

Chapter 24

An Open Source Software: Q–GIS Based Analysis for Solar Potential of Sikkim (India)

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ABSTRACT

Most of the issues regarding power supply occurs due to transmission of power through long distances over diverse and unsuitable landscapes. A solar power plant, if installed within the vicinity of the diverse recipient areas, cuts short the transmission related problems by great numbers and acts like an absolute boon to hilly terrains like Sikkim. The study presented here investigates the land suitability for medium-scale solar power installations in Sikkim by using open source software - Quantum-Geographic Information System (Q-GIS) combined with Multi-criteria Decision Making (MCDM) techniques. Six exclusion criteria are identified to avoid unsuitable areas for plant installation. Analytic Hierarchy Process (AHP) is used to rank the available areas according to their suitability, which have been further presented in a technology-aided suitability map. Such a study greatly reduces the feasibility related issues for investors in such projects to visit every site available for construction of the plant, saving time and money.

1. INTRODUCTION

With an area of 7096 km² and a population of 653,800 inhabitants (2017) (Population of India 2018, n.d.), Sikkim accounts for a picturesque landscape on the mountain terrains of the Indian Himalayas. The geographical excellence of this place lies in the huge variety of its landscape and climatic characteristics. Despite being one of the least populated states (86 persons/km²), Sikkim has a high population growth rate, averaging 12.36% between 2001 and 2011 (Population of India 2018, n.d.) and with this increase in the population, there comes a steep rise of the demand for power. As of May 2018, nearly one-fifth of India's rural households (around 31 million by population) remain in acute or semi-acute darkness. A 2015 World Bank Study done in India entitled, *Power for all: Electricity Access Challenge in India*, mentions, "Even where electricity service has been locally available, many villages have not adopted a connection." The rapid pace of rural electrification has clearly not been matched by adoption at a household level. No states in this category are Sikkim and Tripura regions of the country ("The problem of lack of rural electricity...", 2018).

Only six states (excluding Sikkim) had an average 24-hour power supply in its rural areas ("The problem of lack of rural electricity...", 2018). Rural electrification by itself means little when load shedding and power outages are frequent enough to make those terms a mere technicality. The lack of reliability is one of the major factors which discourage households from adopting electricity, thus undermining investment and ultimately development in rural electrification ("The problem of lack of rural electricity...", 2018). Besides power theft and political factors, the transmission of uninterrupted power through remote and diverse topography from the distant sources of power is one of the major concerns faced by the distribution companies responsible for ensuring power supply to the villages.

Data from November 2015 show that Sikkim has a total allocated power capacity as: Thermal Capacity of 90 MW, Hydel capacity of 174 MW, and power capacity from other renewable energy sources (including solar) as only 52.11 MW ("States of India by installed power capacity," n.d.). Despite that, fluctuating connectivity and sometimes even hours or days without electricity is not very uncommon in the state. Conducting an energy-related research especially on renewable energy sources will clearly bridge a demanding research gap and add value to Sikkim's power system planning sector in specific. On the other hand, the fact that the current development policies of many developing nations, India being one of them, focus on the deployment of renewable energy resources, further adds value to this study (Aly, Jensen & Pedersen, 2017).

Installation of a large-scale solar plant is a project requiring huge amount of financial investments as well as manual labour. Hence ensuring that the output of such a project is at its maximum is of utmost importance. In other words, it is essential to select the plot for the installation of such a plant such that it enables the best possible output for the plant. Thus, location of the plant plays a major role in its long term working and this is the genre which this study explores. Large scale solar power plants (both Photovoltaic (PV) and Concentrated Solar Power (CSP) plants) require extensive as well as prioritized land for its establishment. Identifying the suitable land areas or regions for the same is a complex issue. Contrasting a simple overview, appropriate identification of suited geographical areas is not only dependent on the amount of solar radiation received by that area, but also on an enormous list of technical, social, economic, ecological and environmental factors that should be taken into account: such as topographical characteristics of the land considered, presence of water resources, environmental impacts and their long time effects, the alternate purpose for the considered land, urban potential of the location, proximity to demand centres and proximity to demand centres and power grids (Aly, Jensen & Pedersen, 2017).

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