Finding Suitable Land Areas for Chickpea Cultivation in Kermanshah Province Using Climate and Environmental Data

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Extanded Abstract

Introduction

More and better production of food is one of the necessities of today's world. Since production of agricultural products of one region depends on the air and climatic factors, it is important to examine the role of climate in agriculture (Mohammadi et al., 2004: 123). In relation to agroclimatology, numerous studies by different scientists and agricultural climatologists have been carried out in Iran and the world. Tobaybsir (2004) in a research says that in most regions of the Iran, especially in Lorestan Province like the other arid regions in Asia and North Africa, chickpea is usually planted in the spring and, thus, inadequate soil and water is the main limitation for this crop production. Chalakyan (2011) using data of annual precipitation, growing season precipitation, temperature, growing season relative humidity, elevation, slope, aspect, soil depth and wind speed made a zonation of the agroclimatic cultivated chickpea via AHP method for Ardabil Province. The results of the study indicated that the temperature and height of Ardabil Province are the main effective factors in cultivation of chickpea. Up to 120,000 to 150,000 hectares of land in Kermanshah Province is allocated to planting chickpea and the average yield is 450 kg per hectare (Haghparast, 2012: 13). A summary review of the literature shows that all the studies are conducted on this specific product and exclusively in agricultural areas. This research was employed spatial analysis functions of GIS, AHP and TOPSIS model to identify the areas suitable for cultivation of chickpea in Kermanshah province to put at the center of their attention.

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Materials and Methods

The data used for this research are annual precipitation, growing season precipitation, minimum temperature, growing season, the mean temperature for germination, flowering and ripening temperature, maximum and minimum mean monthly relative humidity of the growing season, and mean monthly sunshine during the growing season, all in a 20-year period (2010-1991) from 17 synoptic stations. Environmental data, elevation, slope and soil type were also included in the study. Delphi technique was used to obtain the weights of parameters by pairwise comparison in AHP (Qodsypour, 2010: 7). Pairwise comparison matrix of random variables was completed by 40 rain fed cultivation experts, and the final criteria were extracted by Expert choice software. To convert the point data to the surface data, with interpolation methods it was found that the best method for the precipitation were Co-Kriging and IDW methods for other elements. In addition, the DEM was used for elevation and slope parameters. Digital Soil Map was achieved from the Department of Natural Resources of Kermanshah Province at 1:250000 scales. Then, according to Login different layers, with the aim of homogenizing values, layers were standardized. In this case, each layer in direct or inverse effect determines the potentials, while standardization (poor to excellent value from 0 to 1) is considered. The weights obtained from AHP were multiplied by the corresponding layers. Then, the positive and negative ideal values for each layer were extracted and entered into the TOPSIS model.

Results and Discussion

The results of this research indicate that annual rainfall with 0.45% has the most influence and wind up with 0.03% the lowest effects on chickpea cultivation. Rainfall has a positive effect and the precipitation less than 250 mm in the areas of not more inhospitable region is not observed in this variable. Western areas have the highest power and the southwest, east and northeast areas have the lowest potential for germination. Western parts of the province such as Qasr-e Shirin and Srplzhab due to the higher temperature, more than 27°C, are inappropriate for chickpea cultivation and southwestern regions; north-east and east provinces will receive the highest score. City of Qasr-e Shirin is considered inappropriate to determine the temperature of the chickpea. Minimum temperature varies from 15-5 degrees; the minimum temperature will increase the growing season to provide suitable environments for the germination and growth of the peas. Thus, the western parts of the province have the greatest potential. The lowest average relative humidity is about 28 percent in the city of Qasr-e Shirin and the maximum of 52% in the southwest and northeast of the province. As the value of this variable increases, the more points it will receive. Due to low relative humidity, southwest and northeast regions points are close to 1 and the western parts of the province will receive a score close to zero. In most parts of the study area, the maximum relative humidity is 60 percent and the resulting exposure of Kermanshah Province, Songhor, Eslamabad-e-gharb rating is good. The highest amount of sunshine hours per day in growing season is 9.9 hours in southern and central provinces and the lowest value of 4.8 time is observed in the north-west part of the province. The mean wind speed during the growing season, which varies from 3 to 7 meters per second, is the highest in the region, Kermanshah, and falcon are between 7-5 meters per second and suitable in Kangavar and western regions including Qasr-e Shirin, Srplzhab, Gilangharb and Eslamabad-e-gharb. The central plains of the province with an elevation of 800 to 1,500 meters has better conditions in

terms of slope, mostly between the levels of 30-0 percent. In the soil situation, Kermanshah province is in moderate to good conditions.

Conclusion

Integration of environmental and climatic GIS layers with TOPSIS model and combination of the layers of dry land farming, it was found that 4 factors can influence unfavorable conditions for chickpea cultivation. In other regions of Kermanshah provinces, the areas of the categories are as following: high level is 0.073%, good 26.43% and average is 73.48 %. The lands with very good features are located in Nosoud and Ravansar cities. The areas with average ability are located in Harsin, Kangavar and parts of the southern province and areas with good potential are located in some parts of the Eslamabad-e-gharb, Kermanshah and East of Sarpolzahab.

Keywords: chickpea, Delphi Technique, Kermanshah Province, climate potential, TOPSIS model.

Simulation of Runoff and Sediment Yield in Haraz River Basin in Mazandaran Using SWAT Model

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Extanded Abstract

Introduction

Simulations of river flow and understanding different components of hydrologic cycle are important for programming of the conservation aspects of water resources. Since the study area is located in the site of dam construction, the estimation of rainfall runoff and sediment yield are very important for better management of water resources. Therefore, in this study, the SWAT model was applied. SWAT model is one of the multipurpose simulation models for management of watershed. The main objective of hydrologic models is simulation and prediction of the behavior of the catchment basin. Hydrologic models can simulate land surface hydrological processes to improve water resources management. Today, GIS tools are commonly used in natural resource management; especially in watersheds with several banks. They have linked information such as digital maps. GIS is designed and developed to predict the results of spatial management activities. For situation awareness systems, we need to add the elements of system dynamics. SWAT model is an advanced communication window possible to combine a set of models and GIS data in groundwater and surface water flows and floods.

Materials and Methods

The study area of this research is located between 539,022 to 622,236 Eastern longitude and 3,923,033 to 4,009,208 north latitude in zone 39 of UTM. Haraz watershed with an area of

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401927.2 hectares is located to the south of the province and in the vicinity of Amol City. The minimum height of 300 meters and a maximum height of 5600 meters are the elevation limits. Calculation of runoff in SWAT model can be simulated in two ways: Green Ampt and SCS curve.

SWAT model to simulate the hydrological cycle on the water balance equation is as:

$$SWt = SWo + \sum_{i=1}^{t}\left(R_{day} - Q_{surf} - Ea - w_{seep} - Q_{gw}\right)$$

Prediction of the rate of soil erosion caused by rainfall and runoff in SWAT model is based on equation MUSLE. In this method, surface runoff is used as an agent of erosion. Sediment transport lag in the effect of snow cover on erosion, sediment and lateral flow of groundwater is also calculated.

In order to improve the quality of model calibration and uncertainty analysis in SWAT-CAP software sufi2 method was used. SUFI2 program combines calibration uncertainty and tries to determine parameter uncertainty, so that most of the observed data in the region of uncertainty can be determined.

Results and Discussion

Using ARC- SWAT software watershed study area was divided into 25 sub basins. Because of the diversity of land use map and soil the sub basins were divided into 91 hydrologic units (HRU). In the following calibration and validation, during the first stage 20 variables were selected and the initial values are based on a list prepared by the guide table of SWAT, the application entered SWAT CUP. After 600 iterations, each algorithm of SUFI2 determined 8 parameters for simulation of runoff and sediment load parameter 5 as sensitive agents. Then, the model was calibrated to simulate runoff for years of 1995-2004, and evaluated using correlation coefficient (R2), coefficient of Nash – Sutcliffe (NS) and Mean of Squared Error (MSE). The results showed that the values of the coefficients R2, NS, and MSE in the Karehsang station are 0.80, 0.77, and 20.93, in Chelav Station are 0.75, 0.73, and 1.23; in Razan Station is 0.79, 0.75, and 5.91 and in Panjab station are 0.68, 0.55, and 2.70, respectively. Sediment yield was also calibrated in Karehsang station for the years of 2002-2006 and the statistical coefficients of (R2) and NS were obtained 61 and 60 percent, respectively. To perform validation, the model was run for years of 2005-2009. The results showed that the coefficients of R2, NS, and MSE are 0.87, 0.75, and 10.17 for Karehsang station; 0.83, 0.77, 0.21 for Chelav station; 0.81, 0.72, 1.34 for Razan station, and 0.75, 0.70, 0.67 for Panjab stations, respectively. Validation of sediment yield was done for the years of 2007-2008 with coefficients of NS and R2 equal to 53 and 68 percent.

Conclusion

The primary objective of this study was to evaluate the performance of SWAT model to simulate runoff and sediment yield of Haraz watershed gauging stations within the basin. In the sensitivity analysis, the various parameters for runoff curve number (CN), Soil Density (SOL-BD) and hydraulic conductivity effects (CH-K2) are of high sensitivity. The high sensitivity of the CN parameter is investigated in the domain of the role of environmental factors and land use in runoff areas. The results of the study are consistent with the results of the studies of

Panagopoulos and colleagues (2011) and Parajuli et al. (2013). To predict sediment parameters for the simulation of sediment load, SPCON, SPEXP and SOL_AWC are more sensitive to be considered.

According to the figures, the values of peak runoff and soil loss estimates are close to the observed values. Finally, the results indicated that the model has a high level of performance in simulation flow discharge and sediment yield simulation, and it can be used for operating watershed management strategies.

Keywords: Haraz Basin, runoff, sediment, SUFI2 algorithm, SWAT model.

Analysis of Spatio-Temporal Variation of Atmospheric Humidity in Iran during 1979-2013

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Extanded Abstract

Introduction

Water vapor is an essential climate element. Through latent heat exchanges, the water vapor is considered as the principal way of energy transport through the global atmosphere and it is also a dominant greenhouse gas (Held and Soden, 2000). Over the oceans, warmer surface temperatures may lead to increased evaporation and, therefore, greater specific humidity, but an approximately constant relative humidity (RH); the greater concentration of water vapor will, in turn, warm the surface further, since water vapor is a potent greenhouse gas (GHG) (IPCC, 2007; Dessler and Sherwood, 2009). As temperature rises, the atmosphere's capacity to hold water vapor is also increased. As the water vapor can be transported vertically through convection and subsidence, and horizontally by atmospheric circulation, changes in surface absolute moisture can cause changes in moisture aloft (McCarthy and Toumi, 2004). The Clausius-Clapeyron relation represents exponential increases in the atmosphere's water holding capacity with increasing T at approximately 7% K^{-1} (Manabe and Wetherald, 1967; Allen and Ingram, 2002; Trenberth et al., 2005).

Knowledge about changes in water vapor in the upper troposphere and lower stratosphere is important because it can result in strong alterations in radiative forcing, hydrological cycle, precipitation intensity, human activities and biosphere. The aim of this study is to analyze spatiotemporal variation of atmospheric humidity of Iran during 1979-2013.

Material and Methods

In conduction of this study, we have used specific humidity and relative humidity gridded monthly data of European Centre for Medium Range Weather Forecasts (ECMWF) from 1/1979 to 12/2013. The data with spatial resolution of 0.125 degree have been selected. According to the spatial resolution of the data, 9965 pixels are located in political boundary of Iran. Annual specific humidity and relative humidity for each pixel are also calculated. The variation of

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Iran's air temperature from 1000 to 200 hPa is analyzed. Two non-parametric tests of Mann-Kendal and Sen Estimator are used to decide about significance of trend and slope of trend, respectively. The cosine of latitude is considered as data weight to estimate area mean annual specific humidity and relative humidity. The following equations are also used to calculate area mean annual specific humidity:

$$IranQ_j = \frac{\sum_{i=1}^{n} W_i Q_{i,j}}{\sum_{i=1}^{n} W_i} \quad (1)$$

$$W_i = \cos(lat_i) \quad (2)$$

where, $IranQ_j$ is weighted specific humidity (Q) mean in year j , and $Q_{i,j}$ is specific humidity mean on pixel i in year j.

Results and Discussion

The results of this study show that atmospheric humidity (specific humidity) and relative humidity experienced significant trend during study period. In lower troposphere, the specific humidity and relative humidity trends are negative over most regions of the country. In spatial view, the highest decrease in the rate is observed on the areas between 34 to 36 northern latitudes. During the study period, Semnan, Shahrod and Gorgan experienced the highest decrease in the rate of specific humidity and relative humidity. In contrast to most regions of the country, positive trend of specific humidity is observed over coastal regions of southern seas and southwestern parts of Caspian Sea. The relative humidity trend is not significant statistically over these regions. According to the Iran area mean in 1000 and 924 hPa, the decreasing rate in specific humidity is 0.04 and 0.05 $g.kg^{-1}.decade^{-1}$, respectively. The area mean decrease in relative humidity is about 1.61 and 1.62, respectively, in 1000 and 925 hPa.

Conclusion

Based on the available evidence, specific and relative humidity is decreased in lower troposphere over Iran but in middle and upper troposphere the trend is not significant. From 1979 to 1998, analysis of zonal mean annual specific and relative humidity show positive anomaly while during the period from 1999 to 2013 the anomalies are negative. Over the oceans, warmer surface temperatures will likely lead to increased evaporation and, therefore, greater specific humidity, but an approximately constant relative humidity (RH). However, over the land area the increased temperature results in less higher humidity and decrease in relative humidity. In some small regions of country include coastal regions and southwestern parts of Caspian Sea the trend of specific humidity is positive. The accumulation of humidity in the atmosphere of coastal regions and southwestern parts of Caspian Sea will alter the radiation balance, by an increase in long-lived greenhouse gases. Water vapor is itself a greenhouse gas. This increase in humidity causes additional warming. The decreasing trends in specific and relative humidity over Iran particularly in land areas are fairly consistent with the increase trends observed in the troposphere temperature. The results of area mean temperature in 9 levels show that temperature trend is positive in lower troposphere. In conclusion, the warming observed in Iran is generally accompanied by a decrease in the moisture content of the lower

troposphere during 1979–2013. Further work should be carried out to investigate controls on subtropical moisture and their possible connections to the pole ward displacement of Hadley cell and subtropical jet stream characteristics and on regional precipitation and/or cloud changes.

Keywords: atmosphere humidity, gridded data, Iran, spatio-temporal variation.

The Prediction of Annual Rate of Shoreline Change in the Caspian Sea, Gorganroud River Delta

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Extanded Abstract

Introduction

The coastal zone is one of the greatest environmental and economic assets of each nation. In coastal regions the natural forces that cause shoreline changes are embodied in waves, currents, wind and other factors. Gorganroud River Delta is located in 53°57 to 54° 1 E and 36°56 to 37° N in Southeast part of Caspian Sea. In this study, gibbosity of Gorgan River delta has been studied at the river mouth. The Gorganroud River basin from the Caspian Sea catchment basin is covering a large part of it in Golestan Province. The total flow rate of Gorgan Bay River Catchment is about 500 cubic meters and total of their discharge is 3.5 million tons per year. With average slope less than 0.1 percent, the study area is very low slope.

Material and Methods

The aim of this study is to evaluate the rate of change in coastline and its predictions with two different methods. The reason of selection of Gorganroud coastline is a very large amount of change over different periods of time. This research is mainly based on an analytical method using mathematical and statistical tests. Topographic maps 1:250000 and 1:50000 of the study area have been used for the analysis. Initially, the satellite images of TM, MSS, and ETM sensors were obtained from Landsat and the images of the coastline in 2005 and 2013 were extracted from Google Earth. The shorelines were extracted by digitization of the images and converted into linear files in ARCGIS 9.3. To investigate the rate of annual change in the coastline, two methods have been applied. The methods used to evaluate the rate of annual change in shoreline and to predict the rate of change in the next years was based on the use of transect. According to the curved coastline, the cuts perpendicular to the coastline are at even intervals of 500 meters. This is to analyze the rate of change within Gorgan River Delta. The first method used is End Point Rate (EPR). The End Point Rate is calculated by dividing the

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distance of shoreline movement by the time elapsed between the oldest and the most recent shoreline. The major advantages of the EPR are the ease of computation and minimal requirement of only two shoreline dates. The major disadvantage is that in cases where more data are available, the additional information is ignored. The second method to predict the rate of changes is The Average of Rates (AOR). The Average of Rates method calculates separate end point rates for all combinations of shorelines when more than two are available. A minimum time criterion is introduced to filter the available shorelines and it is a function of measurement errors and the magnitude of the rate of change. The main advantages of this method are that all "good" data that pass the minimum time criterion are used and the method is sensitive to substantial shifts in trends and data variability. The main disadvantages are that small time differences between the shorelines produce a long minimum time span and there is not a computational norm for modeling of the minimum time span equation.

Results and Discussion

The results of the EPR method show that most of the changes in the coastline are in the middle of Gorganrood river delta. The changes are ranged from 63.7 to 84.2 meters per year. Minimum changes by EPR method is ranged from 18.6 to 12.9 meters per year in the southern part of the study area. In the entire study area, Average annual changes by the EPR method is 40.2 meters. The minimum changes by AOR method is between 32 to 35.7 meters per year in the southern part. The maximum changes by this method are ranged from 60.4 to 90.8 meters per year. Average changes in AOR method is equivalent to 61.1 meters per year.

Conclusion

Since 1882, according to the measurement data of sea-level stations in Baku and Anzali, changes in water level are more than 3 meters. These changes had a significant impact on coastline profile and its surrounding landuses. Evaluation methods used implies that EPR and AOR methods are considered as cyclical changes. According to the Delta jut into the sea and annual average rate of change of 40.2 meters, with EPR method, gibbosity Gorganroud River at the mouth of the river have been added to the coastline in the past 112 years.

Keywords: changes rate, coastline, Gorganroud River, prediction transect.

Allometric Analysis of Barchans Morphometric Parameters in Southeast Part of Haj Ali Gholi Playa

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Extanded Abstract

Introduction

Management principles predominated on the development and evolution stages of the geomorphic landscapes are different. This is because of variability in landscape evolution, its relationship with other system components and its response to environmental changes and feedback. One of the most important methods of management of geomorphic landscape is the study and evaluation of morphometric parameters and allometric measurements. Allometric measurement is the investigation of relative changes between system components. It also represents the development of a system component compared with that of the entire system or other components. Therefore, the study and evaluation of barchan morphometric parameters and allometric relations between them will help managers and environmental planners achieve the unified and accurate recognition from landscape, in one hand. On the other hand, it may be effective in the determination of stability, equilibrium and thresholds of barchan system.

One of the most important problems of management in arid and semi-arid regions is the identification and application of environmental principles governing on the behavior of Barchan dunes. Barchans are one of the aerial depositional features formed in regions by sand and prevailing uni-directional wind.

The aims of this study are to determine the most important morphometric parameters of Barchan dunes in the southeast part of Haj Ali Gholi Playa and also to recognize relationships, the ratio and allometric properties between them. These are conducted to identify the management principles governing on the Barchan dunes.

Materials and Methods

The study area in the research is the barchan field located in the southeast area of Haj Ali Gholi

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Playa. With about 25260 hectares in area, the field is one of the most important ergs of Haj Ali Gholi playa. It is located irregularly along northeastern - southwestern edge of playa with 10 to 12 km long. This region is located at Eastern longitudes between 55° and 55°, 10′ and at Northern latitudes between 35°, 45′ and 35°, 50′.

At first, the study area is recognized via topography maps and Google Earth images. Then, barchans morphometric parameters are measured along 10 transects covering entire extent of the erg.

We define for each barchan dunes, the lengths La, Lb and the widths Wa, Wb independently. Furthermore, this study introduces the length of the slip face Ls and the length Lo from the dune's toe on the windward side to the brink. Finally, the height of the slip face H is defined at the highest point of the brink. This is the intersection of the brink and the longitudinal centerline of the dune. The total width (W) of a barchan is the sum of the widths Wa and Wb. The overall length (L) of a barchan is the sum of the length (Lo) from the windward foot of the dune to its crest, the length of the slip face (Ls), and the average of the horn lengths [(La + Lb)/ 2].

From measurement and determination of morphometric parameters, for recognition of the type and intensity of relationships between them, we have reexamined these relationships using SPSS software and regression analysis technique. Finally, with analysis and evaluation of the obtained relationships using mathematical tests, the ratio and the allometric state of morphometric parameters have been defined and determined for the studied barchans.

Results and Discussion

In the study area, several barchans can be observed that they have the same form and shape, generally. The barchan dunes of the southeast Haj Ali Goli playa are 1.2 and 17.9 m high, between 19.5 and 307.9 m long, and between 6.3 and 165.6 m, wide.

The results obtained from statistical modeling by the regression analysis are presented. Models Summary indicates the correlation index, determination index, adjusted determination index and standard deviation of estimation error. The values of model parameters (coefficient and line slope), t value and their significant level are also demonstrated. Totally, the most important and the most suitable relationships are following from simple linear relationships, in this study. Therefore, in the results part, only, these relationships are presented.

Comparative evaluation of similar studies reveals the application of different equations in other regions. Quantitative researches of the morphology studied by other researchers show the specific relationship between barchan morphometric parameters in their study area.

As mentioned previously, allometric analysis is the investigation of relative changes among system components. It also represents development of a system component compared with development of entire system or other components. In the study, to determine the ratio between morphometric parameters of the studied barchan and identification of allometric relationships between them was first attempted to determine the types of their relationship and, then, find the ratio from them.

Conclusion

The results show that the obtained relationships between morphometric parameters of the

studied barchan represent the maximum significant linear relationship in barchan length and height, with determination index of 0.945 and standard error estimate of 0.889.The obtained relationships and allometric analysis among barchan morphometric parameters are statistical and mathematical models reported in this study. The mentioned models provide the possibility of rapid and accurate calculation of barchan morphometric parameters, and illustrate the allometric relationships among them.

The recognition of morphometric parameters of barchan dunes and their allometric analysis can serve as an index to determine the condition of barchan system and also shed light on their trends. Furthermore, recognition and estimation of these indices is a consequence from rate of threat and distribution. This can provide environmental managers with the required information and help their investigation determine the states in different regions from the view point of environmental management.

Keywords：allometric analysis, barchan, geomorphometry, Haj Ali Gholi Playa.

Assessment of Urmia Lake Water Level Fluctuations and Increase in Salt Areas in the North West Iran

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Extanded Abstract

Introduction

Urmia Lake in the northwestern corner of Iran is one of the largest permanent hyper saline lakes in the world and the largest lake in the Middle East. It is extended as much as 140 km from north to south and is as wide as 85 km east to west during high water periods. Qualitative and quantitative degradation of water resources is one of the major challenges in the way of sustainable development. The features and phenomena in the earth surface have been changed over time; the lakes as one of these features and due to a closed environment are not considered as an exception. Due to climatic changes such as reduced rainfall, increased temperature and also uncontrolled use of surface water resources in watershed areas, distinguished changes are exposed on the earth surface. Monitoring such changes should be considered as an important issue in the national and regional development and natural resource management. Monitoring the coastal areas and extraction of water at different intervals is currently regarded as an infrastructural research interest due to the significance of coastal zone management and dynamic nature of such sensitive ecological environments. Urmia lake is the twentieth largest lake of the world and at the same time one of the most unique and invaluable global water ecosystems. The lake surface area was estimated to have an area as large as 5620 km^2but since 1989 it has generally been declining and was estimated from satellite data to be only 2032 km^2 in August 2011. The decline is generally resulted from a combination of drought, increased water diversion for irrigated agriculture within the lake's watershed and also mismanagement.

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The main insight of this study is to analyze Urmia water levels fluctuation and increase in salt area. This is to model the lake surface fluctuation regime by linking the observed data to satellite data in the northwest Iran.

Materials and Methods

Lake Urmia is an endorheic or terminal lake that is water leaves the lake only by evaporation. As is generally the case, this leads to a saltwater body and in the case of Lake Urmia salinity is quite high. The lake is bounded between 37°5′ -38°16′ latitudes and 45°01′ - 46° longitudes at 1275 m above sea level. Its surface area ranges from 4750 to 6100 km^2 and the average and greatest depths are 6 and 16 m, respectively. In order to study the fluctuations of the Urmia Lake surface area, multi temporal Land sat Images, ETM and TM, were used in a 23-year period, from 1989 to 2011. In the present study, the coastlines information was extracted for each year in two major steps using the ERADS and ArcGIS software. Firstly, geometric and radiometric corrections as well as different filters were applied on the selected images to make the spectral difference of the objects more clear. Secondly, supervised classification method has been used to extract the coastlines. To use the supervised classification, training data from the lake surface has been prepared for further process. The reflection values in these areas have been generalized to the entire lake surface using the software. Thus, the border between the lake and surrounding areas has been set precisely. Finally, through the algorithm for conversion of the two vectors, the coastline limits have been drawn for different years. ArcGIS application has been used for analysis of the images.

Results and Discussion

Satellite altimeter data measured the lake's level in 1989 to be at its highest level of any time in the past 30 years. This is in agreement with Hassanzadeh and others (2011) who mentioned water level of about 1278 m above sea level for the same time. Both the measures show a steady decline from that year on with the most recent satellite altimeter data indicating a drop of approximately 7.40 meters between 1989 and 2011. Because Lake Urmia is a terminal lake with no significant water outflow the only way water leaves the lake is by evaporation. Therefore, if the lake is declining, it is either by increased evaporation or a decrease in water coming into the system. The Zarrineh Rood River is the largest of the thirteen main rivers discharging into the Lake Urmia. The rivers are the source of majority of the Lake water budget. Additional input comes from rainfall directly over the lake, floodwater from the immediate watershed, and a very small fraction from groundwater flow.

Conclusion

The main objective of this study was to assess lake water levels fluctuation using satellite images and Geographic Information System (GIS). To achieve this goal, the satellite images of Landsat Multi-spectral images for the years 2011-1989, sensors of TM, ETM +, were used and processed along with field observations. Based on the results achieved during the 23-year-old, average height of the lake water level decreased 7.40 meter. Vast area of the lake surface turned into the arid soil and sediment salts in the last few decades. Most changes due to water loss, especially in the South East and the east coast of the lake is visible.

Keywords: coastline changes, salt area, satellite image, Urmia Lake, water level fluctuations.

Exploration of the Potential Copper Areas in Khoy City, Ghezel Dash, Using Hyperion Images

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Extanded Abstract

Introduction

In recent decades, a large variety of science experts, including geology and mine scientists, have considered remote sensing technology as one of the most important instruments to receive information. Access to hyper spectral data is one of the main evolutions in the remote sensing technology. The main feature of the technology is its application in identification of minerals and detection of the minerals. Existing narrow and spectral bands of hyper spectral images provide the possible for geologic and mineralogy examination of an area. Paying attention to existing maps of the mineral distribution has been provided by classic method. Therefore, new sensor such as Hyperion has provided new capabilities in planning of biophysical and biochemistry features.

Materials and Methods

Ghezel Dash area is located in longitudes 44° 28′ – 44° 41′ and latitude 38° 43′ – 39° 06′ that is in 68 Km of Khoy City, Northwestern part of West Azerbaijan. The Satellite image employed in this research is Hyperion sensor of EO-1 satellite with 242 spectral bands. Satellite images of

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Landsat 7, ETM sensor, band 8 has also been used for geometric correction of the Hyperion sensor images. In this research, after necessary preprocessing including geometric and radiometric corrections on Hyperion images was performed, we used SAM and Spectral Information Divergence (SID) Algorithms for detection of minerals. Spectral angular mapper (SAM) is an automated method of algebraic that calculates similarity of the spectra between the spectrum of a pixel and the reference spectrum. The similarity between the two spectra is expressed as their mean angle. The SID is a probabilistic method that calculates spectral similarity between two pixel vectors based on the difference in the probability distribution obtained from their spectral signatures. The smaller the divergence, the more is the probability of similarity of pixels.

Results and Discussion

In this research Spectral Library of United States Geological Survey (USGS) was used for matching of unknown spectrum. Then, resample was performed by hyper spectral data of Hyperion with 142 bands. Minerals map was detected after running the algorithms of SAM and SID by spectral signatures of USGS spectral library and Hyperion images spectra to detect minerals. Results of this research indicate that Chalcopyrite, Pyrite and Bornite have the maximum value in both methods, respectively, but their amounts are different in two algorithms. In these maps, secondary minerals such as Malachite and Azurite are very slight. In order to assess the accuracy of these algorithms, the results of these two algorithms were compared with the maps produced in this region. The results indicate that the maps of SAM and SID methods have accuracy of 85 and 76 percent, respectively.

Conclusion

Comparison of the maps produced by the algorithms used in this study with available maps indicates that the minerals are present in the study area. Map of West Azarbaijan province confirmed the effects of industries and mines. The minerals of malachite and azurite were not confirmed in the Geological Organization report. Based on the results of the present study and evaluation of the overall accuracy, Spectral Information Divergence method (SID) can be used as an efficient method in classification based on exited minerals for detection of metal mines. The results of this research also is consistent with the results of Amer et al. (2012) that had used classification methods of SAM and SID for classification of alteration zones associated with gold.

Keywords: hyperion, hyperspectral remote sensing, spectral angular mapper, Spectral Information Divergence (SID).

Application of Multi Criteria Decision Making for Site Selection of Artemia Farming in Arid Region Using Saline Water (Case Study: Siah Kouh Playa, Yazd)

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Extanded Abstract

Introduction

The major threat to habitability of a region may be degradation of arid lands, particularly in developing countries where many people depend upon restricted resources for their livelihood. Although land degradation process in arid regions (desertification) is not new or site specific, the environmental awareness in a world board scale has extended and generated a wider public interest, extensive to the scientific circles and governments. Desertification affects the livelihoods of millions of people, including a considerable proportion of the poor in arid lands which occupies about 41% of the Earth's land and are home to more than two billion people. The persistence of unresolved stabilization of these fragile environments and a substantial decrease in ecosystem services as a result of intensive use of resources, incapacity of wide spread suitable technologies for providing increased supply of food, forage and fuel, water scarcity, and climate change all made desertification as one of the main environmental challenges today and a major limitation to meet human needs. Recently, arid regions and desert ecosystems with several potential and various resources such as unconventional water became remarkable areas for economic projects. With desert condition and in order to guarantee both rich and sustainability and prevent undesirable consequences of these economic projects, it is essential to address suitable areas for aquaculture in any aquaculture activities. In the case of suitable site selection research, the researchers apply MultiCriteria Evaluation (MCE) in Geographical Information Systems (GIS) to determine suitable sites for aquaculture in Iran.

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Therefore, this study was conducted to identify suitable sites for *Artemia* farming development in SiahKouh Playa, Yazd, using Multi Criteria Decision Making (MCDM).

Materials and Methods

The method is based on Analytical Hierarchy Process (AHP) as one of the multi-criteria decision making methods. Analytical Hierarchy Process usually includes three phase: first, the decomposition of a complex problem into a decision hierarchy in order to determine the main components of the problem, second the evaluation of options (comparative judgment) by means of a pairwise comparison, which enables the decision maker to assess the contribution of each criterion to the overall goal, and finally the synthesis of the priorities so as to identify the relative preferences for the selected policy options. One of the major advantages of this method is that it considers the interrelations among different levels of decision as well as the interconnection of the decisions in one level. After the decision makers groups are determined, the most important criteria effective in determination of suitable areas in the study area were identified through comparison questionnaires filled by the experts and researchers. The second questionnaire was designed to determine the rate of each criterion to choose the best alternative. The thematic layers of slope, geology, geomorphology, soil, vegetation, climate, hydrometery, land use, power lines and management quality indices are the main data required to determine the suitable areas for *Artemia* farming. These layers were extracted and manipulated from the available topographic, geologic maps, aerial photographs and field survey data analyses. Spatial analyst function in ArcGIS 9.2 software was used for matching of the thematic layers and evaluating the aquaculture indices.

Results and Discussion

The results of this research showed that three main factors are effective to determine the suitable areas for aquaculture units in desert ecosystem. These factors according to their importance are environmental, technical, and infrastructure, socio-economic conditions. The environmental criteria were included geomorphological faces and rangeland areas. The indices in the technical criteria were slope percentage, soil texture, unconventional water resources and climatic elements such as evaporation, rainfall and temperature. The indices in the infrastructure, socio-economic criteria were based on distance to cities, roads and power sources and also land use. Finally, those criteria and indices were applied to address the optimal areas for *Artemia* farming by using weighted linear combination assessment. In the final result of this study, suitability levels were determined as suitable areas (the areas with high potential, located east and eastern south of study area) and non- suitable areas.

Conclusion

It can be concluded that the best choice among three alternatives is the geomorphological landforms as assessment and monitoring unit of other criteria in arid and desert ecosystems. Application of multi criteria analysis methods will also help the planners make better decisions and choose effective alternatives.

Keywords: Analytical Hierarchy Process (AHP), Artemia, desert ecosystem, saline water, Siahkouh Playa, Yazd.

Determining Capability and Ecological Potential of Roudan City for Ecotourism using Multi Attribute Decision Making (MADM)

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Extanded Abstract

Introduction

Tourism is a process which has been existed with all its special forms from the ancient times so that the mental, cultural, social and economic demands of the human beings can be met. One of the growing branches of this industry is named as ecotourism. Nowadays, tourism has become one of the main levers of economic and social development in many regions of the world. Tourism in the regions should be based on sustainable development to preserve the nature as well as conserve historical and cultural heritage of that region and the intellectual application of the natural resources. Ecotourism development aligned with eco-environmental potential of the land as an effective tool and approach plays a major role in sustainable development, promoting the life standards of human society and maintaining the natural equilibrium. Assessment of ecological potential is an effective step and suitable tool in order to direct the present activities and functions performed for the land toward a sustainable development. One of the ways for identifying and evaluating the ecological capacity of each region is application of the Multi Attribute Decision Making method (MADM) and comparison of other indices. This method has identified the sites with ecotourism potential in the city of Roudan and, ultimately, suggests the appropriate locations for ecotourism development in the city.

Materials and Methods

The study area in this research is the Roudan city, where located in the east of Hormozgan Province. It is located at the geographical coordinates ranging from 56°50′ E to 57°29′ E and from 27°5′ N to 27°59′ N. This research is considered as one of the descriptive studies and of applied type in terms of the relationship. To do this research, first of all, different parameters

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used to select these sites were gathered by means of a documentary review from different local and foreign authorities. Therefore, at this point, 11 major parameters and 36 sub-parameters were selected. The parameters were assessed using Delphi technique and the final attributes of ecotourism development including 9 major parameters and 28 secondary parameters were identified and formulated. In the next step, using Analytical Hierarchy Process (AHP) and corresponding questionnaire, we determined the relative weights of major parameters and sub-parameters. After the parameters were identified, they were incorporated with each other to find the appropriate regions for tourism development.

Results and Discussion

The results of this study, as an attempt for reviewing the parameters experienced in Iran and throughout the world, demonstrated that both parameters and sub-parameters extracted from different resources are applied for identification of the appropriate regions for ecotourism in the city of Roudan. The study showed that the natural recreational resources have 77% of relative weight and the highest degree of importance. In practice, 56.4 % of the experts and respondents have identified this parameter as one with the very high level of importance, 25.6 % of the experts identified it as the parameter with high importance to select ecotourism appropriate regions amongst the natural ecosystems. Based on the obtained results, the regions with low potential of 141323.5 hectares and 43.4 % of the total lands have most of the land areas in Roudan City. About 9.1 % of the total area of the city including 29711.3 hectares has high potential for ecotourism development, 57327.9 hectares from the surface of the city, equivalent to 17.6 percent, has average potential and about 97344.4 hectares, equivalent to 29.9 %,do not have the potential.

Conclusion

According to the results, it is clear that the central regions and the regions close to perennial streams have the most potential for ecotourism application. The reason for this is the concentration of tourism targeted villages of Abnama, Ziarat Seyed Soltan Mohammad, Ziaratali and so on in this district of the city. The map of the suitable regions for tourism development in the city of Roudan indicates consistency of high potential regions with the current utilization including the pilgrimage and tourism status of Abnema and Seyed Soltan Mohammad villages as tourism sites and also the villages amongst the high capacity regions of the obtained map. In addition, the existence of natural resources in the city identified the most important attributes of the regions. Amongst the most important resources and facilities of the city, the existence of perennial streams of Roudan and Jaghin is considered as important factors for tourist attraction. It can be suggested that the researchers in the future study the ecological potential and capacity of other regions of Hormozgan province in terms of the ecotourism applications.

Keywords: ecological strength, ecotourism, Geographical Information System (GIS), Hormozgan, multi attributes decision making, Roudan.