should be noted however that these values are crude estimates considering the time and period wherein the data were collated.

Table 1: Designation of rivers visited

S/N	Names of River	Location	Designation
1	Areja	Ilogun- Ekiti	A
2	Igoi	Ido- Ekiti	B
3	Eleo	Ikole- Ekiti	C
4	Ibu	Iye- Ekiti	D
5	Erinsa	Ikere- Ekiti	E
6	Isapari	Oke- Ako	F
7	Ilagbe	Osi- Ekiti	G
8	Oneh	Efon- Ekiti	H
9	Iureje	Iworoko- Ekiti	I
10	Aiwe	Ijelu- Ekiti	J

Table 2: Flow rate and head of some rivers in Ekiti State (June-July 2009)

Rivers	June		July		Aug.		Sept.		Oct.		Nov.	
	Q	H	Q	H	Q	H	Q	H	Q	H	Q	H
A	50	5.0	50	5.0	52	5.2	55	5.2	54	5.3	50	5.0
B	60	6.0	61	6.0	62	6.2	63	6.4	61	6.2	60	6.1
C	70	5.5	72	5.5	72	5.5	72	5.5	74	5.6	72	5.4
D	40	4.8	42	4.6	42	4.6	40	4.8	42	4.8	42	4.5
E	80	7.5	80	7.2	75	7.2	82	7.1	81	7.2	80	6.8
F	75	5.0	72	5.2	75	5.4	70	4.8	78	4.6	70	4.8
G	30	4.2	25	3.5	28	4.1	24	3.0	28	3.5	20	3.0
H	65	6.4	65	6.4	68	6.0	64	6.0	66	6.2	64	6.0
I	50	8.0	52	7.8	51	7.8	52	8.4	53	8.2	50	8.2
J	45	2.8	40	2.8	45	2.8	45	2.5	38	2.0	35	2.0

Q is measured in m^3/s; H is measured in m.

Table 3: Average (mean) values of flow rate Q and head H (MAF)

River	Average Flow Rate m^3/s	Gross Head(m)
A	51.8	5.1
B	61.2	6.2
C	72	5.5
D	41.3	4.7
E	79.7	7.2
F	73.3	5.0
G	25.8	3.6
H	65.3	6.2
I	51.3	8.1
J	41.3	2.5

The hydropower potential of each of the rivers is estimated and presented in Table 4.

Table 4: showing the hydropower estimate of each of the streams studied

Q(m^3/s)	3.1	3.7	4.3	2.5	4.8	4.4	1.5	3.9	3.1	2.5	
H (m)	5.1	6.2	5.5	4.7	7.2	5.0	3.6	6.0	8.1	2.5	
POWER(kW)	**124**	**180**	**185**	**92.2**	**271**	**172**	**42**	**190**	**197**	**49.1**	**1502.3**

Dams hydropower assessment

There are presently about nine water schemes in Ekiti State. The various schemes are shown in Table 5.

Table 5: Water schemes in Ekiti State

S/N	Reservoir Site	River Source	Commissioned	Cost	Capacity	Discharge $Q(m^3/s)$	Head (m)
1	Ikun-Ekiti	Ero River	1985	N95million	$105m^3$	580	22
2	Egbe-Ekiti	Osse River	1989	N60million	$84,000m^3$	350	25
3	Itapaji	Ele River	1975	N4.2million	$5,175m^3$/day	450	24
4	Ado-Ekiti	Ureje Stream	1961	N1.5million	2,045Litre/day Upgraded to 4,900L/day (1980)	100	5
5	Efon Alaaye-Ekiti	Oni Spring	1953	$198,000	67,000L/day	232	60
6	Ido Ajinnare	Ajinnare	1986	---------	$200m^3$/day	----------	-------
7	Okeimesi	Okeimesi spring	1960	N43,000			
8	Ikere-Ekiti	Artesian borehole	1984	----------	$225m^3$/day	----------	---------
9	Igbara-Odo	Erita	1999	N37.8million	$50m^3$	$350m^3/s$	3.5

Source: Ekiti State Water Corporation Report to the British Department of International Development (DFID) Nov. 2000

Most of these water schemes have since commissioning undergone one form of reconstruction, upgrading and expansion. For the purpose of this work, data provided in Table 5 will be used; however it is recommended that a detailed study be carried out to update information on the dams.

From Table 5, only five dams' sites have sufficient information that can be used to assess the hydropower potential. These five were isolated and assessed. The hydropower generating capabilities for these dams are presented in Table 6.

It can be deduced that the Ado river scheme in the state is capable of generating SMALL HYDRO POWER i.e. in the range of 1MW-10MW while the rest (Ero, Osse, Itapaji and Efon are all capable of producing MEDIUM/LARGE HYDRO POWER in the range of >10MW>30MW. In all about 270MW is realizable, which is about the projected electricity demand for Ekiti State for now.

Table 6: Hydropower potential of selected water scheme in Ekiti State

S/N	Name of River	Discharge Q (m^3/S)	Head, H (m)	Power (kW)
1	Ero river	580	22	100,140.48
2	Osse river	350	25	60,429.6
3	Itapaji scheme	450	24	84,758.4
4	Ado water scheme	100	5	3,924
5	Efon alaaye sheme	180	15	21,189.6
Total	**5NOS**	**1660**	**91**	**270,442.08**

Table 7: Hydropower analysis using selected rivers/stream in Ekiti State

River	Cost (₦)	Payback (years)
A	50m	**8**
B	65m	**9.3**
C	75m	**9.9**
D	40m	**13.5**
E	80m	**8.1**
F	70m	**10.7**
G	30m	**24.4**
H	80m	**9.7**
I	75m	**8.5**
J	**35m**	**24.1**

Table 8: Hydropower analysis using selected dams in Ekiti State

S/N	Name of Scheme	Cost (₦)	Payback (years)
1	Ero river	9 bn	**2**
2	Osse river	7bn	**3**
3	Itapaji scheme	7.6bn	**2**
4	Ado water scheme	1.5bn	**8**
5	Efon alaaye sheme	3.2bn	**3**

Table 7 suggests that sites G and J are not strong potential hydropower sites. However others are promising and should be further investigated. From Table 8, it is noticed that all the existing dams in Ekiti State could be used to harness hydropower. If all the potentials are harnessed, the State will be totally relieved of epileptic power supply. However, in view of the huge financial outlay which will be required, a strategic plan could be investigated to work out the logistics in achieving this. It should be noted that harnessing the hydropower does not compromise the designated functions of the existing dams for water supply.

Financial analysis

A detailed financial analysis of each of the potential hydropower site was carried out. This was to assess the financial viability of such sites. The cost and payback period for each site was determined. The results are presented in Tables 8

Conclusion

From the study, it is obvious that Ekiti State could easily leap out of the current epileptic power supply situation it currently experiences by harnessing hydropower from existing dams and streams. Hydropower from the streams can be utilized by nearby villages while the major towns can be supplied with electricity generated from the existing dams. It should be noted however that only provided preliminary information towards achieving this has been provided. A more comprehensive effort is still required in achieving this noble goal. Such study will include

- ✓ a well coordinated geophysical study
- ✓ a comprehensive design of the hydropower plant
- ✓ a detailed financial study for effective installation and takeoff
- ✓ a more rigorous collation of river data

References

Ekiti State Water Corporation to the British Department of International Development 2000.

Federal Republic of Nigeria National Energy Policy 2003. *The Presidency, Energy Commission of Nigeria*

Iwayemi Akin 2008. Investment in Electricity Generation and Transmission in Nigeria: Issues and Options. *Int. Assoc. Energy Econs.*, 137-141

NERC- The Country Needs Additional 16,000 ME of Power Generation. *All African Global Network*, October 6, 2011.

Sambo AS 2006. Renewable Energy Electricity in Nigeria: The Way Forward. *A paper presented at the Renewable Electricity Policy Conference in Abuja*, 11-12 December, 2006.

Sambo AS 2008. Renewable Energy Options for the Environment and Sustainable Development in Nigeria. A *Paper presented at the National Workshop on Energy Investment and Private Sector Participation at PTI, Warri*, June, 2008.