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Optimal site selection for solar cell farms in Babylon city at (1-8-2023) using RS and GIS

Ebtesam F. Khanjer[1,], Ban abul Al-Razak[1], Mustafa S.Srayyih[1], Mohammed A. Mohammed[1], Ameerah Ab. Al-Sadooni[2]*

[1]Dep of RS and GIS, College of Science, University of Baghdad, Baghdad, Iraq
[2]Physics Department, Collage of Science, University of Babylon, Babylon, Iraq
[*]) Email: Ebtesam.khanjer@sc.uobaghdad.edu.iq

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This study investigates the ideal location for establishing a solar cell farm within Babylon City, considering various factors such as sunlight exposure, land availability, and infrastructure. In addition to improving light absorption and increasing the conversion of light into electricity, nanotechnology can assist break down existing performance obstacles and significantly improve solar energy collecting and conversion. It can also improve thermal storage and transportation. Utilizing GIS and Remote sensing techniques, we assess potential sites to maximize solar energy capture efficiency. Using Arc-GIS version 10.3 and Digital elevation model (DEM) for Babylon city, which is downloaded from (https://search.asf.alaska.edu/) at spatial resolution 12.5 m has been calculated the solar radiation energy for each pixel with in clip image Babylon city. Additionally, economic and environmental considerations are integrated to determine the most sustainable and cost-effective location for the solar cell farm, aiming to contribute to the city's renewable energy goals in this paper hot spot area have been identified. The findings aim to guide stakeholders in making informed decisions for the strategic implementation of solar energy infrastructure in Babylon City.

Keywords: Solar Cell Farms; Digital elevation model; Babylon.

1. INTRODUCTION

Growing interest in renewable energy and the issue of global climate change have contributed to the recent rapid growth of the solar cell sector. An essential component of any solar technology's success is its cost. For large-scale energy generation, today's solar cells are just not efficient enough and are too costly to produce. However, possible developments in nanotechnology could pave the way for the creation of solar cells that are somewhat more efficient and less expensive. Significant advancements in the solar area have already been made possible by nanotechnology [1].

A solar cell farm, also known as a solar farm or solar power plant, is an area where large numbers of solar panels or photovoltaic cells are installed to generate electricity from sunlight. These farms harness solar energy and convert it into electrical power on a larger scale, contributing to sustainable and renewable energy sources.

Solar radiation energy refers to the energy emitted by the sun in the form of electromagnetic waves. This energy reaches the Earth and is a crucial source for various natural processes and human activities [2,3]. Solar radiation includes VL, UVL, and INR R. It plays a central role in solar power generation through technologies like photovoltaic cells, solar water heaters, and solar thermal systems. In fact the solar energy amount that reaching the ground surface is more than 6000 times the actual universal energy consumption [4, 5] and much of it remains unutilized for human prosperity. So to ensure power stability while resolving environmental issues in developing countries, solar energy plays a significant role[6,7]. In Iraq, solar energy has enormous potential. With 8.5 hours of radiance duration, most areas in Iraq earn around 300 sunny days per year. The average daily incident in Iraq involving solar power range varies from (4.6 to 6.6) kWh /m^2 per day [8,9].

Unavailability of regulation, infrastructure in addition to solar data (including mapping of appropriate solar land areas with possible local estimates) are major obstacles to the introduction of solar energy technologies)]. The purpose of this paper is to deal with several of these obstacles through the use of a GIS to mapping the locations of solar potential, taking into account the suitable areas and the intensity of solar radiation as minimum as possible [10,11].

2. STUDY AREA

Babylon is an ancient city located in present-day Iraq, about 85 kilometers south of Baghdad. The city is a major cultural and political center in ancient Mesopotamia. Today, the ruins of Babylon are a UNESCO World Heritage Site. Location of Babylon city between latitude 32˚6` N to 33˚8` N, and longitude 43˚57` E to 45˚12`. It is considered the fifth largest governorate in Iraq in terms of area and its population is approximately two million citizens [12,13].

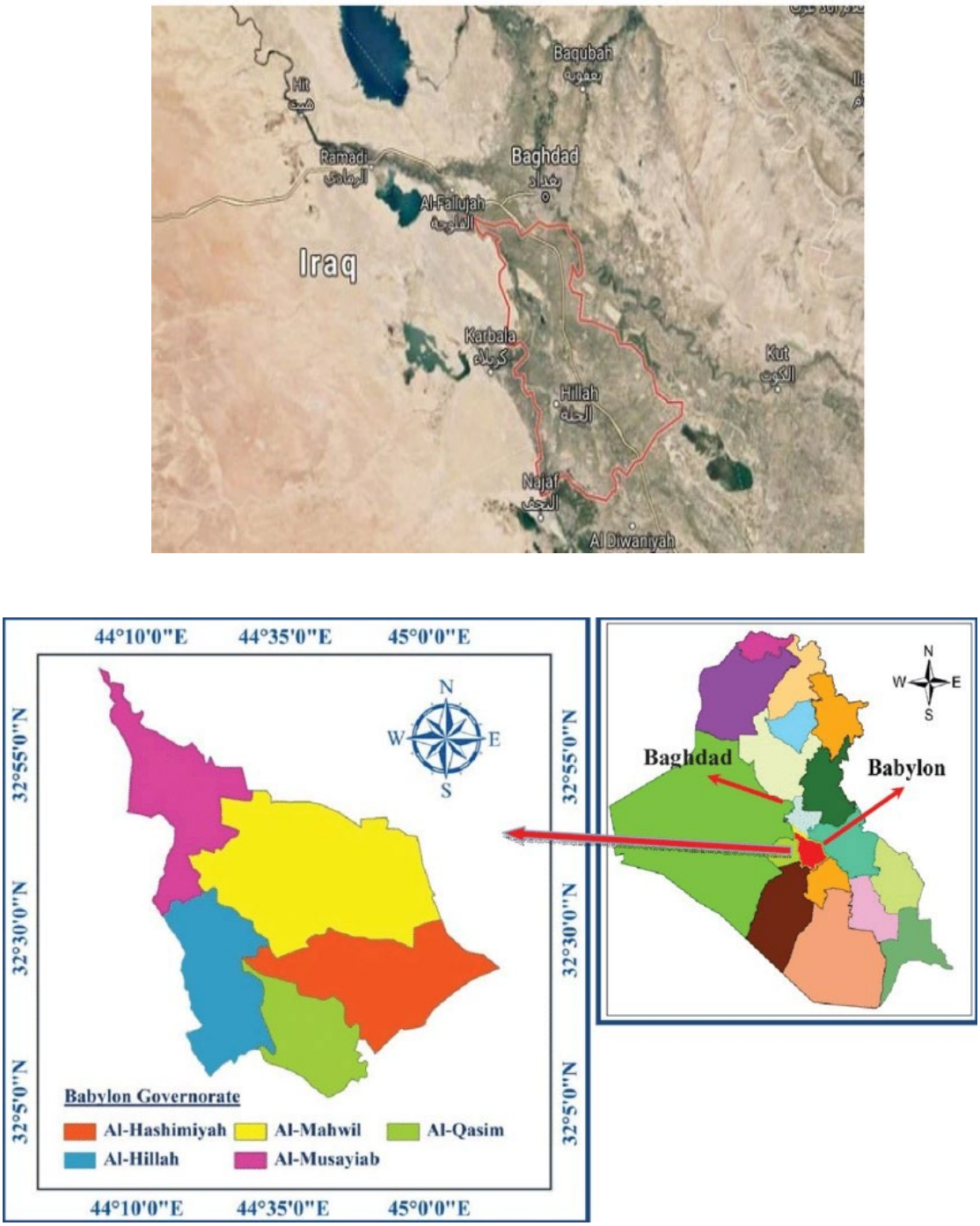

Figure 1 The location of Babylon city in Iraq.

3. DIGITAL ELEVATION MODELS (DEMS)

Elevation model are created from point data that samples the x,y,and z coordinates of locations on the earth's surface. Two main type elevation models exist: DEMs, which are raster datasets depicting the earth's topography as a regularly spaced grid, and triangular irregular networks, which connect irregularly spaced elevation points with triangular surfaces [14, 15]. In general, DEMs tend to be created from imagery, with triangular irregular networks created from survey data. The earth's topography forms the natural foundation for working in three dimensions, where objects are placed above, on, or below the terrain surface.To work in 3D, the GIS analyst must have a model of the earth's topography. By

representing topography, elevation models provide a 3D context for mapping and analysis and are an indispensable tool for the GIS analyst [16,17].

4. METHODOLOGY

1. Data Acquisition: (DEM) at spatial resolution 12.5 m has been calculated the solar radiation energy for each pixel with in clip image Babylon city, which is downloaded from (https://search.asf.alaska.edu/).
2. Preprocessing: Preprocess for the satellite imagery to remove noise, correct for atmospheric effects, and ensure geometric and radiometric accuracy. Preprocess the DEM to correct for any inaccuracies and ensure it is properly aligned with the satellite imagery.
3. Terrain Analysis: Use the DEM to analyze terrain characteristics such as slope, aspect, and elevation. These factors influence solar radiation by affecting the angle and duration of sunlight exposure.
4. Solar Radiation Modeling: Utilize GIS software to model solar radiation distribution across the study area. This can be done using algorithms such as the Solar Radiation Model (SRM), which calculates solar radiation based on terrain features, atmospheric conditions, and solar geometry.

5. RESULTS AND DISCUSSION

The map of classification of Babylon city shows the distribution of land cover indicates that agricultural lands occupy the largest percentage of the governorate's area, while barren areas are reduced to a few areas.

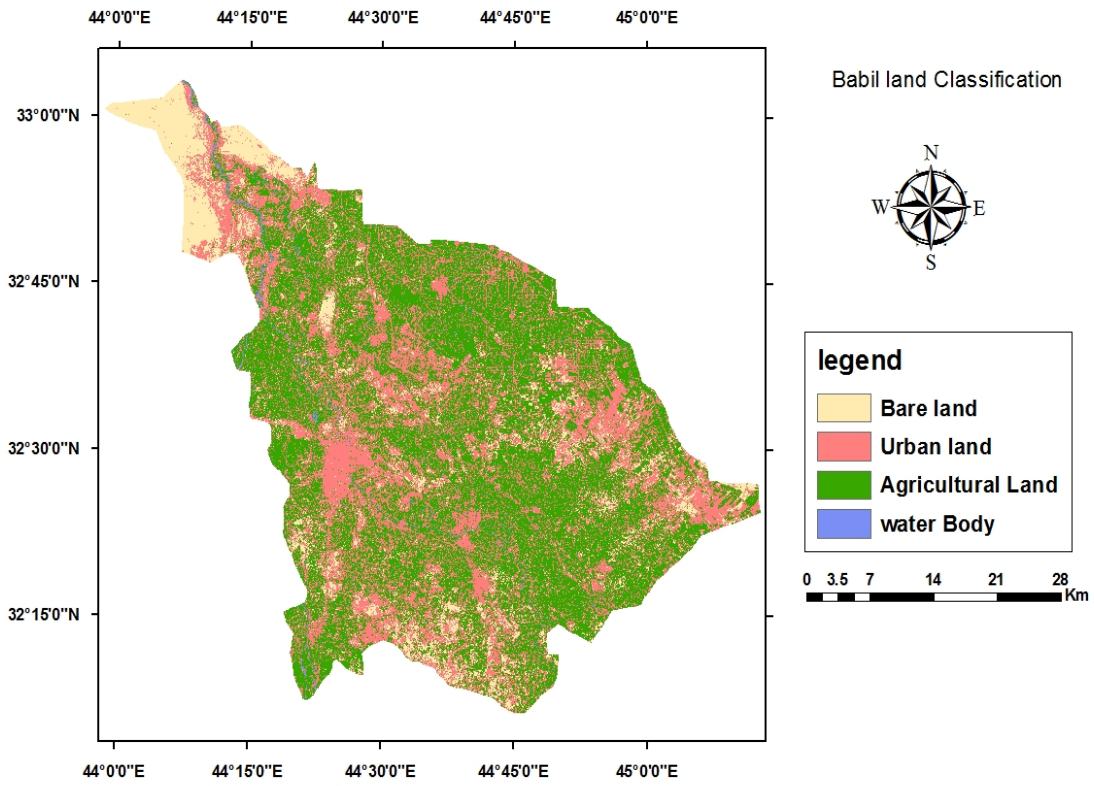

Figure 2 show the classification of Babylon city.

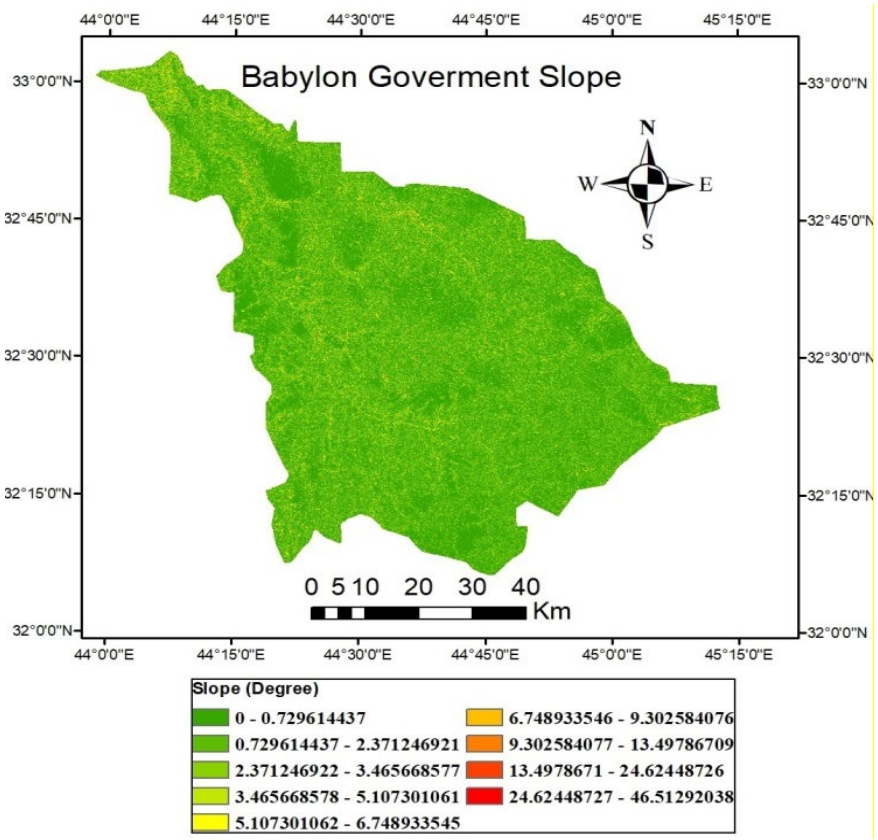

Figure 3 Illustrated the Babylon government slope.

The results show that Babylon governorate has a semi-flat surface, as most of the surface of the region has a slope degree of (0-3.4), and green areas constitute the largest area of land cover followed by urban areas.

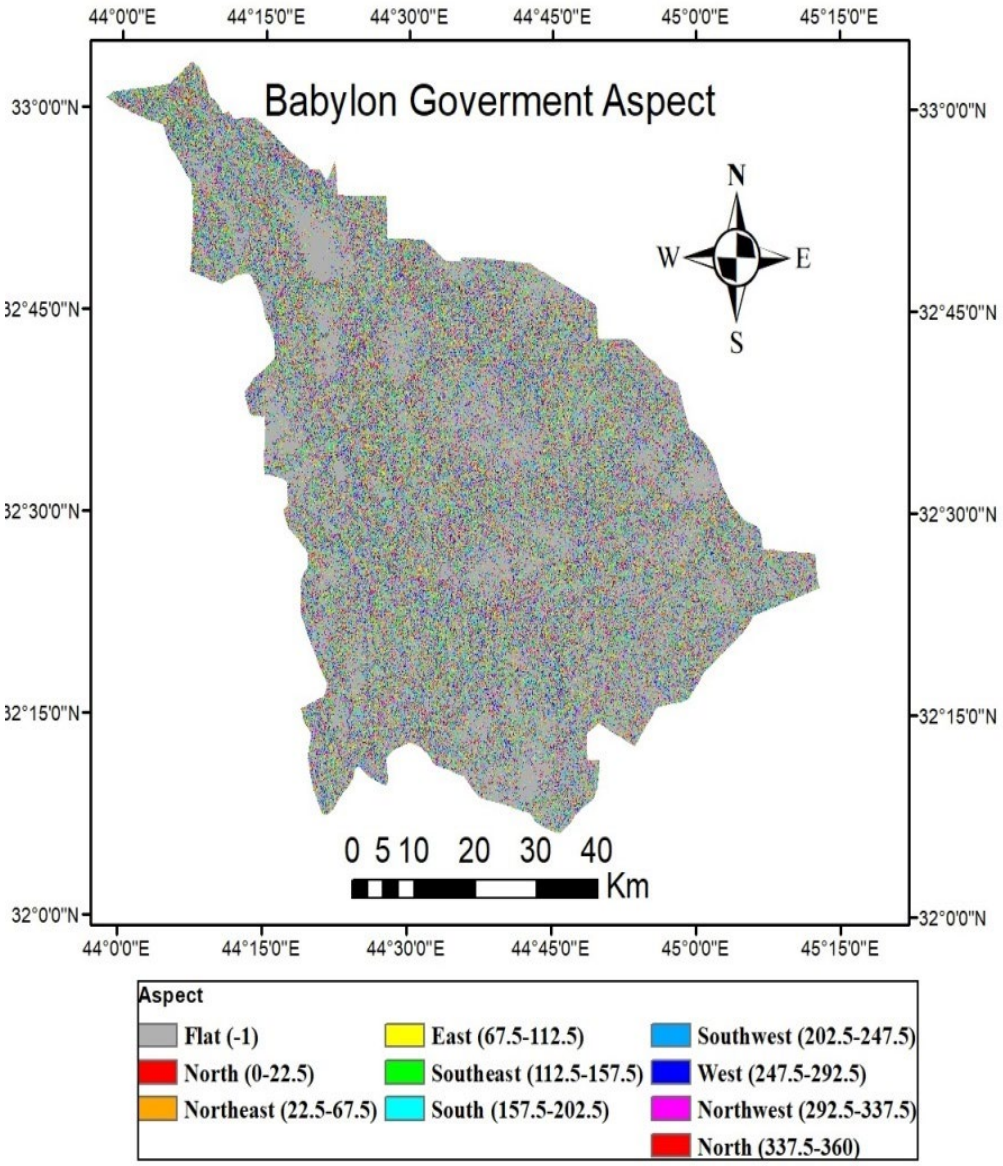

Figure 4 Illustrated Babylon government aspect.

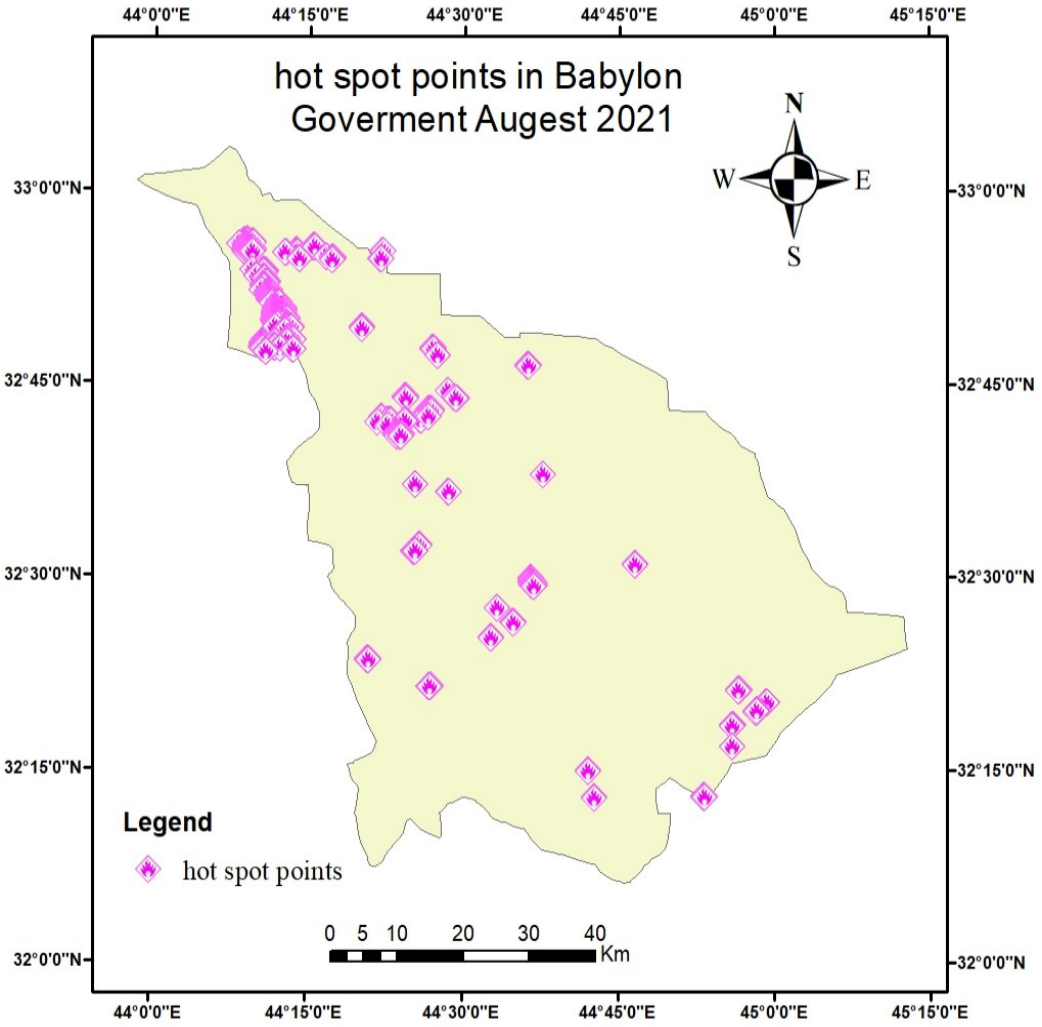

Figure 5 Illustrated the hot spot in Babylon government in August.

The above figure indicates that the Hot spot points are concentrated in the north of Babylon governorate and gradually decrease as we move towards the south parallel to the distribution of urban areas.

6. CONCLUSIONS

According to the results, the Babylon Governorate has significant solar radiation exposure each year, which supports efforts to harness this energy for the production of clean electricity and mitigation of the negative environmental effects of traditional energy sources. The solar radiation standard, slope, and type of land cover are some of the most crucial factors in deciding where to locate solar farms, according to the solar energy project's results.

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