

Original Research Paper

Investigation of Landform and Sunlight in Zayandeh Roud Basin

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Abstract: Solar energy is as of energy that it is significant in human activities. Human activities can use in agricultures, factories, industrial and residential plan. In other hand, solar energy is as renewable energy can help to have safety environment. This study tries to say significant of identification of landforms and getting cheap and safe energy. In this study, classification of landform map was identified for Zayandeh Roud Basin (Z. R. B), Iran. The methodology presents elevation of landscapes that are useful to get additional information for geomorphological and landscape studies. Using a relative classification model, the object primitives were categorized as landform elements, made both on the objects' altitudinal position and the surface shape. The classification has three classes: Low land, midland, high land. Solar energy advantage has been considered by measuring sunlight data in 10 climate stations. Elevation parameter and sunlight value are two parameters that used for this study. The methodology introduced in this study can be used almost for any application, where relationships between topographic features and climate parameters are to be assessed.

Keywords: Landform, Sunlight, Zayandeh Roud Basin, Classification

Introduction

Landforms are resulting of endogenic and exogenic on earth surface that appear as geomorphological features. There are many type of landforms and geomorphological map by automate and manual methods. Several studies have explored how to make geomorphological maps and review developing methods. Many landform mappings have been made over the past decade using the digital tools and automatic classification, such as the DEM based on the Geomorphometry (Paron and Vargas, 2007). Geomorphometry derives primary and secondary topographical attribute from the landform classification techniques, automatic classification (non-supervision and supervision) and the DEM. Manual method has been employed for geomorphological measurement in the last few decades (Drăguț and Blaschke, 2006; Hammond, 1954) The GIS has been used as incorporate technique to analyze data (Drăguț and Blaschke, 2006) for exploring

the spatial and non-spatial relationships among spatial objects and to analyze data as more compound landscape (Gustavsson *et al.*, 2006). The digital elevation data are used in the GIS, which are easily accessible. Moreover, results of landforms classification are time-saving and more accurate (Gustavsson *et al.*, 2006), but often some essential qualitative aspects are ignored because the method is purely quantitative (Barzani and Salleh, 2016). Geomorphological map methods are influenced by the development of technology. Slope morphology can be used for classification landform mapping. Drăguț and Blaschke (2006) used the DEM data for classification landform map, based on the slope morphology. Accordingly, digital elevation tools, such as the DEM, can be used in large scales to save time and money. In this study DEM will be used for classification landform map.

The Earth's surface is being continually subjected to external forces induced basically by energy (sunlight). The influence of topography is felt through the amount of exposure of a surface covered by parent materials to

sunlight and the amount of surface and sub-surface drainage over and through the parent materials. In middle latitudes, the south facing slopes exposed to sunlight have different conditions for vegetation and soils and the north facing slopes with cool, moist conditions have some other soils and vegetation. Since the 1970 the use of solar energy more seriously, it has been widely studied around the world. The amount of solar radiation reached and remarkable about land surface and its estimation and suitable models according to the geographical and climatic conditions of the regions Various was presented (Samimi, 1994). Energy for human societies have long been important and in recent years with advances in technology and advancement industry has found an important place in human life increased and cheaper energy from fuels fossils have led humans to use this energy renewable. Hejazizadeh *et al.*, 2018) in recent years, oil shortages and increasing pollution has caused developed countries to think of using this clean energy. Our country should not, given its potential use only fossil fuels but must use current technologies and solar energy converts into usable in our life. The sun is the main source of energy for the planet earth. At The field of estimating the radiant energy of the research sun there this includes the following.

Togrol and Onat applied six parameters that included air temperature, solar radiation, sundial, air pressure, soil rate and soil temperature, a linear regression model multivariate for radiation estimation. Needle used the network artificial neural to estimate the potential of solar radiation paid in Turkey. They in their study of data meteorological and geographical latitude and longitude, height, month, average sundial and average temperature (Sözen *et al.*, 2005). Ramachandra (2006), entitled an article by determining the potential of solar energy by using GIS that the potential of renewable energies and the accessibility of these resources needs to be examined Geographic Information System and Remote Sensing (Rs) in physical-temporal scales and demand from renewable sources and planning. He used GIS for solar potential map for Indian Karantka for the exploitation of the energy. In addition to obtain potential maps from solar energy he identified susceptible and the amount of radiation reaching to regions. Sabziparvar (2008), mixed height, number days of dust and seasonal parameters in Sabbagh, Paltridge and Associate models, radiation Solar for horizontal surfaces in different cities calculated the dry deserts of central Iran and to this it was concluded that the modified Sabbagh model was a better estimate with less than one percent error. Bakirci (2009), used modeling and estimation for amount of solar radiation from factors such as the amount of hours Sunny, precipitation, dew point temperature, relative humidity, temperature and air

pressure in Turkey. Safaripour and Mehrabian (2011), predicted the average total amount of solar radiation daily from a linear regression relationship with the effect of seven geographical and meteorological parameters in Kerman city. Solar energy is one the most important renewable energies in Iran, according to Iran's high potential of using this energy, but it has not been seriously used. There are expanded deserts so that it brings about a high capability of using solar energy. Nowadays, the growth of population in the world has led to the limitation of energy resources and many ecological effects have been occurred so the attraction of attentions to the renewable energies has increased. For example, the plan of using solar energy has been started in Germany, although it is located in high latitude. As Iran's oil resources are nonrenewable energy, by constructing solar power plants can produce electricity, save money and by exporting to neighbor countries can increase its income. The main purpose of this study is to estimate and assess the time-spatial variation for the received radiation by earth surface in Zayadeh Rood basin by using spatial analysis.

Study Area

Z. R. B is a rectangle with its longer side stretching from North-Western to South-Eastern. The highest part of basin is located in the West and South-Western regions which embraces the eastern slope of Zagros heights. The lowest part is the Govkhooni marsh which is located in the east of basin. Regarding elevation in the study area, Zayandeh Roud Basin has two distinctive parts. One of them is the high and mountainous areas in Zagros which slopes in the West and South-Western of basin and the other is the extensive plains in the middle of the basin (Fig. 1) (Barzani and Khairulmaini, 2013). The topography of Z. R. B has been divided into several categories. The first section of the elevation is in the western part of the basin. The trend of mountains is in the northern and south and the topographical system is deferent from the eastern part of Z. R. B. The second elevation system basin is approximately in the middle part of the basin which stretches northwest to southeast with an approximate distance of about a hundred kilometers. The third elevations of the basin are hills and complex shapes of domes. The highest elevation is located in the south-western. The fourth elevation of the basin are scattered across in the middle of the plains. The fifth system height, low altitude areas and plains are part of the basin. The Z. R. B height is reduced from west to east. So that, the lowest part of the basin, namely in the eastern most point to the altitude of marshes in Gavkhoni reaches about 800 m (Barzani and Khairulmaini, 2013).



Fig. 1: Location of Z. R. B in Iran (Barzani and Khairulmaini, 2013)

Methodology

This stage of the research had two phases.

Classification Landform Mapping by SRTM DEM

In this research, classification landform map was developed based on the slope morphology by the automate classification land form method. Classification landform map was provided by layers, such as the elevation, profile curvature, plan curvature and slope gradient. For mapping classification landform, the DEM (Digital Elevation Model) was used. For the first step, several data layers were produced from the SRTM data, including the elevation, profile curvature, plan curvature, slope aspect and slope gradient in the GIS environment. Segmentation analysis in the software was done in two stages: 1. segmentation of the area based on the elevation in three classes of high land, mid land and low land. The results of classification landform for the Z. R. B are presented in the form of vector maps based on the slope morphology. In fact, classification landform based on the slope morphology is subset of classification land obtained from the map based on the elevation.

Table 1: Shows meteorological stations geographical location and elevation

Station	Longitude	Latitude	Elevation	Sun light
Isfahan	51.660	32.61	1554.4	273
Kabotrar Abad	850.510	33.51	1545.0	295
Kashan	450.510	33.98	982.3	278
Ardestan	52.383	33.38	1252.4	289
Daran	50.360	32.96	2290.0	262
Sharge Isfahan	51.860	32.66	1543.0	287
Naïen	53.080	32.85	1549.0	267
Golpeyegan	50.280	33.46	1870.0	276
Khoor	55.080	33.78	845.0	291
Shahreza	51.830	31.98	1845.2	271

Climatic Parameters Analysis

In solar radiation studies cannot be considered all climatic parameters. As a result, only some limited number of climatic parameters are used for estimation amount of solar radiation. Sunlight is the most experimental equations estimates solar radiation parameters. In addition many researchers use sunlight and some other parameters such as relative humidity, elevation, latitude and temperature. The most accurate method of measuring solar radiation is pyrometer but there is limitation such as lack of facilities and

higher cost. A few station use from pyrometer for measuring the total radiation (Hejazizadeh *et al.*, 2018).

In this research sunlight time and elevation has been considered from 10 meteorological station (Table 1). Classification sunlight map provided which is the combination of elevation and sunlight time. In order to make result of relation elevation and sunlight data, the homogeneity of layers is important, the homogeneous layers of topography and climate data are as input layers by cell statistic and spatial analysis. Figure 3 shows cell grid of the layers which are the analysis.

Integration of Parameters Classified Sunlight and Elevation

Classification sunlight map has been provided by carrying out average of sunlight in meteorological stations during (1992-2015) in GIS environment.

This step focuses on classification of parameters based on the range of attributes, scoring of the parameters, the sum of the scores and analysis interpolation. The ranges of parameters have been shown in Table 1.

In order to measure each parameter in 10 (km²) grids map would recognize parameters unit the parameters were

measured for each grid (km²) and subsequently the map was classified into 5 classes.

Classified sunlight and elevation are the datasets for integrated map. These datasets consist of a series of scoring and summing the parameters. These classification maps were provided by scoring and weighted sum estimation. The following Fig. 3 shows part of grid maps and formulate that use for classification sunlight map in grid map.

Results and Discussion

Classification Landform Map based on Elevation

The altitude landforms were classified in three classes. The classification was based on high land, mid land and low land (Fig. 2). According to the classification landform, the low land is made up of the largest part of the Z. R. B with 26152. 11 km² and low elevation >2000. This part is located on central, east and northeast of the Z. R. B. Mid land that covers a minimum area of 6932. 59 km² and elevation is between 2000-3000. High land of the Z. R. B is located on the west and northwest of Z. R. B with 8574. 56 km² and high elevation (<3000) (Table 2).

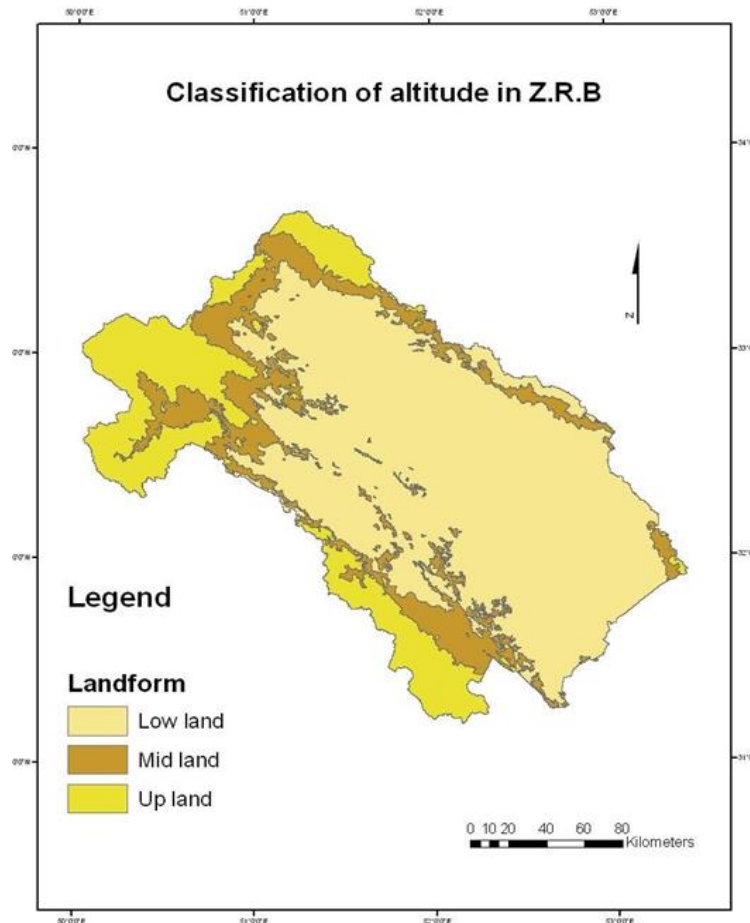


Fig. 2: Shows classified altitude landform

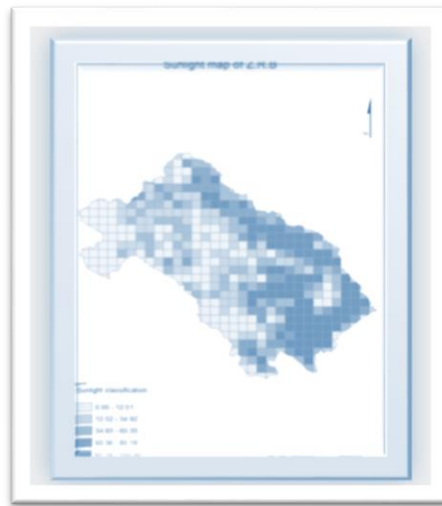


Fig. 3: Shows classified altitude sunlight map

Table 2: Shows altitude classification landform area

Landform classes	Area/km ²	Area%	Elevation
Low class	26152.11	62.77	>2000
Mid class	6932.59	16.64	2000-3000
High class	8574.56	20.58	<3000
Total:	41659.27		

Table 3: Shows sum of sunlight time in four season

Parameters season	Winter	Spring	summer	Autumn
Sum of sunlight time	664	906	1006	698

In this study to estimate the amount of radiation received by the surface Zayandeh Roud Basin from the monthly data of 10 stations synoptic. Solar radiation values and elevation from landform were considered then by spatial analysis in GIS environment. Considering spatial features and characteristics climate estimated. Required inputs for direction calculate the model in the form (Fig. 3).

Late spring and early summer, in low elevation (east) of Z.R.B (desert areas) has a higher amount of radiant energy than other regions. In this season the months of June and July, there is the highest amount of solar radiation energy and cause its main receiving direct radiation in most areas (Table 3).

The sunlight radiation in the North and East of Z.R.B are more and thicker. According to topography analysis, West and South are on high topography location and sunlight radiation is lower than East and North area. The maximum amount of radiation received it belongs to the Eastern, Southern, Northern regions of the Z.R.B.

The average amount of radiation in the area 9.12 MJ/m². The month of July the height of the sun decreases. In autumn the highest amount of radiation received is related to Khor station that it is a desert. The

average amount of radiation received in autumn reaches 1/95 MJ/m² (Fig. 3).

Conclusion

The main propose of this research is estimation of elevation and solar energy that means spatial analysis of solar energy in areas. The gained model from this model were using spatial analysis by landform map and sunlight data in GIS environment. The results of this study shows elevation and aspects of landform can be important for long term propose in arid and semiarid area.

Due to the limited fossil energy resources in about 11% of the energy required by industrialized countries and a large part of the expenditures of other countries of the world forms, different strategies to deal with consider a possible crisis and the future energy supply of the world taken. To use today renewable energy, especially solar energy much attention has been paid to it all accurately measure the amount of radiant energy received by the earth's surface estimate high. Many parameters in the rate the total radiation is effective on the Earth's surface. Some of these factors are climatic in nature and some of them environmental.

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Author's Contributions

Kaveh Ostad-Ali-Askari: Contributed to design the study, write, edit, analysis data and revise the manuscript.

Maryam Marani-Barzani: Contributed to write and design the manuscript.

All authors approved the final manuscript.

Ethics

The present study and ethical aspect were approved by University of Malaya.

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