GIS Based Site Determination Model for Productive Solar Farm: A Case Study in Eskişehir

Sunay Mutlu, Alper Çabuk, Yücel Güney
Satellite and Space Sciences Research Institute, Anadolu University
Eskişehir, Turkey

ABSTRACT

It is the most known word throughout the human-being’s long journey in this planet: ENERGY. Even now, the energy is necessity for us. The world is now in quest of new energy resources because of the decrement of environmental energy resources. Solar energy is the most abundant permanent energy resource on earth and it is available for use in its direct (solar radiation) and indirect (wind, biomass, hydro, ocean etc.) forms. This commentary is limited to the direct use of solar radiation, the earth’s prime energy resource (World Energy Council, 2007). It is all free and nature-friendly energy resource. Today’s technology allows us to use that sort of energy efficiently, especially for the some countries whose have high sunlight availability. Turkey is one of the countries that are strongly exposed to direct sunlight during the year due to its geographical location. Thus, it is highly significant to utilize kind of energy effectively and efficiently. Many methods are available to produce electricity from solar power by using varying equipment and the latest point reached is solar farms. These farms are set of thousands of photovoltaic solar panels located in order to use them to convert the direct sunlight to electric power. In addition, a solar cell is a member of solar panel and we bring together solar panels it constitutes solar farms. Thus, if the right place should be chosen for solar farms in order to get the ability to produce enough electric energy for a city, a village or a specific place where. In this study, the site selection process for a productive solar farm in Eskişehir discussed. Geographic Information System (GIS) is used to select and determine the suitable place to settle the solar farm. Geographical information system is best method to analyze and solve mentioned method. Some vital parameters are used such as energy potential, land characteristics, distance to fault zone, roads, settlement etc. By overlaying these different types of spatial data and using GIS the most suitable place to set the solar farm in Eskişehir determined. ESRI ArcGIS 10 is used to store data, query and analyze in this study and a useful tool has been created with Model Builder tool.

KEY WORDS: GIS; Site determination; Solar Farm; Multi criteria; Photovoltaic; Turkey; Case study

INTRODUCTION

Energy has been need of mankind for many centuries. The all-time needed energy in our lives has been provided by energy resources. These resources can be divided into two categories as renewable and nonrenewable. Fossil fuels and radioactive elements are nonrenewable ones and coal, petrol and natural gas are used for producing electricity in thermal power plants. The raw material of oil, diesel, LPG (Liquefied Petroleum Gas) and plastics which are used in our daily lives is petrol, too. While these fossil fuels which came into existence millions of years ago are decreasing because of such causes as advancing technology and rising population and industrialization, they cause air, water and soil contamination with their wastes. When burned, these fossil fuels emit CO and CO₂ gases into the atmosphere. Too much accumulation of these gases in the atmosphere poses a danger due to causing greenhouse effect and global warming. And it is called nuclear energy that comes off after core reactions of radioactive elements such as uranium and plutonium.

It can be said the renewable energy sources have almost endless power and they don’t pose any danger to the environment. These renewable energy sources are: Solar, Wind, Geothermal, Biomass, Hydroelectric, Wave and Hydrogen. The most popular of these resources is solar power, the basis of life. Solar energy is a renewable energy source nearly inexhaustible and pollution free. Solar energy application can increase clean energy supply and reduce pollutant emission, which is helpful to establish a sustainable energy system necessary to maintain the socio-economic development (Wang and Qiu, 2009).

Being a thermonuclear reactor, the sun radiates too much energy with various wave lengths (62MW/m²) and only one two billionth of energy reaches to the earth. The radiation value of the sun in the atmosphere is 1375 W/ m². The distribution of solar power on the earth changes considerably due to the form of the earth and the average solar power reaching to the earth changes between 0 and 110 W/ m² (See Fig.1). Not all the solar power reaches up to the earth, 30% is reflected by the earth atmosphere to the space, 50% of the energy reaches to the surface of the earth by passing through the atmosphere. 20% of radiation from the sun is held by the atmosphere and clouds (EIE, 2011).

Having a high solar energy potential due to its geographical location, Turkey has 2640 hours of total annual average of sunshine duration (a