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Flow regime changes of Gamasiab River under climate change scenarios

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Expanded Abstract

Introduction

In the recent decades, temperature has increased and rainfall has changed significantly. Based on the Intergovernmental Panel on Climate Change (IPCC) surveys the average temperature of the earth has grown about 0.6°C in the twentieth century. Understanding the impacts of these changes on watershed hydrology is important for human society and ecological processes. Nowadays, with releasing fifth series of General Circulation Models (GCMs) by IPCC, new researches have been focusing on the effects of climate change by statistical downscaling of CMIP5 models. Potential impacts of climatic changes on aquatic ecosystems species, nutrient delivery, temperatures and hydrology have been studied. In addition, the effects of climate change on hydrology have been examined in many studies using the CMIP5 series to study the stream changes in global scale under climate change conditions. These studies indicated if the greenhouse gas emissions are continued, available water levels will be reduced. The amount of hydrological impacts of climate change is varying based on different RCPs. In some studies, the greatest change in the rate of large flooding reported under RCP2.6 and the smallest changes under RCP4.5. Further studies indicate more floods occurrence under RCP8.5.

The first effects of climate change are visible on temperature and precipitation; changing these variables will disrupt the current order of the hydrological cycle. The new state of the hydrological cycle causes a change in the flow regime. Natural flow regime plays a major role in sustaining native biodiversity and ecosystem integrity in rivers. Characterization of flow regime has been examined by some researchers via metrics that describe the magnitude, frequency, duration, timing and rate of change for stream flow.

The Gamasiab River watershed is one of the five main branches of the Karkheh River in the west side of Iran; it plays an essential role in preserving the life and ecosystem of this area, so preserving the quality and quantity of water in this river is of great importance. We perform such an assessment in the Gamasiab River watershed, and subsequently project future flow regime for the Gamasiab River using the downscaled climate data using metrics that are useful to policymakers and ecologists.

Material & Methods

The Gamasiab River watershed is located between Hamedan, Kermanshah and Lorestan provinces. The watershed area is about 11690 km^2, with 515816 hec of agricultural land, 619583 hec of pasture, 4938 hec of urban land, and 28663 hec of others lands.

In this study, the SWAT model was used to simulate flow discharge. The SWAT model needs three maps to simulate discharge including Digital Elevation Map (DEM), soil and land use map. This model divides sub-basins into a number of Hydrologic Response Units (HRUs), each HRU is the main simulation unit in the SWAT

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model (30). Daily precipitation (Pcp), minimum and maximum air temperatures (Tmin and Tmax) for the period from 1977 to 2005 were obtained. The daily discharge in the Polchehr hydrometric station during the years 1977 to 2005 were used for calibration of the model as well as the comparison of changes in flow regime under climate change conditions.
Optimization of parameters and uncertainty analysis of the SWAT model were performed by using SWAT-CUP software by the SUFI2 algorithm (Sequential Uncertainty Fitting Ver. 2).
In order to simulate and predict the effects of climate change in the future, General Circulation Models (GCM) were used. The main problem in using general circulation models in regional research is their large scale. There are various methods for producing regional climate scenarios from these models, which called downscaling. In this research the Change Factor Mean-Based Method was used to downscaling CMIP5 models.
The flow regime and its changes were studied under conditions of climate change for high flow disturbance and low flow disturbance distribution. The distribution of high flow was investigated by using three indexes including 7-day maximum flows (7QMAX), a high discharge distribution (Q1.67) and flood duration (FLDDUR). A seven-day minimum flow (7QMIN) parameter was used to investigate the distribution of low flows. The Daily Flow Coefficient of variation was also used to show the overall changes of the flow regardless of the time series. 7-day maximum flows are the average of maximum daily discharge of seven days per year. For this purpose, the moving average of the daily discharge in seven-day is calculated for each year and the biggest one selected as 7-day maximum flows of the year. The Q1.67 index is defined as flow of magnitude exceeding a return interval of 1.67 years based on a log-normal distribution. Flood duration (FLDDUR) is also the average number of days per year when flow equals or exceeds Q1.67. Seven-day minimum flows are the average of minimum daily discharge of seven days per year. The Kernel probability density graph was used to show the flood duration for observational data and scenarios

Results

In this study, the model was calibrated to daily stream flows at the watershed outlet. To perform sensitivity analysis and evaluation of the model, SUFI2 algorithm in SWAT-CUP software was also used. Model performance was assessed using the Nash–Sutcliffe efficiency metric on daily flows (NS).
Change factor method was used for downscaling the CSERO-K3.6.0 model. Rainfall data and minimum and maximum temperatures were obtained under two scenarios RCP2.6 and RCP8.5 for the periods 2049-2020 (near future) and 2050-2099 AD (far future).
To study the flow regime changes under RCP2.6 and RCP8.5 scenarios for the period 2020-2020 (near future) and 2050-2099 AD (far future), the calibrated SWAT model for the Gamasiab basin, run again by using downscaled data from CSIRO-Mk3-6-0 model including the minimum and maximum daily temperature and the daily precipitation. The results of future flow simulation in the Gamasiab basin show that based on RCP2.6 the mean of the discharge will be close to 36.6 m^3/s in the near future, which is slightly more than the mean of the discharge in observation period (33.1m^3/s). Continuing this scenario would increase the average of discharge by 17.8% and reach to 40.4m^3/s in the future. The average discharge under RCP8.5 will be reduced to 30.6m^3/s in the near future, and the continuation of the RCP8.5 in the far future will cause a very sharp decrease in average of discharge and reach 19.1 m^3/s.
We assessed climate induced-changes in flow disturbances. The 7QMAX changes under RCP2.6 in the near future show the same trend by comparing observation period. The average of 7QMAX in the observation period is 209 m^3/s. Under the RCP2.6, the average of 7QMAX in the near future will reach 154.4 m^3/s, and in the far future it will reach 183.7m^3/s. The 7QMAX under the RCP8.5 will be reduced in the near and far future. The average 7QMAX in the near future will be close to 146/6 m^3/s, and in the far future it will reach 96.8 m^3/s.
The 7QMIN in the near and far future will a little change compared to the observation period. The average of 7QMIN in the observation period is 2 m^3/s, and this average under RCP2.6 for the near and far future will be 1.2 and 1.6 m^3/s respectively. Under the RCP8.5, 7QMIN will be significantly reduced, with an average of 0.9 m^3/s in the near future and 0.48 m^3/s in the far future. With the fitting of the log-normal distribution, the maximum instantaneous velocity of the discharge was calculated with a return period of 1.67 years, thus the value of Q1.67 was calculated 211.29 m^3/s. To calculate the flood duration in each year, the number of days which flow was equal to or greater than Q1.67 was counted. According to the kernel density diagram, during the observation period and the selected scenarios, flood events with a maximum of 5 days' duration are most likely to occur. It is also observed that under RCP2.6, in the near and far future, the probability of occurrence of floods with longer duration is expectable.

Discussion

The study shows that the Gamasiab River watershed is flashy. Under the scenario RCP2.6, which is a favorable scenario with minimal greenhouse gas emissions, the coefficient of variation will be reduced significantly. It can

be concluded that in addition to increasing the average of the runoff under RCP2.6, the flash floods of the river will reduce. In this regard, under the scenario RCP8.5, more floods in the Gamasiab River watershed were occured.
The 7QMAX and 7QMIN in all scenarios will decrease compared to the observation period. In both indexes, the lowest decreases are under RCP2.6 in far future, and the largest decline is under RCP8.5 in the far future.
The kernel chart in observation period shows that the duration of floods occurrence most likely is maximum 5 days. Under RCP2.6, in the near future floods with a maximum duration of 5 days are the most likely to occur but are less than the observation period, instead of under RCP2.6 10 to 15 days of floods duration are more than the observation period. Base on this chart, it can be concluded that under the scenario RCP2.6, the duration of the floods will be increase compared to the observation period, and it will be longer in the end of this century. The results under the RCP8.5 scenario indicate that the flood duration in the near future will be dramatically reduced and at the end of the current century, the flood frequency with a discharge equal to or greater than Q1.67 will be sharply reduced.

Conclusion

The results of this study indicate that the flow regime will change under different scenarios in the upcoming period. The intensity of these changes in far future (the end of this century) will be greater than in the near future. It can be concluded that under RCP2.6 watt/M^2 forcing scenario will have no significant changes in the amount of available water in the near future, but the continuation of this trend in the far future causes to increase the average of discharge along with reducing the risk of flooding. It is a great indication that the future situation is favorable if this trend continues. Increasing radiative forcing to the RCP8.5 watt/M^2 level in the near future addition to reduce the average discharge, the risk of large flood events increases, and the continued increase in greenhouse gas emissions in the far future will be result in a very severe decrease in the average discharge, then water availability will be reduced.

Keywords: flow regime, CMIP5, Gamasyab, SWAT.

The spatial pattern changes of dust interior sources in Khuzestan province in recent decades

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Expanded Abstract

Introduction

Dusting phenomena are among the most serious environmental problems in certain areas of the world . Most of the dust in the atmosphere is due to the origin of fine particles, and these fine particles are more prevalent in the arid and semi-arid regions of the world. In general, a dust storm is a heavy wind that carries sand particles in the air and transfers them from one place to another. The diameter of the particles of these grains has a direct relation with the wind speed, so winds can transport coarser material faster and vice versa. In examining the scientific sources available in the field of dust, it can be concluded that so far there has been a lot of research in this regard. And in most of these studies, the transmission, publication, synoptic causes and the destructive effects of this phenomenon are expressed. In this research, we try to investigate and analyze the spatial pattern of dust and changes in spatial displacement of these patterns during different periods.

Materials & Methods

The purpose of this study was to investigate and analyze spatial Autocorrelation of Khuzestan province over recent decades. For this purpose, data collected from 20 synoptic stations on a daily basis from 1986 to 2016 were obtained from the country's Meteorological Organization

In order to investigate more accurate changes of dust, the spatial variations of dust cores were investigated and analyzed in six periods of 5 years (1990-86, 1995-1991, 2000-1996, 2005-2001, 2010-2006, 2016-2011) and three decades (1995-1986, 2005 1996, 2006, 2016-2006) were analyzed. In order to obtain a general view of the dusts of Khuzestan province, some descriptive characteristics of the dusts of Khuzestan province were first studied and analyzed. The Alexander's method was then used to identify the dominant mutations in the Khuzestan circle.

In order to investigate fluctuations of dust, Alexanderson statistical method was used. The SNHT test (Standard Normal Homogeneity Test) was developed by Alexanderson (1986) to detect a change in a series of rainfall data. The test is applied to a series of ratios that compare the observations of a measuring station with the average of several stations. The ratios are then standardized. The series of Xi corresponds here to the standardized ratios. In this method, the mean score of k in the first year is compared with that of n-k in the subsequent year, which yields T (K) (Alexanderson, 1997: 25-34):

$$T(K) = K \times \bar{Z}_1^2 + (n-K) \times \bar{Z}_2^2 \qquad (1)$$

In this formula, $\bar{Z}_1^2$ and $\bar{Z}_2^2$ are calculated through the following formula:

$$\bar{Z}_1^2 = \frac{1}{K}\sum_{i=1}^{k}(Y_i - \bar{Y})/S \qquad \bar{Z}_2^2 = \frac{1}{n-K}\sum_{i=k+1}^{n}(Y_i - \bar{Y})/S \qquad (2)$$

In this equation, Y_i is the value of annual set (from 1 to n), $\bar{Y}$ is the mean of set and S is standard deviation.

$$T_o = \max\big(T(K)\big) = \max(\bar{Z}_1^2 + (n-K)\bar{Z}_2^2 \qquad 1 \le k \le n-1 \qquad (3)$$

If T_0 is greater than a particular critical value, then the null hypothesis is rejected for that significance level.

In this study , in order to study and analyze the spatial pattern of dust in Khuzestan province, two indicators of Moran (I) and (GI*) have been used.

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Index (GI*)

Then, in order to examine the spatial autocorrelation pattern of changes within a decade of dust, the hot spot analysis, Getis-Ord Gi, was employed. Analysis of hot spots calculates Getis-Ord Gi for all effects in the data. Z scores indicate in which section data are clustered in large or small quantities. In fact, this instrument considers every location in the light of its neighboring locations. If a location has high values, it is interesting and important; however, it may not be a statistically significant hot spots by itself. For a location to be considered a hot spot and also be statistically significant, both the location and its neighbors should contain high values. Local sum of a location and its neighbors is relatively compared to that of all the locations. When the local sum is significantly higher than the expected local sum, the Z score will be obtained. In fact, this instrument considers every location in relation to its neighboring locations.

$$\bar{x}_i = \frac{\sum_j x_i}{(n-1)} \quad (4)$$

$$s^2(i) = \frac{\sum_j x^2{}_j}{(n-1)} - [\bar{x}(i)]^2 \quad (5)$$

And Gi is calculated through the following formula:

$$Var(G_i) = \frac{W_i(n-1-W_i)}{(n-1)^2(n-2)}\left[\frac{s(i)}{\bar{x}(i)}\right]^{\bar{2}} \quad (6)$$

The values of G and G* are calculated through this statistical procedure $\boldsymbol{W_i}$/ (n-1) and is standardized through calculating the second root of its variance.

$$G_i(d) = \frac{\sum_j w_{ij}(d)x_j - W_i\bar{x}(i)}{s(i)\left\{\left[\left((n-1)S_{1i}\right) - W_i^2\right]/(n-2)\right\}^{\frac{1}{2}}}, j \neq i \quad (7)$$

If we also consider the weight of *i* $w_{ii} \neq 0$, the standardized G* is calculated through the following formula.

$$G_i^*(d) = \frac{\sum_j w_{ij}(d)x_j - W_i^*\bar{x}}{s(i)\left\{\left[\left(nS_{1i}^*\right) - W_i^{*2}\right]/(n-2)\right\}^{\frac{1}{2}}}, j = i \quad (8)$$

In equations 7 and 8, $W_i^* = W_i + w_{ii}$, $S_{1i} = \sum_j w_{ij}^2$, where $j \neq i$ and $S_{1i}^* = \sum_j w_{ij}^2$, where $j=i$ and $\bar{x}$ and s^2 show the mean and variance of the model, respectively. The standardized values of G and G* are interpreted based on the table of Z scores.

Index Moran (I)

Moran's I is a global measure of spatial autocorrelation statistic designed to test the dependence of dust values on neighboring values. Moran's I is calculated from the following formula:

$$I = \frac{n}{S_0}\frac{\sum_{i=1}^n\sum_{j=1}^n w_{i,i}\, z_i z_j}{\sum_{i=1}^n z_i^2} \quad (9)$$

where $\boldsymbol{z_i}$ is the deviation of dust for point i from its long-term mean ($\boldsymbol{x_i - \bar{x}}$), $\boldsymbol{w_{ij}}$ is the spatial weight between points i and j, n is the total number of points, and so is the sum of all the spatial weights:

$$S_0 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_{i,i} \quad (10)$$

The score statistic $\boldsymbol{z_i}$ is computed by the following formula:

$$z_i = \frac{I - E[I]}{\sqrt{V[I]}} \quad (11)$$

where $\boldsymbol{E[I]}$ and $\boldsymbol{V[I]}$ are computed as:

$$E[I] = -1/(n-1) \quad (12)$$

$$V[I] = E[I_1^2] - E[I_1^2] \quad (13)$$

The values of Moran's I vary from 1 for the perfect positive correlation and clustering to -1 for the perfect negative correlation and dispersion. The high similarity of dust in neighboring areas results in the positive spatial autocorrelation. The negative autocorrelation describes patterns in which neighboring areas differ and random patterns exhibit no spatial autocorrelation.

Discussion of Results

The results of the frequency distribution of dust in different periods showed that in the first period (1986-1986), the core of the occurrence of the summits was observed in the central parts of Khuzestan province and south, while during the second period core events, it is formed in the form of spots in northern parts of the province. In the third period (1996-1996), the core of dusts is almost the same as in the first period, with the exception that during this period the severity of the events has decreased. Distribution of dust events in the fourth period (2001-2005) has almost reached the same level as the second period, with the exception that the aggregate core has tended to be closer to the border areas of Iran and Iraq. In the fifth period (2006-2010) and the sixth period (2011-2016), the frequency of the occurrence of storms in comparison to previous periods, in addition to being increased, has been observed more in the border areas of Iran and Iraq. The results of spatial pattern changes in the dusts of Khuzestan province showed that the positive spatial Autocorrelation pattern on the districts of the province was more dispersed in the first three periods more sporadically, especially in central parts, southern parts and insignificant parts of Northern Province. Since the third period, the spatial variations of the dust patterns of Khuzestan province have been quite evident. The status of the spatial autocorrelation pattern of dust on the annual scale is approximately the same as the pattern governing the dust of the fifth and sixth periods. In the annual scale, the pattern of the dusty areas of the province in the border areas and parts of Ahwaz has formed a high cluster pattern and the southeastern regions and parts of the north of the province, have a low cluster pattern (negative spatial autocorrelation pattern). As a result of recent periods, the pattern of positive spatial Autocorrelation patterns is more concentrated in the border areas of Iran and Iraq and southern parts of Khuzestan province. The low cluster pattern (negative spatial Autocorrelation pattern) is more focused along the Zagros Mountains and the southeastern provinces of the province.

Conclusions

The dusty phenomenon is one of the most important climatic events in many parts of the world, especially in countries in the dry and dry land, especially in the subtropical regions. In this study, the spatial pattern core of dust the Khuzestan province has been investigated. Then, the spatial autocorrelation pattern was used from two indicators of the Hot Spot Index (GI *) and Moran (I) or Moran Index. The results of this study showed that the dust of Khuzestan province were more severe in the western and southern parts of the country. On the other hand, since the third period, the incident has increased dramatically over recent periods. The results of the analysis of spatial autocorrelations hotspot indicates that during the first three core dust for spots in parts of central, northern (part of Safiabad) and parts of South and West Khuzestan province scattered. The low cluster pattern (negative spatial autocorrelations pattern) is further concentrated along the Zagros Mountains and the southeastern provinces of the province. So, we can say that as far as recent periods are farther away from the border regions, the severity of positive spatial mapping patterns is reduced and, in spite of the severity of the spatial autocorrelations pattern, is increased.

Keywords: dust, index of Alexanderson, hotspot index, Moran index, spatial Autocorrelation.

Assessment and environmental zoning of soil erosion potential using RUSLE model (Case study: Gharahsoo watershed)

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Extended Abstract

Introduction

Soil erosion is one of the serious land degradation processes, which can be exacerbated by intensification of land utilization, land degradation and global climate change. Overgrazing by livestock, unsustainable agricultural practices, over cropping and deforestation, commercial and industrial development, urban expansion, and road construction are the possible causes that accelerate the removal of soil material, which can make serious environmental problems and disastrous economic consequences. So, estimation of soil erosion potential rate and identification of critical soil loss-prone areas is necessary for the best soil conservation management. Therefore, it is necessary to take actions such as management, conservation, and control in the watershed to restore the soil production potential and to prevent further damages. Generally, experimental methods and field observations are often time consuming and costly in developing countries. Therefore, use of alternative and less expensive methods such as various erosion risk models are more desirable to predict and assess of soil erosion rate. The zoning models of soil erosion potential identify critical areas to erosion. Awareness of erosion rate in watershed helps planners and managers to identify critical areas of the watershed as well as to select and prioritize appropriate practices and conservation strategies to control erosion and conservation of natural resources. A wide range of empirical models has been developed to quantify and assess the soil loss. Revised Universal Soil Loss Equation (RUSLE) is one of the most widely used erosion models to soil loss predictions that introduced by Wischmeier and Smith in 1965. The advantage of this model is its convenience in implementation and compatibility with GIS technique, which can be considered as an efficient approach for estimating the magnitude and spatial distribution of erosion. In conclusion, the study shows the application of the RUSLE model in estimating the total annual erosion rate in Gharahsoo watershed, north of Iran. By applying erosion models, we are able to identify the areas with high erosion potential in watershed, and then prioritize them for soil conservation schemes.

Material and Method

The study area is situated in Golestan Province, south of Caspian Sea in Iran. The area of Gharahsoo watershed is 1769 Km^2, which is located between latitudes 33° 36′-37° 00′ N and longitudes 54° 00′-54° 45′ E. Soil erosion is one of the environmental problems that can be considered as a serious threat for natural resources, agriculture, and the environment in this watershed. This study aimed to qualitative estimation of annual soil loss in the Gharahsoo watershed, northern Iran, using the RUSLE model in Geographic Information System (GIS) technique framework. The soil erosion parameters were evaluated for this model applying different methods. The parameters involved: soil erodibility factor (K), rainfall erosivity factor (R), land cover management (C), slope length and steepness factor (LS), and support practice (*P*). The *R*-factor map was obtained from the rainfall data, the *K*-factor map was obtained from the litological map, the *C* factor map was generated based on Landsat-ETM image, and the *LS*-factor was generated by using digital elevation model with a spatial resolution of 30 m. Because the watershed doesn't have conservation practices, the *P*-factor map was assigned the value of 1.0 for the watershed. The spatial distribution of soil loss in the watershed was generated by overlaying and multiplying pixel-by-pixel soil erodibility factor, rainfall erosivity factor, land cover management, slope length and steepness factor, and support practice.

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Discussion of Results

RUSLE is an empirically based model that ability to estimate average annual soil loss and sediment yield based on spatially distributed input data such as rainfall pattern, soil type, topography, crop system, and management practices in a Geographic Information System environment. After establishing the set of factors, input factors should represent as map layer in the GIS-based database to quantify, evaluate, and generate the map of soil erosion potential.

Soil erodibility factor (K)

The soil erodibility factor determines intrinsic susceptibility of soil particles to detachment and transport by runoff and raindrop impact according to soil texture, organic matter, and permeability. For the present study, the soil erodibility (*K*-factor) was generated with the use of the soil map provided by the Soil Geographic Data Base of Iran at the scale of 1:100,000. By considering the particle size, permeability class, and organic matter content, the *K*-value for the soil types were obtained from the USDA soil erodibility nomograph (Fig. 2). Soil erodibility values vary from 0.08 to 0.48 t ha MJ^{-1} mm^{-1}.

Rainfall erosivity factor (R)

The rainfall factor determine the erosive power of rainfall to soil erosion that kinetic energy of rainfall (A storm's maximum 30-min precipitation intensity) is used for indication of erosive power. If the values of these factors have not recorded at meteorological stations, researchers can use readily available rainfall values like annual rainfall that have correlated with *R*-values. In the presented study, the annual and monthly precipitation data for calculation of rainfall erosivity factor was derived from the Meteorological Organization. This data imported into ArcGIS as a point layer and were used for calculating the Fournier index and R factor using Equations (3), (4), and (5). In next stage, the spatial interpolation techniques such as Inverse Distance Weighted (IDW) method were used to generate a rainfall erosivity maps. The *R*-factor was in the range 3.9 to 274.2 MJ mm ha^{-1} h^{-1}. The highest *R*-values prevail in the southern part of watershed and the lowest occurs in the upper of watershed.

Land cover and management factor (C)

The land cover management factor (*C*) reflects the effect of vegetation cover on soil erosion. Plant cover can protects the soil surface from runoff velocity. In order to determine the C factor coefficient, the NDVI layer is required. The NDVI layer was produced by Landsat–ETM^{+} satellite image. The NDVI values vary between -1.0 to +1.0. Healthy vegetation (with photosynthetic activity) absorbed the light red spectrum (R) by plant chlorophyll and reflected the infrared spectrum (IR) by water-filled leaf cells. Therefore, NDVI values for green vegetation will be positive. In addition, areas with low vegetation cover, bare lands, and residential areas usually show NDVI values between -0.1 and +0.1. Clouds and water resources show negative and zero values. Then the *C* factor layer produced according to NDVI values. The *C* factor inversely correlates with the NDVI factor. The *C* factor coefficient was in the range 0.002 to 1.0. As a result, the mean *C* values range inside the watershed from 0.002 for the forest class to 1.0 for the bare land and residential area categories.

Slope length and steepness factor (LS)

The slope length and steepness factors (*LS*) are topographic factors that reflect the effect of topography on soil erosion. The LS calculation was performed using flow accumulation and slope steepness. The flow accumulation and slope steepness was generated based on DEM layer with a pixel size of 30 m using Arc hydro extension in ArcGIS software. In next stage, the sinks in DEM layer were identified using the "sink" tool and were filled using the "Fill" tools. Then, the filled DEM was used as input to calculate the Flow Direction and Flow Accumulation for each cell. In addition, the steepness was generated in Surface raster tool. In next stage, the *LS* factor was computed using Raster Calculator in ArcGIS according to Equation (6). The *LS* factor values in the watershed vary from low 0 to high 32.6%. The highest *LS*-values are associated with steep slopes greater than 15°-20° and 20°-30° slope category in the middle and lower of the Gharahsoo watershed. The lowest *LS*-values consist in flat areas.

Support practice (*P*)

The support practice factor (*P*) reflects the effect of land management such as terracing, counter tillage, etc. in reduced soil erosion and runoff velocity. The *P*-value ranges from 0 to 1, the value close to 0 indicates good conservation action and the value close to 1 represents poor conservation action. Because most regions in

Gharahsoo watershed have no conservative practice management, so the *P* factor coefficient has been assigned as 1.0.

The annual soil loss

When all factors required for the RUSLE were prepared, these data layers were overlaid and multiplied pixel-by-pixel for soil loss per year according to the RUSLE equation. The annual soil erosion value varies between 0 to 54 t ha^{-1} yr^{-1}. The spatial patterns of annual soil loss rates represent that areas with moderate to severe erosion risk are located in the north and southern parts of the study area, while areas with low erosion to moderate risk are located in the central parts of the watershed. In the next stage, the annual soil erosion map was categorized to five risk classes to easy spatial management. The results showed that about 65.9% of the study area is classified under moderate to high erosion risk (>15 ton h^{-1} y^{-1}), while the rest of the area (34.1%) is classified under low to very low potential erosion risk. In terms of actual soil erosion risk, the spatial distributions of erosion risk classes were 20.6% as very low, 13.5 as low, 9.1% as moderate, 4.2% as high, and 52.6% as very high.

Conclusion

Soil erosion is the most important environmental challenges at developing countries, which can have negative impacts such as soil fertility decline, soil salinization, sedimentation in agricultural lands and water storage facilities. A quantitative assessment of average annual soil loss for Gharahsoo watershed was undertaken applying GIS based well-known RUSLE equation. Potential soil loss was obtained by overlaying six factors such as rainfall erosivity, soil erodibility, slope length and steepness, cover management, and support practice. The results showed that soil loss rate varies from 0 to more than 650 tons per hectare per year. The results show that 65.9% of the extent in the watershed is in moderate (9.1%) to high (56.8%) erosion potential. In the studied watershed, the land use pattern in potential areas to soil erosion indicates that areas with natural forest cover in the have minimum rate of soil erosion, while areas with human intervention have higher rates of soil erosion. By reviewing the value of parameter *A* and correlation coefficient of the study area, we noted that the cover management and slope length and steepness factors were more influential than the others. The highest amounts of erosion have occurred in the north and southern regions. In the central parts of the watershed, in spite of high values of *LS* factor (10– 30), the areas depict low to moderate erosion potential. This is due to the dense forest coverage in the region that decreases the energy of rain droplets. In the southern part of the watershed, the erosion rate increased by factors such as steep slopes and medium vegetation density. In addition, the results of this study showed that the factor of cover management with the highest coefficient (0.69) had the most effect in estimating annual soil loss potential in the watershed. According to result, it is appropriate to plantation of tree on steeper slopes, and plantation of tree crops on moderate and slightly steep slopes to protector of soil from the energy of the raindrops and control of soil erosion. The predicted amount of soil loss and its spatial distribution can provide a basis for comprehensive management and sustainable land use for the watershed. Areas with high and severe soil erosion warrant special priority for the implementation of controlling practices.

Keywords: potential annual soil loss, rainfall erosivity factor, RUSLE, zoning of soil erosion.

The effect of high-rise buildings on the pedestrian thermal comfort in urban areas, based on the Penn index (Case study: Hamadan Jihad Axis from Bu Ali Sina Square to Jihad Square)

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Expanded Abstract

Introduction

In relation with buildings behavior against wind, because of being three dimensional, buildings allow airflow around lateral sides same as their top. The wind (air) diverts into three sides following contact on impermeable building, top of roof, lower face to wind edge and sides of the building. The most of main flow is transferred to bottom of wall face to wind which causes to increase of small vertical flows back to the wind created by around short buildings and makes extreme vertical flow near the ground.

If the building to have sharp corners, the increasing wind flow separates on top and sides of building. In result, a suction wind is created for roof, sides and back to the wind wall, from the main perturbation which tall buildings are creating, could refer to downward wind stormy flows and towards street that, in cold climates, this phenomenon could have unpleasant effect on residents. The proportion of width, height and direct of radiation influence greatly on thermal comfort level on the street level and enclosure rate of passage becomes determinant factor. The shadowing in streets, most important, is dependent on main geometry of internal space of street and could be considered function of time. Location and geometric proportions of the street in termis of quality.Generally, tall buildings could be described based on two indices, i.e. height limit determination and settlement location.the city of Hamedan which is the center of Hamedan province, was located on foothill of Alvand. The height of these mountains reduce towards city until reach on a plain. These mountains enclosed Hamedan and only from northeast side, have open and free span. The Hamedan- Tehran road passes through this span. The altitude of Hamedan is 1747 m.

The easternmost and westernmost points of Hamedan are 49', 27" and 48', 20" away from Grennwich meridian respectively and was located in median of 34', 35" to 35' northern latitude. In view of topography. Hamedan, from south and south west leads to heights of Zagros mountaion range such as Alvand with 3574 m altitude which was located between Tuyserkan and 18 km from Hamedan that come back to third era of geology and as move toward north, the level of heights is reduced and in north parts of city, reach to plains with average 1550 altitude which these figures show height difference about 2020 m. the general slape of the area which Hamedan is located on it is toward north and only in parts of north east, the general slope changes toward west.

In the present project, the meteorology data from both weather stations of airport and Nojeh has been used because of not providing data by Ekbatan dam station.

Baded on it, it became possible to recognize using type in whole unit and is appreciable the utilization type of passages in different hours of day and various parts of the road. The conducted interpretations and land use map. Are determinant of commercial use dominance in road- edge of BoAli with regard to other uses.

The review of available activites on Jahad road, has introduced this road as an active commercial road with 90 percent activity, this fact is justifiable with regard to location of Jahad road along the old bazaar of Hamedan.The most rend through this road is related to retail operations and in functional category of sale and services related to durable consumer goods, this type of activates, consists 46.6 percent of total available activities on road. The reason for selection of this road is the presence of tall buildings of trade and administrative ones (Arian and

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Zagross towers).The methodology of research is of description analytical one. In the present research, we conducted library research on Persian and English resources and also field review following recognition of influensive factors on comfort through these resources and determination of research frame in next step in order to designate the heights of total buildings was specified. Also, the latest weather data of Hamedan was prepared from provinces meteorology organization (temperature, wind speed…).
Following review the height data of buildings, total of these data has became three- dimensional in AutoCAD software. With regard to placement position. Construction masses were reviewed through the year, and time gap to analysis were considered as the middle of urdibehesht, Mordad, Aban and Bahman months and also in daily reviews, was based on 10 Am and 16 pm. After that, high- rise buildings were recognized with regard to components of high-rise buildings. Then, data related to temperature and shadow mask and air flow one were analyzed in Ecatect and Air flow Design softwares respectively and the results of this research was obtained.
Condusion) in order to review and analysis of thermal situation of urban context. The context comfort criterion has been used. For this reason, by transferring maximum and minimum means of any month on vertical axis and windstorm speed in the horizontal context of total year moths, the thermal situation of Arian and Zagros towers has been reviewed with regard to comfort region of shadow and sun. Based on provided case, could recognize that through context comfort index could benefit from provided quidence in order to evaluation of thermal situation of one location, determination of it's eating demands and in result, designation of confrontation politics in order to control and promotion of thermal comfort conditions.For example, if it is inferred from comfort index such, the weather of an urban space will be felt comfortable because of presence of shadow and sensible wind flow in summer, it means that, should utilize the solutions related to provision of shadow and increasing wind speed and more ventilation of space and if it is inferred, the weather of desired urban space will be felt comfortable because of presence of sun and lack of sensible windflaw in winter, it means that, designer should utilize design quidences in terms of provision of more sun and reducing wind flow in order to provide space thermal comfort.With regard to that, Hamedan is located in cold and mountainous climate, it firstly was seemed, the presence of tall buildings would disturb the comfort of passengers. But, following review the high-rise building in temrs of thermal comfort on BuAli road, could conclude that, any of these buildings provide different comfort conditions for passengers in various environmental situation and couldn't considers high- rise buildings generally, unsuitable for comfort of passengers.
Therefore, Could propose solutions in order to promote climatic conditions as follows.
1) In order to prevent turbulent wind flow on the passage as much as possible should avoid construction of tall buildings over than 25 m around urban spaces.
2) in the case of construction of tall buildings over than 25 m around urban spaces, in order to divert the created wind pressure by these buildings on the passage, the surface toward urban space of these building should have projections and depressions.
3) In order to reduce the created downward wind pressure around the tall buildings inside the urban spaces, it is recommended that, tall buildings to have circular or poly gonal form.
4) in order to reduce the effect of downward vortex and consequently, promotion of comfort conditions against the winter wind, the tall building should have circular and aerodynamic comers and it's narrow front be toward winter wind and/ or be angular relative to wind.
5) In order to prevent from intensification of created turbulent flows by tall buildings around or inside the urban spaces, the concave front shouldn't be used for the front face to winter wind.
6) In order to prevent from intensification of the effect of corner around tall buildings, it is recommended that. Tall buildings with wide plates don't be directed against dominant wind.
7) In case of locating passage beside the tall buildings, in order to protect passage surface from created corner effect by tall buildings, the passage should be preserved with windbreak.
8) In order to reduce underside winds in urban spaces in cold season for buildings higher than adjacent ones face to wind, they should be designed as stepping and retreat form Retreat should be started from 6-10 m above street level.

Keywords: Thermal comfort, Tall Buildings, Hamadan Jihad Axis.

Measurement framework for assessing Iran's provincial state in terms of green economy concept

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Expanded Abstract

Introduction

The concept of green economy was first introduced in 1989 by a group of environmental economists aiming at setting up operational sustainability agendas, developing a framework for measuring the rate of economic progress in the form of a report for the UK government. Following these efforts, in 1991 and 1994, reports titled as blueprint 2: Greening the world economy and blueprint 3: Measuring Sustainable Development was re-published. In 2008, this concept was revived by the United Nations Environment Program (UNEP), which supported the idea of "green stimulus package" for certain areas where massive public investment leads to green growth. Also, in April 2009, a Global Green New Deal (GGND) report, including a series of operational restructuring policies for the economy, was published by one of the authors of the Green Economy Blueprint.
As a summing up of all existing definitions, the green economy is defined as a new redefinition of the concept of sustainable development and the new 21st century model of economically sustainable, low-carbon economy with low emissions that respects ecological frameworks and capacities while supporting peaceful coexistence of human and nature. Having this introduction with the intention of answering the main question of "What is the status and position of Iranian Provincial Regions in terms of the Green Economy Concept?" the present paper aims to "formulate a proper framework for assessing the analogical situation of the Provinces according to the concept of the green economy" and "pathology situation of the regions". Due to the incomplete conventional global benchmarking methods in the regional analogical assessment, in this research, the proposed methodology of a multi-sections based on the typological analysis has been used in the framework of PSR-analysis (pressure-state-response).
As the outputs of this research, the regions are divided into six groups: (non-developed), unsustainable regions, unpredictable growth regions, protective and distributive areas, the emerging areas towards the green economy and the green economy regions. Four approaches to absolute protection/ prevention, contingency or restorative, sustainability and ecological innovation have been proposed base on the location.

Materials and Methods

In this study, meta-synthesis methodology has been used to infer the proposed operational framework as a result of the reviewing the operational frameworks in the world. Based on this methodology as well as the frameworks of the main sources and references in the field of green economy indices, the proposed pressure-state-response model of the Organization for Developmental-Economic Co-operation, the conceptual framework of this paper has been formulated and proposed in the form of the following chart. As a compilation of writers in this framework, the green economy refers to the balance between the two pillars of the environmental sustainability system as well as the economic growth and development system.

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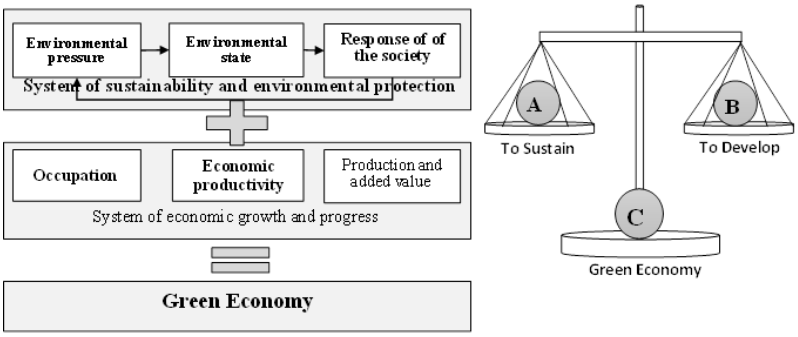


Fig. 1. The Conceptual Theoretical Framework of the Paper on Green Economy Concept

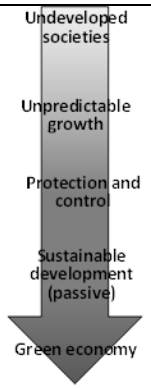
Based on the conceptual-operational model, and with the intention of assessing the status of the provinces of the country in terms of the green economy concept, the following steps have been taken in the agenda:

• First step: Determining the operational (measuring) model of the green economy and proposing measuring indices for the dimensions and components of the model based on the meta-analysis of the indices introduced in the quadruple resources of UNEP, OECD, World Bank and GGGI for the green economy.

• Step 2: Collecting the required data for measuring each index, producing a composite index (CI) in order to measure the components of the operational model while generating a model for measuring the green economy of the 31 provinces.

• Step 3: Explaining the wisdom and the logic for the typology of the 31 provinces based on the conceptual model of the paper aiming to rank and assess the analogical state of the regions. Then they were classified in six categories in a structural analysis based on the logic and wisdom of Table 1.

Table 1. Typology of the regions based on the green economy concept (the basis of the conceptual model of this research)

	The continuum of sustainability system	The continuum of growth and development system	Typology of regions based on the green economy concept
	Low consumption	Low production	First type: undeveloped societies
	High consumption	Low production	Second type: unsustainable societies
	Unpredictable consumption and distribution	Unpredictable growth of production and GDP	Third type: regions with unpredictable growth
	Consumption Control and Production / Production (Pressure Reduction)	Distribution of wealth and job creation	Fourth type: protective and distributive regions
	Consumption and production within the framework of environmental potentials and constraints along with the innovative promotion of environmental capabilities (environmental improvement)	Productivity and efficiency	Fifth type: regions moving towards green economy
	Green and innovative production, consumption and employment along with environmental responsibility	Competitiveness and Fair Productivity	Sixth type: regions with green economy

• Step 4: Analogical analysis and assessment of the provincial state. In this final step, the position and analogical state of the regions is determined. In this four-dimensional diagram, (1) the horizontal axis (X) represents the growth and productivity of the economy, (2) the vertical axis (Y) represents the amount of pressure control imposed on the environment. Also, (3) is the intensity of management and control responses from these regions to environmental issues in four different sizes, and (4) is the environmental state as well as the natural and human assets of the region. These are represented in the form of colored circles from white to black (meaning the natural richness of the area).

Discussion of Results

Based on the proposed methodology of the research, in order to provide an accurate understanding of the relative situation of the provincial regions, the four-dimensional analyzing and assessing logic of analogy for the regional state according to the composite index of the green economy are classified according to their state in one of these four dimensions based on the six states:

- Regions that have a relatively higher productivity, economic growth and competitiveness, but at the same time have made a lower relative pressure on the environment and also provide optimal response to environmental issues are classified as the regions with green economy.
- Regions with a relatively high productivity, economic growth and competitiveness (higher than average) and at the same time have brought a relatively low (below average) pressure on the environment, provided that they offer an appropriate response to environmental issues, are classified as the regions moving towards a green economy.
- Regions with a relatively high impact on environment (above average) experience a range of very high to moderate growth and are categorized as the regions with unpredictable growth. Of these, the regions that are facing environmental poverty and have not responded adequately to environmental challenges, are far more unsustainable.
- Regions that have a low growth and production but at the same time add high pressure to the environment are categorized as unstable regions.
- Regions of relatively low growth and low pressure on the environment are classified as protective regions.
- Regions with very low economic growth, which have little impact on the environment are classified into undeveloped and basic regions.

Based on this conceptual classification and the analysis made:

- There are no provinces with the green economy in the country;
- Yet, the province of Semnan can move towards the green economy in case of providing measures to confront existing environmental issues and planning to respond to environmental challenges. This will be achieved by adopting strategies. Also, Kohkiluyeh and Boyerahmad province can maintain this in case of controlling the pressure on the environment by improving the tension and water poverty, reducing carbon dioxide and carbon emissions in different sectors, with an emphasis on oil and gas industries, as well as optimizing water consumption and energy carriers.
- Ilam, South and North Khorasan provinces are considered as undeveloped regions.
- Hormozgan, Khuzestan, Yazd, Markazi, Tehran, Kerman, Isfahan, Qazvin and Fars provinces are growing rapidly due to high consumption and high pressure on the environment. So, they are far from achieving the status of green economy. Among all, Tehran province will have the opportunity to access the green economy due to the better position in the environmental responses in case of controlling the pressure on the environment and improving the productivity of the economy. But provinces such as Yazd and Hormozgan will lose their resilience in the face of the ongoing economic downturn and environmental constraints (natural poverty).

Other provinces of the country are considered unsustainable because they have neither good economic efficiency nor proper control of their environmental pressures. Among them, the provinces of Qom, Zanjan, Hamedan, Golestan and Alborz have a much more critical situation because of the limitations and poverty that they have in terms of renewable and non-renewable environments and the quality of human environments as well as human health and safety.

Conclusion and Compilation

Based on the model of the research and given the need to pay attention to the differences in the regions, the macroeconomic approaches to green economy planning could be categorized in four groups. (A) Strict approaches of precautionary or absolute protection that focus on less emissions and limitations on the use of natural resources and the production of publications and waste. The regions with unpredictable growth of the land are in this group. Of these, Hormozgan, Yazd, Esfahan and Qazvin, which are also facing natural poverty, are in the top priority. (B) Forecast or post-crisis approaches (environmental restoration) that focus on responding after an environmental crisis.

This approach will be effective in the regions of natural richness and positive ecological balance (environmental capability is more than environmental pressures), and their economic growth is a priority based on the national divisions or internal strategies. (C) Sustainable approaches that focus on adjusting population and activity loading within the framework of regional environmental capacity. In this approach, consumption and economic growth are coordinated with the speed of nature's self-healing. (D) The ecological innovation approach focuses on modified and updated patterns of low carbon or zero-carbon production and consumption. Application of this approach seems to be more effective in the spatial planning system of provinces such as Tehran, which, in terms

of environmental response and development status, enjoys a more appropriate position than the majority of regions. Although the successful realization of the green economy agenda requires the integration and simultaneous implementation of all the outlined approaches in the regions, of course, with different prioritization of approaches based on regional conditions.

Green production and employment, through increasing the attractiveness of green jobs, will help to maintain or restore environmental quality. This will require education through strengthening the institutions of consolidating the green economy and training various skills to promote this concept. To meet the needs of green skills, in addition to the need for governments to participate in the provision of green skills, joint efforts by employers and professional education institutions as well as higher education are essential. Support for innovation and green entrepreneurship and technology development will also help to establish environmentally friendly production processes: Attracting and supporting the flow of green investments through legal and financial measures, building capacity and awareness of the development of green infrastructure, promoting energy efficiency, water, renewable energy, industry, and so on.

Ultimately, the implementation of the aforementioned depends on the planning, management, and monitoring phase through a combination of operational tools and approaches, such as the implementation of the national and corporate integrated environmental and economic accounting or full cost accounting (FCA), both in the calculation of national added value and in the auditing of profits and benefits of economic units, fiscal environmentalism, new environmental regionalism, Green Taxation System, carbon trading system and emissions, necessitating a Strategic Environmental Assessment (SEA) in integrated land use plans at national and regional levels, and promoting community participation in the conservation as well as using sustainable management practices.

Keywords: green economy, performance assessment framework, provincial regions of Iran, regional planning, sustainable development.

Ecological landscape design in semi-arid areas on basis of water sensitive urban design approach (Case study: Mohajeran City)

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Expended Abstract

Introduction

Today cities are facing a variety of complex challenges called “wicked problems”. Increase in frequency and severity of rainfall and long periods of heat and drought resulted from climate change, urban population growth and its consequences, water crisis and its’ supply challenges, environmental pollutions in all dimensions, and extensive changes in land use are some of these issues. There are different approaches to integrate managing water resources in urban areas, one of which is "Integrated drinking water management" suggested between 1960 and 1970 by the Civil Engineering Society. This approach has been introduced as *low impact development* in the United States, *sustainable drainage system* in the UK, *water sensitive urban design* in Australia and New Zealand, and *the sponge cities* in the Netherlands, which is generally known as the Green-Blue Infrastructure.

Australia is the pioneer in the development of Water Sensitive Urban Design (WSUD) approach due to climate change and drought. WSUD is based on a decentralizing approach in water resources management which focuses on the local Practice. The purpose of this approach is to plan and design the urban fabric in order to manage and protect the natural water cycles in the urban environment in a way that ensures the sensitivity of water management to hydrological, natural and ecological processes. This approach seeks to manage two contradictory problems of flood/ runoff and water stress both caused by drought. For this reason, it tries to conceive the cycle of water as a multi-layered system, avoid isolated and fragmented approaches, and manage the water system in the artificial environment and ecosystem appropriately. WSUD approach is comprised of two key dimensions. The first dimension is water sensitivity consideration and the second dimension is planning and designing. In the first dimension, the integrity of water management in the urban environment is considered while in the second dimension, the planning and design of landscape regarding the management of water resources is regarded.

In hydrology, the concept of ecological design is well defined by WSUD. Ecological design can be considered along with WSUD in landscape design, which embraces any form of design that minimizes environmentally destructive impacts by integrating itself with living processes.

Nowadays, more than 500 cities in Iran are facing water shortage problems. The city of Mohajeran is one of them, which is the study area in this paper. This city has difficult emitting runoff during the rainy season and suffers from the drought in the dry season. We believe that following WUCD principles and employing ecological principles concurrently is the best approach to address these problems in such cities.

Methods and Materials

In this study, after reviewing the literature about water shortage resulting from climate change, rainwater harvesting, reusing of gray water in urban landscapes, and promoting water consumption efficiency, the ecological principles were applied to create a strategic plan to improve the urban landscape. The second part of the research was conducted based on the ecological design principles, suggested by Van der Ryn and Cowan in 1996, and WSUD concepts, in order to design an effective green landscape. To achieve this goal, it was necessary to estimate the exact volume of rainwater using Equation (1).

$$Q = C_a \times S \times A \times (H \times 10^{-3}) \quad (1)$$

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where Q [m^3] is the annual volume of collectible rainwater; Ca is the average runoff coefficient; S is the seasonal loss coefficient (the ratio of rainfall in rainy season to annual rainfall); I is the initial split-flow coefficient (the ratio of rainfall rejecting the first flush to annual rainfall); A [m^2] is the rainwater harvesting area; H [mm] is the rainfall with different occurrence probabilities. Ca was estimated by using Equation (2).

$$C_i = \frac{\sum A_i \times C_i}{A} \quad (2)$$

where Ci is the runoff coefficient of different underlying surfaces; Ai [m^2] is the areas of different underlying surfaces

Runoff is a precious resource and should be reused in Mohajeran. However, this fact has been neglected and, as the consequence, many problems such as inundation, flooding, and water shortage in dry seasons have been generated. In order to come up with an appropriate solution for this problem, the runoff should be stored and reused. To calculate the capacity of cisterns that are capable of storing water in the rainy season and being used in the dry season, we used Equation (3).

$$V = A \times C_a \times h \quad \times 10^{-3} \quad (3)$$

where Ca is the runoff coefficient of different underlying surfaces; Ai [m2] is the areas of different underlying surfaces; and h [mm] is the rainfall with different occurrence probabilities.

Another uncommon water resource that can be used for irrigation purposes in Mohajeran is grey water. Applying some stages of purification will help this water to be reused for this purpose.

Annual precipitation in the study area is 337 mm. Therefore, using Equation (1), the volume of the collectible water was calculated to be 4021.7 m^3 annually. The total volume of runoff belonged to rooftops (2389.8 m^3), asphalts (1241.5 m^3), and paved. Figure 3 shows the volume of collectible water in different land uses in the study area.

This article assumed that the collectible rainwater in residential areas will be used for sanitary usages every month. Using Equation (3), the volume of cisterns was estimated. The total volume of cisterns was calculated to be 301.1 m^3 and 435.4 m^3 for rooftops, and 156.5 m^3 and 226 m^3 for asphalt. The population of the study area in 1395 was 268 people. According to the Water and Sewage Office of Markazi province, each person produces 154 lit gray water. So, the total volume of gray water in the study area was calculated to be about 41.3 m^3 per day.

Discussion

Heavy rain in rainy seasons along with rapid constructions and increase in the rate of impermeable surfaces in Mohajeran put this city in the danger of severe floods in rainy seasons while the city suffers from water shortage for irrigation purpose during dry seasons. Therefore, by the collection and the storage of runoff during winter, fall and spring, and the reuse of the harvested water in summer, we can deal with these natural phenomena.

The ecological strategies that are considered for this area, according to site analysis, are categorized into four categories of protective, offensives, restoration, and opportunistic strategies. In the first category, protection, the native green patches that are adapted to climatic conditions and are resilient will be protected. Species that are scattered in different patches, but they are native, drought resilient and adopted with climatic and environmental conditions are also protected. Obviously, the water infrastructure has been designed to provide water for this sector, based on the previous section. In the offensive strategy, patches that are not adapted to the local conditions of the area are identified and inappropriate or exotic species will gradually be replaced by appropriate species. In order to achieve the objective of this strategy in a better way, the design of the infrastructure for supplying water is also considered. The sample of this group of patches can be found in some parts of the study area.

In the restoration strategy, those parts of the area that are degraded or damaged due to construction or urban infrastructure development will be restored. Restoration actions include the restoration of the degraded patches and ecosystems, rehabilitation of ecological connectivity between patches, and renovation of ecological water streams.

In the opportunistic strategy, the objective is to create green structures in the area or changing some grey infrastructure to green infrastructure. Managing and designing integrated water management, and creating green patches in suitable areas are other practices to make diverse patches, with emphasis on habitat creation. In all these cases, ecosystem resilience and ecosystem integration are considered.

Conclusion

Landscape design could apply ecological principles in order to deal with climate threats, especially in dry regions. The city of Mohajeran was selected as a study area to examine its potentials for improvement based on ecological design and hydrological planning. The results demonstrated that green spaces in urban landscapes

could be developed by utilizing all water resources, and urban landscape could be improved through appropriate water resource management. As a result, ecosystem services will be improved by the development of urban landscape through ecological design principles and WSUD approach.
It is necessary to focus on the decentralization approach and integrated water management while considering the application of appropriate landscape design strategies in order to reduce the need for water. Through this study, it is demonstrated that water resources management in the WSUD framework in coordination with ecological landscape design could address some of the environmental challenges such as reducing urban water demand.

Keywords: ecological design, Mohajeran, water resource, water sensitive urban design, water shortage.

Simulation and determine hydraulic capacity Gorsouzan estuary in urban flood whit use HEC-RAS model (Case study: Part of Bandar Abbas)

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Expanded Abstract

Introduction

The flood can be considered as the most important natural disaster which has the highest probability to occur, and has the most impact on the people life in comparison with the other natural risks. Furthermore, climate changes increase the probability and frequency of flood. The floods have direct relationship with the social and civil problems, environmental problems, and economic losses. Evaluating and managing the flood risk is a base for identifying the current risks, the ready areas for flood and reducing the future flood disasters. The Hydraulic Simulation Models are a proper substitute for improving and managing the channel function by understanding the flow behavior in channel network. HEC-RAS software is provided by Hydraulic Engineering Center which is related to the engineering team of America army, to analysis the river system. by the fifth version of HEC-RAS model. The user is able to one dimensional and two dimensional simulation of the unstable flow. The HEC-RAS model is an integrated program which calculates the water surface profile by using the energy equation.

Materials & Methods

The coastal city of Bandar-abbas is the capital of Hormzgan province and is located in the south of Iran. This city, in the north of Hormoz strait, is on the way of some runoffs which are coming from Geno Mountain and going to the sea. This transport is done by the five estuaries. These estuaries are acting as the drains of the city which disembark the surface runoffs of the city to these estuaries. The under study area includes Gor-souzan estuary in the coordinate of northern 27 degree and 10 minute and 30 second to 27 degree and 12 minute and 30 second, eastern 56 degree and 15 minute and 30 second to 56 degree and 18 minute and 30 second which is a part of city with the area of 0.252 km^2. The height change of the district is between 1.05 and 44.58.

Gor-souzan estuary channel was drawn in the Arc GIS, 10.2 versions, based on the map DEM with 2*2 mm^2 pixel, and 1.500 tilt and blocks. In the section of the geometric data of the HEC-RAS model, to determine the exact border of the channel bottom and its surrounding and also to control the high points of the channel bottom by a GPS device, the number of the Ground Control Points in each 500 m range was considered 32 points. All of the points were moved to the Arc GIS environment. Then for rivers geometric simulation, after providing the Triangle Irregular Network model (TIN) by the use of the existing tools in the appendix HEC-GeoRAS, the layer of the estuary's main channel, 6 subsidiary channel, 170 cross- section on the estuary's main channel and 3 cross- section on each estuary's subsidiary channel and the effective parameter of the Blocked obstructions were drawn.

The format of the mentioned parameters are changed and moved to the HEC-RAS software. Some of the parameters including six bridge structures and two culverts, contraction coefficient caused by sections narrowing equal to 0.1 and the expansion coefficient caused by sections opening equal to 0.3 were considered. One of the important and effective parameters is Manning roughness coefficient. This coefficient was determined based on frequently field visits in the different channels sections, model guide, experts ideas, the offered tables in the technical books such as the Hydraulic of the Open Channels and Chow method, for the main section of the channel between 0.016 to 0.024, subsidiary channels between 0.013 to 0.019, the sides of the main channel between 0.014 to 0.016, the sides of the subsidiary channels between 0.011 to 0.015, and right and left flood plain between 0.01 to 0.03. In the under study urban basin and upstream basin, there is no hydrometric station

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any discharge registration base. Therefore, we started to measure the flow speed and depth during five raining, in three points of the channel, by the help of gauge and current meter. The Manning coefficient was checked in the sections that the depth and the speed of the flow were measured between 0.016 and 0.024, and the results were evaluated based on N.S coefficient and squares error and mean.

In the other hand, there are two natural basins in the upstream urban district. There is no rain measuring station with discharge in these two basins. In order to determine discharge or return period, the nearest station, called Bandar-Abbas rain measuring station with 30 year statistical period length, from 1392 to 1362 was used. And by the method of soil conservation structure (SCS), different discharge or return periods were calculated. In order to do calibration of soil conservation structure (SCS) model in the output and begging of the urban upstream basin, the input discharge of the upstream was measured during a rain occurrence.

In order to determine the capacity of the hydraulic channel, after modeling the under study range with the different discharges, rating curve of each section was formed. Then the height of the Bank Station Points (or the border points in which the flow point overflows from the section) in the right and left sections were determined. In the place of separation of the main section of the channel from the right and left flood plain (in the place of Bank Station), the number of right and left points of the river were studied and moved to the discharges, rating curve. From discharges, rating curve, the flow discharge corresponding to the right and left points of the channel were determined and the least flow discharge (from two studied discharge) was considered as the secure discharge or capacity. Then, finally, by the help of the existing information of the interval geometry and the flow kind of the performed model, the flood areas of the return period were calculated. Flood level in the different sections, among all output data of HEC RAS model including the water depth, flow speed in the different sections as the output were considered.

So, the output data was entered GIS environment in order to provide the flood area. In the Arc Map, by using HEC-RAS outputs, the maps like the flood area per each return period was obtained. To determine the absolute sensitivity of each parameter, we calculated the relative sensitivity level (SL) according to it the flow features are categorized based on their level of importance. To analysis the model function in calibration phase of the statistical tests, two methods of the error analyses are considered. The first one is Nash-Sutcliffe efficiency, and the second one is Root Mean Square Error. In this part, in order to study the flood with the different return period in Gor-souzan estuary and the flood area of each of them, we have simulated the hydraulic behavior of the flood flow in the stable mood. And this simulating is proposed in four scenarios.

In first scenario, we have no input discharge from the upstream basin, and the sea is tide. The upstream and downstream border condition is introduced as the normal depth.

In second scenario, we have input discharge to the urban basin from the upstream out of the city basin, and the downstream condition of the urban basin which ends to the see and is considered as the sea tide condition. To define the downstream border condition, the six normal depth methods were used.

In third scenario, we don't have the upstream discharge input, but the downstream condition which is the sea and is the high. In this condition in order to define the downstream border condition we measured the water height in the estuary. This measurement was done in the time of maximum high. Therefore, in order to introduce the height of the high, we used the known W.S option for the downstream condition. And the upstream condition was introduced as normal.

In forth scenario, we have the upstream basin of the input discharge to the urban area. In the downstream condition, the sea is high. In this scenario, for the upstream condition, input discharge of the out city basin, and for the downstream condition, the height of the high water, was introduced.

Results

By considering that the flood with the return period of 25 years was chosen as the flood of the study designs and the base of the determining the basin limit and the under study district, so with the increase and decrease changes of the manning coefficient, the sensitivity of the average changes of the water height and the flow speed mean of the Gor-souzan estuary were evaluated. The results showed that by increasing the Roughness coefficient, the amount of the water depth increased, but the flow speed showed an inverse relationship. The results of the evaluation showed that by considering the RMSE and N.S factors for the water depth and the flow speed, the simulation model of HEC-RAS has proper efficiency. The results of the calibration of the Soil Conservative Structure (SCS) is also caused by the proper efficiency of the model. The result conclusions of hydraulic simulation of the under study estuary flow is presented in the following based on the different scenarios.

Scenario 1: Based on the first scenario, not entering the flow discharge from the upstream and the tide condition of the sea, the capacity of all intervals of the main channel of Gor-souzan estuary has the ability to transport the flows with the different return periods. Of course, in some intervals, some parts of the estuary channels do not have the ability to carry 100 year discharge. But, the most of the intervals own the ability to carry discharge with the different return periods.

Scenario 2: In this condition on average, from the first interval to the fifth one, has the ability to carry 10 to 25 year discharge, and in some parts there is the ability to carry discharge with 50 year return period. But in the sixth and the seventh interval, the best ability of these two parts of the channel is in transporting the discharges with under 100 year return period.
Scenario 3: In this condition, the situation of the first to the fifth intervals of the channels is the same of that of the first scenario, but in the sixth and the seventh intervals, because of the high water condition and rising the sea water in the estuary, the ability of discharge transportation from these parts in the different return periods decreases to 23.5 and 40, respectively.
Scenario 4: Based on the fourth scenario, the first to the fifth intervals show the ability to carry discharges with 25 year return period. The sixth and the seventh intervals, with the high water condition in some sections, and full capacity, generally have shown a good ability to carry discharge with 50 year of return period.

Discussion and Conclusion

In this research for zoning the flood risk, we have used the combination of two hydraulic and hydrologic models, because of the lack of any data related to the flood and not existing any hydrometer station. At the first the Soil Conservative Structure (SCS) method was used for the hydrologic calculating. By considering the measurements of the depth and flow speed in three sections of the channel, the results of the validation showed that this method, by considering data shortage, can present good results, as in the calibration level, on average, the statistical coefficient amount was higher than 0.75, which shows the good simulation. In the following, to study the hydraulic behavior of Gor-souzan estuary, we used HEC-RAS model. Also, to calibrate the roughness coefficient as an effective factor in the simulation procedure, the measured rain was used. The obtained results from calibration and validation of HEC-RAS model, between the amounts of model simulation and the observations of the water depth and flow showed that based on the statistical coefficients RMSE and N.S. This model has a proper efficiency. Therefore, in each measured sections, the average amount of the roughness coefficient was determined. These results are correspondent to the findings other researchers in the field. Also, the findings show that HEC-RAS model with the high accuracy and low cost can be used for studying the hydraulic features of estuary channel flow, by considering the conditions of Bandar-abbas city which is located on the coast.
From the other hand, the two software Arc GIS and HEC-RAS have the proper ability to show the results of the flood zoon, and this is correspondent to Patel and Gundaliya, 2016. The results of the flood zoning shows that from the total of the area in the 100 year floods zoning, on average about 50.5% are ready for flood by the floods with the return period of 25 year or less. This is correspondent to the findings other researchers, who know the percentage of the 100 year floods zone ready for the 25 year floods. Existence of the tide and high water, which has impact on the Gor-souzan estuary channel, is somewhat uncontrollable.
Based on the third scenario and the condition of the high water, although some parts are faced rising the water, but still the estuary channel has the ability to transport the 100 year discharges. But, based on the second and the forth scenarios which we have input from the upstream basin of the discharge, the capacity of the channel is decreased extremely and we observe the extreme floods, it is shown is 7 to 10 figures properly. In fact the estuary channel only has the capacity to transport the discharge of the urban area. Therefore, by considering the urban planning, we must pay enough attention to this problem.

Keywords: flood, Gor-souzan estuary, hydraulic capacity, sensitivity analysis, zoning.

CO removal using single stage plasma- catalytic hybrid process in laboratory scale

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Extended abstract

Introduction

Air pollution treatment using plasma- catalytic hybrid process is an acceptable approach, accounts for high efficiency and economic effectiveness in the world. In spite of various advantages of non- thermal plasma, two technical problems associated with this technology should be solved before its industrial application. In addition, catalytic treatment alone has limitations such as performance at high temperature, deactivation of catalytic active sites, not economic for treatment of low concentration of pollutants. Therefore, the combination of plasma with catalyst has been interested by most of the researchers.

The technology of Plasma Driven Catalysis (PDC) possess energy saving importance to treatment of exhaust gases from stationary and mobile sources. In comparison with common catalyst, PDC has advantages including high distribution of active species, reduction of energy consumption, increase of catalytic activity and selectivity as well as low sensitivity to poisonous.

Removal of carbon monoxide pollutant emitted from stationary and mobile sources at indoors and outdoors based on plasma combined catalyst supported on precious metals, in particular, Platinum Group Metals (PGM) had been investigated by most of the researchers. In addition to the high cost of these catalysts, they have also performance limitation in low temperatures. At the present study, CO removal using plasma combined mixed metal oxide catalyst has been investigated.

Materials & Methods

In present study, three types of reactors have been applied. A coaxial Double Dielectric Barrier Discharge reactor (DDBD), a catalytic reactor including catalytic mixed metal oxide film of Ceria-Zirconia- gamma Alumina (CZA) coated on quartz tube by sol- gel dipping method, and a single stage plasma- catalytic reactor (plasma driven catalysis) which is combination of two above mention reactors and catalytic film has been applied in NTP discharge zone. In design of reactors, two inner and outer tubes of quartz and Pyrex have been used with outer diameter of 4 and 10 mm, respectively. It is notable, in catalytic and hybrid reactors, quartz substrate (inner tube with D_{out} = 4mm) is coated by catalytic film of CZA.

In plasma alone and plasma- catalytic reactors, Tungsten wire is used as cathode, copper foil as anode, and high voltage AC power supply has been applied to support strong electric field.

Design of Experiment (DOE) and desired performance conditions for hybrid reactor have been chose by considering of optimum performance condition of plasma and catalytic reactors.

Discussion of Results & Conclusions

The effect of gas stream temperature on removal efficiency. This effect is found significant in plasma alone reactor ($p < 0.05$) but not significant in catalytic alone and hybrid reactors ($p > 0.05$). The positive effect of temperature on removal efficiency is described by improvement in the secondary decomposition of hydrocarbons as well as increase of impaction surface of active molecules following suitable temperature and decrease of gas stream viscosity in reactor space.

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The interaction of gas stream temperature and space time is found significant ($p < 0.05$) in hybrid reactor which could be important from specific input energy aspect.

The effect of space time on removal efficiency. This effect in plasma alone reactor is significant ($p < 0.05$) and the mean removal efficiency is improve with increase of space time. At the catalytic and hybrid reactors, this effect is not significant ($p > 0.05$). However, the optimum condition of removal efficiency is when the space time is decreased. Improvement in removal efficiency of CO due to positive effect of space time is explained by mean power enhancement of discharges and thereby space time increase, as mean power determines the mean electron density which in turn, gives the excitation rates and molecule separation in gas. Also, from specific input energy aspect, optimum removal efficiency is achieved at low specific input energy (SIE) and lower space time of experiments (0.13 s) at 80°C.

The effect of C_3H_8/CO ratio on removal efficiency. This effect is positively significant in the catalytic reactor ($p < 0.05$), but not significant in plasma and hybrid reactors ($p > 0.05$). However, presence of propane shows better removal efficiency in both NTP and Hybrid reactors. It is concluded that carbon monoxide removal is being improved due to hydrocarbon decomposition and thereby, generation of hydrocarbon radicals.

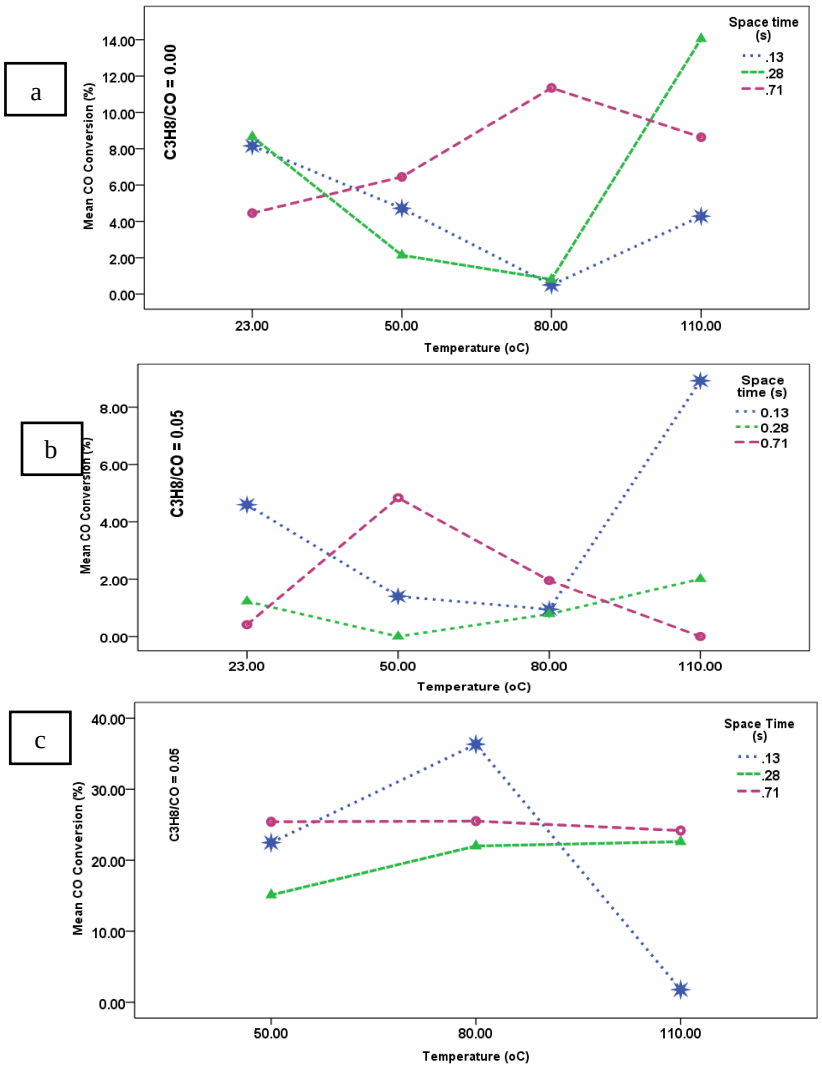

Fig.1. The optimum performance conditions of CO removal using non- thermal plasma only (a), catalytic only (b) and plasma- catalytic hybrid reactor (c)

Temperature and space time interaction. According to data analysis, the interaction of temperature and space time in hybrid reactor is significantly positive ($p = 0.001$, Fig. 2). Based on the studies, this effect can be explained by the key role of some active species, in particular, OH radicals at the presence of hydrocarbons.

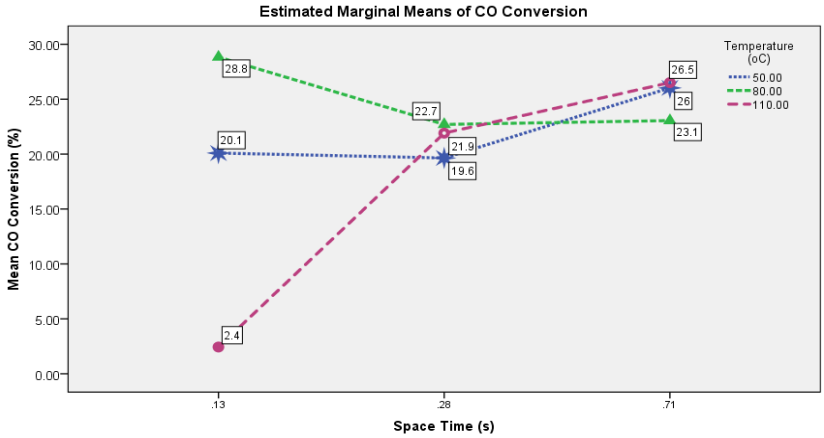

Fig. 2. Temperature and space time interaction in hybrid reactor

Synergy factor. The synergistic effect of plasma combined with catalyst on CO removal at 80°C is better, due to improvement in catalyst activation temperature, reduction of activation energy and also, better selectivity results from positive interaction of plasma discharges and catalyst active sites (Fig. 3).

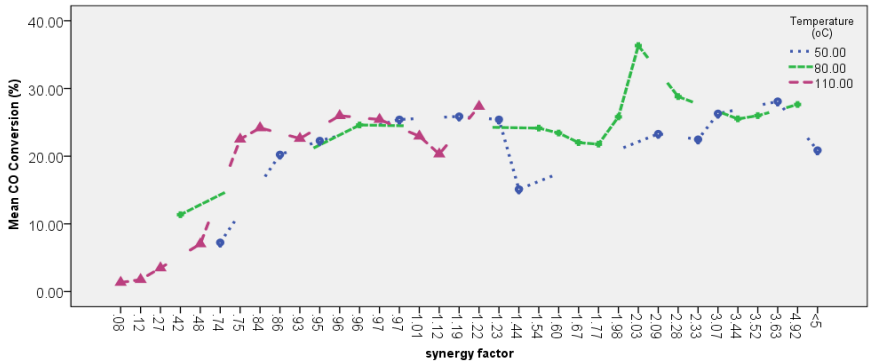

Fig. 3. Synergy factor of plasma catalyst hybrid process in CO removal

Conclusion

Air pollution is a worldwide challenge and its control using clean technologies are being interested of many researchers from different aspects. Carbon monoxide removal using plasma- catalytic hybrid reactor has been studied from different viewpoints of improving removal efficiency, catalytic performance temperature, energy consumption, hydrocarbon decomposition, and synergy factor of hybrid process. The mean removal efficiency of CO (36.33%) is achieved using single stage hybrid reactor at optimum experimental condition of temperature= 80°C, space time= 0.13 s, C_3H_8/CO= 0.05 and specific input energy of 860 j/l. Also, our findings confirm positive synergy effects of plasma and catalytic techniques in pollutant removal and synergy factor of 2.03 is achieved.

Keywords: carbon monoxide, PDC, plasma- catalyst, removal, synergy.

A investigation of the quantity and quality of coastal solid waste (Case study: Coasts of Noor city)

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Extended abstract

Introduction

Coastal areas are always attractive for tourists due to special features. Descending the environmental quality of coastal areas as a consequence of human activities, tourism as an effective factor causes pollution of the coasts. One of the most important environmental problems in these areas is the lack of proper waste management. A large amount of solid waste is accumulated daily on the coast and causing serious damage to these areas (Rezazadeh et al., 2013; Joozi et al., 2012). Noor city is one of the most favorable regions of Iran for tourism due to its natural and climatic conditions, especially in the summer. Also, it has ease of access to Tehran and other populated mega city of Iran. At present, the municipality of the Noor city, as a trustee of waste management in the coastal areas, collects waste from these areas like other areas on a daily basis and transfers directly to the waste disposal site of the Noor city. Solid waste in coastal area disturbs beautiful landscape. One of the most important factors in improving the environmental and health conditions of the coast, is proper waste management. Solid waste management is a big challenge in the coastal area. First step in designing waste management systems is calculating the amount of generated waste. Generally, various factors are effect generation rate increase, including economic situation, geographical location, seasons, days of the week, and customs (Del Angizan & Mahmodi, 2012). One of the most important duties of the municipality is waste management, which includes collecting, transporting and disposing it, and a significant portion of the municipal budget is allocated to it. Therefore, increasing tourism in coastal areas and the amount of waste generated by them Couse to increase that cost. Therefore, in order to improve the environmental and health conditions of the coasts, planning and management of waste is necessary.

Material & Methods

Noor city as the center of the Noor county with a population of 26,947 people is located between 36° 34' 25" northern latitude and 52° 00' 50" eastern longitude. The length of the shoreline of the Noor city is about 11 km. Due to the public access to coast and investigating these coastal areas by existing maps and field visits, three stations were allocated for sampling reasons.

This research is a cross-sectional descriptive study and the solid waste of coastal areas of Noor city during 12 months from July 2017 to May 2018 has been investigated. The weight analysis method has been used to measure the quantity of waste. Random samples were taken from the contents of the bins available at the selected stations. Every month, three weeks were determined, and two days a week were selected, and 216 random samples were performed in year. For studying the effects of tourism and holidays on the composition of waste components, sampling was performed on Mondays and Thursdays. Sampling of the contents of each beans was performed to separate the components and determine the weight. These components were divided into eight categories: degradable, paper and cardboard, glass, plastics, PET, metal, textile and others. From the results obtained each month, a numerical mean for each of the eight components was obtained. In order to measuring density of solid waste, one sampling every month and tree sampling every season perfumed and means of them calculated as a seasonal density. According to information of the Governorate, the Municipality and the Cultural Heritage and Tourism Bureau and field visits, the approximate number of the visitors was estimated during the year. Then, data were analyzed using SPSS software, ANOVA and Tukey tests.

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Discussion of Results & Conclusion

In order to improve and increase the participation of people, it's needed to effective and efficient programs to increase people's awareness and the importance of recycling them to reduce environmental pollution. Based on the results of this research, the highest part percentage of waste components were included respectively: degradable (53/50 %), plastic (17.39%), paper and cardboard (8.48%), other (6.69%), glass (4.98%), PET (4.22%), textile (2.69%), and metal (1.77%). The results of the study on Scotland's coast in 2007 also showed that parts of waste consist of plastic (46%), glass (9%), metal (6%), paper (6%), textile (4%), wood (4%), ceramics (3%), other (2%), rubber (2%), poly Styrene forms (7%) of the waste weight (Storrier et al., 2007). The results of the investigation on the Catalan coast of northeastern Spain showed that plastics (21%), degradable (28%), glass (22%) and paper (4%) are main parts of waste (Ariza et al., 2008). This difference can be due to cultural differences, nutritional patterns, and quality of raw materials. In the study, the annual rate of degradable is 53.50 % of the total waste. Therefore, it has a high potential for material and energy recovery such as compost or digester. Also, 39.8% of the total waste product is recyclable materials, including paper and cardboard, plastics, glass, PET, metal and cloth, which can be taken as an effective step in the recovery of waste. The results of this study showed that the average annual density of waste was 172.70 kg/m^3, and the highest amount of waste density was related to summer season with 238.08 kg/m^3 and the lowest amount was in winter 12.08 kg/m^3. Since, having more moisture and density in fruits and vegetables, and generally , degradable materials are higher than other components of the waste, having large amounts of glass in summer as a result of the increased use of these products, having increased the density in this season than in other seasons. The results showed that theper capita of daily waste generation in the Noor city and in the study area is 1.4 kg and 0.620 kg, respectively. The results of study on the island of Menorca in Spain (2013) showed that the per capita of daily waste generation by urban residents and a tourist is 1.48 kg and 1.31 kg, respectively (Mateu-Sbert et al., 2013). This difference (1.31 kg compared to 0.620 kg) in per capita generation of each tourist can be due to the following reasons: (1) The present study is conducted only in part of the coastal areas of the Noor city, while on the island of Menorca, total waste of the island has been examined. (2) It can be due to the difference in economic, social and cultural status between two regions. In support of the above, the daily per capita generation in whole city of Noor (1.4 kg) is slightly different from that per capita in Menorca Island (1.48 kg).

In this study, the highest amount of waste generation was in September and the lowest amount was in December. In the coastal Liduo plague of the Ramsar city, it was stated that waste generation in the months of August and April is higher than in December (Bakhshi et al., 2013). This comparison showed that the situation in the regions is somewhat similar because of the months of the tourist's presence. There was also a significant difference between visitors to the coastal areas of the Noor city in different seasons of the year, where in summer has the largest number of visitors. By the study in the coastal Liduo plague of the Ramsar city, there was also a significant presence of tourists in the warm months of the year stated (Bakhshi et al., 2013). In the present study and Bakhshi et al. (2013), there is a direct relationship between holiday and number of tourists with waste generation. One option can be considered is managing based on the policy of separation from the source by the customers, giving tourists two bags of different colors at the time of their arrival and obtaining appropriate deposit to ensure that they would return wet and dry components of their wastes.

One-way test (ANOVA) was used to examination the different components of waste in the months of the year. There was a significant difference in the variables of degradable, glass, plastic, and PET in different months ($p <$ 0.05). Average difference between the different components of the waste and the months based on Tukey's test was presented. The results showed that there were the highest amount of spoilable materials in the July, August and September, and a significant difference between them and other months (in a significance level of 0.05) was seen. It is expected that the generation of degradable will increase in the range of study area due to holidays, weather conditions, increase in the number of tourists, and more use of fruit, vegetables in accommodation period. Tukey's test showed that the glass has the highest content in July and August, and there was a significant difference between July and August with other months. Also, there was no significant difference in compared to April, July, and September. The reason for this difference can be the increase in people's use of drinking glass bottles to relieve thirst in hot summer months. The results showed that the highest amount of plastic was in April, and there was a significant difference between April with November, December, and March, but there was no significant difference with other months. One of the reasons for this item can be traveling tourist on Norooz and their excessive use of plastic jars and vacuumed food in the coastal areas. The results showed that the highest amount of PET was in August and it had a significant difference with other months, but there was no significant difference in compared to April, July, August, and October. The reason of this item could be from increasing the use of water bottles by travelers due to thirst in hot months in coastal areas.

Keywords: costal areas, Noor city, quantity and quality of waste.

Photocatalytic degradation of humic acid in aqueous media using MnFeN-tridoped TiO_2 nanoparticles

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Extended abstract

Introduction

Humic acid (HA) derived from decomposition of plants and animal's residual and it widely present in surface resources of water. They are found to be the main precursor of carcinogenic disinfection byproducts (DBP_S) such as THM, HAA in in the water disinfection process with chlorine. Nowadays, several techniques have been applied for removal of HA but they have their own limitation. Recently Photocatalytic oxidation based on semiconductors has been widely studied. Photocatalytic processes are types of AOPs processes that start with the radiation of photons (equal to or greater than energy bands) on the surface of the semiconductor catalyst and generation of electron/hole (e^-/h^+) in the valence and conduction band respectively. The photons generated holes ($h^{+)}$ and electrons (e^-) produced hydroxyl (OH°) and super oxide (O_2°) by oxidation and reduction of adsorbed H_2O molecules and dissolved oxygen. Therefore, OH° and O_2° radical efficiency can removed HA at catalyst surface.

TiO_2 is considered as one of the best catalyst due to its high photocatalytic activity. However, the broad application of TiO_2 has limited because of its large band gap (3.2eV) which requires UV light irradiation for photocatalytic activity. Furthermore, high recombination rate of photogenerated e^-/h^+ pairs is another drawback that reduces the quantum efficiency of TiO_2.

Research has shown that doped TiO_2 with various metal and nonmetal ions is one of the most promising strategies to solve these problems. The ions dopant in TiO_2 can improved the photocatalysis efficiency by decreases the band gap and inhabitation of the e^-/h^+ pair recombination. In this study, TiO_2 doped simultaneously with Fe, Mn and N. MnFeN-tridoped TiO_2 was synthesized by so-gel method and photocatalytic activity of the synthesized pure TiO_2 and tri-doped TiO_2 evaluated by monitoring the degradation of HA as target pollutant.

Material and Methods

MnFeN-tridoped TiO_2 was prepared by a traditional sol–gel method. In a typical procedure, a certain amount of TiCl4 as procedure of TiO_2 was added dropwise into deionized water under strong magnetic stirring in water bathroom. Then, another solution containing ethanol and certain amount of precursors of nitrogen, iron and manganese was dropwise added to the above solution to form sol. After stirring for 30 minute, drops of ammonium hydroxide were added wisely into above obtained solution to formation of white precipitate and solution was made to settle for twelve hours. Then, precipitate was centrifuged and washed with deionized water. Finally, the precipitate was dried in oven at 200°C for 4 hours and nanoparticles MnFeN-tridopedTiO_2 was obtained. The resulting nanoparticles were calcined at 400°C for 3 hours.

The crystal structure of the samples were characterized by X-ray diffraction, SEM, XRD and EDX analyses. The photocatalytic activity of MnFeN-tridopedTiO_2 particles evaluated by degradation of HA in atmospheric pressure and room temperature. The experiments were conducted in a lab-scale batch photocatalytic reactor with a 3500 ml capacity under the radiation of ultraviolet and visible light (6 lamps with 30 w intensity) sources. The

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nanoparticles were fixed on a glass bed and synthetic solution containing humic acids, flows on the glass bed using a peristaltic pump.
The effects of pH values (3, 5, 7, 9, 11) nanoparticles dose (0.5, 1, 1.5, 2, and 2.5), initial concentration of humic acid (2-50 mg/L) were investigated as critical parameters. HA concentration was monitored using spectrophotometer at wavelength of 254 nm.

Results & Discussion

Characterization of nanoparticles

The results obtained from the XRD analysis of pure TiO_2 and doped TiO_2 with N, Fe and Mn nanoparticles indicated that all samples consist of anatase phase as the dominant crystalline phase nanoparticles. The size of the nanoparticles was calculated with Scherer's equation. It is observed that the size of nanoparticles decreased with increasing ions dopant into the TiO_2 lattice as follows TiO_2>$NTiO_2$>$FeNTiO_2$>$FeMnNTiO_2$. It might be due to this fact that the dopant ions can restricts the crystal growth. Furthermore decreasing peaks intensity and increasing the width of the peaks confirmed the substitution dopants into TiO_2 lattice. The surface morphology of pure and doped TiO_2 with N, Fe.N Mn.Fe.N nanoparticles are revealed by SEM micrographs. SEM micrographs of doped and un-doped nanoparticles exhibit particles size in the range of 20–60 nm, which is in agreement with the results obtained from the XRD analyses. These results confirmed the impurity added to the TiO_2 structure by preventing the expansion of the Ti-O-Ti bond decrease the growth of the crystalline particles. Also, EDX analysis indicated the corresponding signals to Fe, N and Mn in the synthesized samples that confirmed all dopants incorporated into the TiO_2 crystal structure. Fourier transform infrared (FTIR) analyze of synthesis nanoparticles performed in the wavenumber range of 400–4000 cm^{-1}. The absorption peaks at about 3440-3420 and 1630-1620 are related to stretching vibration of O-H and the bending vibration absorbed water molecules. The bands in the range of 400-800 cm^{-1} were attributed to the symmetric and asymmetric stretching vibrations of Ti-O-Ti and Ti-O bands.

Effect of operating parameters on the degradation of humic Acid

The effect of different values of pH (3, 5, 7, 9, 11) on photocatalytic degradation of HA was evaluated in a solution with the same initial concentration of humic acid (10 mg/L), dose of stabilized nanoparticle on the surface of glass bed (1.5 g MnFeN-tridopedTiO_2) under ultraviolet radiation for 120 minutes. The results showed that the maximum degradation of HA was obtained at pH=3 (86.72%) and the degradation percentage decreased with increasing pH to 11. At acidic pH, the surface of the titanium dioxide due to existence of h^+, has positive charge. Therefore, removal efficiency of HA increased by electrostatic attraction of the negatively charged HA molecules and positively charged TiO_2 surface.
In order to evaluate the effect of catalytic dosage on photocatalytic degradation HA, different amounts of nanoparticles were investigated. This study showed that the increase of dosage of nanoparticles and the increase of removal efficiency. The increase in degradation efficiency with increasing dosage of nanoparticles can be attributed to increasing the available surface area, number of active sites at the catalyst surface and UV trapping that leads to the more electron/ hole pairs release and production more oxidizing radicals such as OH° and O_2° to degradation of HA.
Effect of initial concentration of HA on the efficiency process was tested by various concentrations (10, 20, 30, 40, 60, and 100 mg/L) in the same reaction conditions (1.5g MnFeN-tridopedTiO_2 fixed on the glass, pH =3) under ultraviolet radiation for 120 minutes. In this study, with increasing initial concentrations of HA, from 2 to 50 mg/L, the photocatalytic degradation efficiency of MnFeN-tridopedTiO_2 nanoparticles decreased from 92% to 30%, respectively. In the photocatalytic process with the constant reaction condition such as pH, catalyst dosage, intensity light and contact time leads to production the same number of electron/ holes and also hydroxyl radicals. Therefore, by the same number of available oxidizing species, the solution with a lower concentration of HA will have a higher decomposition rate than a solution with higher concentration solution. Also, at higher concentrations, more HA molecules were absorbed on the surface of the catalyst, which prevents from reaching photons on catalyst surface that leads to reduce the formation of hydroxyl radicals and efficiency of photocatalysti.
In order to evaluate the photocatalytic efficacy of various samples of doped TiO_2 nanoparticles (N-doped TiO_2, Fe-N-codoped TiO_2 and MnFeN-tridopedTiO_2) and pure TiO_2, photocatalytic degradation of HA took place in the same conditions (10 mg/ l humic acid, pH= 3, and 1.5 g catalyst dose) under radiation of ultraviolet radiation. Results showed that the photocatalytic activity of nanoparticles follows the UV/TiO_2 <UV/N-dopedTiO_2 <UV/FeN-codopedTiO_2< UV/ MnFeN-tridopedTiO_2. Increasing photocatalytic efficacy with substitution of impurity elements (N, Fe, Mn) into the structure of TiO_2 relative to pure TiO_2 can be attributed to the reducing crystalline nanoparticle size, anatase dominant phase, efficient separation of electrons/ holes and reducing their recombination rates in the charge transfer path.

The effect of all synthesized nanoparticles with visible radiation on the degradation of HA in optimal conditions (10 mg/L HA, pH= 3, and 1.5 g catalyst dose) was investigated. It was observed that photocatalytic activity against visible light has improved with the substitution of N, Mn, Fe into the structure of TiO2. N, Mn and Fe doped with titanium dioxide reduce the energy gap by creating sub-levels between the capacity and conduction bands. Thus, by reducing the energy gap, the light absorption spectrum changes to the visible light region and photocatalytic efficiency of TiO_2 increases against visible light.

Conclusion

According to the results obtained from this study, it can be concluded that simultaneous doping is an effective way to improve the efficiency of photocatalytic activity of TiO_2 in the removal of environmental pollutants such as humic acid in aqueous media. Also, by doping of TiO_2 and enhancement of visible light response, the sunlight can be used as a natural source of energy in the photocatalytic process.

Keywords: doped titanium dioxide, humic acid, hydroxyl radical, photocatalyst process.

Developing a framework for community resilience to drought in Isfahan through qualitative research method and ATLAS-ti software

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Extended abstract

Introduction

Over the past few decades, studies on local communities have been increasingly developed. In these studies, there is an emphasis on the role of social interactions between community members and the bottom-up approaches to encourage local communities' participation and identify human agents on community level. Amongst the most recent approaches, there is community resilience. Despite considerable progress in defining community resilience and its attributes, there are several ambiguities in the theorization of this concept. Due to the nature of resilience as a complicated and multi-dimensional concept, which is strongly linked to the cultural context of a society, the investigation of the beliefs, attitudes, and values of stakeholders is essential in its conceptualization. Thus, this study conceptualizes community resilience and develops a framework for resilience assessment through the qualitative analysis of various stakeholders' viewpoints and experiences in regard to the matter. Although, before entering the research field, diverse studies related to this concept were reviewed. After reviewing the literature on community resilience and its conceptualizations, research method is presented.

Materials and Methods

The current literature on community resilience mostly focuses on the reaction of communities to the external risks, pressures, changes, and stresses that threaten their welfare, physical and mental health, and identities. The majority of these studies examine the local and small communities with limited geographical extent, such as neighborhoods or small towns.

Finding appropriate indicators for resilience assessment highly relay on developing an appropriate conceptual model for conducting the research on community resilience. Thus, after reviewing the prior conceptualizations, an initial conceptual model was extracted. However, this diagram is merely a primary model and due to the exploratory nature of the study, it is modifiable, and its components can be eliminated or added during the study process.

Since community resilience is a complex and multi-dimensional phenomenon, which is significantly affected by the stakeholders' attitudes, it can be defined differently in diverse communities. Therefore, it is essential to target the identification of participants' beliefs, attitudes, and values. It is also necessary for the researcher to develop a close relationship with the participants, and he/she has to consider the participants as collaborators. In order to achieve this goal, this study utilized the interpretive paradigm and qualitative research method.

Several in-depth semi-structured interviews were conducted with key stakeholders including local residents, government officials, non-government organizations, consulting firms, university lecturers, and researchers. The residents were recruited via available sampling technique and other participants were recruited via purposive sampling technique based on an initial list that was developed including key stakeholder categories. This was followed by sequential sampling to identify more participants relevant to each stakeholder group on the list. The snowball sampling began with the recommendations of the first group of respondents. Lastly, to be able to include stakeholders outside the social network of the first respondents, all key stakeholders on the initial list were also contacted. Each interview was completely recorded and during interviews notes and memos were written.

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The gathered data were analyzed through qualitative content analysis using ATLAS-ti software. ATLAS-ti was mainly used for accuracy and comfort of data analysis process. There were three main steps in data analyses: (1) the initial coding of interviews' texts, (2) the concepts' categorization and themes' identification, (3) the reduction/ modification of codes and themes to achieve the research model.
Case studies were two local communities in the vicinity of Madies (neighborhood aqua-ducts from Zayandehrood River) in Isfahan, namely Abbasabad and Barazandeh districts.

Discussion of Results

Overall, 32 interviews were conducted from May to September 2018. The average time of each interview was 57 minutes. After initial content analysis, 96 codes were extracted. Following several reviews and modifications, some of these codes were combined and integrated into mutual categories. The study conceptualized the resilience of both cases in two major social and communal levels. Additionally, 48 sub-themes and 10 major themes were identified. Therefore, this study confirms the prior conceptual frameworks. However, some other themes and sub-themes also were identified in two selected communities. The main themes of social level include urban governance, economic situation, sustainable development, and laws. The major themes of local community level consist of economic, socio-cultural, political (local governance-institutions), natural, spatio-physical, and informational and communicational.
The main difference between the final model and the initial model involves the addition of social level and its sub-themes. In addition, social and cultural domains were combined and according to the data analysis, spatio-physical domain was added to the model. Finally, due to the critical role of informational and communicational domain, it is placed in the center of the final model.

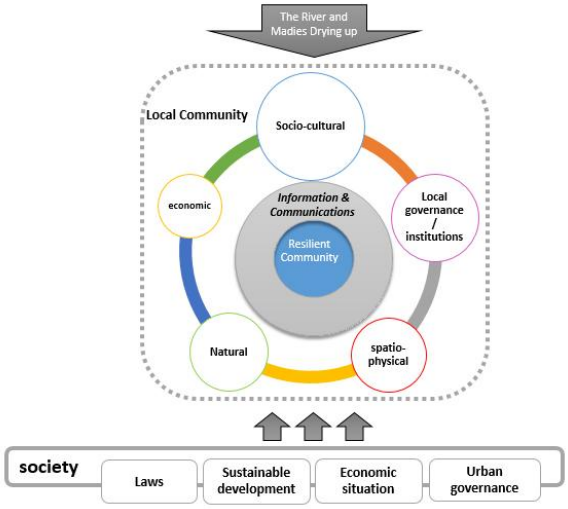

Fig. 1. Isfahan's Resilient Communities Framework

Conclusion

Recently, many studies have examined conceptualization of different natural and urban systems' resilience. One of the recent approaches in the resilience literature is community resilience. Despite developing various community resilience frameworks, few studies have highlighted the role of stakeholders and just few of them have focused on a unique slow-onset hazard, such as drought or rivers and aqua-ducts' drying up. Whereas, resilience is a complicated and multi-dimensional concept that is strongly linked to the cultural context of a society. Thus, this study studied the stakeholders' beliefs, attitudes, and experiences about the main contributing factors to the resilience of two diverse communities in Isfahan.
The study conceptualized the community resilience of the selected communities in two major levels. These levels included society and local community. Additionally, 48 sub-themes and 10 major themes were identified. The main themes of social level critical for community resilience include urban governance, economic situation, sustainable development, and laws, and the major themes of local community level consist of economic, socio-cultural, political (local governance-institutions), natural, spatio-physical, and informational and communicational factors.
Amongst all of the identified themes in this study, the most contributing factor to the resilience of selected communities in Isfahan is socio-cultural domain. This domain included 16 sub-themes and 289 quotations of all

the 32 conducted interviews. Lastly, it is suggested that the qualitative research methods be utilized by researchers working on development of urban and community resilience frameworks.

Keywords: ATLAS-ti, community resilience, Isfahan, qualitative content analysis, resilience conceptualization.

Optimal placement of rows of buildings in residential areas to reduce the accumulation of sand particles affected by sadobistrozeh wind of Sistan

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Extended abstract

Introduction

Iran is located in western Asia. Iran has a variable climate which ranges from semi-arid to subtropical. But in general, Iran has an arid climate in which most of the relatively scant annual precipitation falls from October through April. In most of the country, yearly precipitation averages only 25 cm or less.
Sistan area with 15197 km^2 is located latitude 31 ° 2' north longitude and 61 ° 29' east longitude and 489 m high in the north of Sistan and Baluchestan province and east of Iran. This area is bordered by the north and east with Afghanistan, the border with the Southern Khorasan province and the south with the city of Zahedan. The average number of sunspots per annum for more than 260 days of sunshine, the range of high temperature changes overnight, an average annual rainfall of 64 mm with inappropriate dispersion, high temperature and sunny hours. Zabol is located near Lake Hamun and the region is irrigated by the Helmand River. Lake Hamun is a seasonal lake that is often dry.

Material and Methods

Sistan is one of the windy areas in eastern Iran. In fact, the wind has three main characteristics: direction, speed and frequency. According to estimates of the number of days with storm and dust for a period of 10 years, the Sistan region has more than 1500 days, the highest proportion at the national level. Drought is a dominant phenomenon in the Sistan region, which has also had a profound negative impact not only on the biodiversity of the communities (plant-animal) but also on the physical environment of urban and rural residential areas.
The Zabul area is well known for its sadobistrozeh wind "120-day wind", a highly persistent dust storm in the summer which blows from north to south. The disappearance in the 2000s of the nearby Hamoun wetlands has exacerbated the dusty conditions in Zabul, leading the World Health Organization to name Zabul the most polluted city in the world in 2016.
Although in Sistan (due to the presence of 120 days of winds and the existence of a soil susceptible to wind erosion in this area), erosion has already occurred in the past, but after drought, due to the provision of wind erosion conditions, dust storms have been formed and reached their maximum intensity. In addition to the incorrect management of the drought in the area, it seems that problems such as inappropriate physical shape and inappropriate building patterns in accordance with the existing climatic conditions and the lack of planting of climate-friendly plants in the area seems to have increased the severity of these damages.
Dust storms regularly arise in arid and semi-arid regions around the world. Indeed, the Iran sits in the center of a Northern Hemisphere “dust belt” stretching from the west coast of North Africa, through the Middle East, and across South and Central Asia to China. Winds gusting over the open, level landscape of Iran’s dry plateaus, deserts, and salt flats readily pick up loose soil and sand, lifting bits of dirt and grit into the atmosphere and carrying it tens, hundreds, or even thousands of miles away.
Nationwide, erosion annually strips thousands of tons of surface soil and sediment from every square mile of the country. The resulting dust storms can cloak cities in debilitating air pollution, endangering public health. These thick dust storms can wreak serious damage. Billowing dust can reduce visibility to 100 yards or less, shutting down air and road traffic. Shops and schools are closed. Searing, sand-bearing winds blow down power lines.

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Grit-filled machines grind to a halt. Drifting dust buries crops and farmland, suffocates livestock, and fills wells and irrigation canals. One analysis of the area around Zabol estimated that the lost economic activity and physical damages from dust storms cost the city $100 million between 2000 and 2005.

Results

Yet nature is not the only culprit stirring up the dust clouds that blot the country's horizons. Iran's own water and land management practices have worsened environmental conditions that exacerbate dust storms. So too, Iran's neighbors have made equally detrimental policy choices, with damaging regional repercussions. And lurking behind these national and international pressures, global climate change may further increase drought and desertification across Iran and southwest Asia, potentially intensifying future dust and sand storms.

This wind has accumulated sand and gravel. Due to the severity of these winds and the volume of very fine particles of sand, it is very difficult to control their flow. Creating an appropriate urban form can help reduce these problems. Wind erosion causes problems such as the influx of sand grains, which can lead to severe dust and air pollution, reduced public health, reduced immune system against diseases, children's asthma, threats of sensitive electronic power transfer systems, damaged agricultural land, rural settlements, roads and increased accidents.

Wind flow in complex urban zones is a very complex phenomenon to simulate. CFD is applied to a wide range of research and engineering problems in many fields of study and industries, including aerodynamics and aerospace analysis, weather simulation, natural science and environmental engineering, industrial system design and analysis, biological engineering and fluid flows, and engine and combustion analysis. Scientific Validations of CFD softwares are therefore necessary.

Simulations results presented in this article show that FLUENT is a good tool for evaluating critical effects of wind around buildings. The software has been validated qualitatively and quantitatively for assessing mean wind speeds around an isolated building, around a small group of buildings, in a dense urban area with uniformly low buildings and in a dense urban area including a high building. In addition, this validation process allowed us to define CFD simulations guidelines for numerical wind modelling in order to quantify wind discomfort levels. We studied and optimized the choice of various modelling parameters for wind comfort studies in the built environment: dimension of the simulation volume, size mesh, turbulence model, order of accuracy of the calculation scheme, etc.

Conclusion

This CFD guideline is an important basis for further scientific research in the study field of wind within the built context. The methodology developed in this article may be used in the future to continue this study of critical wind mechanisms in urban areas or to model more specific or complex configurations with CFD simulations.

The statistical data (wind speed and direction) is derived from the statistics of the synoptic meteorological station in Zabul. Subsequently, using computational fluid dynamics (CFD), using simulation to understand the behavior of the wind in urban form. Flow3D software is used for simulation. In this software, the k-standard model is selected. This model is mostly used to simulate the mean flow characteristics in turbulent flow conditions. Modeling was done using 3D drawing software. Boundary conditions and direction of flow and speed were determined.

Due to the nature of the wind, the most important factor in controlling the flow of air on a city scale is space geometry. All spaces between buildings, both horizontal distances, the relationship of the building with its height, are the parameters when exposed to the wind, affect wind in terms of pressure distribution, average speed and etc.

In general, when two or more buildings are constructed in proximity, the fluid flow surrounding the buildings may be significantly deformed and of a much complex nature than usually acknowledged. Knowing the strong dependence of comfort on velocity and turbulence, it is of practical interest to study these flow features associated with certain building arrangements, typical of urban areas and hence to assess the comfort conditions on the neighbour pedestrian circulations. This paper focuses on modeling the airflow associated with natural disasters, especially sandstorms. Article focus on the modeling of airflow related to natural disasters, such as sand accumulation, with urban form studies.

The goal is to understand which kind of urban form can speed up the flow of sand and prevent sand deposits in the building area (streets, alleys, open spaces). Urban design was studied through simulation of airflow using Flow 3D software. Initially, a flat surface was selected with an initial configuration for the model. Each time the flow of air was tested in different models.

In this study, the relationship between urban wind speed and morphological parameters such as dimensions, building geometry and building density were investigated. By creating an appropriate geometric form of the buildings, this research is looking for solutions to reduce this accumulation. For this purpose, simulations were first performed to find the threshold velocity for sand particles, and it was concluded that the wind carries sand particles with a diameter of 50 microns at speeds greater than 2 to 4 m/s and Able to move them. So, to prevent sand accumulation, the wind speed should not be less than 2 m/s. Since sand is more near the surface of the earth and during the winds are not much off the ground due to heavy loads, the study of the airflow at the ground connection to the building was tested in various cases.

According to the simulations performed in four urban models, it is observed that the highest proportion for achieving this goal is for buildings clinging together in a column with an urban length of 80 me and buildings in a row. It was concluded that the maximum urban length is 80 m when the buildings are 1 m above the ground.

It was concluded that urban wind speed could help reducing the depression of sand, taking into account the proper values of these parameters. Therefore, the study of the shape of the city can be avoided by studying the urban form and choosing relationships such as placing a building at a distance of more than 1 m from the ground, and an urban length of 8 m, and connected buildings.

The sand is near the surface of the earth and during the wind they do not get too far from the ground because of heavy heights. The flow of air at the ground connection to the building was also tested in different cases and the behavior of the airflow was simulated around the building (on the ground, at a distance of 1 m from the ground and at a distance of 2 m from the ground). It was found that around the buildings and on the ground, with the wind speed decreasing, at the boundary of earth connection to the building, the speed reaches zero, while the building on the pilot boosts wind speed at all points of the building near the ground.

Therefore, distance from the earth was considered as the next criterion for reducing the depression of sand. Following up with these two subjects (distance from the earth and speeds above 2 to 4 m/s), simulation was developed. Since the structure of the buildings affects the aerodynamic behavior of the wind, and vice versa, the buildings are modeled together in rows, and the aim is to find the E (length of the block block) and also to find the minimum distance from the ground (h) to reach, the speed was up to 4 m/s, and as a result of the decline in sand.

Keywords: CFD Modelling, Sadobistrozeh wind, sand deposit, Sistan.