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Comparing the Performance of Artificial Neural Networks, Decision Tree, Principal Component Regression and Multiple Liner Regression in Modeling Urban Air Quality Index

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Expanded Abstract

Introduction

Air pollution is a problem contemporarily in the large cities of the world . Increase in urbanization and industrialization rate in the cities of developed and developing countries, such as Tehran, has led to increased air pollution. Urban air pollution is a growing global concern, because it has significant impacts on the environment, climate, and public health. Todays, the prediction and estimation of air quality parameters in urban regions are important topics in environmental studies due to their effects on human health. High concentrations of pollutants lead to negative effects and early death of sensitive and vulnerable groups of society including the elderly and those who suffer from shortness of breath. In addition, global concern about the effects of air pollution on human health has increased. There are several strategies for control and management of air pollution. Measurement of air quality are widely used in air quality control plans. These measurements classify air quality based on the amount of pollution and various contaminants. The first measure of air quality is Pollutant Standards Index (PSI) which has been developed by the U.S. Environmental Protection Agency (USA-EPA). This index converts concentration of the main air pollutants such as carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter less than ten microns (PM_{10}), ozone (O_3), and nitrogen dioxide (NO_2) into the air pollution standard index. In 1997, PSI was expanded by the US-EPA and presented under a new index named Air Quality Index (AQI). One of the first steps that must be taken for air pollution control is measuring the concentration of air pollutants including PM_{10}, CO, O_3, SO_2, and NO_2. However, to measure the concentration of pollutants is nothing more than raw data. An index named AQI can determine the relationship between concentration of pollutants and the level of public health and controlling measures related to air pollution. This index classifies air quality into six main groups of good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous. This index also involves the controlling measures related to each class for preventing adverse effects of pollutants on different walks of life. Poor air quality caused by high concentrations of pollutants in the large city of Tehran has caused various diseases and many problems to the public health and welfare of citizens and also causes damage to the environment and living organisms. Hence, assessment and modeling of urban air quality with a nonlinear nature and also determining the factors affecting it are considered as one of the most essential environmental programs in large cities. Therefore, the purpose of this present paper is to compare the efficiency of artificial neural networks, decision tree, multiple liner regression and principal component regression in modeling and estimation of urban air quality index.

Materials and methods

In the present study, hourly data on concentrations of air pollutants and meteorological parameters related to Tajrish and Gholhak stations in Tehran will be used for modeling and estimation of AQI. The data of the study included hourly concentrations of air pollutants including CO, PM_{10}, NO_2, O_3, SO_2, NO, hydrocarbons without methane (NMHC) and methane (CH_4). In addition, the data included some meteorological parameters including wind speed (WS), wind direction (WD), air temperature (T), pressure (P) and humidity (H). Meteorological and air pollution data recorded at Gholhak and Tajrish stations, Tehran, are covering the period from 2005 to 2011 to develop models. For assessment of the performance of the models and comparison of the obtained results in train and test phases, we used statistical indices such as Index of Agreement (IA), Fractional Bias (FB), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Square Error (MSE), Correlation Coefficient (R) and coefficient of determination (R^2). The initial objective of this study is to use the guidelines of US-EPA and

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Iranian Center Environmental Health and Work (CEHW) to calculate air quality index based on the hourly concentrations of each pollutants. In the next step, air pollution and AQI value will be obtained using time series of meteorological data. Then, simulator and estimator models of air pollution will be developed using artificial neural networks (ANN), decision tree, multiple liner regression (MLR) and principal component regression (PCR) methods in MATLAB software. In the first step, concentration of each of the pollutants is the input to the algorithm of AQI calculation and the output will be air quality index for each pollutant. The overall air quality index will be used for development of models along with meteorological data. To develop the models, data were randomly divided into two categories of training and testing. In this study, 80 percent of data were used in the training phase and 20 percent of them were used in the testing phase. The number of samples for Gholhak station is 15872 in training phase and 3968 in testing phase which include 13 input parameters and one output parameter. The number of samples for Tajrish Station is 21370 in training phase and 5343 in testing phase which include 12 input parameters and one output parameter. The final objective is simulation and estimation of air quality index for the studied stations in Tehran. At the end, the methods used for modeling in this study will be compared with each other in order to identify the model which produces better results of estimation and modeling.

Results and discussion

The results of calculation of air quality index show that the dominant class of air quality in Gholhak Station is "unhealthy for sensitive groups" with 11165 hours and the main cause of poor quality of air in this station is nitrogen dioxide. In Tajrish station, the class "moderate" is dominant with 17538 hours and PM_{10} are the major factor responsible for this quality of air. The results of the modeling showed that the efficiency of the applied methods in the study has different performances for the estimation of AQI. According to the findings, CART algorithm is of high performance in estimation of air quality index, as the correlation between simulated and observed values are very close to 1. Error values of decision tree in three phases of training and testing are negligible and similar. Based on train and error, it was found that Perceptron artificial neural network with a hidden layer and Levenberg-Marquardt training algorithm, with 20 neurons in the hidden layer of Gholhak station and 25 neurons in the hidden layer of Tajrish station, yields the best performance in estimation and modeling of the air quality index. In addition, the number of hidden layer neurons and the best number of neurons was determined through 2n+1 (n=the number of inputs) and through minimum error, respectively. The highest correlation between target variable and estimated values was also determined. Also, a Perceptron artificial neural network with 25 neurons in the hidden layer of Gholhak station and 24 neurons in the hidden layer of Tajrish station and conjugate gradient algorithm has a better performance than a Perceptron artificial neural network with a resilient post-release training algorithm. Initial investigation showed that there is significant correlation between the input data used in Gholhak and Tajrish stations. To resolve this problem, Principal Component Analysis (PCA) method was used. KMO test was used in order to determine the feasibility of PCA. Since KMO value was obtained 0.581 in Gholhak station and 0.606 in Tajrish station, the feasibility of PCA method was confirmed. To perform this method, after standardization of input variables, the correlation matrix was established and 13 eigenvalues and eigenvectors for Gholhak Station and 12 eigenvalues and eigenvectors for Tajrish station were obtained. The components 1 to 5 in Gholhak station and components 1 to 4 in Tajrish station had an eigenvalues greater than 1. These components were selected as the main components and used as the inputs to the regression model. The results of models indicated that the regression model created by all meteorological and air pollution parameters has a better performance in estimation of air quality index compared with the model created by the main components. Equations 1 and 2 show the regression model of AQI estimator in Gholhak and Tajrish stations, respectively.

$$AQI = -63/74 + (9/89 \times PC_1) + (0/2 \times PC_2) + (0/19 \times PC_{3)} – (0/094 \times PC_4) - (1/09 \times PC_5) \quad (1)$$

$$AQI = 28/23 + (0/933 \times PC_1) + (0/2415 \times PC_2) + (0/0336 \times PC_3) - (0/0088 \times PC_4) \quad (2)$$

During the training stage, the level of error statistics such as RMSE and MAE for MLR were 10.5 and 5.7, respectively, in Tajrish station, while during the test stage the values were 10.4 and 5.7, respectively, in the same station. Furthermore, during the training stage, the level of error statistics such as RMSE and MAE for MLR were 10.86 and 8.74, respectively, in Gholhak station, while during the test stage the values were 10.77 and 8.69, respectively, in the same station. Comparing these statistics pertaining to the two stations reveals that the MLR model in Tajrish station outperformed the MLR model in Gholhak station. The R correlation coefficient statistics for Tajrish station were 0.9498 in the training stage and 0.9460 in the test stage, while for Gholhak station the values were equal to 0.9007 in the training stage and 0.9050 in the test stage. The correlation coefficient values signify that the correlation between the estimated values of the model for Tajrish station and the observed air quality figures in the same station is greater than that of Gholhak station.

Conclusion

Error statistics in two stations showed that decision tree model in Gholhak Station has a better performance than this model in Tajrish Station. Correlation measures indicated that there is a negligible difference between the estimated and calculated values of air quality in decision tree model in both stations. Correlation coefficient (R) and coefficient of determination (R^2) in both models were very close to 1 which suggests the high ability of regression decision tree model in estimation of urban air quality. Comparison of error statistics in the studied stations showed that ANN model in Tajrish stations has a better performance than this model in Gholhak Station. Correlation coefficient (R) and coefficient of determination (R^2) in both models in Tajrish Station were 0.9996 and 0.9993 in training phase and 0.9995 and 0.9991 in testing phase. These figures for Gholhak station were 0.9997 and 0.9994 in training phase and 0.9996 and 0.9992 in testing phase. Correlation measures indicate that there is a stronger correlation between the estimated and calculated values of air quality in ANN model in Gholhak station compared to this model in Tajrish station. Error statistics in both stations showed that PCR model in Tajrish station has a better performance than this model in Gholhak station. Correlation coefficient in both models was 0.9425 in in training phase and 0.9447 in testing phase. These figures in Tajrish station were 0.6332 in training phase and 0.6298 in testing phase. Correlation coefficient suggests that there is a stronger correlation between the estimated and calculated values of air quality in Tajrish station than those in Gholhak station. Therefore, it can be concluded that PCR model in Tajrish station has a better performance than PCR model in Gholhak station. The use of PCA reduced the number of input variables to the regression model. It also reduces the correlation between input variables, leading to an easier interpretation of linear regression model. The results of investigation of all methods used for modeling and estimation of air quality index in the studied stations show that ANN model with Levenberg-Marquardt training algorithm had the best performance in both stations. The worst performance was observed in PCR model. According to error evaluation criterion, Perceptron artificial neural network with Levenberg-Marquardt training algorithm in Tajrish station presented better performance than this model in Gholhak station. In this research study, the air quality was monitored in two stations. Due to the paramount importance of the air quality issue in polluted cities such as Tehran, it is advisable that future studies can be conducted in a much larger scale, and for obtaining a better understanding about the air quality in highly polluted areas of the city, air quality zoning maps need to be prepared through geo-statistical methods as well as air quality estimation models like artificial neural networks and the decision tree technique within the Geographical Information System (GIS). The findings of this research suggest that the models employed here are proper for the appraisal of air quality in the studied stations. They can be used by researchers as a tool for gaining knowledge about the air quality and taking measures for controlling, decreasing, and preventing pollution as well as for more accurately informing the public on the air quality level in the polluted urban areas.

Keywords: Modeling, Air Quality Index, Artificial Neural Network, Decision Tree, Principal Component Regression

Aannual Numerical Simulation of the Radionuclidal Atmospheric Dispersion and Optimized Monitoring Network Design for BNPP-1

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Expanded Abstract

Introduction

According to the industrialization of human societies, it is obvious that knowledge of environmental pollutants, their emission, transportation, dispersion and control will play as an important factor in the survival of humanity. Monitoring and observation networks are recognized as powerful tools for detection and control of environmental pollution concentration and their applications will be increased when it is combined with predictive atmospheric chemistry and physics tools and will convert to a management tool to be used in comprehensive projects (Rao, 2009).

Environmental monitoring and observational networks are generally designed to detect human health and environment variables. These networks not only detect background patterns but also must have the ability to display anomaly values in critical conditions. Various types of network monitoring such as air quality, water quality, radiation and climatic conditions are designed in this century. Network design is important subject for both public health and human costs of construction and maintenance of the observational stations (Chang et al., 2007). Radiation monitoring networks in order to observe gamma by natural resources and man-made artificial structures (nuclear facilities) are designed in recent decades. Special events such as the Three Mile Island incident (1979) and Chernobyl (1986), Fukushima (2011) shows us the high level importance of radiation monitoring systems design and installation. Some of the criteria considered parameters in such projects are included environmental characteristics of the site region, the meteorological parameters responsible for transport, dispersion and transmission of pollutants and distribution of population density (Melles et al. 2010). The final aim of this study is to design a monitoring network to measure the level of gamma dose radiation in the area around the nuclear power plant in Bushehr. For this purpose, it wants to optimize number and location of these stations in 100 km around this site.

Material and method

In this study, 100 km radius around emission radionuclide source (Bushehr nuclear power plant) is considered as the study area for the aannual dispersion pattern estimation. Bushehr nuclear power plant is located in the coordinate of 28° 49’ N latitude and 50° 53’ E longitude in the Bushehr province and at 20 kilometers southeast of the city of Bushehr.

Dispersion code used in this study by ADIM1.0, is a Double Gaussian function base as follows:

$$C\left(x,y,z\right)=\frac{Q}{2\pi\sigma_y\sigma_z u}\exp\left[-\left(\frac{y^2}{2\sigma_y^2}+\frac{z^2}{2\sigma_z^2}\right)\right] \qquad (1)$$

Where, $C(x,y,z)$ is concentration of an especial air pollutant at the point (x, y, z) (gr. or Bq. per m3), Q is the release rate of air pollutant (gr. or Bq. per sec.), σ_y , σ_z is dispersion coefficients in horizontal and vertical directions (m), u is Wind speed at release altitude level (m/s). This equation is a practical equation in Gaussian

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dispersion computations that with some development and aannual climatic parameters and wind conditions are introduced into ADIM 1.0 model.

Locating algorithm

In this study, we applied some interpolation approaches and approximation function. The locating algorithm is working based on recognition of the areas with the highest standard deviation (σ) of interpolation. The reason for this selection is that in the main criterion of the interpolation methods are minimization of the interpolation error in this purpose. However, the most common method to minimize the error values in the areas with the highest error of interpolation. This is considered as the correct value after conducting the new interpolation. The location of the observational station is considered to be the area with the greatest amount of interpolation error. This method has been used in many projects in order to design the monitoring network. Locating algorithm has been developed in this study, after reading the input dispersion matrix in Matlab software environment. It is applied step by step to be able to determine the location of the first to the last station in the final step as follows:

1) In the beginning, the code searches maximum and minimum of the original function and these values are in the same location in a new matrix.

2) By taking zero values in the four corners of the new matrix and the maximum and minimum of basic matrix, the interpolation is done between these six initial guesses, as the average of the interpolated matrix is equal to the original matrix.

3) The next step, the code is calculating the standard deviation of the differences between these two matrices. The next point for the observational site will be the point with the highest standard deviation.

4) The next step, the original value from basic dispersion matrix in the selective point with the highest error will be replaced by the interpolated value in this point.

5) Now with the values for seven-point, interpolation will be repeated again and the new estimate of the dispersion function will be achieved. The second step will repeat and the point with the highest standard deviation will be in the compression with the main function, and the third step will be repeated.

6) This process will continue until when the estimate of the dispersion function for interpolation is closest to the original matrix and the last place to be find for site establishment.

As mentioned earlier, the purpose of this study was to determine the optimum location of monitoring stations around Bushehr nuclear power plant to 100 km radius and for this purpose we will conduct below four steps to achieve this aim:
A) In the beginning, by conducting annual dispersion simulation using wind directional distributions, boundary layer stability and other input parameters to ADIM1.0 code (Feizinejad and Khamoushi, 2003), annual radionuclide dispersion pattern will be archived. For this purpose, atmospheric observations from BNPP tower and weather station and radionuclide emission data for normal operating conditions (composition and concentration) during 2011 were introduced into the code.
B) By applying an interpolation method (Kriging), the ADIM1.0 radial dispersion pattern (16 directional sectors) in the region is converted to the square pattern mesh with 5 km resolution. Error variance in Kriging method is usually smaller than other conventional methods such as IDW and Spline.
C) The final version of annual dispersion present into developed monitoring network design MATLAB code in this study as input data.
D) The locating algorithm will determine the location of observational stations.

Results and discussion

The converted annual dispersion pattern to square mesh was presented maximum, minimum and average values equal to 348×10-10, 4.6×10-10 and 15×10-10 Bq/m3, respectively. The results showed that the pattern of annual dispersion pattern of ADIM 1.0 code is corresponding to the prevailing wind and bigger vales in the northwest-southeast.
The primary endpoint of the study is to find the areas with the highest standard deviation in the interpolation is worked perfectly valid. The estimated dispersion pattern with increase in replication process of locating algorithm showed more similarity to original dispersion pattern.
The iterations results showed that the rate of decreasing absolute value of relative error level could be approximately around 283×10-10 Bq/m3 between the first to fifth iterations. It could be approximately around

5×10-10 Bq/m3 between the 15th to 20th iteration, and then it is remained almost in this level. According to this interpretation, for optimization of the cost of construction and maintenance of network monitoring, the number of station for monitoring network is considered equal to 20 stations within 100 km radius of the Bushehr nuclear power plant. The spatial distribution of observational network, designed by developed locating algorithm code in this study, is represented in fig. 1.

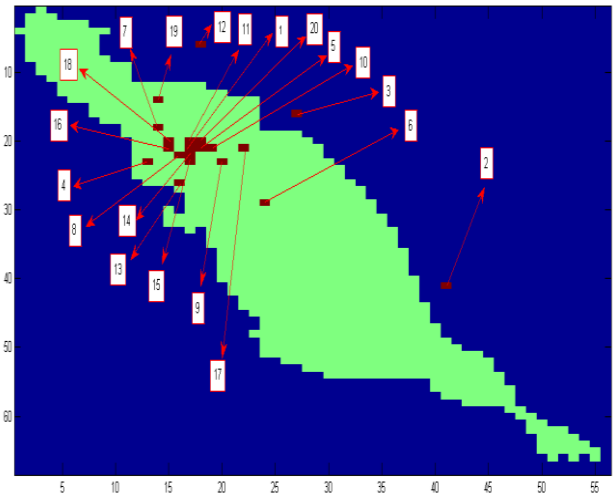

Fig. 1: Spatial distribution of observational network within 100 km radius area of BNPP-1

The 20 monitoring stations can be represented as a suitable view of dispersion pattern of radionuclide particles of the Bushehr nuclear power plant. It will be available to experts and managers for safety and other applications. The results showed correctly spatial distribution anomaly in the South East and North West directions and background values.

Keywords: Monitoring network, Design optimization, Radionuclide atmospheric dispersion, ADIM1.0 model, Locating algorithm

Investigation of heavy metals contaminant in downstream landfilling site of Ardebil municipal waste

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Extended Abstract

Introduction

Landfilling sites of wastes contains big volume of wastes. In recent years, lack of correct management caused landfilling sites of municipal waste as one of main source pollution emission at environment. From among diverse contaminants heavy metals are more important because of environmental stability, biogeochemical process, poison biology, sorption and desorption, redox potential, sedimentation, dissolve, ciliating and hazardous habitat. Heavy metals prevalent in leachate are As, Cd, Cr, Co, Cu, Pb, Hg, Ni and Zn. The traditional method of landfills was directly stack wastes in valley and watercources that are naturally formed in artificial pits and pounds without any treatment to prevent wastes from diffusion and transference is caused during filling, the wastes will release leachate of high concentration due to self-zymosis and rain fall washing as well as dipping in both surface and ground water. This will flow slowly with groundwater, polluting its surroundings for decades, even hundreds of years. The problem and major environmental concerns associated with the dispersal or disposal of industrial and urban wastes generated by human activities is the contamination of the soil. Groundwater pollution from landfills depends on several factors, such as hydraulic conductivity of the strata underneath the landfill site, depth of vadose zone, type of soil in vadose zone, hydraulic gradient of aquifer and the type of landfill. Faults and gaps of rock bed can lead to leachate infiltration in groundwater. Main purpose of this study is investigation of contaminant heavy metal derived from waste landfilling on soils and waters downstream landfilling site of Ardebil municipal waste.

Methodology

Ardebil is a city located in the northwest Iran in central part of Ardebil province in west Alburz – Azarbaijan zone. The landfilling site of Ardebil municipal waste located between 48° 13′ 40″ east longitude and 38° 26′ 33″ north latitudinal. Landfilling site of Ardebil municipal waste with an area of about 50 hectare and at an altitude of 1575 m above the sea level is located in distance 22km north west part of Ardebil city. Daily 300 tons of municipal waste is disposing in this site with traditional method and without any preservative. The location of the study area is shown in the Figure. 1.

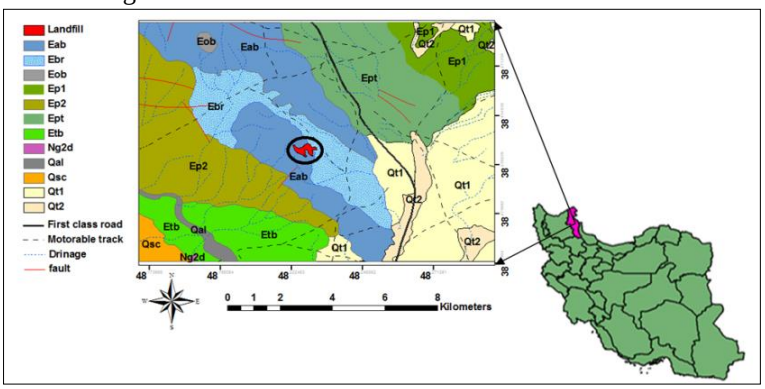

Figure 1. Location of the study area

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In preliminary area we investigated aspect topography, surface and groundwater position, soil texture, soil depth and lithology of rock bed. In order to investigate concentration of some heavy metals in downstream soils landfilling site of Ardebil municipal waste, 1 sample control was taken from distance 400m upstream from landfilling site and 11 sample were taken from distances 50 to 1300m from landfilling site in downstream. To avoid influence of various arbitrary surface conditions, the selected depth of sampling is ranged from 10 cm to 0 cm below the surface. After soil texture and pH were determined in the laboratory, the elements of Cu, Co, Ni, Cd, Zn and Pb were measured using atomic absorption spectrophotometer (AAS). To assess soil samples pollution, the metals concentration in the soil samples was compared with the reference values recommended by Iran soils standard and enrichment factor. The geoaccumulation index was also calculated for all samples. Based on enrichment factor, we can estimate elements concentration relative to their natural concentrations. This factor is calculated from following relation:

$EF = S_c / R_c$

Where, EF is the enrichment factor, S_c concentration of element in soil and R_c is concentration of element in reference material. Bhuiyana et al (2010) divided contamination into different categories based on EF values. These categories are presented in Table 1.

Table 1: classification of enrichment factor values

pollution degree	enrichment factor values
no enrichment	0
no enrichment to moderate enrichment	1
moderate enrichment	2
moderate enrichment to severe enrichment	3
severe enrichment	4
severe enrichment to extremely severe enrichment	5
extremely severe enrichment	6

Geoaccumulation index (I_{geo}) introduced by Muller (1969) can be calculated by the following relation:

$I_{geo} = \log_2 [(C_n) / (1.5B_n)]$

Where C_n is the measured concentration of the element n and B_n is the geochemical background value element n in average crust. Muller divided geoaccumulation index values into four classes (Table 2).

Table 2: classification of geoaccumulation factor values

pollution degree	geoaccumulation index values
no pollution	>0
no pollution to minor pollution	1–0
minor pollution	2–1
minor pollution to severe pollution	3–2
severe pollution	4–3
severe pollution to extremely severe pollution	5–4
extremely severe pollution	<5

Because of impurity in perpetual surface water sampling from surface water, for sampling from ground waters source, 1 sample control were taken from upward landfilling site and 4 samples from downward in dry and wet season. Then, general parameters (EC, pH, COD, BOD, and TDS) and heavy metals (Cu, Fe, Mn, Co, Ni ,Cd, Zn and Pb) of water was measured in laboratory.

Results and discussion

In all the samples, sand particle was very high and soil texture is sandy. The pH values in the samples are ranged from 6.84 to 8.11 and the EC values in the samples are ranged from 9.818 to 17.532 $ds.m^{-1}$. The results of element concentration of soil samples compared with the reference values recommended by Iran soils standard show that Zn is higher and Cu, Cd, Co, Ni and Pb are lower than soils standard.

The enrichment factor results indicate high enrichment in Pb, Zn and Cd elements. Ni, Co, and Cu elements show low enrichment. Considering enrichment Pb, Zn and Cd in control sample is lower than downstream samples. This can be concluded that leacate and litologic and geology conditions can cause enrichment increase in Pb, Cd and Zn elements in soils downstream. With increase in distance from landfilling site, enrichment rate is decreased.

Results of geoaccumulation index indicated that Zn and Cd elements have the most accumulation relative to other elements. With classification of Moller geoaccumulation index areas, soils are extremely polluted by these elements. The soils show that negligible accumulation from Pb, Cu, Co and Ni have negative accumulation and classification of Moller areas soils have no pollution from these elements. Accumulation rate in control sample is lower than downstream samples.

Decrease in concentration of elements measured in soil with increase in distance from landfilling site show leachate influence on downward soils contamination. Soils downstream shows high contamination by Cd, Zn and Pb elements. Given that these elements in control sample are higher but not higher than downstream samples, these metals are derived from anthropogenic and lithologic sources. Lithologic source of the elements are derived from igneous rocks collection of inner and volcanic sources in the area. Anthropogenic source of the elements are derived from colored plastic, battery, medicine apparatus, electronic apparatus and toiletries of wastes. Since the soils are sandy, richment heavy metal is lower.

In the water samples, EC concentration is ranged from 0.502 to 3.815 $ds.m^{-1}$in dry season and 0.348 to 3.655 $ds.m^{-1}$in wet season. EC is in control sample lower and in downward samples higher than standard limit of drinking water of Iran. The pH concentration is also ranged from 7.22 to 7.77 in dry season and from 7.26 to 7.96 in wet season. The pH in all samples is lower than standard limit. The TDS concentration is ranged from 313 to 1754 mg/l in dry season and 225 to 2482 mg/l in wet season. TDS is in control sample lower than standard limit and in downward samples higher than that. The BOD concentration is ranged from 6 to 9 mg/l in dry season and 2 to 4 mg/l in wet season. The BOD in all samples is lower than standard limit. The COD concentration is ranged from 7 to 11 mg/l in dry season and 2 to 5 mg/l in wet season. The COD in all samples is lower than standard limit. The Cu concentration is ranged from 0.008 to 0.01 ppm in dry season and 0.005 to 0.02 ppm in wet season. The Cu in all samples is lower than standard limit. The Fe concentration is ranged from 0 to 0.07 ppm in dry season and 0.02 to 0.09 ppm in wet season. The Fe in some samples is not detected. The Fe concentration in all samples is lower than standard limit. The Co, Ni and Cd were not detected in none of the samples. The Zn concentration is ranged from 10 to 62 ppm in dry season and 16 to 71 ppm in wet season. The Zn in all samples is higher than standard. The Pb concentration is ranged from 0.22 to 0.32 ppm in dry season and 0.16 to 0.38 ppm in wet season. The Pb in all samples is higher than standard limit. High concentrations of Zn and Pb elements are derived from condition of lithology and geology area.

Conclusion

Comparison of data average in samples of downward with control sample using from T-Test showed that soils of landfilling site are contaminated with wastes leachate. Comparison of the results analysis samples of soil with Iran soils standard showed concentration in all of the elements except Zn is lower than standard limit. Calculation of enrichment factor and geoaccumulation index indicated high amount of Pb, Zn and Cd. Results analysis of water samples didn't explain pollution in 5 water samples. Considering landfilling site located in elevation and wells located in a distance from landfilling site leacate cannot pollute those soils. With the findings, the present research can take items in order to investigate geochemical, Medical geology and environmental aspects:

1- Determining leacate pollution index (LPI) in current landfilling site

2- Air analysis to determine the contaminant rate derived from gas emission and smoke due to waste burring.

3- Agricultural lands located in landfilling site downward; it had better do chemical analysis for farm product to determine carcinogen metals concentration such as Cd, Hg, As, Pb and Cr.

4- Considering wells dispersal in low surrounding landfilling site; water samples located in distance 2 to 5 kilometer, for accurate monitoring of groundwater pollution.

5- The Zn and Pb concentrations in both soil and water samples was high to determine origin of the lithologic elements.

Keywords: Ardebil, landfilling site, heavy metal, soil pollution, water pollution

Determination of Mercury Levels in Different Tissues of Common Coot (*Fulica atra*) and Common Teal (*Anas cerecca*) Associated with Age and Sex in the Fereydoonkenar International Wetland

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Expanded Abstract

Introduction

Among the metals, mercury (Hg) is unique in that it is present in different organic and inorganic forms in nature. Its bio-accumulation, abundance, world-wide distribution and more toxic hazards caused most attention to Hg. Metallic of Hg as a special threat for aquatic systems, so that the methylation occurs during biological transport process and concentrates in Biota. Thus, studying environment situations of waterfowls is important with respect to Hg contamination level. Selecting birds can be a good choice for monitoring environmental pollutions such as Hg. Because birds are sensitive to contaminant accumulation, since these pollutions are mainly through the consumption of contaminated foods. In addition, birds feed from top levels in the ecosystem and thus these species can provide interesting information about the monitoring of environmental quality.

Studied birds, Common coot and Common teal have the similar feed strategy, that both are omnivorous. Both studied species have a relatively high position in the food chain. Thus, the aim of this study is to determine Hg concentrations in different internal organs of the Fereydoonkenar International Wetland's birds for the first time and to determine the influence of this metal on their health.

Materials and Methods

This study has been done in the Fereydoonkenar international wetland where the most important wetland habitat are present in the central areas of Hyrcani ecosystem. This wetland is also the overwintering habitat of only surviving flock of Western Siberian Crane in Iran. It attracts about one-third of overwintering bird species (150 species) every year, that will migrate the northern geography latitudes to Iran. The region was registered as the twenty-second International Wetlands in the list of the Ramsar Convention under Fereydoonkenar hunting banned region in 2003.

It was sampled from Common coot and Common teal that are the most widely consumption waterfowls and local people are hunting them as food more than other birds in Fereydoonkenar international wetland in fall, 2011. It was hunted Common teal (Anas crecca; n= 15) and Common coot (Fulica atra; n= 16). Then, they were examined for biometrics after weighing. Sex of the birds was determined through reproductive organs that are located above the kidneys of both species and their appearance shape. Also, the age was identified by the breast feathers and cloacae. Finally, liver, kidney and breast muscle of each bird was completely separated from the body, placed and coded in pollution-free plastic bag and were kept until beginning to analyze in temperature -20 °C.

In order to easily implement the various stages of testing, at first all wet samples were weighed by digital scale with 0.01 g accurate. Then, after recording their wet weight, the samples were dried in the freeze dryer in a temperature of -60 °C for 48h. Then, all dried samples were weighed by digital scale and were powdered by Pyrex mortar. We used the standard method to prepare the samples according to the proposed standard method for biological samples. Then, 0.2 g of the homogenized powder of dried sample (liver, kidney, and breast muscle) was added to 5 mL of nitric acid HNO3 in closed polytetrafluoroethylene (Teflon™) lined digestion vessels and incubated for 20 minutes at 40 °C. The temperature was increased to 180 °C for 40 minutes. The samples were left to cool. Then, 2 mL of H2O2 was added, and the sample was heated again until any precipitation was fully dissolved. Upon cooling, 5% potassium permanganate (KMnO4, ACS reagent) was added to ensure oxidation of all organic Hg compounds. The samples were then heated again to 90 °C for 30 min, cooled, moved to volumetric tubes, where hydroxylamine hydrochloride was added (Fluka, AAS grade, 99.9%)

to reduce excess oxidizing reagents, and were diluted with ultrapure water to 50 mL. All the mineralization stages were carried out in Milestone START D Microwave Digestion System. The elemental Hg concentrations were measured by a cold vapor atomic absorption spectrometer (PerkinElmer AA 700). Argon (Arkan gas, grade 5.0) was used as the carrier gas. Standard solutions (100, 200, and 300 ppb) were prepared with 1000 ppm standard Hg solution (Fluka, analytical standard solution), HNO3 (to achieve 1.5% weight in volume (w/v) of standard solution), 5% KMnO4 (to fix the solutions), and a mixture of caustic soda and sodium boron hydrate solution (to achieve 1 and 3% w/v of standard solution, as regenerative and to react in the reaction flask and release Hg vapors from the samples). The parameters obtained for the calibration curve were good (linearity 0.9996; standard error of the estimate 0.0046).

Analysis of the data was carried out by SPSS 18 software. The data fitted the assumption of parametric tests (Kolmogorov-Smirnov and Levene tests), so the one-way ANOVA followed by the Tukey test was used to evaluate the differences between various tissues on Hg concentrations. Also, we used GLM test (two-way) to evaluate the differences between species and genera {species × sex}, species and age {species × age} on Hg concentrations. In addition, we used the Pearson correlation test to evaluate the correlation between the various organs and total body length and weight and correlation among the organs on Hg concentrations. The significance level was set at 0.05 value in all the analyses.

Results and discussion

The results showed that the highest Hg concentrations were in the liver of both species (0.34±0.16 $\mu g/g^{-1}$ ww in Common coot and 0.28±0.11 $\mu g/g^{-1}$ ww in Common teal). Also, the concentrations of Hg in the kidneys of both species (0.22±0.08 $\mu g/g^{-1}$ ww in Common coot and 0.25±0.13 $\mu g/g^{-1}$ ww in Common teal) were higher than muscle. There was significant difference in Hg concentrations among different tissues (between liver with two other tissues), ($P < 0.01$) in common coot. Also, there was no significant difference in Hg concentrations among different tissues of Common teal. In this study, liver and kidney of both species had greater amount of Hg than their breast muscle. Because in animals, liver is the most important part for detoxification processes that metabolically transforming these harmful compounds to methyl Hg, so they convert harmful components into metabolites, that is directly discharged to bile for detoxification. The Hg salts are excreted through the kidneys and liver, so that the most important excretion route is urine and stool. It also seems that the most important reason for lower concentration of Hg in breast muscle of Common teal and Common coot than the other tissues is physiologic conformity with environment that simultaneously occur with bird growth. This is effective on omitting or neutralizing of Hg. Therefore, after increasing weight and length of bird and then its consistency with environment, the concentration of these metals is declined in muscles and increased in intestine and gut**.** Therefore, these stated issues can be important reason for the higher levels of Hg in liver and kidneys than breast muscle of birds in the present study.

We also compared differences of Hg concentrations in both species according to effects of sex. The results showed that there was no significant difference in Hg concentration between tissues of male and female of both species. The case can be a reason that female birds can excreted out 58% of the Hg in a breeding season from its body. But this amount is equal to 49% for a male bird in a breeding season that is, with a difference, equal to 9%. Therefore, although the female birds can excrete out some Hg during laying eggs from the body, but this amount of Hg which excreted out from body by this way is negligible than Hg excreted out during molting. Then, it can be concluded that male birds sometimes has same or less Hg concentration than female birds. In addition, it may be because both sexes of both species have a similar strategy to find food, which these subjects are true for the birds of this research.

In addition, we compared differences of Hg concentrations in both species by effects of Age. There was no significant difference in Hg concentration between tissues of adult and juvenile of both species. In spite of Hg as a food, it is an unnecessary element for the body and has long biological half-life, so its accumulation in body will increase along with growing and pollution level in environment, molting system of Common coot (60 days, completely) and Common teal (182 days, completely) could be partly due to the above reason. With the sampling season (autumn, the end of molting for both species) more amount of Hg has been excreted out from the adult body of both species. Also, molting of both species is long and they completely lose their feather, subsequently they excrete out more Hg from their body in short period. Therefore, above mentioned instances has been the reason for similarity in Hg level in adult and young birds of both species.

Also, the results of comparing effects of species on Hg concentrations showed that there was no significant difference in Hg concentration between tissues of two species. It seems that presence of both species in similar food level, same environment and using similar food can be due to this subject**.** Common coot and Common teal had similar size and additionally, using same food caused that they have almost equivalent metabolic rate. Thus, it can be the reason of high similarity of Hg concentrations in organs of both species. In addition, simultaneous

migration in Common coot and Common teal and using same fly path during the migration and the same time of sampling can almost be the reason of similarity in Hg concentration in these two species.
The results of correlation of Hg concentrations in various organs with biometric data showed, there was no statistical correlation for the amounts of Hg in different organs of Common coot. This result was the same for Common teal. Just there was negligible statistically significant correlation between the amounts of existing Hg in the liver of Common coot with the length of total body ($P < 0.05$). However, there was not any statistical relationship between other organs of Common coot with body weight and the length of total body. This result was the same for the different organs of Common teal with weight and length of the total body. Therefore, it can be concluded that large body is not necessarily a reason for high levels of Hg concentration in birds' tissues. Because, it is possible that an individual with larger body do not feed on larger prey.
Reports showed that increase in Hg concentrations up to 5000 µg /kg in birds' body cause negative effects on reproduction and the birds' behavior. Also, increase in Hg concentrations to this amount provides fatal symptoms (limit that damage to the animal, but it does not cause death) and even be fatal for the birds. According to the results of this study, Hg concentration was lower than the threshold affecting normal behavior and breeding.

Conclusion

Given the results of the study and position of studied birds in the food web, their crucial role in maintaining this wetland is to place them in some people food basket. Other environmental values on one hand and agricultural activities, especially cultivating rice in the region and people extreme dependence on agricultural lands on the other hand, lead to extreme increase in metals specially Hg in the other living organisms of this region and consequently in humans. Also, in recent years, because of replanting rice in Fereydunkenar International Wetland and using organo chlorine and phosphorous fertilizers and pesticides, even more than the first planting, it seems that the metals accumulation was increased in water, soil and body of living things. Therefore, this study will be a primary hazard warning to increase pollution of metals in this area.

Keywords: Mercury, Common coot, Common teal, Fereydoonkenar International Wetland

Development of pressure management analytical equations in water distribution networks

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Expanded Abstract

Introduction

Considering water scarcity, population growth, increase of water consumption per capita and high cost of drinking water production, optimum use of existing water resources is a vital issue. Pressure management is one of the most effective solutions among the water demand management methods to help solving these problems.
Although pressure management is one of the best methods for water demand management, some operation managers ignore using this method in their water distribution networks and would prefer to use other methods such as water rationing when they face water scarcity. It may be because of lack of experience on pressure management. The main objective of this paper is to show the good results and practicability of pressure management especially for old and existing water distribution networks.
The N parameter in the FAVAD's pressure-leakage formula represents the power-law relationship between leakage rate and pressure. The value of the exponent N may vary from 0.5 for "Fixed Area" leaks to 1.5 or more for "Variable Area" leaks where leak area varies with pressure. In this paper, we employed a new modified method for calculation of the N exponent.

Materials and Methods

An isolated water distribution network in Tehran city was chosen for this study (Figure 1). The region is supplied with only one reservoir. After isolation of the region, a modulated PRV in the entrance of the isolated region was assembled, moreover, a pressure regulator was installed to induce different pressure patterns. Also an ultrasonic flowmeter was used downstream the reservoir to measure input flow to the isolated region.

Figure 1. Satellite photo of the study area, yellow lines (thin lines): distribution network and white lines (thick lines): region border

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Since at the begging of the study the optimum pressure pattern was not exactly known, after preparation of isolated region and setting up the equipment, different pressure patterns were applied to the modulated PRV as try and error process to find the best pattern. These patterns are shown in Figure 2. This process continued by applying more pressure reduction to the PRV until the first complaint was received from the customers. On the other hand, by having different pressure patterns and measurement of night flow for each one, it could be possible to follow changes of night flow with water pressure variation.

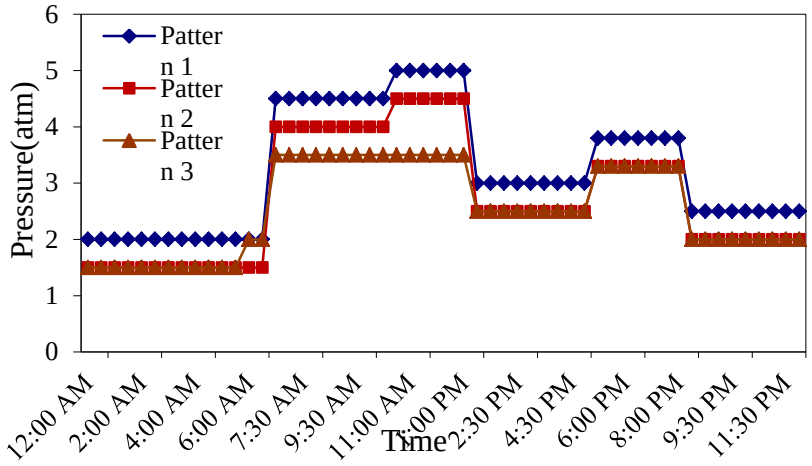

Figure 2. 3 patterns applied on the modulated PRV

For each pattern, inflow was recorded in 10 minute intervals and the measurements were continued for a week. Output pressure of PRV before installation of modulated PRV was 50 meters. It should be noticed that output pressure patterns of PRV were adjusted such that the costumers didn't face any pressure shortage and no complaint was reported during the study.
Different conditions and information of measurements are shown in Table 1. For better comparison of the mentioned patterns (Figure 2), average amount of applied pressure patterns during 24 hours is also mentioned in table 1.

Table 1. Different conditions of measurements

Purpose	Week	Output pressure of PRV
Measurement of minimum night flow, inlet flow and consumers' consumption	1	Constant 30m (in the month of Ramadan)
	2	Constant 50m (in the month of Ramadan)
	3	Constant 50m
	4	Pattern 1 (average 32m)
	5	Pattern 2 (average 27m)
Measurement of minimum night flow	6	Constant 40m
	7	Constant 33m
	8	Pattern 3 (average 25m)

Results and discussion

After completion of measurements, the data was analysed and following results are obtained:
Results show that with no complaints of consumers, total inlet flow reduced about 21 percent in final week. Inlet flow is composed of network leakage and consumer's consumption, reduction of inlet flow means lower consumers' consumption and/or lower network leakage.
To study the effects of pressure management on the consumers' consumption, 64 consumers were selected as sample of total consumers and their domestic water consumptions measured by reading their flow meters in different weeks during the study period. Results for domestic water consumptions are shown in Table 2.

Table 2. The consumers domestic water consumption and saved water values in the different weeks

week	Output pressure of PRV	The Consumers' Domestic Water consumption (m^3/week)	Water Consumption Reduction (%)
3	Constant 50m	1419	0
4	Pattern 1(average 32m)	1222	14
5	Pattern 2(average 27m)	985	31

Results show more than 30 percent of water saving for the consumers' consumption in final week. Minimum night flow is composed of network leakage and consumer's night consumption. Since the amount of consumer's night consumption is almost constant, the minimum night flow could be a convenient indicator for estimation of network's leakage. Minimum night flow occurs at midnight hours and especially between 12 to 4 AM.
The trend of results shows a reduction of minimum night flow with reduction of pressure and a potential for reduction of night flow more than 30 percent. It should also be mentioned that no complaint was received from consumers when final pattern was applied to the modulated PRV. Table 3 shows the measurement results of minimum night flow in the different weeks (weeks).

Table 3. Minimum night flow and upstream pressure of the isolated region

week	Output pressure of PRV in time of minimum night flow (m)	Minimum night flow (m^3/hr)
3	50	21.96
4	20	19.26
5	15	10.69
6	40	18.55
7	33	16.79
8	15	14.44

In this study, using data obtained from the pilot, a novel analytical method for estimation of the pressure exponent (N) has been presented. Using this method, N=1.15 was estimated for the network under study.

Conclusion

In present study, results of pressure management on distribution network show that with no complaints of consumers, some benefits such as leakage reduction and consumer's consumption are practically achievable.
A novel analytical method for estimation of the pressure exponent (N) in the FAVAD equation as well as analytical equations for evaluation of pressure management effects on leakage and water consumption have been recommended.
Considering complexity of water networks in term of flow hydraulic, geometrical and material of pipes, more researches are still needed to study the relation between pressure, leakage and consumers water consumption.

Keywords: Water distribution networks, Pressure management, Leakage, Leakage-pressure relationship, N exponent.

Simultaneous Removal of Salinity and Organic Loading Rate using Phytoremediation

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Expended Abstract

Introduction

Water scarcity has led to the search for alternative water resources. One solution is the recycling of wastewater for irrigation. Wastewater treatment is often based on biological systems such as activated sludge or other engineered units in urban areas. In rural areas, low-cost environmentally-friendly alternative treatments such as constructed wetlands (CW) are more common. CWs are man-made planted systems that utilize natural processes to improve water quality for human benefit. Salinity in treated wastewater is often increased, especially in arid and semi-arid areas.

Phytoremediation is the use of plants to remove or control soil and water pollution. Soluble salts, heavy metals, oil and oil derivatives and radioactive substances are pollutants that have been removed using phytoremediation from different environments.

In the past two decades, use of phytoremediation was thrived in the treatment of urban and industrial wastewater and also the treatment of contaminated shallow soil. The sun is the main supplier of energy and is a clean source of energy in terms of creating secondary materials arising from the treatment. Plants use three organs, root, stem and leaves to absorb various pollutants from soil or water. By transferring the pollutant to its tissues, the plant can collect the pollutants from artificial pond cumulatively.

The purpose of this study was to compare the performance of two plants in simultaneous removal of organic matter and salinity of wastewater. In order to have a close estimation of the saline wastewater characteristics, both saline and organic matters were used. A comparison was also done on morphological characteristics of two plants affected by salinity tensions and organic matter. The results of this study can help the researchers treat saline wastewater biologically and economically, lateral goals such as creating beauty, producing feed for livestock and also preventing soil erosion.

Materials and methods

Setting up sector includes the preparation of the mature plant, making the laboratory pilot, preparing artificial wastewater, determining the different concentrations of wastewater, determining the number of plants in each tank, transfering plant to pilot and ultimately adding wastewater to the reactor. In order to ensure the effectiveness and safety of plants, rooted plants with a life of at least two months were needed. Therefore, by referring to the vetiver farm belonging to the Iranian Association of promotion and development of Vetiver plant in Tankabon, the required plant was prepared. Swamp palm was provided from the center of Oxus houseplants and transferred to the laboratory. Pilot has 17 batch reactors with a volume of 1.7 liters and was made of Plexiglas according to Figure 1.

The aim of this pilot is to create the proper context for simulation of artificial wetlands, existing multiple tanks in order to apply different levels of salinity and different amounts of organic matter to each plant and also compare the amount of removal in tanks containing plant against the control tanks. The pilot was set on the basis of permanent flooding. In this way, the platform holder was used that usually kept a plant and directly floated on the reinforced solution. An air pump which has also pumped air into air rocks and created tiny air bubbles in solution, take the required oxygen to plant root. Aeration in addition to supply required root oxygen, also provided mixing in the solution. To measure the parameters, we used the spectrophotometer system Hach model

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DR 4000, digital scales PJ300 model manufactured by Mettler by precision of 0.001 hot, and EC meter Martini model of MI 805. Stem diameter measurement was done with Vernier caliper with precision of 0.01 cm and measuring leaf area with measuring system of leaf area Delta T area meter mk2. ATF was used to dry the leaf. In order to make the electrical conductivity in the solution, NaCl was used and to meet required COD of the starch, ultrapure Merck Company used to prepare solutions, distilled water twice distilled. Plants were fed with liquid fertilizer Pokon made in Holland. Experiment was done with three replications.

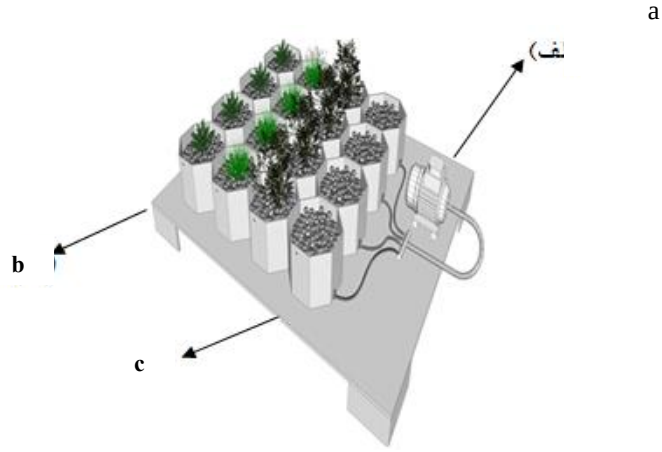


Figure 1. Used pilot in research a) air pump b) reactors with plant c) control reactor

Five wastewaters with different amounts of electrical conductivity and organic matter were produced artificially in the laboratory. Their characteristics are shown in Table 1.

Table 1. Amount of salinity and COD in different solutions

Number	COD (mg/L)	Electrical conductivity
1	300	0
2	225	2500
3	150	5000
4	75	7500
5	0	10000

Both swamp palm and Vetiver plant in addition to treatment with 5 mentioned wastewaters were irrigated with distilled water as the control. Up to 5 of the reactors without plant was irrigated with mentioned wastewater to investigate the effect of aeration in reduction of the amount of electrical conductivity and COD parameters. In every reactor, we added the amount of 5 mL liquid fertilizer to provide nutrients and maintain the ratio of NPK at 5: 7: 7 . As long as fertilizing was enough for a period of two months of plant growth. This amount was selected based on the company of making fertilizer. Table 2 provides the reactor arrangement and placement of the plant and control reactors.

Table 2. Ordering reactors and wastewater and each reactor plant

Vetiver 1	*swamp palm* 1	Without plant
Vetiver 2	*swamp palm* 2	Without plant
Vetiver 3	*swamp palm* 3	Without plant
Vetiver 4	*swamp palm* 4	Without plant
Vetiver 5	*swamp palm* 5	Without plant
Vetiver in pure water	*swamp palm* in pure water	--

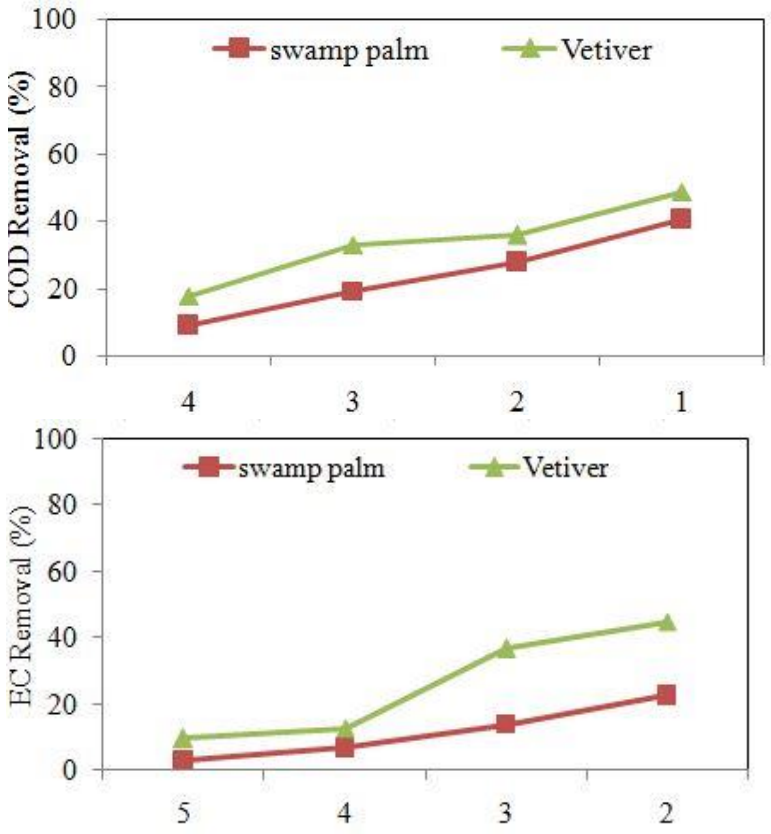
To investigate the obtained results of removing organic matter and salinity, experiments were done at 5 reactors containing Vetiver plant and control (without plant) during four periods, , 10, 15, 15 and 20 days respectively. The specifications listed in reactors containing wastewater in Table 1.

Results and discussion

The obtained results of this research in laboratory scale showed that using phytoremediation method in artificial wetland, in different levels of salinity and organic matter, on average, for every single plant and vetiver was 17%, and per unit of swamp palm plant have had 15% of salinity reduction and wastewater.

The process of reducing the amount of electrical conductivity in both species reduced increase in salinity levels. The highest amount of salt intake by plant of swamp palm in the electrical conductivity was observed 2500 micro Siemens per centimeter and about 30% and about 53% for Vetiver.

The process of reducing organic matter in both species reduced with increase in salinity level with the highest efficiency of COD reduction by plant of swamp palm in the electrical conductivity was observed 0 and organic matter mg / L 300 about 50% and for Vetiver plant about 58%.



Comparison of COD and Electrical Conductivity Removal

Conclusion

Based on the measurement results and the importance of plants, the highest level of leaf area, dry weight and diameter of stem was obtained in vetiver plant and the highest root velum in swamp palm plant. All of these characteristics according to salinity tolerance by the plant, since the transfer to pilot have increased the toxicity and wilting in the mentioned plants and since then has remained static or due to loss of plant and destruction of associated tissues was reduced. Chlorosis in Vetiver plants shows the accumulation of salt in the root that indicates the process of root phytoremediation in this plant. Creation of Toxic effects on palm leaves and also the tiller of the plant in salinity before the drought threshold acts as a control on dilution mechanism in phytoremediation of swamp palm. This mechanism was observed in Vetiver due to observing green tillers.

By changing the rinsing characteristics of plant and also destroying the balance of plant enzymes, the electrical conductivity of solution causes reduction in the amount of water taking, drought of plant and results in the lack of transfer of pollutants from the flooding environment into the tissues of plant. Finally, Vetiver plant was diagnosed in comparison to swamp palm for phytoremediation of saline wastewater with appropriate organic matter.

Keywords: Phytoremediation, Salty Wastewater, *Vetiver, Cyperus alternifolius*

The decay time and rate determination in oriental beech (*Fagusorientalis*Lipsky) deadtrees, Asalem forests, Iran

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Expanded Abstract

Introduction

Today, maintaining the dead woods in forest ecosystems are important to the conservation of biodiversity in forest ecosystems. The importance of maintaining diversity in natural ecosystems, has led to the formation of different perspectives of the forestry projects. In the most forestry projects, especially in the conservational projects and management based on the ecological point of view, one of the main objectives of forestry plans is to maintain biological diversity in forest ecosystems. In addition, biodiversity has been introduced as one of the main quantitative indicators to evaluate the sustainable management of forest ecosystems and high variability in forest ecosystems demonstrate the health and sustainability of ecosystems.

An important feature of natural forests is that they possess high amounts of dead trees in all stages of decay and also high proportions of old, living trees with dead parts. Dead tree has been denoted as the most important, manageable habitat for biodiversity in forests, supporting a wide diversity of organisms, including birds, mammals, insects, mites, collembolans, nematodes, bryophytes, lichens, fungi and bacteria. As the most important agent of wood decay, fungal diversity can be regarded as a crucial indicator of dead tree biodiversity.

The Caspian forests of Iran are largely natural temperate broad leaved with minimal active management during the last four decades. *F.orientalis* stands in the Caspian region have been managed chiefly using shelter wood system, but now all of the beech forests managed using selection method.

Researchers have figured out the importance of dead trees in the 1970s. Most publications have been proved its importance in biodiversity, nutrient cycling, natural regeneration, wildlife habitat and other processes. However, the important goal of this research is that dead tree is a predominant carbon stock in the forest. One of the major events leading to carbon flux, that is released to the atmosphere or stored as soil organic carbon, is the decomposition of dead trees. Given the importance of dead trees for nature forestry, due to the change in the overall attitude toward forest management and conservation approaches and highlights of the role of forests in carbon sequestration and storage, today aware of the time the trees stay in the forest can help managers of forest regulate forestry plans. According to dynamics of the dead trees volume in the forest ecosystem, knowledge of the changes in volume over time will be very helpful to maintain dead woods in different period forestry project. This research attempts to answer these questions; (1) How long it takes for total decay time of a dead beech in natural conditions? And (2) how many year each of the four decay classes naturally spent to reach this stage?. The answers to these questions can help us achieve the main objective of this research to provide appropriate quantitative information from the decay rates of oriental beech trees.

Materials and Methods

This study was conducted at Asalem Forest (37°36' N, 48°52'E). The climate of the area is temperate with an annual mean temperature from 7.3 to 8.3 C and an annual mean precipitation of 586–885 mm. Forests occupy plateaus on moderately inclined slopes, largely free of rocks with limestone bedrock. Caspian forests occupy an approximate area of 2,000,000 ha being dominated by oriental beech (*Fagusorientalis*Lipsky). The field sampling for the case study was carried out in August 2014. A chronological sequence of samples for 0, 2, 5, 11, 15, 19 and 25 years after the harvesting period was established. In total, 90 stumps of beech were chosen randomly for dead wood carbon measurements.

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The climate is sub-Mediterranean with a mean annual temperature of 9°C and total annual precipitation of 1380 mm. Selected forest communities occupy plateaus or moderately inclined slopes which are dominated by moderately acidic to alkaline brown forest soils with deep, organic A-horizons, limestone bedrock, and a surface largely free of rocks.

Dead tree comes in many forms, but above ground they tend to predominate dead trees on the forest floor (logs), and standing dead trees (snags and stumps) and these are the two parts on which the present study focuses. Stumps were considered as a representative of dead trees, because their mortality age was specified and it was possible to establish chornosequence plots. Consequently, the sample a cube shape with 4cm length was removed from two opposite parts of a cross-section using chain saw and axe. Consequence plots were a representative of the defined decay class in this forest. Decay class of stumps was specified by visual characteristics which were observed in the structure of the bark and tissue of the wood. It was not always possible to take the old samples using a chainsaw or axe in the advanced decayed woods, because of the high decay grade. Thus, they were picked up by hand and were placed in plastic bags and weighted on the same day as sampled.

Decay classes were defined according to Albrecht (1990) as Class 1 (recently dead), Class 2 (bark loose with some decay in the sapwood), Class 3 (decay obvious throughout the secondary xylem) and Class 4 (woody debris mixing with soil, little structural integrity). Most dead trees displayed a mixture of different decay stages along their total length; therefore, the dominant decay stage class was used during the analysis. Diameter at breath height was measured on dead trees in the early stages of decay.

The samples were oven-dried at 70ºc for 48 h to determine the dry sample weights. The dry weight of the wood and volume were used to determine density (g cm-3) the bulk density of each wood sample was calculated with the following formula:

$\dot{\rho}=m/v$

Where, m is the dry mass in gram and v is the raw volume in cm3.

All statistical analyses were performed using SAS 9.3 software. Analyses of variance (ANOVA) were used to detect differences in carbon contents, C concentration and wood density of beech and hornbeam trees. Tukey's HSD procedure was used to determine significant differences in the mean density of wood with years at $\alpha = 0.05$ level.

Results and discussion

The findings showed that the decrease in wood density over following a negative exponential function. Based on the results, the total decay time of about 95% dead wood can be estimated or in other words time of reduction to estimate the 95% of the timber weight can be estimated. This is consistent with the findings of the studies in northern Iran and correspond in other similar areas in forests. The results of this research in the Asalem of beech forests revealed that the time required to decay and lose 95% of the weight of a beech tree dead wood lasts about 46 years. Different results for different tree species have been reported. The decay time varies among different species. The rate of decay in trees in addition to geomorphic features and environmental conditions the sites such as climate as influential factor in the decay process are also affected by genetic species there.

Table 1. The decay time of dead beech trees in different decay classes

Decay classes	$T_{0.5}$	$T_{0.05}$	Decay rate	Density (g cm^{-3})
1	1	1	0.052	0.616
2	17	7.5	0.041	0.481
3	12	5.5	0.034	0.267
4	6	4	0.031	0.159
Total	36	18	-	-

Numerous studies have mentioned the differences between species in the rate of decay. Mackensen et al. (2003) reported differences in the rate of decay in the eucalyptus species. The tree species of *E.radiata* and *E.elata* showed differences in the rate of decomposition of the wood. In addition, conifers and broadleaf tree species also varies by the chemicals properties of wood caused differences in the decay rates. Studies of showed differences in the decay of tree species due to differences in moisture content and density of trees. In Mazandaran province, Alidadi et al (2015) reported that the total time of beech dead wood decay need approximately 36 years. The contradiction in the results can be caused by different climatic condition between two study sites. In the European beech forests Müller & Bartsch (2009) reported 30 years for total decay of beech trees. Differences caused by environmental factors like climate and also initial density of tree species.

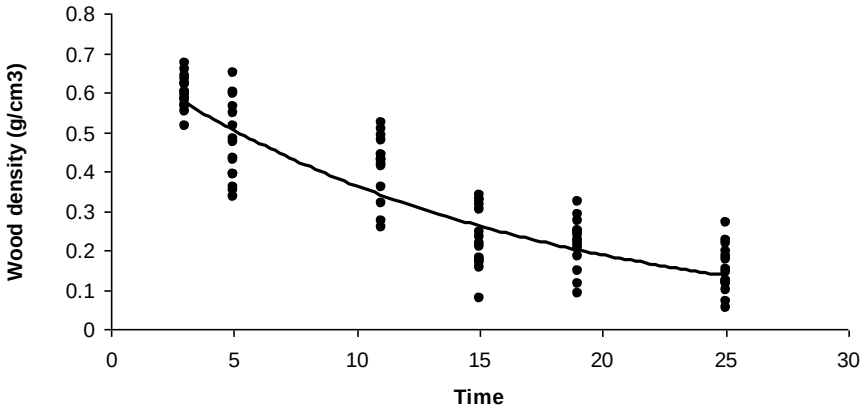

Figure1. The change of dead wood density through the time

The results also showed that wood densities significantly are different among samples from different years and the curve of density variation fitted to the negative exponential function. The results also showed that there is no significant relationship between decay rate and wood extracts. According to the results in the maintaining dead wood as source of biodiversity in the forest ecosystems, the dynamics of density and volume of dead wood must be considered.

In addition to the aforementioned issues, the chemical characteristics of wood can also be more effective on the activity of microorganisms and the development of decay process. The decomposition process of chemical oxidation and also adsorption of different organisms affect the content of the timber. In this study, we studied the extractives of wood in various stages of decay. Accordingly, in the advanced stages of wood decay lignin to cellulose and hemicellulose will rise due to the relatively slow decomposition of lignin in relation to cellulose. The rate of decomposition didn't show significant relationship with the percentage of the extractives that was emphasized the results of Mackensen et al (2003).

Conclusion

Today, we are witnessing a change in attitude and overall approach of the managers of the forestry sector to the management of our forest ecosystems. In the concepts based on the conservation of biodiversity in forest, the health of ecosystem has been an important position. The maintenance of dead trees can guarantee species diversity, especially in the population of birds, insects and fungi in the forest ecosystems. In addition to maintaining the quality and quantity of dead trees due to their dynamics (change in size of dead trees over time), it is a required for forest manager to estimate the establishment dead trees in the forest stands close to reality. According to the findings of this research, it is recommended that in the maintenance of dead trees in the forest ecosystems, beside to the volume of dead trees in the forest floor, it is important to consider the dynamics and volume changes over time.

Keywords: Dead wood, Decay time, Decay grade, Beech, Ecosystem integrity

Application of environmental risk assessment in the sustainability of marine protected areas, Case study: Nayband Marine National Park

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Extended abstract

Introduction

Establishment of Marine protected areas (MPAs) is one of the most important approaches in biodiversity protection and fishery management. Coastal marine environments are facing with numerous threatening factors. Therefore, having a comprehensive assessment of multiple risks faced with socio-economic dimensions of marine protected areas is crucial and this should be integrated in ecological research for management of these areas. Environmental risk assessment is the process of examining stressors factors and exposure to these factors. Chemical and non-chemical stress factors should be taken into consideration in a comprehensive risk assessment. In addition, socio-economic aspects have been integrated to other factors in risk assessment process of marine protected area.

The purpose of this study is to identify, evaluate and rank stressors of marine protected areas. Hence, Nayband marine national park was selected as a case study, this area is located in south of Iran. Nayband marine-coastal national park is located in the northern part of the Persian Gulf in Bushehr province, 300 km south-east of Bushehr city. It has an area of about 30217 and 19597 hectares in marine and terrestrial parts, respectively. This area has a wide range of terrestrial and marine habitats including coastal sand dunes, rocky, muddy and sandy shores, coral reefs, mangrove forests, sea grass meadows and estuaries which is threatened by high pollution and excessive exploitation more than capacity by different organizations. Therefore, the environmental risk assessment and management is essential in this national park. This study was carried out by field visit, interview with Bushehr's department of environment staff and residents around the park.

Materials and Methods

Today, a framework is needed to help greater perception of ecological processes, social interactions, sustainability and resilience of coastal-marine system. Pressure-state-response framework has been used to conceptualize risk analysis and risk management issues in this study. An environmental issue is divided into five parts by DPSIR model. (D) Represents Driving forces which indicates the social, economic, human and climatic conditions. These forces produce biological, chemical and physical pressures. (P) Pressures are tensions produced by human on environment. (S) State shows the condition of the environment. (I) Impact indicates environmental degradation like loss value of fishery. (R) Responses are measures by decision-makers to respond to environmental issues.

In this study, we used integrated framework from integration of multilayer DPSIR model and current approach of ecological risk assessment. This has been archived in four major steps a) identifying potential threats, b) data collection, c) data classification and d) ranking risks. In the first step, potential threats such as maritime transportation, fishing and land-based marine pollution was investigated. In the second step, environmental and socio-economic factors that are associated with potential threats were identified. In The third step, we established a multi-layered framework to explain causal relationships between ecological interactions and socio-economic development. The data have been classified into five categories in the DPSIR ring based on causal relationship. In the fourth step, the identification and ranking criteria, taking into account the risk of environmental threats and their consequences. Ranking for each criterion was conducted by a team of experts based on the principle of

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quality of each index and weight of evidence. Each indicator was assigned a qualitative score of very low (VL), low (l), medium (M), high (H) and very high (VH) based on the "Seven Rapid Ranking Criteria" for MPA management. The risk quotient (RQ) was applied as the quantitative ERA approach to determine if measured levels of chemicals in the target waters and sediments were likely to cause harms to local MPAs. This coefficient is calculated by comparing measured environmental concentrations (MECs) which predicted no effects on concentrations (PNECs) to obtain the RQs (RQ = MEC / PNEC). If RQ < 1 the assumed risk (the risk of adverse effects) is Low. If RQ ≥ 1, the risk is high and a large proportion of adverse effects increases with RQ.

Results and discussion

Indicators related to the driving forces are divided into two major groups: coastal marine pollution and land use change. The most important risk factors in the study area is the South Pars Special Economic Energy Zone activities adjacent to the western side of the park and its further development along the park's northeastern activities of Phase 12 and 13 of this economic zone as well as 8 petrochemical units that emit 5 to 6 tons of caustic soda per day into the study area. Gas and petrochemical industries are very close to coast of the Persian Gulf. Other factors are land use change, development and construction of roads, border military activity causing severe disturbance in the hydrological system in mangrove habitats. The population is another risk factor, based on the population census in the year 2011, the population growth rate is 11.3 percent, which is one of the highest rate growth in Iran. The results from study of geochemical pollution Muller (Ipoll) and pollution KARBASI (Igeo) show heavy metals (except lead) in surface sediments in standard ranges. By comparing these results with the international quality standards, sediments (SQGs) shows that cadmium and copper deposits are none pollutant, nickel and lead are in the middle range of pollution. Mangroves have some level of cadmium and copper pollution. Lead has severe contamination based on geochemical index. Oil and gas pollutions are decreasing water quality and sediment degradation in Nayband. Proximity to oil and gas facilities in Assaluyeh, Taheri oil terminal and passage of oil tankers produced heavy metal pollution.

The results showed that nickel and lead have RQ ≥ 1(high risk level) and Copper and Cadmium in low risk level RQ <1. Habitat Destruction is another indicator related to the states. Rapid coastal development (Assaluyeh region's activities) and military activities are a serious threat to marine life especially for coral reefs. Blocking the estuary leads to Bsatyn tidal cycle disruption, drying mangrove forests, disruption and destruction of fish migration and spawning sites in the estuary. Constructing loading docks between Bidkhon and Assaluyeh in the northern part of the gulf of Nayband damaged reefs and habitats of the larvae region. Water consumption, human effluent, solid waste and water quality are pressure indicators; water consumption is predicted to be nearly 1250 liters per day. The effluent is 1,000 liters per day. Waste production is predicted to be between 124 and 205 kg of waste per day in the study area. Water quality decreased to increased turbidity and sedimentation rate.

Swimming, richness and the costs of waste collection are impact indicators. There are 23 coli forms per 100 ml in the water of study area, which indicates low risk to quality standards of Swimming. The bird's species richness in the National Park keeps declining. Annual waste collection fee has been estimated to be $ 1,400.

Response's indices include wastewater treatment programs, environmental legislation and scientific support. Unfortunately, Nayband National Marine Park does not have any comprehensive program for wastewater treatment and effluent disposal system. The lack of protective measures, shortage of mangers in four sections of the park including protection, education, research and recreation has been observed in this study area. There are only 4 scientific articles and 3 conference papers about this study area. It is suggested that the scientific community needs to pay more attention to Iran first marine national park.

Conclusion

This study showed that there is a practical limit in the application of conceptual models; these models are very abstract and general. Because of the complexity of coastal- marine ecosystems, it is essential to integrate DPSIR framework with ecosystem approach. This study proposed a framework that considers all activities, pressures, states, and impacts on ecosystems, human and social responses which is a problem–based approach. These are based on the seven criteria of risk assessment, were ranked as a qualitative and quantitative techniques. In this study, we focused on risk assessment and management procedures. The driving force indicators, pressure and their possible impacts on ecosystem services have been shown in form of risk assessment in this study. Management measures and compensation are investigated under driving force, pressure and states modification. The results revealed that indicator with high degree of risk are docks, channels and harbors, oil platforms and terminals, refineries activities, land use changes, sediment quality, oil pollution, air pollution, environmental sensitive areas and biodiversity. Degradation of these factors can occur due to the industrial area pollution of South Pars in its upstream, inappropriate use of capacity and conversion of land by different organizations. Management should answer not only the causes and consequences of the changes caused by the internal system pressure, but should also cover the consequences of stress out of the system. These measures have been offered

according to interaction between driving force and pressures in DPSIR model. In order to maintain the integrity of outstanding ecosystems and valuable Nayband marine national park and its educational and recreational value we need to take into account measures and strategies to control and reduce the marine national park environmental risks presented in table 1.

Table 1: Control measures, reduction of environmental risks to Nayband marine national park

Risk factors	The degree of risk	Measures and Strategies
Pollution (oil pollution, air, water and sediment)	Very high and high	establishing monitoring system and the requirements of the EMS in the activities of the South Pars Periodic monitoring of air pollution emphasizing on measuring the amount of particulate matter in the National Marine Park at a distance of 100 meters creation of an integrated system of waste disposal in the National Park avoid to produce solid waste, reduce the volume of waste applying teaching methods to reduce waste generation for staff and visitors Solid waste source separation programs Environmental management around the park area (EMP) with a focus on environmental impacts from Pars Special Energy Zone
Land use change	Very high	Develop a regional binding instructions to avoid land use change National Park and its surroundings Prevent or minimize disruption of the national park area by setting biological limits to the national park Zoning and planning according to the ecological and socio - economic capability The balance between development, utilization and protection of the area around the park because the relationship bounds
Loss of biodiversity and environmental sensitive areas	high	Participation of indigenous people in biodiversity conservation of National Park efficient permits for local beneficiaries for the sustainable use Online monitoring of coral reefs Online monitoring of mangrove species

Keywords: DPSIR Model, Indicator, Risk Analysis, Risk Management, Nayband Marine National Park.

Estimation of Aerosol Optical Depth Using MODIS sensor Images over Persian Gulf Surfaces

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Extended abstract

Introduction

Atmospheric aerosol plays a significant role in the Earth radiation budget through radiative forcing and chemical perturbations. Aerosols are intricately linked to the climate system and the hydrologic cycle. The net effect of aerosols is to cool the climate system by reflecting sunlight. Quantifying the net effect requires accurate information on the global distribution of aerosol properties that have to be estimated from satellite observations. Estimation of aerosol properties is also one of the first steps in generating high-level land surface products from satellite observations. Effective aerosol retrieval information is also essential to satellite imagery atmospheric correction. Satellite remote sensing has been employed to supplement the prediction of ground-level dust concentration. Satellites are able to cover vast spaces at a relatively low cost. For aerosol studies, the launch of the Moderate Resolution Imaging Spectro-radiometer (MODIS) has enabled the retrieval of aerosol optical depth (AOD) data globally from the satellite spectral observation. MODIS AOD is a measure of light transmittal by aerosols in an atmospheric column during the satellite overpass. With the evolution of the retrieval algorithm, MODIS AOD has become increasingly important in the role of producing more accurate estimation for the aerosol. Estimation of aerosol loadings is of great importance to the studies on global climate changes. Meteorological numerical models and ground stations are not able to track and detect dust storms and in many cases have significant errors. This issue show necessary use of reconstruction ways of dust according to remote sensing techniques. The purpose of this study was use of remote sensing technology and MODIS images to estimate dust concentration on the Persian Gulf surface and estimating the linear correlation relationship between the dust measurements in ground and atmospheric. In this study, we develop a new algorithm for estimating the aerosol optical depths using MODIS data over Persian Gulf surfaces. This algorithm is validated using AERONET measurements.

Materials and Methods

In the current study, we analyze atmospheric aerosol optical properties over Persian Gulf. The Persian Gulf is located between 24° to 30° 30' N latitude and 48° to 56° 25' E longitude. Annually, Dust storms are imported into Persian Gulf from the West and North West and South West. Data corresponding to the station was extracted for channels of 0.644, 0.855, 0.466, 0.553, 1.243 and 1.643 µm of satellite image. The ocean algorithm was designed to retrieve only over Dark Ocean, (i.e. away from glint).

Our primary means of true ‘validation’ is comparison with ocean-based sun photometer measurements, specifically, those of AERONET. The AERONET measured AOD is easily interpolated to the exact MODIS wavelengths (for example 0.55 µm) by quadratic interpolation in log reflectance/log AOD space. The AERONET ‘sun-measured’ definition of FW differs from either of the MODIS (land or ocean) definitions, but should be correlated with either. In the following validation, we use AERONET Level 1.5 data of the Dalma, Bahrain, Abu Al Bukhoosh, Sir Bu Nuair, Umm Al Quwain, MAARCO and Mussafa station when available.

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The theory and strategy of the aerosol retrieval over the ocean is well described by Tanré et al., 1997, Levy et al., 2003; Remer et al., 2005. The algorithm is based on a LUT approach, i.e., radiative transfer calculations are pre-computed for a set of aerosol and surface parameters and compared with the observed radiation field. The algorithm assumes that one fine and one coarse lognormal aerosol modes can be combined with proper weightings to represent the ambient aerosol properties over the target. Spectral reflectance from the LUT is compared with MODIS-measured spectral reflectance to find the 'best' (least-squares) fit. This best fit, or an 'average' of a set of the best fits is the solution to the inversion. Although the core inversion remains similar to the process described in Tanré, et al. (1997), the masking of clouds and sediments, the special handling of heavy dust including dust retrievals over glint, and revisions of the look-up table are new.

There is a special case when we retrieve over glint, and that is described below. The algorithm calculates the glint angle, which denotes the angle of reflection, compared with the specular reflection angle. The glint angle is defined as:

$$\Theta_{glint} = cos^{-1}((cos\theta_s cos\theta_v) + (sin\theta_s sin\theta_v cos\phi)) \quad (1)$$

Where θ_s, θ_v and ϕ are the solar zenith, the satellite zenith and the relative azimuth angles (between the sun and satellite), respectively. The retrieval requires a single fine mode and a single coarse mode. The trick, however, is to determine which of the (4 x 5) twenty combinations of fine and coarse modes and their relative optical contributions that best mimics the MODIS-observed spectral reflectance. The reflectance from each mode is combined using η as the weighting parameter:

$$\rho_\lambda^{LUT}(\tau_{0.55}^{tot}) = \eta\rho_\lambda^f(\tau_{0.55}^{tot}) + (1-\eta)\rho_\lambda^c(\tau_{0.55}^{tot}) \quad (2)$$

Where $\rho_\lambda^{LUT}(\tau_{0.55}^{tot})$ is a weighted average reflectance of an atmosphere with a pure fine mode 'f' and optical thickness $\tau_{0.55}^{tot}$ and the reflectance of an atmosphere with a pure coarse mode 'c' also with the same $\tau_{0.55}^{tot}$. Before the final results are output, additional consistency checks are employed. Our primary means of true 'validation' is comparison with ocean-based sunphotometer measurements, specifically, those of AERONET. The AERONET measured AOD is easily interpolated to the exact MODIS wavelengths (for example 0.55 μm) by quadratic interpolation in log reflectance/log AOD space. The AERONET 'sun-measured' definition of FW differs from either of the MODIS (land or ocean) definitions, but should be correlated with either. AOD images were compared with values obtained in AERONET stations, in finally AOD values were evaluated using statistical indexes of Average, standard deviation, correlation, Mean Squared Error (RMSE) and Mean Difference Square Error (RMSD). In the following validation, we use AERONET Level 1.5 data of the Dalma, Bahrain, Abu Al Bukhoosh, Sir Bu Nuair, Umm Al Quwain, MAARCO and Mussafa station as available. Data corresponding to the stations were extracted for channels of 0.644, 0.855, 0.466, 0.553, 1.243 and 1.643 of satellite image. AOD images were compared with the values obtained from AERONET stations. Finally AOD values were evaluated using statistical indices of Average, standard deviation, correlation, RMSE[1] and RMSD[2] according to 1 and 2 relations.

$$RMSD = \frac{1}{N}\sum_{n=1}^{N}[(m_i - \bar{m}) - (o_i - \bar{o})]^2 \quad (1)$$

$$RMSE = \frac{1}{N}\sum_{n=1}^{N}[(m_i - o_i)]^2 \quad (2)$$

Where, the m_i and o_i is simulation and measured data, $\bar{m}$ and $\bar{o}$ means simulation and measurement data and N is number of data, respectively.

Results and discussion

The evaluation results showed that good correlation exists between the AOD simulation and AERONET data, with the correlation coefficient exceeding 0.90. The best and most suitable mode demonstrated for 1.243 and 1.643 bonds with the correlation coefficient is equal to 0.94 and 0.99 and RMSE and RMSD indices are equal to 0. 2 and 0.02 for band of 1.243 and 0.1 and 0.01 for band of 1.643, respectively. We can argue that there are significant limitations for aerosol retrieval using marine AERONET stations. The number of matching points between the two datasets may become sufficient to attempt the reduction of the current uncertainties. Given the identified uncertainties, the results of this study do not contradict these previous validation efforts. Future research may reduce these uncertainties and require modifications to the retrieval algorithm. We used AOT data from a comprehensive set of Persian Gulf AERONET stations to evaluate the dust retrieval algorithm. Data evaluation was performed by using the Pearson correlation coefficient, root mean square error index (RMSE) and root mean square deviation index (RMSD). The evaluation results showed that good correlation exists

1 Root Mean Squared Error
2 Mean Difference Square Error

between the AOD simulation and AERONET data, with the correlation coefficient exceeding 0.90. The regression analysis of AOD data revealed similar limitations. We found that the AOD simulation are on average 5%–25% more than the corresponding AERONET values, depending on the regression weighting assumptions for the comparison dataset. For further evaluation of the performance of the algorithm in comparison with the AERONET measurements, we used the RGB image from MODIS. Overall, the comparison with the AERONET data has revealed similar performance of the two satellite datasets with a tendency of the simulation AOTs to underestimate and the MODIS over-ocean AOTs to overestimate the AERONET values. The range of these discrepancies is comparable to the uncertainties associated with the limited number of ocean stations and natural aerosol variability. The comparison of AOTs in the Persian Gulf AERONET stations showed that AOD values in AERONET stations are, on average, 5%–25% lower than the corresponding simulation ones. While the biases in ocean retrieval algorithms and cloud screening procedures may not be excluded, these results indicate that aerosol loading in marine locations may differ significantly from that in adjacent land areas, thereby limiting the achievable validation accuracy.

Conclusion

We conclude that significant limitations exist for aerosol retrieval using marine AERONET stations. These limitations can be linked to the extreme sparsity of the marine AERONET data, uncertainties associated with local conditions at the marine stations, and regression accuracy limits imposed by natural aerosol variability. The number of matching points between the two datasets may become sufficient to attempt the reduction of the current uncertainties. Given the identified uncertainties, the results of this study do not contradict these previous validation efforts. Future research may reduce these uncertainties and require modifications to the retrieval algorithm.

Keywords: Optical Depth, MODIS, Persian Gulf, AERONET, Dust

Troubleshooting the Independent Factors and Uncertainty of Agricultural Capability Evaluation Using the AHP FUZZY Method

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Expanded Abstract

Introduction

Agriculture is regarded as the main use of the land. The use of agricultural land to increase production is always with acidification and loss of groundwater reserves. Therefore, with proper planning for use of agricultural land so that to leave the least negative impacts on the soil and water pollution, it is regarded imperative to consider sustainable development. This study is aimed to better understanding of the environmental assessment of the area to be examined in the Birjand agricultural water reserves and to assess the agriculture. One of the problems that exist in the common assessment methods is the lack of precision of space, as well as the assumption of independent valuation factors and not seeing the relationships and feedbacks in the evaluation process. of the purpose of this research is to resolve the problem to determine a more accurate assessment of using agricultural land according to environmental factors and the underlying factors of the "Fuzzy" method and techniques using a network analysis process.

Materials and Methods

–Introduction of the Study Area

The study area of this research is the Basin Area in the City of Birjand. The river basin of Birjand is located in the East part of Iran and the County of Southern Khorasan and the City of Birjand is at the center of there. The scope of the geographical location is located at 41, 58 and 44, 59 E and 44, 32 to 8, 33 N latitude. The Birjand plain has an average annual rainfall of 140 mm and an average temperature of 16.5 degrees Celsius, according to the climate classification, it is one of the most arid areas.

Method

The use of the "Fuzzy" logic in the Evaluation of land use

In 1996, Zou and Sivico found some of the problems associated with the implementation of multi-criteria assessments, GIS of these states are input for multi-criteria assessment methods, GIS usually are ambiguous, inaccurate and wrong. Despite the awareness of these methods assuming that the input data are accurate. In this connection, some efforts in connecting to this problem by combining multiple criteria techniques in GIS was conducted, and the analysis of the sensitivity and the propagation were performed. Another way to deal with withdrawals and uncertainty of input data (values and priorities of decision-makers) was to use the "Fuzzy" logic approach.

Weighing up Analytical Network Process (ANP)

In this study, we used the ANP method based on various factors and the intrinsic nature of space problems. One of the techniques of analysis is the process of the network in making a decision with multiple criteria (MADM). The ANP method is a developed method by AHP, which can be correlation and give a feedback between effective elements in the decision making and modeling. All internal effects of effective components in decision-making are used and entered into the account. The ANP technique with a comprehensive framework, with all interactions and relationships, between decision-making levels are the formation of a network structure. Clusters represent levels of making decisions and arrows indicate interactions between the decision making levels. The

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direction is determined by the dependence arcs. In some cases, where the elements of a cluster or all the elements affect other clusters (or are influenced by it), communication between clusters are called external dependence.

Results and discussion

According to the issue mentioned, it will be decided by a structured value tree. The figure below shows the framework, where the measurement to achieve the objectives set are introduced and presented.

-Preparation of "Fuzzy" Maps for each factor

At this stage, for each of the factors identified, in the previous stage a map was provided based on the utility of the aim (areas suitable for agriculture) to study. For drawing up the maps, GIS and Idrisi Selva Software is used.

-The Prohibition Layers: protection land use

The areas with slope above 70%, protected areas of the Department of Environment and flood-prone areas (Figure) capable for protection can not to be used and should be removed from the research area. Determining prohibitions and standardization are based on Boolean Logic (0 and 1).

-The Weighing up of the Factors by using the AHP Method

According to factors affecting land capability of agricultural development is identification, and has drown in the software. Then, the software gives us the final weight (as below). All of these steps use the Super Decision Software 2.0.8. version. The values are including climate:0.148, rainfall: 0.046, Evaporation: 0.015, slop: 0.066. distance to river: 0.0149, distance to water resources: 0.022, texture soil: 0.058, Soil fertility: 0.073, Soil drainage: 0.028, Depth soil: 0.045, soil erosion:0.074, and land cover: 0.406.

Weighing up the Linear Combination

At this stage, the layers of the raster weights are based on the equation (1) to obtain the final suitability map. In this relation: S is suitable areas, W-i is operating weight, X-i is the operating phase, and C-i is rating the prohibited criteria.

$$S = \sum_{i=1}^{n} W_i X_i \prod C_i \qquad \text{Formula(1)}$$

Comparison between the Evaluation by the Iranian Model with the ANP FUZZY Technique

From the following forms, the area assigned to each floor for two methods can be stated as follows:

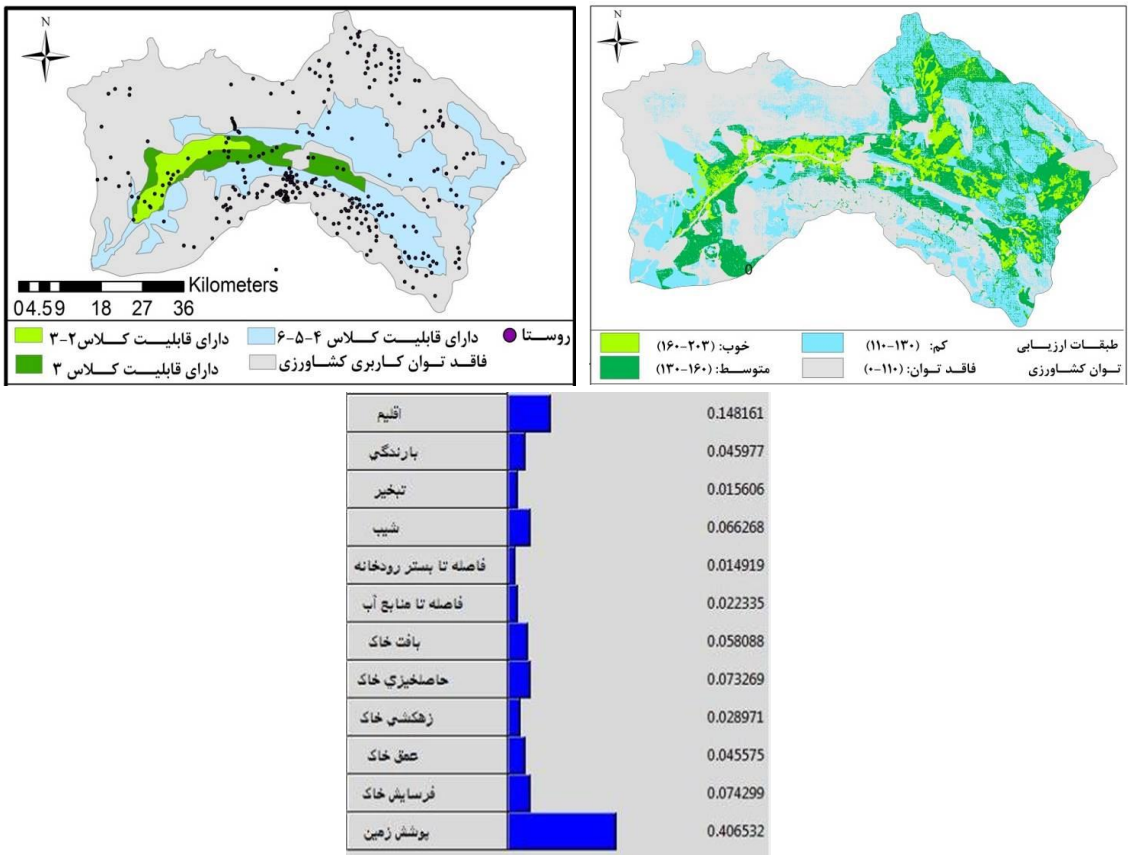

Figure 1. comparison between the results of evaluation, using the ANP FUZZY Method and the Iranian Model (overlay)

Table (1) comparison between the results of evaluation, using the ANP FUZZY Method and the Iranian Model (overlay)

quota ANP FUZZY (%)	Area ANP FUZZY (m^2)	quota overlay (%)	Area overlay (m^2)	
7.93	271674384	3.21	110108345	Good capability class
20.66	707816248	4.40	150745348	Moderate capability class
28.80	986628010	25.86	885840235	less capability class
42.59	1458895384	66.52	2278320097	no capability class

Conclusion

In this study, at first, based on 12 environmental and infrastructure factors and also the restrictions, the value of each pixel of the study area, the ANP FUZZY technique has been achieved in agriculture. In drawing up the map, we tried a few things to observe: 1- Comprehensive measures to select for proper evaluation. 2- The uncertainties and standardization of all factors carefully raised the ranking. 3- By using the network analysis process, incorrect assumption of independence has been removed, the feedback and interaction are considered in the assessment.The map of multi-criteria evaluation is to determine the suitability of the land and suitable areas for agriculture in the study area. This is a consolidated map with a raster format for the areas where do not have a development limit, values from 0 to 203. There are not areas with a value higher than 203 in this area and this shows that the areas with great potential for agriculture are not available in the area. More utility indicates the higher capability of degree, and the less desirability indicates lower capability for the corresponding user. The utility of each pixel represents the favorable factors and the weights assigned to them. According to this method, it was revealed that 93/7%, 66/20%, 80/28%, and 50/42% of the study areas, respectively. They have a high, medium, low and unable capability to make them useable for agricultural suitability. Thus, by comparing the two methods of the Iranian Model and the ANP FUZZY Technique, the conclusion is that the Iranian Method has been a simpler approach to nature and its interactions. In the present method, we have a more comprehensive identification of impact factors, entering uncertainty of the “Fuzzy” Technique and also see interactive network analysis techniques to design more realistic and arriving at a more detailed process closer to the situation of villages.

Keywords: Agriculture capability evaluation, Analytic Network Process(ANP), fuzzy, protection, Birjand's Watershed.

Determining the ecological sustainability of Kalshoor Basin using the Ecological Footprint method

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Extended abstract

Introduction

During the recent years, the issues such as emission of greenhouse gasses, environmental degradation and deforestation along with reduction of the biological capacity of the Earth have been one of the most important global concerns. Obviously, an individual has a daily effect on the planet Earth, however, the problem is the rate of the impact that each person leaves on the Earth. In this respect, the present study aims to investigate the effects of different land uses on the Kalshoor watershed applying the EF method. For this purpose, first, we introduce the concept of ecological footprint then the result of the calculation of this indicator will be presented and discussed.

Material and methods

Study area

The study area is Kalshoor watershed as a mountainous area located in the North East part of Iran in Sabzevar city (36° 12′ 48.63″ N, 57° 40′ 35.39″ E). The study area is about 243232 hectares.

Methods

Based on the method proposed by wackernagel and Rees, following steps should be taken to calculate the Ecological Footprint (EF):

1- Estimation of per capita consumption of consumers as the regional data and division of the total consumption by the population of the area.
2- Estimation of the land allocated to an individual for production of each case through the division of average annual consumption of each case by the average annual production or land yield.
3- Calculating the average EF for an individual through the addition of all the allocated area for the parts consumed by a person in a year.
4- Calculating the EF of the designated area through multiplying average EF for an individual by the population size.

Result and discussion

The primary result of this study showed that the basin of Kalshoor, due to its geographical position, has productive lands, which makes the agriculture the second prevalent land use in the area after range management. Other parts of the area are composed of forest, residential areas, lake, river, and springs. Moreover, part of water consumption, and services and energy have the highest and the lowest rate of EF, respectively. Regarding the population of the study area (775033), overall EF of the Kalshoor is about 1076337 ha. Given the total area of the region (243231.61), meeting the needs of the residents requires for an area 4.4 times bigger than the present basin. This means that we have the land shortage of 1052105.39 ha for ecological land. In other words, the Kalshoor watershed basin should be supported in meeting its needs. In all parts of consumers goods, EF exceeds the total available land. Of total land shortage in the area, 48% belongs to the section of Water consumption. In the section of transport with 15% of the total land shortage of the basin, it has the least role in the unsustainability of the area. The partial calculation also shows that only in the sections of agriculture, constructed land, the EF of Kalshoor basin is lower than biological capacity, and there is no ecological shortage for these two sections.

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Conclusion

The rate of per individual EF in Kalshoor basin, in comparison with that of Iran and world (with 1/16 and 1/60ha respectively), is low. The Unsustainability of the Kalshoor basin is due to inordinate exploitation of the present resources. Moreover, another reason for unsustainability in the study area is a low yield of agricultural productions. In addition, due to the presence of the tourists in this area and the subsequent environmental impacts, the rate of EF increases. If the current trend of resource depletion continues, regional sustainability will be endangered. For lessening the rate of EF, three comprehensive solutions have been presented: 1- enlargement of the planet Earth! 2- reduction of the population and 3: reduction of the per capita consumption. The first solution is apparently impossible and the second one is very difficult and time dependent. Nevertheless, the third solution seems quite necessary. Tomas Malton (1798) suggests the second solution. This scientist warns the population growth and assert that consumption increases with increasing population, while in the long term the rate of food production will be lesser than population growth (Salehi et al., 2010). Wakernagel et al (2000), believe that technology can improve the capability of lands to increase the efficiency of the resources. One of the proposed methods to reduce the EF is decentralized density. Holden and Hoyer (2004) argue that the decentralized density (building relatively small cities with high-density and low distances between houses and public and private services) will ultimately reduce the EF in the residential section. In other words, by construction of small and dense towns, EF is reduced. Therefore, the policies about redistribution of the population in the lands are debatable. One of the major factors in reducing EF is scientific management, especially in urban residential which guarantees the achievement of sustainable urban facilities. Many environmentalists believe that the continuity of the traditional economic patterns and excessive consumption of materials and natural resources in a region will jeopardize the human survival. Conclusively, considering the environment and natural ecosystems in decision-making processes require a profound understanding of EF concept and taking political protective actions to control and decrease the rate of EF. Therefore, informing about the extreme use of the ecosystems and decrease in the production of waste and its retrieval apply efficient technologies to decrease the rate of exploitation of ecosystems and controlling industrial pollutions of modern technologies to supply the ecological sustainability of different ecosystems.

Keywords: Ecological Footprint, Ecological Deficit, Kalshour Basin, Biological Capacity

Tourism Development in Kandovan Village

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Expanded Abstract

Introduction

Diversifying economy, increasing human development index, industrialization problems, beyond standard pollution especially in metropolises, rural immigrations, boosting efficiency and human resource effectiveness, employment, cultural communications, protecting environment and generally constant development are the major concerns of the present world. All countries in different development levels are trying to respond these concerns. Meanwhile, those who are interested in diversifying economy and try to get away from single basis economy, try to create new methods or path. One solution is tourism. Most of the countries especially those with environmental potentials have long term programs in their national development. Today, tourism as a vast service industry has gained a proper status in economic, cultural, social and political affairs. Tourism is the phenomenon of the twentieth century and cannot be disregarded.

Population growth especially in youth generation in the recent decades has made us think of new ways of employment and economic development. One solution is to utilize different tourist attractions for income creation and improve economic status of country.

Location of Kandovan village and its unique structure and also tourism effectiveness in economic development call it "invisible export" by thoughtful insight and also by training natives and tourists. According to this study findings gathered through field study and library research, it is practical to have effective programs in rural areas and ultimately due to the fact that Kandovan has tourist attractions, it can have important effects on family economic status and village economy improvement.

Method and materials

This study has a descriptive- analytic method and practical goal. It is conducted to help organize rural areas and have effective role in activities.

Tourism development in rural areas is an important element and a solution to help the village from poverty, immigration, economic and social problems. Besides tourism is an effective variable in enhancement of infrastructure, promotion of social and cultural exchange, attracting capitals and using it in the village is an economic development. Wilson points out that tourism development is a solution in attracting foreign currency, employment and comprehensive growth. Netherland believes that tourism development can help rural restoration. Hall states that Development of rural tourism can improve the performance, production efficiency, and increase in rural income.

Ivana believes that rural tourism development has an important effect on economy diversifying. Some believe that rural tourism is a facilitator for revitalization of rural areas. Studies prove that there is relation between rural tourism development and expanding production support and promotion of the indicators of health and well-being. Development literature indicates that development of tourism in rural areas, including diversification of the local economy, promote development and social progress and development of the rural character in light of their own cultural values. Din believes that there is meaningful relation between prosperity of the tourism industry by strengthening the role of rural women and strengthening the efficient use of natural resources in rural economic revival.

Conclusion

Based on the findings gathered through field study and library research by survey analysis, we conclude that this area has the potentials for tourism development which can have noticeable economic effects. This village has

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lots of tourist attractions such as: Natural, historical, cultural, economic attractions, etc. each is a factor for attracting visitors. Among economic attractiveness of the village, we can mention garden and dairy products and honey and mineral water.

One of the results of this study is to consider the presence of the culture of tourist acceptance by people who want internal and external tourists from all study groups (women, youth, those working for municipality, men, etc.). As a result, development of the basic facilities including transport, construction of tourist accommodation and necessary training for women and youth in the groups can be necessary.

Health services at an advanced level are the issues that are of interest in tourists and the absence of which can have negative effects on village development and Kandovan's family economy improvement.

On the other hand, based on the findings and in light of the fact that Kandovan is located in a region that is dominant by cold weather in the second half of the year, tourists can visit the area only in the first half of the year. Thus, there should be solutions for the first half of the year to protect the village from environmental damage and for the second half of the year for financial and economic matters. Thus, lack of the tourists is compensated for residents.

Of other outcomes of this study is that most of the visitors are from different provinces and less foreign visitors can be seen here. Job creation is another outcome of tourist attraction which even promotes hand craft making in the area. Due to the arrival of tourists during the past 7 years, more than half of the residents are employed in the service sector, this also can decrease immigrations comparing to other cities. Of other positive effects of tourist attraction is residents cultural communication and improving government attention to the area. All mentioned can distinguish Kandovan from other villages. Kandovan village development in the last decade was due to tourist presence, we can also point out the construction of rock hotel.

Given the theories provided in this research and also a summary of relevant theories mentioned in the chapter on theoretical framework, and comparison of these theories with the results of test hypothesis, significance of hypotheses were concluded. It can be concluded that there was a direct relationship between hypotheses of this research and the theories provided by scholars, and there was no conflict between them and can complement each other.

Test of hypotheses:

Hypothesis one: It seems that tourism has an effect on development of Kandovan rural area.

Table 1 – Chi2 test of role of tourism in development of Kandovan rural area

P value	Degrees of freedom	Chi2 test
0.01	4	4.48

Given the above table, hypothesis one showed significance at chi2 difference value of 4.48 and 4 degrees of freedom and alpha level of smaller than 0.05 and equal to 0.01. This means that tourism has an effect on development of Kandovan rural area, which was consistent with literature. Data analysis using SPSS software showed significance of hypothesis one. We found out that the hypothesis was confirmed.

Hypothesis two: It seems that tourism is a direct factor affecting economy of Kandovan.

Table 2 – Role of tourism in economy of Kandovan rural area

P value	Degrees of freedom	Chi2 test
0.04	8	14.95

Given the above table, hypothesis one showed significance at chi2 difference value of 14.95 and 8 degrees of freedom and alpha level of smaller than 0.04. This means that tourism has no effect on development of Kandovan rural area, which was consistent with literature. Data analysis using SPSS software showed significance of hypothesis two, we found out that the hypothesis was confirmed.

Table 3 – Test of reliability of questionnaire

Cronbach's alpha coefficient	Standardized Cronbach's alpha	Number of items
.457	.423	16

Given the results of the study, for calculating reliability of questionnaire, Cronbach's alpha test was used. Cronbach's alpha was estimated to be 0.457, which was an average coefficient. This value shows the extent to which the results of questionnaire are reliable and the extent to which the questionnaire can give the same results. None of the items were excluded based on the results of this test.

Solutions

- Preparing and implementing reconstruction, retrofitting and perseveration plans to preserve the current status
- Landscaping and constructing wide streets and passenger parks
- introducing Kandovan rural area in International level to attract domestic and foreign visitors
- Promoting health level in Kandovan rural area and constructing an adequate number of sanitary services to ensure comfort and convenience of visitors and their revisit to the rural area
- Establishing residential camps and resting places to increase the length of stay for different people and creating more income for resident households
- Establishing quality restaurants for use of visitors to ensure comfort of the tourists and revisit of the rural area by the tourists; thus creating job opportunities and improving economic condition and development of Kandovan rural area

Keywords: Tourism, village, Development, Kandovan

Investigation about the relationship among economic growth, environmental pollution, financial development, and trade openness in 8 large Muslim countries

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Expanded Abstract

Introduction

One of the macroeconomic goals of countries is continuous and sustainable economic growth and development. This often creates environmental problems such as increased use of natural resources and lead to the releasing of larger amounts of contaminants. With its importance, economists paid attention to this issue. Many factors affect economic growth of a country. Among these factors, we can cite the country's financial development and size of trade. The quality effect of financial development on economic growth as well as the role of financial intermediaries depends upon assessment of the firms performance that attempt to innovate in organization. On the other hand, in addition to the structure of the financial sector in a country, trade as a factor in business growth and economic development by creating competition at the international level is to increase competitiveness in the international arena.

Many economists maintain that increase in the trade is one of the ways to achieve the high growth, but economic growth and increased production requires greater use of natural resources and energy, especially fossil fuels which in turn has led to environmental destruction. Thus, in the two past decades global warming and climate change has been the world most important environmental problems that Co2 emissions are the maximum amount to itself among greenhouse gases. On the other hand, the negative effects of climate change on the global economy are strongly endorsed by the world scientific centers.

In addition, international organizations try to prevent overheating of the planet and climate change, through agreements between different countries. For this reason, improvement in the quality of the environment through economic growth was part of the sustainable development topics in the World Commission on Environment and Development in 1987.

Although free trade between countries in the long term brings economic prosperity, the freedom to trade in some circumstances may not lead to prosperity. Given the importance of this issue, the impact of trade liberalization on environmental pollution has become one of the challenges for policy makers. Given the importance of the issue, this study examined the interrelationship between economic growth, environmental pollution, financial development and trade openness during the period of 2012-1980 in the eight largest countries. Many studies have examined the causal relationship between carbon dioxide emissions, economic growth, financial development and trade openness. However, what distinguishes this study from other studies in the field of econometric techniques is using panel data and simultaneous equations for the first time in these countries. We examined simultaneously the influence of a) environmental and economic development and openness on economic growth, b) economic growth, financial development and openness on environment pollution, c) economic growth, environmental pollution and degree of economic openness on the financial development, d) economic growth, environmental pollution and financial development on the openness of the economy. However, in most studies, only causal relationship between two variables is investigated. In addition, the study authors suggest that such experimental work has not been done for the D8 countries Group.

Materials and methods

The general form of the Cobb-Douglas function is used in this study as follows:

$$Y(t) = \theta . C(t)^{\lambda 1} FD(t)^{\lambda 2} T(t)^{\lambda 3} K(t)^{\alpha} L(t)^{1-\alpha} \quad (4)$$

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By getting Logarithm of the above series, the following equation is achieved:

$$LnY_t = \alpha_1 + \alpha_2 lnC_t + \alpha_3 lnFD_t + \alpha_4 lnT_t + \alpha_5 lnK_t + \varepsilon_t \quad (5)$$

As our study is the panel data, equation (5) is rewritten as follows:

$$LnY_{it} = \alpha_1 + \alpha_{2i} lnC_{it} + \alpha_{3i} lnFD_{it} + \alpha_{4i} lnT_{it} + \alpha_{5i} lnK_{it} + \varepsilon_{it} \quad (6)$$

Where i=1,…,N represents the number of countries, t=1,…,T is a period of time. System of simultaneous equations in the present study is as follows:

$$\mathrm{LnY_{it}} = \alpha_1 + \alpha_{2i}\mathrm{lnCO_{it}} + \alpha_{3i}\mathrm{lnFD_{it}} + \alpha_{4i}\mathrm{lnT_{it}} + \alpha_{5i}\mathrm{lnK_{it}} + \varepsilon_{it} \quad (7)$$

$$\mathrm{LnCO_{it}} = \alpha_1 + \alpha_{2i}\mathrm{lnY_{it}} + \alpha_{3i}\mathrm{lnFD_{it}} + \alpha_{4i}\mathrm{lnT_{it}} + \alpha_{5i}\mathrm{lnY^2{}_{it}} + \alpha_{6i}\mathrm{lnEN_{it}} + \alpha_{7i}\mathrm{lnUR_{it}} + \varepsilon_{it} \quad (8)$$

$$\mathrm{LnFD_{it}} = \alpha_1 + \alpha_{2i}\mathrm{lnY_{it}} + \alpha_{3i}\mathrm{lnCO_{it}} + \alpha_{4i}\mathrm{lnT_{it}} + \alpha_{5i}\mathrm{lnIF_{it}} + \varepsilon_{it} \quad (9)$$

$$\mathrm{LnT_{it}} = \alpha_1 + \alpha_{2i}\mathrm{lnY_{it}} + \alpha_{3i}\mathrm{lnCO_{it}} + \alpha_{4i}\mathrm{lnFD_{it}} + \alpha_{5i}\mathrm{lnFDI_{it}} + \varepsilon_{it} \quad (10)$$

$$i = 1, \dots, 8 \qquad t = 1990\ to\ 2012$$

The equations are specified and the method of 2SLS is used for estimation. In the above equation, Y ،CO ،FD ،T ، K ،EN ،UR ،IF and FDI represent the economic growth, the CO2 emissions , financial development, trade openness, capital, energy, urbanization, inflation and net inflow of foreign direct investment, respectively.

Results and discussion

We apply two-stage least squares method to estimate the system of equations. The results are presented in table 1.

Table 1: Estimation results

Dependent variable	L1.Y		CO			L1.FD			T		
Independent variables	Coefficient	Probability	Independent variables	Coefficient	Probability	Independent variables	Coefficient	Probability	Independent variables	Coefficient	Probability
CO	-45.43	0.030	L1.Y	47.35	0.001	L1.Y	0.53	0.072	L1.Y	0.0084	0.003
L1.FD	0.011	0.024	L1.FD	3.11	0.042	CO	0.185	0.284	CO	-4.65	0.546
T	0.034	0.000	T	7.30	0.000	T	0.316	0.041	L1.FD	0.083	0.030
L1.K	3.42	0.000	Y^2	-8.12	0.36	L1.IF	-0.412	0.019	L1.FDI	0.894	0.000
			EN	0.38	0.000						
			UR	0.023	0.033						
CONS	612.23	0.56	cons	-0.68	0.08	cons	12.54	0.053	cons	0.086	0.000

As it can be seen in Table 1, the effect of CO2 emissions on growth (Y) of D-8 member countries is significant and negative. Development Index variables, trade openness and capital have a significant positive effect on economic growth. Production growth has a significant and positive effect on greenhouse gas (CO) emissions. Financial development, trade openness, energy and urbanization variable have positive and significant effect on the environment pollution. Moreover, y2 has a negative effect on CO2 gas emissions, but this effect is not significant at the 5% level. Economic growth in these countries at 10% has a significant positive effect on financial development (FD). Trade openness has a significant positive effect on the development of financial growth. Inflation has a significant and negative impact on financial development. Production growth, financial

development and foreign direct investment has a significant and positive impact on the degree of trade openness (T).

Conclusion

This research investigates relationships among four variables of economic growth, environmental pollution, financial development and trade openness. The results show that there is a bilateral relationship between economic growth and CO_2 emissions. In fact, by economic growth, environmental pollution is increased because production takes place without regard to their environmental effects. Financial development system has bilateral relationship with economic growth in these countries. In other words, financial development growth in this group of countries increases production and adds environmental pollution. The financial development increases energy consumption or industrial activity improves and thereby increases CO_2 emissions. In other words, financial development in this group of countries has not led to the achievement of environmentally friendly technology, yet. In these countries another variable which is affecting environmental pollution is urbanization. This is, in one hand, by increasing urbanization and industrial plants, and on the other hand by increasing a large number of vehicles, causing more pollution in the environment. Other effective factors in these countries is trade openness that can help finance growth and development but also increases CO_2 emissions. Trade openness enables countries to access the technologies of their business partners, find their way to the larger markets and thereby increase economic growth. The development of the financial system, increase in capital efficiency and capital goods can buy foreign countries and thus make it possible to be feasible for foreign trade. In these countries, high inflation makes financial intermediaries able to operate with maximum efficiency. Thus, if the inflation rate rises, it makes the financial sector less and less efficient in allocation of capital. These results can be found in the D-8 countries, which Iran is also present. It should provide the basis to develop the financial system and thus increase production, gain new technologies in the field of environment for sustainable growth.

Keywords: Economic growth, environmental pollution, financial development, trade openness, 8 large Muslim countries