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Solar Energy Resource Assessment of the Geba Catchment, Northern Ethiopia

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Abstract

The global shift towards renewable energy is manifested in developing countries such as Ethiopia primarily because of continuous economic growth in the last two decades and secondly due to the vast untapped potential resources. In addition to other factors, the lack of accurate data of the resources has, however, hampered the development of solar energy technologies. The aim of this paper is to investigate the resource estimation by undertaking direct measurements at selected sites in the Northern part of Ethiopia. This paper presents an assessment of the solar energy resource based on the primary data collected between January 2011 and December 2012. The daily and monthly average global solar radiation is analyzed based on the 10 minute interval measurement retrieved from the data loggers.

From the analysis it is seen that the measured values give a better accuracy and distribution of the global solar radiation than earlier Fig.s that were based on satellite images and model calculations. Furthermore, these results can be used to determine the solar resource potential of Northern Ethiopia for further energy development.

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1. Introduction

The backbone of Ethiopia's energy supply remains to be hydroelectric power supplying a staggering 90% of the total electricity while the newly emerging wind energy comprises 3.7% with further wind parks under commissioning. With only 6.1% of electricity derived from fossil (diesel) generators [1], Ethiopia's electric energy source can be dubbed a clean one. Nonetheless, despite the remarkable improvements, more than half of the population is not connected to the grid and has little or no access to electricity [2]. This segment of energy demand is met by traditional means of biomass energy where by it contributes to the degradation of the environment through deforestation.

The global shift towards renewable energy is gaining momentum as the technology to harness those resources further matures. Recent researches in the areas of solar technology continue to produce promising innovative technologies that not only could bring the costs down but also do increase system efficiency [3]. These factors certainly boost the initiatives by which developing countries like Ethiopia could benefit by utilizing their untapped renewable energy resources, albeit indirectly. This is a good news for a country whose economy has experienced a strong and broad based growth over the past decade, averaging 10.6% per year in 2004/05 - 2011/12 compared to the Sub-Sahara Africa (SSA) that stood at an average of 5.2% as indicated in the Fig. 1. [4].

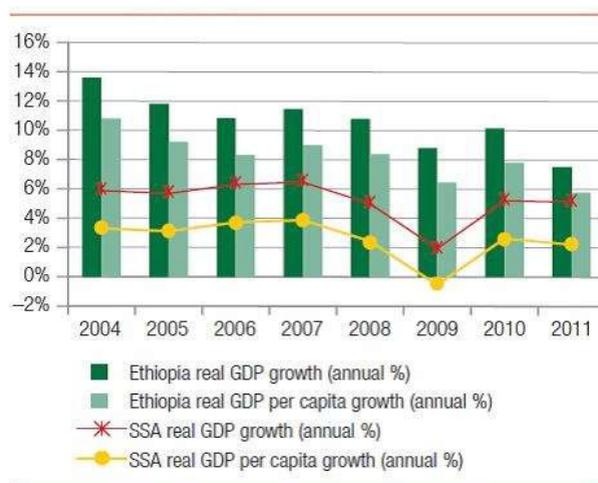


Fig. 1 Ethiopia GDP Growth Rates, 2004 to 2011 [4]

In addition to its double digit economic growth, Ethiopia is the second most populous country in the SSA region (estimated 84.73 million in 2011) with an annual growth of 2.2%. These factors add up in looking for alternative ways to supply the ever increasing of energy demand estimated to be growing at 25% annually for the last five years [5]. It is thus significantly relevant to seek alternative means of satisfying the energy supply of the rural community that is distributed across a wider range of area in a country known for its rugged plateaus and mountains. Even with the Ethiopian Electric and Power Corporation's (EEPCo) continued effort to more than double the generation capacity, addressing the energy demand of the rural community will continue to be a challenge for which there should be an alternative other than the grid system. Further issues that are related to the supply and demand of energy in the country have been discussed in other works [6], [7].

Although the government of Ethiopia (GoE) has yet to ratify an updated energy policy, various developers are showing their interest to invest in the energy sector. To cater the demands in this sector, the Ministry of Water and Energy (MoW&E) has prepared a national master plan on the wind and solar energy resources[8]. The MoW&E in its recent assessment report of solar and wind resources has indicated significant improvements to the previous estimates from satellite data including that of the Solar and Wind Resource Analysis (SWERA) conducted and was jointly sponsored by Global Environment Facility (GEF) and United Nations Environment Programme (UNEP) to about 1,350GW potential, up by about 30% [9].

However, there is limited study of solar energy resource assessment in Ethiopia that is based on a consolidated in-situ measurement of the wind and solar resources. Meteorological stations in the country lack radiation data measurement equipment and as a result radiation data was only available for the capital city, Addis Ababa [6]. Most of the studies were based on meteorological data of specific locations estimating total daily or monthly solar irradiance

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