Estimation of the potential of building rooftops for the use of Photovoltaic (PV) systems in urban areas and its development in Web-based Geographic Information System

Case Study: Region 4 of Ahwaz

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Date of receive:95.06.19 **Date of accept:96.04.30**

Extended Abstract

Introduction

Energy is one of the essential components for industrial activities and the need of all people, therefore, its supply and demand is continually increasing in human societies. Population growth, its expansion and distribution, along with the ever-increasing human need for new and more efficient energy, have forced man to turn to natural renewable energies. The sun is considered to be the largest energy source in the world, which can be used in many ways. Being non-polluting, clean, free and accessible, are the important features for using renewable solar energy. Solar energy is one of the best and most economical renewable energy in Iran, which not only reduces many human concerns, such as environmental pollution, energy exhaustibility, energy conversion, etc., but also considering the climate of Iran, it can well develop in Iran. Despite the great potential of using solar energy in the country due to the intensity of radiation as well as a very good area for installation and use of solar energy, it is possible to install photovoltaic panels. Regarding the climate of Ahwaze city in terms of radiation intensity (According to the statistics of the New Energy Organization, about 4.5-5 kWh / m 2 / day) and sunny days and on the other hand, due to the establishment of important factories and large industries in the city, it faces the problem of energy and pollution caused by fossil fuels. Therefore, the study of solar energy and its potential for using solar energy to plan for the use of this energy seems necessary. Since no significant steps have been taken in this regard, this study focuses on this important issue, so that by designing a Web GIS system, one can take a step in the direction of data management and decision-making to improve the status quo.

Materials and methods

The present research seeks to exploit renewable solar energy using solar technologies. The spatial distribution modeling of this renewable resource was performed using GIS analyses and computational intelligence. For this purpose, during the implementation of the survey, Solar Analyst Model available in ArcGIS software was used to estimate the solar radiation in the region. Also, in order to prioritize the region based on having the required potential to exploit solar photovoltaic systems, three categories of effective criteria including environmental criteria, building-density criteria and technical criteria were identified. Then, modeling was done using Fuzzy Inference System. The knowledge of available solar energy and the area of building rooftops are essential components for calculating the potential of electricity generation of photovoltaic systems, but there are technical considerations that must be taken into account in these calculations. In most cases, the calculation of photovoltaic potential requires the consideration of the output capacities of the panels. For this purpose, the technical potential of photovoltaic systems was calculated based on the formulas, the requirement of which is to estimate the geographic potential of the study area. The final stage is the design and implementation of the solar energy Web GIS system.

Discussion and Results

Estimation of the total radiation received by the earth in the study area using Solar Analyst model, showed the total solar radiation from 0.4 to 1461 kWh per square meter per year. Also, the calculation of the geographic potential of the region and in particular the geographic potential of the rooftops, was performed using Digital Surface Model (DSM) and the results showed that major parts of the region had the potential from 1 to 49 kW per day. Technical potential of photovoltaic systems (Ei) for the roofs, was calculated using the geographical potential and its value varies from 0.1 to 138 kW per day. The results of fuzzy inference system shows that 10 square kilometers of the total area has a medium development priority and 0.7 square kilometers of the total area has a high development priority that form the highest and the lowest respectively.

Conclusion

Based on what has been stated so far, it can be said that the findings of the present study indicate the success of the integration of two Web GIS and solar energy knowledge in meeting predetermined objectives of the research. Utilizing this process, while providing the opportunity to assist in the decision-making process, provides web-based solar maps using spatial data. In fact, the designed system can be considered as a decision-making tool, if it allows users to view spatial information in the form of a map in addition to providing descriptive information about the region's potential of energy generation. Users can use this system to identify appropriate locations for installing solar equipment and maximize their benefits.

Keywords: Renewable Energy, Solar Analyst Model, Geographic Information System, Web GIS, Fuzzy Inference System