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TECHNO-ECONOMIC ANALYSIS OF SMALL HYDROPOWER PLANT DEVELOPMENT IN SOUTHWESTERN NIGERIA

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ABSTRACT

The study identified the available dams and assessed the barriers to small hydropower plant systems in Southwestern Nigeria, surveyed available technologies for small hydropower plant for production of electrical energy and assessed the engineering economics and human capability of small hydropower plant. This was done with a view to making appropriate recommendations for policy formulation and implementation in the power sector.

Data on the technical specifications for and barriers to small hydro power energy development in Southwestern Nigeria as well as information on economic factors such as investment, operating costs, salvage value, life of the project and revenue received were sourced from Nigerian Electricity Regulatory Commission (NERC), Energy Commission of Nigerian (ECN), Ministry of Power, Power Holding Company of Nigeria (PHCN) and Nigerian Integrated Power Projects (NIPP). The information were obtained using structured questionnaire sets administered on 120 respondents purposively selected from the institutions listed above. The data obtained were analysed using descriptive statistics and engineering economy methods.

The study identified three major dams in Ondo, five in Ekiti, six in Osun, ten in Oyo and two in Ogun States. Nineteen percent (19%) of the respondents agreed that incentives to local manufacturing suppliers and users of small hydropower electrical system components will not affect adequate utilization of small hydropower into electricity generation while the majority (80.9%) disagreed. It also showed that 35.8% and 46.7% agreed that promotional and advocacy activities on small hydropower electricity as well as Research and Development into small hydropower electricity technology will influence its utilization. Also, some barriers to hydropower systems were identified which include funding, resources base, poor infrastructure, lack of integration and communication among agencies and absence of specific design for

small hydropower plants. The identified appropriate technologies for small hydropower development depending on the available head range between 7.5m and 400m designed for any of the already identified dams include cross flow type, vertical tubular and horizontal francis. The Engineering Economics of small hydropower plant development showed that the revenue from electricity in the area using the year 2010 template to be unviable with present worth of - ₦8,165,965.56 and Annual worth of - ₦1,328,051.59 for 10-year target and present worth of - ₦3,794,686.01 and annual worth of - ₦446,515.99 for 20-year target. The revenue from electricity using year 2012 template was estimated to be viable with present worth of ₦7,961,477.31 and Annual worth of ₦1,296,557.54 for 10-year target, present worth of ₦18,550,186.28 and annual worth of ₦2,778,093.14 for 20-year target.

In conclusion, the study determined that electricity generation from small hydropower plants in Southwestern Nigeria was technologically and economically viable for year 2012 due to the review of tariff payable by the consumers over the 2010 template which was not technologically and economically viable.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The nature and extent of energy demand and utilization in a natural economy are to a large extent indicative of its level of economic development. For a productive economy and for a rapid, secured economic advancement, the country must pay maximum attention to the optional development and utilization of her energy resources and to the security of supply of her energy demands.

Energy flows from many sources, exists in a variety of interchangeable forms and drives all systems, it is fundamental to the quality of our lives and today, we find ourselves totally dependent on an abundant and uninterrupted supply of energy for various activities. It is undoubtedly the key ingredient in all sectors of modern economies (IESCO, 2005).

The bulk of our energy comes from coal, oil and gas, exhaustible resources that create pollution when burnt and contribute to global warming (Okpenefe and Owolabi, 2002). Renewable energy (RE) is a non-polluting energy that comes from inexhaustible resources, such as wind, sunshine and falling water (British Hydropower Association (B.H.A), 2005). Due to increasing global interest on conservation of the environment, distribution generation of power is gaining attention. These are the clear pollution free, eco-friendly energy sources with the advancement of technology (Uhunmwangho and Okedu, 2009). It is possible to harness hydro electric power efficiently with the head as low as 2 meter.

Renewable energy resources and technologies have the potential to provide long-lasting solutions to the problems faced by the economic and environmental sectors of a nation

(Uhunmwangho and Okedu, 2009). Besides the overall global benefits, renewable energy system can provide direct benefits at national and local levels, which justify their wide use in developing countries. They can contribute to substantial savings in import bills for fossil fuel. At the local level, availability of electricity contributes to improved productivity and indirect positive effects are also viable in the form of the creation of new employment (UNIDO, 2003).

Energy production has become highly expensive worldwide and its shortage has led to intensified research studies for developing alternative services energy (ECN-UNIDO, 2003). Small hydropowers are some of the alternative sources which utilization can improve the overall energy picture of the world (ECN-UNIDO, 2003). They are the pollution free, eco-friendly energy sources, integrated generation and distribution for rural areas on fuel availability.Small hydro capacity on run off the river shall improve the availability and reduce energy consumption and economic development and because prices for imported energy mainly oil are always increasing. Yearly energy bill and consequently the balance of payment deficits are growing. Though we pass major natural resources in the form of water power that have to a large extent remained untapped.

Some big and medium scale hydropower schemes such as a few to hundreds of MW capacity exist (Okpenefe and Owolabi, 2002). But a small portion of the existing potential is used this and high grade energy in the form of electricity is produced in such installation. The large qualities of electricity produced require complex transmission and distribution network (Okpenefe and Owolabi, 2002). Bringing electricity to the consumers is therefore a costly affair and economically only possible where large loads exist. These are usually to be paid in urban areas where population density is high, thus creating a high domestic demand in a relatively small area (UNIDO-SHP, 2012).

Hydropower is a renewable, non-polluting and environmentally benign source of energy. Hydropower is based on simple concepts. Moving water turns a turbine, the turbine spins a

generator, and electricity is produced. Many other components may be in a system, but it all begins with the energy in the moving water. The use of water falling through a height has been utilized as a source of energy for a long time. It is perhaps the oldest renewable energy technique known to the mankind for mechanical energy conversion as well