The Power of Panels

Identifying Effective Locations for Solar Panels in the United Arab Emirates

Introduction

The United Arab Emirates (UAE) has become one of the Middle East's most important economic centers, predominantly because of its large oil and gas exports (Mokri et. al, 2013). However, the country has also become increasingly involved in renewable energy activities. Multiple factors have driven the UAE to enter the renewable energy sector. Their rapid population growth and economic development has generated an increasing demand for energy and water, the depletion of their oil reserves has created a need for economic diversification, and they are located in a part of the world with high sun exposure (Mokri et. al, 2013). One of the fastest-growing renewable energy technologies is Photovoltaics (PV) -- more commonly known as solar panels (Rogers & Wisland, 2014).This analysis considers multiple factors that may affect the efficiency and success of solar panels in the United Arab Emirates in order to determine which regions of the United Arab Emirates are the most suitable for solar energy projects. Solar panels could play an important part in diversifying the UAE's economy and transforming it into a more sustainable nation.

Spatial Question: Where are the most suitable locations in the UAE for solar panels?

Methods

The analysis was conducted using ArcMap 10.7.1. Each suitability factor was scored on a scale from 1 to 5 — the most suitable elements being classified as a 5 and the least suitable as a 1. A Raster Calculator was used to create a weighted suitability score than factored in all elements. The level of Direct Normal Irradiance (Fig.1) was given the most weight (45%), the distance to power plants (Fig. 2) was assigned a 30% weight, and the wind speeds (Fig. 3) were given the least weight (25%). Lastly, zonal statistics were used to determine the average level of suitability in each of the 7 emirates.

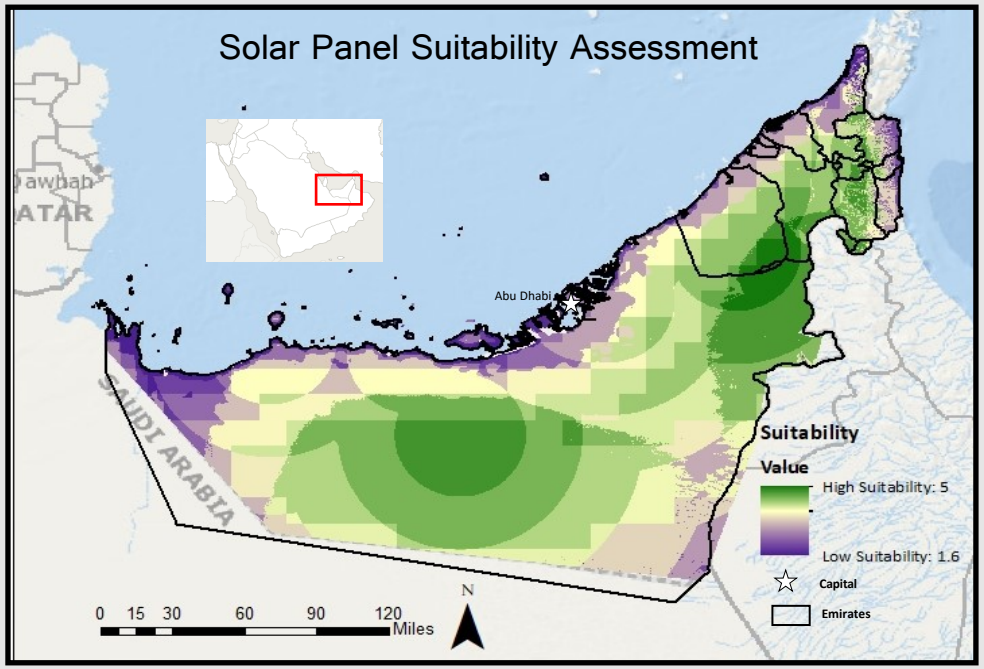

Figure 4. Level of Suitability for Solar Panels.

Distance to Power Plants

Placing solar panels near electrical power plants would be financially and technically favorable.

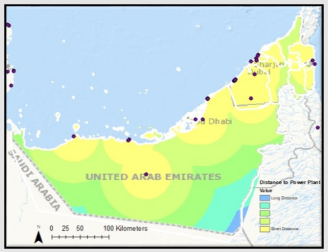

Figure 2. Distance to Power Plants.

The distance to power plants was calculated and reclassified.

Solar Radiation

Direct Normal Irradiance (DNI) is the amount of solar radiation received on a plane normal to the sun (Blanc et. al, 2014).

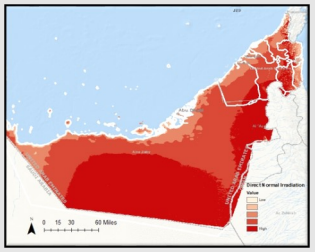

Figure 1. Levels of Direct Normal Irradiance (DNI)

The levels of Direct Normal Irradiance (DNI) were reclassified.

Wind Levels

While light winds can lead to increased energy efficiency, high speeds generally degrade solar panels (Adeh et. al, 2019)

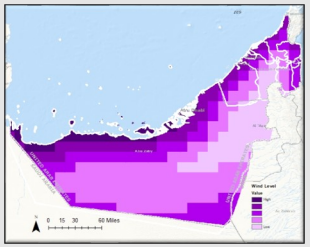

Figure 3. Wind Levels.

The wind levels were reclassified.

Cartographer: Miranda Macaulay Miller **Date**: 5 May 2020 **Course**: Introduction to GIS
Sources: World Resources Institute, Solargis, TerraClimate **Projection**: Universal Transverse Mercator (UTM)

Results

The results show that the most suitable locations for solar panels are towards the center of the country (Fig. 4). The coastal regions are the least suitable. The most suitable of the 7 emirates is the Neutral Zone (Fig. 5), with an average suitability score of 4.7. The largest emirate, Abu Dhabi, received a suitability score of 3.99. There are locations within Abu Dhabi, Dubay, Sharaj, and the Neutral Zone that received the maximum suitability score of 5.

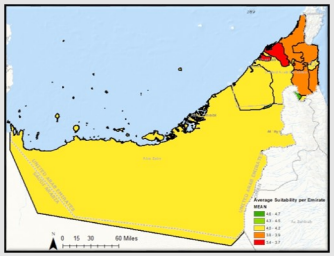

Figure 5. Average Suitability Level per Emirate.

Discussion

The results show that the most suitable locations for solar panels in the United Arab Emirates are towards the center of the country. While the regions with the highest levels of solar irradiation are in the south and the windiest areas are on the coast, the coastal location of all the power plants in the UAE impedes the southernmost region from being the most suitable. Previous understandings may have led developers to place solar panels in the regions with the most sun exposure. However, this analysis shows the relevance of other factors in determining solar panel effectiveness. The major limitation to this project was the lack of datasets available for relevant factors in the UAE. A complete suitability analysis would require many more factors. The results could be used by developers to plan future solar projects in the UAE. However, further analysis with additional data would be required to adequately determine the most suitable locations.