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Spatio-temporal distribution of particulate matter ($PM_{2.5}$) with an environmental approach in west and southwest of Iran based on SeaWifs, MISR and MODIS sensors

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Expanded Abstract

Introduction

The assessment of air pollution has become one of the increasing global concerns and has a significant impact on climate and environment. So far, various strategies for controlling and managing air pollution have been presented, which are widely used in air quality monitoring for air quality measurement indicators. One of the most important indicators in measuring air quality is $PM_{2.5}$. These particles make up 60 to 70 percent of the total particle and play a significant role in radiative forcing induction through the absorption and diffusion of sunlight and, as it has been said, also greatly reduce the air quality and public health. In recent years, several studies have been carried out based on air quality measurements and $PM_{2.5}$ observations based on urban pollution. With the launch of satellites and continuous improvement in data retrieval technology, $PM_{2.5}$-related studies have become more dynamic. The method of data retrieval of $PM_{2.5}$ based on satellite data during long-term statistical periods, especially for areas with no measured data, can be of great help to climate studies and air pollution. The aerosols optical depth (AOD) derived from satellite data can be very useful for $PM_{2.5}$ monitoring, which will be of great importance when developing countries such as Iran are not available in land-based data. Or they do not have a decent time distribution. The precise estimation of $PM_{2.5}$ involves the application of surface parameters, geographic data and local meteorological data, which leads to the development of more sophisticated models such as multiple regression models and nonlinear models. The method of data retrieval of $PM_{2.5}$ based on satellite data during long-term statistical periods, especially for areas where no measured data is available, can be of great help to climate studies and air pollution. AOD, derived from satellite data, can be very useful for monitoring $PM_{2.5}$. This is important when it is not available in countries with development such as Iran, land data or they do not have a good time distribution. This study, using SeaWIFS, MISR and MODIS data, evaluates the long-term (2016-1998) $PM_{2.5}$ in the western and southwestern atmosphere of Iran.

Materials and Methods

The study area of this study is west and southwest of Iran including five provinces of Kurdistan, Kermanshah, Hamedan, Ilam and Khuzestan. In this study, $PM_{2.5}$ hourly data of air pollutants were received from the State Environmental Protection Agency. To calculate AOD, three data sources of SeaWfis, MISR and MODIS were used for long-term data. We predicted and accounted for the bias in the annual mean of these geophysical-based SAT $PM_{2.5}$ estimates using GWR46. GWR is a statistical technique that allows spatial variation in the predictor coefficients of a linear regression-based predictor-response relationship, making it possible to predict using the spatial structure of both predictor variables and their coefficients. Finally, for calculating the average annual $PM_{2.5}$ satellite, we used Geographic Weighting Regression (GWR) method and $PM_{2.5}$ was calculated with spatial resolution of 0.01 arc for west and southwest of Iran. Compositional concentrations for mineral dust (DST) and the sum of sulfate, nitrate, ammonium and organic carbon (SNAOC) were represented by simulated relative contributions of each species applied to SAT $PM_{2.5}$ by weighting the near-surface aerosol concentration and the simulated compositional contribution of each species. We interpolated all predictors onto a common 0.01° grid. The GWR is a statistical method that allows spatial mapping in predictor coefficients of a relationship

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(predictive variable of response) based on linear regression and allows us to use the spatial structure of both predictor variables and its coefficients.

Results and Discussion

The estimated $PM_{2.5}$ data validation was calculated using two indices coefficient of determination (R2) and Root Mean Square Error (RMSE) for Abadan and Ahwaz stations, and the results showed that the $PM_{2.5}$ value was estimated using data. The SeaWifs, MISR and MODIS sensors have good performance in the west and southwest of Iran. Three sensors SeaWifs, MISR and MODIS have shown a similar pattern in the amount of aerosols in the area, so that the Ilam and Khuzestan provinces exhibit maximum AOD, and the widest latitude. The AOD was decreasing. The spatial distribution of $PM_{2.5}$ concentration during the period from 1998 to 2016 indicated that $PM_{2.5}$ concentrations in the west and southwest of Iran showed that there was a distinct spatial pattern with strong changes in the whole region. Khuzestan province showed maximum $PM_{2.5}$ levels between 1998 and 2016, which is significantly higher than other provinces. After the province of Khuzestan, southern parts of the province of Ilam have shown the maximum $PM_{2.5}$. The average $PM_{2.5}$ concentration in the west and southwest of Iran is 12.25 $\mu m/m^3$; the Khuzestan province can be considered a unique region in Iran, due to the high concentration of desert dust transported to this region of the country and the maximum amount of $PM_{2.5}$. Minimum AOD value for three sensors was investigated in Khuzestan province, east of Kermanshah province and Lorestan. This significant difference in the amount of aerosols can be due to several demographic variables, complex topography, meteorological factors such as lower wind speed, high relative humidity and precipitation, distances from dust sources, and eventually vegetation. Due to the fact that a large part of the Zagros Range, which has a height of more than 4,000 m, prevents the influx of dusty aerosols into the area. Also, large areas of Zagros are well covered with vegetation. As a result, complex topography with appropriate vegetation and low population density and significant human inactivity in the mentioned areas are reasons for the lower amount of aerosols compared to the provinces of Ilam and Khuzestan. Trapped desert dust under the meteorological patterns plays a regional role in reducing and increasing $PM_{2.5}$ in the studied area. Another factor that can greatly influence the variability of suspended particles in the studied area is due to the complexity of the topography and the pathway of many common systems (such as the Sudanese and Mediterranean systems), which is the wetting phenomenon, and can underestimate the precision of the combined and estimated data impact. The assessment of the location of the cities with the highest increase has shown that most of these cities are located in the border regions or are not far from the border areas of the country. These changes are clearly indicative of the apparent impact of the dust burden on the country and the increase of suspended particles in the atmosphere. Also, the relationship between AOD and $PM_{2.5}$ can be changed with meteorological parameters such as the depth of the mixture layer, relative humidity, air temperature and wind speed.

Conclusion

AOD in the west and southwest of Iran from south to north and west to east has shown a decrease; the high AOD in the studied area relative to the absorption of wet deposition, the formation of secondary aerosols and contamination caused by regional dust storms and human factors (such as combustion of fossil fuels), especially in the areas adjacent to the western borders of Iran, which accumulates particles in these areas due to their proximity to high dust sources. The particles matter in the atmosphere of the provinces located in the west and southwest of Iran have shown that the amount of entrained air entering Iran under dusty storms is the most important factor in the increase of $PM_{2.5}$ in this region of Iran. The maximum particulate matter was calculated in two provinces of Khuzestan and Ilam. The effect of dust storms have a significant role in this increase. The evaluation of the $PM_{2.5}$ variation over the course of the period from 1998 to 2016 has shown that between 1998 and 2012, the increasing amount of $PM_{2.5}$ and subsequently showed a decrease, a change from an inactive diet to a volatile active period. Also, the coefficient of variation of $PM_{2.5}$ during the studied period showed that more than 30% of the particles in the border regions and the route of storm surges in Iran. The coefficient of variation of $PM_{2.5}$ during the studied period showed an increase of more than 30% of the particles in the border regions and the route of storm surges in Iran, so that Saqez, Mehran, Masjed Soleiman, Dehloran and Kermanshah showed the maximum gradient of the computational process.

Keywords: aerosol optical depth (AOD), estimation of particulate matter, particulate matter ($PM_{2.5}$), remote sensing, west and south west of Iran.

Investigation of oil removal from water by the modified Nano tin oxide

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Expanded Abstract

Introduction

Introduction

Oil pollution has several long-term effects on environment and economy. Cleaning oil pollutions and oil spills are very expensive, and among different methods for removing oil from water- such as physical methods, adsorption, and biological treatment- adsorption methods are widely applied. Nano-materials have interesting characteristics that make them promising sorbents in aqueous solutions. Surface modification of nano-materials by grafting of polymer chains enhances their structural properties and sorption capacity. This study focuses on removing oil pollutions from water by synthesizing an efficient nano-sorbent. Tin (IV) oxide (SnO_2) nano-particles were synthesized using the co-precipitation method; after modification by 3-mercaptopropyl trimethoxysilane, they were grafted with N,N-dimethylacrylamide and allyl butyl ether. The performance of this grafted synthesized nano-sorbent was then evaluated for use in oil adsorption from water.

Materials and Methods

1. Synthesis of SnO_2 nano-particles grafted with hydrophobic groups

At the first stage, to synthesize nano-SnO_2, $SnCl_2.2H_2O$ (116.3 g) was dissolved in 250 ml distilled water to prepare 2 M $SnCl_2.2H_2O$ solution. Then, 2 M NH_3 solution was added gradually to the $SnCl_2$ solution while stirring at room temperature (25°C) to reach pH = 7. The slurry was stirred for 2 h and then filtered and dried.
Then for polymer grafting, a two-step method was applied for this stage. The first step was modification of SnO_2 with 3-mercaptopropyl trimethoxysilane and second step, Graft polymerization, was grafting the N,N-dimethylacrylamide (DMAA)- allyl butyl ether (ABE) copolymer onto the modified SnO_2.

2. Oil pollution index assessment

Total Petroleum Hydrocarbon (TPH) is considered as an index assessment of oil pollution in water, and this index is measured by Gas Chromatography (GC).

3. Batch adsorption experiments

A set of solutions (each 200 ml) containing crude oil and water were prepared and their pH values adjusted to the optimum value of 5. Then each 200 ml solution was divided to two 100 ml solutions, and one of them considered as standard solution for initial TPH assessment. Then desired dosage of AD-GNS was added to other 100 ml solution and it was shaken for 1 hr. The sorbent was filtered, and the suspensions were centrifuged at 7000 rpm for 5 min and the clear supernatant and the standard solution were analyzed using a GC-FID.

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4. Parameters optimization for AD-GNS sorption and isotherm study

In this study, the effects of initial pH, contact time, and adsorbent dose were investigated to obtain the optimize condition for adsorption of oil on AD-GNS. Then adsorption isotherms, Langmuir and Freundlich isotherms, and adsorption kinetic models, the pseudo-first-order and the pseudo-second-order are applied to investigate the mechanism of adsorption and efficiency of oil removal.

Results and Discussion

The AD-GNS was characterized by FTIR, TEM and SEM. FTIR of the SnO_2 nano-particles confirmed the presence of Sn-O-Sn and O-H at about 618 cm^{-1} and 3422 cm^{-1}. A peak at 1091 cm^{-1} caused by the Si-O band in the FTIR of the modified SnO_2 nano-particles confirms the modification with 3-mercaptopropyl trimethoxysilane. The presence of CH_2, CH, and OH are indicated at 1431, 2938 and 3437 cm^{-1}, respectively. The IR spectrum of the AD-GNS was compared with that of the modified SnO_2nano-particles. Two additional bands appear at about 1103 and 1641 cm^{-1} that correspond to C-O and C=O, respectively. TEM showed spherical agglomerated micro-particles with diameters of less than 100 nm, and SEM confirmed that particle size for AD-GNS was ranged from 30 to 50 nm. The degree of oil sorption by pH value was determined using the batch equilibration technique at pH values ranging from 3 to 8. Result shows that the adsorbate uptake depended on solution pH and the maximum adsorption was achieved at a pH of 5. The effect of contact time on the adsorption of TPH was investigated at different initial concentrations of oil and an optimized pH of 5. The AD-GNS amount was constant during this stage. According to the result, oil uptake was rapid at the start of the process in response to the huge surface area with functionalized and available active sites, but then slowed. The adsorption rate became constant as the active sites were covered with xylene and equilibrium being reached. At lower initial concentrations, adsorption was faster, and 10 min was usually enough for complete sorption. This reflects that active sites on the sorbent are easily accessible. The effect of adsorbent dose is also evaluated by adding different dosage of AD-GNS to solutions with constant TPH value and pH=5 and for better interpretation of the results, Langmuir and Freundlich isotherms, can be determined. According to the related calculation, R_L =0.02, and it is in the range of 0-1, which shows highly favorable adsorption. The maximum adsorption capacity of AD-GNS for complete monolayer coverage on the surface (q_{max}) is 11.61 and it confirms the very high capacity of the synthesized sorbent. To analyze the data and evaluate the mechanism of adsorption and efficiency of oil removal, two adsorption kinetic models- pseudo-first-order and pseudo-second-order- are applied, and proves that the pseudo-second-order model presents the adsorption kinetics better.

Conclusions

A new sorbent synthesized by a two-stage method for modification of tin (IV) oxide using (3-mercaptopropyl) trimethoxysilane and grafting of N,N-dimethylacrylamide-allyl butyl ether copolymer. Although the synthesis of the sorbent is simple and economical, it is time-consuming. The optimum pH for oil removal from water by the sorbent was 5, and contact time was 10 min. The capacity of the sorbent was 11.46 mg g^{-1}. Results showed good accessibility of the active sites. The equilibrium adsorption data of TPH sorption onto grafted nano-tin (IV) oxide were analyzed using the Langmuir and Freundlich isotherm models. The adsorption data were modeled as pseudo-first-order and pseudo-second-order kinetic equations. The results show that adsorption followed by the Langmuir isotherm and the pseudo-second-order model. The sorbent removed more than 80% of the TPH from the real water solution samples.

Keywords: Nano tin oxide, modified sorbent, oil removal, TPH removal from water.

Numerical evaluation of the effects of Green Belt development on local meteorology and air quality over Tehran metropolis

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Extended Abstract

Introduction

Urban green spaces are essential parts of the city's configuration which can be expanded in the urban areas in the forms of parks or gardens, as well as green urban structures such as green roofs or green walls. Green areas around the city are constructed as Green Belts or forest parks. In recent decades, land-use/ land-cover alterations have remarkably reduced the urban green spaces which cause environmental concerns such as air pollution, an increase in surface runoffs and greenhouse gases, the phenomenon of dust and the urban heat island. Studies on the role of urban greening on the urban air quality in different regions have shown that the structure, physical characteristics and vegetation species can be decreasing factors of urban air pollution, but in special circumstances, they may show adverse negative impacts. Indeed, on the one hand, trees affect the wind and temperature fields, as well as the atmospheric dispersion patterns and natural ventilation over the city, and on the other hand, they may accelerate the rate of the ozone production by the emission of biogenic organic volatile organic compounds. Therefore, proper selection of plant species and management of urban green space design are intricate issues in urban management programs. One of the proposed strategies to control the excessive expansion of megacities and the prevention of marginalization and population growth is the Green Belt development. According to the definitions, the Green Belt is a green borderline in the margins of the city that has numerous environmental performances such as beautification of the urban landscape, stabilization of the soil and prevention of the aerosols and dust entrance to the city center. The area and density of the Green Belt play major roles in changing the concentration of atmospheric pollutants due to sedimentation and deposition processes. The history of the Tehran Green Belt Project backs to about 40 years ago, and its fulfillment is one of the priorities of the urban management programs. It is predicted that the area of Tehran Green Belt reaches more than 40,000 hec, so it is expected to show significant changes in the micro-climate of the city. Therefore, in this study, the role of the Tehran Green Belt development on metrological parameters such as wind field, near-surface air temperature and relative humidity, surface heat flux and planetary boundary layer height (PBLH), as well as concentrations of gaseous air pollutants (SO_2, NO_2, CO and O_3) are studied, using a coupled Meteorological-Chemical numerical model (WRF-Chem).

Materials & Methods

1. Overview of the study area

Tehran is the capital of Iran and the most populated city in the country with an approximate area of 700 m^2, located in the north of the country. Three important factors affect the climate of the city: the Alborz Mountain Range on the northern border of the city, western winds and expansion of the city that cause different micro-climate situations in the north and south of the city. The temperature difference in these regions reaches 3°C. The average city temperature varies from 15 to 18°C. Complex urban structure, relatively dry climatic conditions, high population, high consumption of fossil fuels, along with global warming and heat waves, have caused the 8.2 million people in the city to experience a considerable level of urban thermal discomfort. According to the

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Tehran air quality report, because of the over-population of the city, the increase in vehicles usage and Tehran geography, air quality situation in this city is facing unfavorable conditions. In recent years, the main reason of the air pollution in this megacity has been the spread of pollutants by motor vehicles, and the phenomenon of dust and suspended particles have also increased the severity of the air pollution.

2. Model setup

WRF-Chem numerical model (version 3.8) coupled with the Noah Land Surface Model and the Single Layer UCM urban canopy model is used for numerical simulations. Before conducting basic numerical simulations, urban land-use data extracted from Sentinel-2A free satellite images with a horizontal resolution of 10m×10m (https://earthexplorer.usgs.gov) in ArcGIS program, and relative data introduced to the model. In the next step, the green belt of Tehran was ideally designed and its land use category considered as the Mixed Forest category of the standard classification of USGS archived data. The National Centers for Environmental Prediction (NCEP) global forecast system (GFS) reanalysis data on a 1˚×1˚ grid used for the atmosphere and soil initial and boundary conditions (ftp://nomads.ncdc.noaa.gov/GFS/). MOZART (Model for Ozone and Related chemical Tracers) data (http://www.acom.ucar.edu/wrf-chem/mozart.shtml) applied for boundary conditions of domain 1 and initial conditions for 4 domains in the chemistry section. The 2005 version of carbon bond chemical mechanism (CB05) and the MADE (Modal Aerosol Dynamics Model for Europe) aerosol scheme used for numerical simulations. Model of Emissions of Gases and Aerosols from Nature (MEGAN) used for biochemistry, and anthropogenic emission produced by PREP-CHEM-SOURCES preprocessor from RETRO global data. Tehran updated emission inventory (2013) mapped over the global anthropogenic data in the 4^{th} domain, and emissions introduced to the model through two separate times (wrfchemi_{00z,12z}_d04). Two weeks early summertime days (15-30 June 2016) with the cloudless condition, calm wind and without precipitation are selected for the simulations. Control case is the representative of the Tehran land-use properties in 2016. In the next step, the green belt scenario is conducted to re-simulate the meteorological and chemistry parameters. Data for the first three days, which is the model spin-up time, is not included in our analyses, and comparative analysis is done for 11 days averages of observed differences between the green belt scenario and the control case parameters in both meteorological and chemical sections.

Discussion of Results

1. Meteorology

Comparison of the 10m wind field and wind speed for two separate times (00:00 UTC, 12:00 UTC) between the control case and green belt scenario shows that alterations in land-use properties and roughness length have led to remarkable changes in the wind speed and wind direction in both the city center and city margins. At 00:00 UTC (local time ~ 3:30), on the northern border, reduction in wind speed up to 2 m/s is observed. Green belt area has shifted the airflow from the north-east to the north. Also, airflow into the city is limited in the eastern margin, and there is a significant decrease in wind speed as well as the wind direction change, which reduces the influence of the katabatic winds being the dominant wind flow during the night over the city. At 12:00 UTC (local time ~ 15:30), findings show that the wind flow in the control case is north-west, but in the green belt scenario, it shifts to the north. The daily decreased values of the temperature up to 2°C in the city center and the margin of the city observed which indicate the positive role of this green space in the air temperature reduction due to the shading and changes in the surface heat fluxes. Reduction in the wind speed also limits the hot and dry air flows entrance from rural areas to the city in summer days. The maximum air temperature reduction observed in the east part of the city (about -2.5°C). In the city center, relative humidity is increased by about 7% (4%) at nighttime (daytime). Relative humidity levels in summer hot days are higher in cities than rural areas due to the irrigation of green spaces, artificial lakes and domestic usages. Designed green belt traps wet air over the city. Also, the green area added to the boundary of the city increases the process of evaporation and transpiration, and it plays an important role in environmental humidity enhancement. Planetary boundary layer height (PBLH), especially during the nighttime, is one of the most important factors affecting atmospheric pollutant concentrations near the surface. Nightly changes in the city center reach -200 m, and relative values in the northwest and southeastern boundaries are -300 and -500 m, respectively, which corresponds to the air temperature reduction patterns. Besides, at night, due to wind speed reduction, the role of the surface dynamic factors in the formation of turbulence is reduced, resulting in a significant reduction in the PBLH. Reduced simulated daily values reach -1000 m in the city center and -500 m near the green belt margin. Reduction in the air temperature and the surface heat fluxes reduce surface and turbulent convection processes and reduce the depth of the boundary layer.

2. Air quality

As mentioned in the previous section, the development of the green belt in the borders of Tehran cause significant changes in the wind speed and wind direction, and as a result, alters the atmospheric dispersion processes over the city. As expected, the decrease in the height of the boundary layer and the turbulent processes

caused by air temperature reductions, worsen the air quality over the city and numerical simulation results confirm the increase of pollutants concentrations near the surface. According to the findings of this study, nightly CO concentrations in the city center and southwest margin increased by 0.2 ppbv. In the western and southern margins of the city, its concentrations decreased by about -0.6 ppbv and -0.2 ppbv, respectively. On the other hand, the increased concentrations of this pollutant throughout the day are prominent in all areas of the city and reaches around 0.07 ppbv in northern areas of the city. The highest alterations in SO_2 and NO_2 concentrations are simulated at the daytime with 0.02 ppmv and 0.016 ppmv in the center of the city, respectively. During the nighttime, increased values are about 0.2 ppmv for SO_2 and up to 0.06 ppmv for NO_2. Considering the southern wind patterns, emission of these pollutants has been limited over the northern areas of the city. These results indicate that wind flow is the most important factor in determining the dispersion pattern of pollutants. Despite the decrease in air temperature and its expected positive effect on the reduction of the photochemical production of ozone, the daily concentration of this pollutant also shows a significant increase over the city. Reduction of the PBLH and turbulence processes increase concentrations of NO_X and VOCs near the surface, which accelerates the process of ozone production. In addition, during the nighttime, the transfer of NO_X compounds to higher levels is limited, and the process of ozone consumption is reduced. The maximum simulated values is 0.005 ppmv (0.032 to 0.042 ppmv) at night (daytime).

Conclusions

Urban green spaces development programs such as green belts are cost-effective and long-term measures for urban environmental problems such as the air quality and urban heat island. Therefore, the true prediction of their effects and their management are essential. The coupled meteorology-chemistry numerical models allow the simulation and evaluation of both positive and negative side effects of these programs since they simultaneously incorporate the interaction of chemical processes and the meteorological parameters of the urban boundary layer. Numerical results help to develop the most efficient scenarios with the least adverse environmental impacts. Related studies have shown that the optimal performance of vast urban green structures, including the green belt and green corridors, depends on the climatic features of the area such as the wind field, as well as the correct design of them with regard to the sources of pollution and dust in the region. Wind speed, turbulent flux and momentum transfer reductions have also reported in several studies which prove that the aerodynamic characteristics of trees in some cases have a negative influence on the urban air quality. The present study shows that Green belt development on the eastern and southeast boundaries of the city has reduced the temperature and increased relative humidity by reducing the warm and dry suburbs airflow over the city which confirms the positive role of this green area in improving the environmental comfort level. Also, the cooling effect of this green space in the borders of the city is noticeable (decrease in the air temperature and heat flux). However, this urban green approach reduces the wind speed and changes the wind direction over the region. This factor, as well as the observed decrease in PBLH, cause the accumulation of polluted air in the city center. Particularly during the night, the green band of the northern margin of the city has reduced the influence of local winds to the city, and it causes a significant reduction in wind speed in the city center which has a negative impact on the air quality and the heat island severity in this area. Changes in the wind direction in the western border of the city prevent the outflow of polluted air and entrance of the suburban clean air which has a negative effect on the concentrations of industrial pollutants in this part of the city. Based on the current results, low-density plants with limit height which have less undesirable impacts on the wind field and natural ventilation of the city are proposed to be used in the Green Belt project of Tehran.

Keywords: air quality, Green Belt, Tehran Metropolis, thermal comfort, WRF/ Chem/ SLUCM.

Analysis the quality of residence in urban residential complexes through contextual components (Case study: Ardabil city)

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Expanded Abstract

Introduction

Principles and criteria related to the quality of the environment and the relation between this quality and its cultural, historical and social contexts in the design of residential complexes are ignored, which also reduces the satisfaction of residents from the complexes.

The purpose of this research is to improve the quality of residence in the residential complexes through contextual components. Accordingly, in the first part of the article, by reviewing the literature in this field, different dimensions of context and quality of residence in residential complexes are explained. Then, in the research methodology, the tool and the method of testing the theoretical model in some selected residential complexes in Ardabil city and the method of data analysis are described. Further, the findings are analyzed and the results of the study are presented.

According to the main hypothesis of the research, it is likely that the application of contextual components will improve the quality of residence in the design of residential complexes in Ardabil, as well as the sub-assumptions of the research including: (1) The components of the terrain and external conditions of the complexes have the most impact on the quality of residential complexes and the quality of residential units. (2) The natural component has the greatest impact on the quality of residence in the residential complexes of Ardabil. The present research seeks to answer the following main question: Does the application of contextual components improve the quality of residence in Ardabil's residential complexes? Also, the following sub-questions: (1) Which components have the most impact on the quality of residential complexes and complexes in Ardabil? (2) Which subjects have the most impact on the quality of residence in the residential complexes in Ardabil?

The context or contextual discussion is one of the topics that are of great interest today in the world. The lack of relation between implemented projects and environmental issues, especially in Iran, has led to issues such as inconsistency, identity crisis, and lack of utility and dissatisfaction with residence in residential complexes. So, one of the solutions is to adopt a context-based design approach. There was no research on the study of the field of contextual factors affecting the quality of residential housing development in the residential complexes; therefore, not repeating the issue and the need for a new look at the residence issue would justify the necessity of this review. The present research can help policy and planning to design the deep and efficient architecture of residential complexes in accordance with the needs of residents.

Materials and Methods

The present research is descriptive-analytic in nature and time-consuming as a future-oriented cross-sectional research and is considered as a quantitative method in terms of the purpose of the applied research part. The primary information gathering tool in this study was a questionnaire based on various dimensions of the research variables (field components and quality of residential complex) to assess the residents' views of residential complexes in the new and central context of Ardabil city. Initially, the original study and pilot scale was in the form of a scale of five Likert options (1. very low, 2. low, 3. medium, 4. high and 5. very high).

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The target population of this study is residents of Ardabil's residential complexes, which are selected by Cochran sampling method with a confidence level of about 6%, 240 residents of the complex. In order to determine the statistical sample, eight cluster models with observation and review of the writers, eight residential complexes named Negin Sarsotoun complex (with physical field), Abrovan complex (with physical, natural and historical context), Mansoorieh complex (historical and natural), Mahtab complex (Natural), Sabalan complex (physical, historical and cultural), Nastaran complex (physical and environmental), Vesal complex (physical and natural) and Aseman complex (physical) with different contexts were selected.
In this study, four main components of contextualism, namely physical context, socio-cultural context, historical context and natural context are chosen as independent variables and quality of residential complex as dependent variable, and individual factors of gender, ownership, age groups, marital status and the length of stay as controlling factor. Cronbach's alpha coefficient was used for reliability of the questionnaire. The Cronbach's alpha coefficient was 0.889 for 23 questions about contextual components and quality of the residential complexes, which is a sign of the reliability of the questionnaire. To analyze the data of the questionnaire, Means-test and T-test and multiple regression analysis are used in the SPSS software. Finally, the path analysis model is mapped to three levels based on regression coefficients.

Discussion of Results and Conclusions

The results of individual factors affecting the quality of residence through contextualism showed that, as time passes and age increases, the mean of contextual components increases. There is also a linear relationship between the level of components and the level of education, and with the increase in the length of residence in the complex, the quality of residence and contextual increases. Also, with an increase in residence duration in the city, the average historical context increases.
The results of the findings showed that contextualism improves the quality of residence in the residential complexes in Ardabil. There is a linear relationship between the contextual components and the quality of residence of the complexes. This means that with the increase of contextualism, the quality of residence is increased, except for the historical context, and thus the main hypothesis of the research is proved. Among the eight complexes, the highest average quality of residence and contextualism in the Nastaran complex is maintained, and it has the lowest level of quality of residence as well as the contextualism in the Vesal Complex.
The results of the findings showed that the quality of residential complexes in Ardabil is moderate to high, where social quality has the highest score in terms of residence and the lowest score is related to physical quality. As expected, residential complex residence, in terms of participation, community and security, is an effective factor in increasing social quality of complexes. Also, the highest average quality of residential units is related to exterior conditions, to the internal conditions of the units such as light, brightness, visibility and landscape. On the other hand, in terms of impact, the quality of contextual component has the greatest impact on the quality of residential complexes and the external component of the units has the most impact on the quality of residential units in Ardabil. Therefore, the first sub-hypothesis of the research is also proved.
Among the contextualism, the natural context (especially respect to nature and environment) has the most impact on the quality of residence, that is, the quality of residential complexes and also the quality of residential units in Ardabil. Therefore, the second hypothesis of the research is proved. The highest mean of contextualism is related to the physical context, and the lowest average is related to the historical context. In the historical context, which has the lowest score in terms of residence in the studied complexes, the least attention is given to the connection with the monuments that today are not getting much attention in the design of residential complexes, monuments and historical monuments, and this is the reason that the symbol dimension of the cultural context is also the lowest in terms of inhabitants.
On the other hand, Pearson correlation test showed that in each of the eight complexes, the highest correlation coefficient was related to the quality of residence and natural context. Among the selected complexes, the highest correlation coefficient between the quality of residence and the physical context was found in the Nestaran complex, and the highest coefficient of correlation between the quality of residence and the historical context was found in the Mansouriyeh Complex, which is located in the central-historical context of the city. Therefore, in order to improve the quality of residence in residential complexes, planners and architects and urban planners need to pay attention to the quality of the complex context (including environmental health, maintenance costs and lifestyle), as well as the external conditions of residential units (such as lighting and Green space), especially in the natural context, including respect for nature and environmental protection.

Keywords: Ardabil, contextualism, quality of residence, residential complex, residential unit..

Natural-historical landscape regeneration of urban green infrastructures based on AWOP and Gravity models (Case study: District 3, Isfahan)

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Expanded Abstract

Introduction

The present cities are so far from sustainability indicators and living standards. At present, no balance is observed between urban networks and natural patterns while urban networks are more dominant over ecological networks. The presence of nature in the city is considered as a vital environment to enhance the quality of biological, environmental, and landscape characteristics. The question of this study was that due to the dense and worn-out texture of some urban areas like District 3 in Isfahan where the designing a green infrastructure network is impossible due to the lack of spatial openness such as green spaces and urban spaces, what will be the solution for the current problems and future developments?

Green infrastructure is a response to modern human need for sustainable development and can be regarded as an approach focusing on the protection of natural environments and their performance as well as the human need results in a comprehensive framework for environmental, social, and economic sustainability results. In this regard, regeneration is a strategy which reorganizes the economic, social, and environmental structures, leads to the restoration of environmental quality or ecological balance, and combines them within the framework of sustainable development goals.

In this approach, considering landscape is similar to a vast mosaic, identification of the disturbances created in the natural process of the inherent natural patterns forming such mosaics, regeneration and design through for restoring the patterns, streams, corridors and green networks. The goal of designing the green infrastructure of many activities is based on ecosystem and human health.

In order to regenerate historical-natural landscapes, the current models in the field of green infrastructure planning were studied and reviewed and then in accordance with their criteria, the optimal natural-historical patch and corridors were selected. Then, the framework of strategic policies and actions in the areas of strengthening, protecting, improving and restoring the landscape was presented to enhance the quality of environmental life- landscape at the regional level after field observations in accordance with the criteria of quantitative and qualitative methods for urban green infrastructure matrix.

Materials and Methods

In this study, the combination of both quantitative and qualitative models was used with the regeneration of natural-historical landscape to increase the degree of reliability and efficiency. District 3 of Isfahan is located on the northeast part of central Isfahan in the old city of Isfahan. After examining the satellite images, the percentage of mass to space, the study of social-cultural problems, the amount of worn-out texture and its comparison with the standards and models of urban green infrastructure were used by examining the current potentials (including stream axis, etc.). This area was selected to regenerate the natural-historical landscapes and approach the naturalistic cities and sustainable development.

1. Patch, corridor, matrix

The structural elements of landscape are introduced as patch, corridor, and matrix based on Forman model. This model itself is part of AWOP model. Patchs include urban parks, gardens, cemeteries, vacant lands, urban

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spaces, semi-private-public green spaces, etc., and corridors include rivers, canals, streams, linear parks, energy transfer paths, streets, etc. After analyzing the structural elements of landscape based on patch and corridor at the regional level, an appropriate pattern of green and open spaces network in an interconnected system at the regional level was presented.

2. Natural- historical landscape regeneration

In this method too, based on Forman model, the valuable natural- historical patchs of the region were selected for regeneration and simultaneously used in the design cycle of green continuous network.

3. AWOP model

This model identifies the landscape elements and presents solutions after overlapping the extracted layers. Based on this model, the small patchs and corridors should be protected and then connected to larger patchs and corridors with ecological function to have a strong connection. This model is of a qualitative type and does not alone respond to the design of green infrastructure. For this reason, the patchs being selected in this method were determined with other quantitative and computational criteria through Gravity model. Then, the aforementioned layers were identified, extracted, and overlapped while the valuable patchs were highlighted and interconnected.

4. Gravity model

Gravity model examines the ecological impact of patchs and corridors on each other based on the extent and distance between them and ultimately achieves the optimal matrix in terms of complexity, connection, and the ratio of manufacturer/user cost. After overlapping the layers in the principles and criteria of AWOP model, the patchs and corridors were selected based on the criteria and at the same time the patchs which could be regenerated in the region and having common conditions with the model were selected. Finally, they were weighted and formulated based on the principles and criteria of Gravity model.

The studied and measured items were

1. Weighing the selected non-historical patchs
2. Weighing the selected historical patchs
3. Studying the interaction of both non-historical patchs based on the extent of patchs and the distance between them
4. Studying the interaction of both historical patchs based on the extent of patchs and the distance between them
5. Valuing the selected natural- historical-traffical corridors based on ecological indicators
6. Weighing the scores of selected ecological corridors.

Dicussion of Results and Conclusions

Based on the physical, structural, functional, and other situations, several networks can be produced and evaluated in this model based on green network typology such as the combination of hierarchical and Beckman models. Cities have converted in such a way that the natural and historical layers at their surfaces have disappeared into dense urban masses. As a result, the city has suffered from lack of self-purification, climate change, and the spread of mental, physical and mental diseases. In this regard, the idea of the interconnected urban green infrastructure network is one of the raised strategies to achieve a balance between the natural and artificial environment in the city and the sustainable structure of the city. It should be noted that each of the above-mentioned methods (not only with a merely qualitative model and not merely a quantitative one) could not respond to the local needs of the region and urban management. Thus, by combining AWOP model and Gravity models, it is the best and most applicable model for responding to the research goals regenerating the past self-sustainable city.

This method can also be generalized to other cities and towns with similar conditions to the sample under study such as worn-out, historical, natural textures, and so on. Based on the results, the large patch of Isfahan's Tabark Castle, which has been the oldest part of the city and the center of government in past times but has been neglected, at the same time the natural-historical landscape regeneration of the castle, that can work as the biggest ecological- landscape node in the central loop of hierarchical and Beckman patterns. Finally, some strategies can be presented separately for each zone in the framework of strategic actions in the domains of strengthening, preserving, improving, reparation and regenerating the natural and historical landscape.

Keywords: green infrastructure, historical landscape, landscape, natural landscape, regeneration.

The effect of sediment particle size on the characteristics of phosphorus adsorption

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Expended Abstract

Introduction

Disintegration of excess sludge from activated sludge units for production of a carbon source in post-anoxic processes in order to remove nutrients from wastewater streams has been widely used in recent years. For this purpose, ultra-sonication is one of the most applicable methods for disintegration of cell membranes to provide carbon, the source from disruption of microorganisms. Such substances extracted from disintegrated sludge can be used as readily bio-degradable sources of carbon to be used by other microorganisms in following process units. The amount of power (P) per volume (V) applied to the samples in specific durations (t) as well as the concentration of sludge is the most dominant factors in determination of the disintegration process. The main hypothesis of this research is that if the sonication of samples is intermittent during the total time of ultrasonic radiation, the defensive mechanism of cells will be weakened due to irregular forces applied to the cell membrane. This will lead to degradation of microorganisms at lower Specific Energy (Es) while the energy consumption in the whole process will be reduced accordingly. The effect of this parameter has been investigated through this research, whilst no research has been focused upon this issue earlier in previous studies. In this research, samples of secondary sludge have been disintegrated at the frequency of 24 kHz while the applied power, time of sonication and sludge concentration were changed for each set of experiment. As an extra independent variable, intermittent sonication was altered from 0.3 to 0.9 second. Degree of Disintegration (DD) was monitored as a dependent variable to evaluate the efficiency of the sludge disintegration process.

Materials and Methods

Rivers are considered as one of the main sources of water supply for agriculture, drinking water and industrial use. Water pollution is one of the most important problems in the world, especially in developing countries (Bandpey et al., 2013). Transferring the suspended sediments and pollutants into the outlet of the watersheds by runoff can be classified as an important reason for reducing the quality of water systems (Blanco et al., 2010). Meanwhile, Phosphorus is one of the most important nutrients in aquatic systems and plays an important role in the trophic state of water resources, which need to be managed in order to prevent eutrophication. So, sediments are specified as a main source and factor for the nutrients transferring to rivers, which have a significant impact on factors such as light penetration and water temperature (Eder et al., 2010). Sediments may act as a phosphorus sink due to certain physical, chemical and meteorological conditions that can release a significant amount of phosphorus to the water column leading to various problems in water resources (Fytianos % Kotzakioti, 2005). The release of soluble phosphorus in rivers is strongly influenced by the interactions between phosphorus and suspended and bed sediments (House et al., 1995). Therefore, studying of characterizes of phosphorus adsorption by sediment is necessary in order to better understand the interactions between phosphorus and sediments.

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Several studies have been carried out on the effects of sediments and various adsorbents on the adsorption of pollutants including heavy metals, etc. in Iran. But those only have focused on the heavy metal adsorption, while nutrients such as nitrogen and phosphorus are also the main source of contaminants in rivers. On the other hand, studying the effect of sediment particles on the adsorption and transfer of nutrients including phosphorus has not been carried out using river sediments and most of them focused on the adsorbents. Therefore, the purpose of this study is to investigate the effect of sediment particles on the absorption and transfer of phosphorus and to determine the kinetics of phosphorus adsorption using natural river sediments.

Materials and Methods

The studied and sampling area located in Karaj River, Alborz Province in 36° 0'40.14"N, 51° 35'-51° 2'E attitude and longitude with an area of 855 km^2 (Khorasani et al., 1997). The natural sediments under 15 cm surface sediment from the 7 points of the Karaj River were collected and sent to the laboratory. In order to reduce the effect of other sediment components on the physical absorption of phosphorus, all sediment samples underwent a pretreatment process to remove a large number of inorganic, organic, metal ions from natural sediments particles. After removing sediment contaminate, Grinding drum and sieve were used to size the sediment samples. After the clean and sized preparation, four groups of different sediment particle sizes were obtained (Meng et al., 2014) including D1 with size (<63 μm), D2 with size (0.05-0.1 mm) represent fine particles, D3 with size (0.1 - 0.6 mm) represent moderate particles and D4 with particle size (0.6 to 2 mm) represent coarse particles sediments.

1. Phosphorus adsorption kinetics

Absorption experiments were carried out at different concentrations in order to investigate the rate of adsorption of sediment with time progression. Dried sediments samples (0.2 g) with different grain size D1 to D4 were added in a series of 250 ml beakers with 100 ml phosphate solution (KH_2PO_4) at various concentrations including 23 and 100 mg/L. Two initial phosphate concentrations were adopted, 23 mg/L for the low concentration and 100 mg/L for the high one. The pH values of the solutions were maintained at 7.5 by adding 0.01 mol/L of NaOH and 0.01 mol/L of HCl. All reaction bottles were agitated at a rotational speed of 190 r/min. The sample solutions were taken at different time (5, 10, 20, 30, 60, 120, 180, 240, 480, and 720 min) and centrifuged immediately at a rotational speed of 5000 r/min for 10 min. The supernatant was immediately filtered through 0.45 ym Whatman GF/C filters for phosphorus analysis. The total phosphorus concentration in the sediment samples was monitored using the molybdenum-blue complex method with a UV/visible spectrometer at the wavelength of 780 nm (Murphy & Riley 1962). Each test was carried out three times, and the average results were recorded if the results of the three tests varied within a certain range. The amount of P adsorbed onto sediment was calculated as the difference in the concentration in the water phase at the beginning and end of the experiment. The difference between the concentration of phosphorus in the initial and final solution was considered to be equal to the amount of phosphorus absorbed (Eq. 1) (Onyango, 2010).

$$Qe = \frac{[(C_0 - C_e)].V}{M} \quad (1)$$

$$\text{Adsorption (\%)} = \frac{C_0 - C_e}{C_0} \times 100 \quad (2)$$

where Qe is the amount of phosphorus absorbed in mg/g, C_0 and C_e are, respectively, the initial and equilibrium phosphorus concentration (mg/gL), V is the volume of solution, and M is the mass of sediment (g).

The quasi-first-order adsorption kinetic equation, and quasi-second-order adsorption kinetic equation (Chien & Clayton 1980) were used to model the adsorption kinetic process. They can be expressed, respectively, as follows:

$$q_t = q_e\left(1 - e^{-k1t}\right) \quad (3)$$

$$q_t = q_e \frac{q_e k_2 t}{1 + q_e k_2 t}$$

where q_e and q_t is the amount of phosphorus adsorbed by the sediment sample at equilibrium and time t (mg/g), k_1 is the rate constant of the quasi-first-order equation (min^{-1}), and k_2 is the rate constant of the quasi-second-order equation (g/(mg·min)).

Discussion of Results

Migration and transformation of pollutants in the water environment depend on the adsorption and desorption characteristics of interactions between sediment particles and surrounding water (Zhu et al., 2014). The dynamic adsorption process in different sediments showed that there were clear differences in phosphorus adsorption in

various particle sizes of sediment. The kinetic process of the phosphorus adsorption appears to occur in three distinct stages: an initial fast adsorption stage, a relatively gradual adsorption stage, and an eventual equilibrium state where the amount of phosphorus adsorbed reaches a maximum. The evaluation of absorbed amount over time indicates that the rapid stage absorption process and the highest absorption amount take place in the first 5 hours and its concentration ranges from 0.04 mg/g to 0.2 mg/g at the concentration of 100 mg/l and from 0.02 to 0.16 mg/g at 23 mg/l concentration and tends to reaches the equilibrium level after 7 hours. Compared to coarse-grained particles, fine-grained particles due to the large specific surface area deserved large amount of phosphate adsorption. Particle with the diameter of 0.05 mm or D1 adsorbed much more phosphate than the other ones as it had the smallest size and largest specific surface area. With time increasing, the corresponding adsorption kinetics curves became flatter as the adsorption amount of phosphorus had the tendency to reduce, indicating that the kinetic adsorption process was time-dependent.

Variation in the amount of *P* adsorption per unit mass of sediment at time *t* for different sediment concentrations (S0) when the initial *P* concentration (C0) in the water was 100 mg L^{-1} illustrates that the P adsorption amount increased with increasing sediment concentrations from 1 to 2 g and in this study, it is approximately 1.5 times. Rapidity of adsorption kinetics during the first few minutes can be interpreted by the availability of a significant number of active sites on the surface at the beginning of adsorption, compared to that remaining after a certain time (Mustafa et al., 2010).

Variation of q_t over time (t) and its fitting with pseudo-first-order and pseudo-second order equations for the four groups of sediment with different particle size can be seen in Figure 1. The results of two kinetics models were applied the sorption kinetics of sediment samples showed that the kinetics of *P* adsorption onto sediment are well described by the pseudo-second order model. The quasi second-order equation has the highest correlation coefficient (R^2) and it can be concluded that the quasi-second-order equation provides the best representation of the kinetic adsorption process.

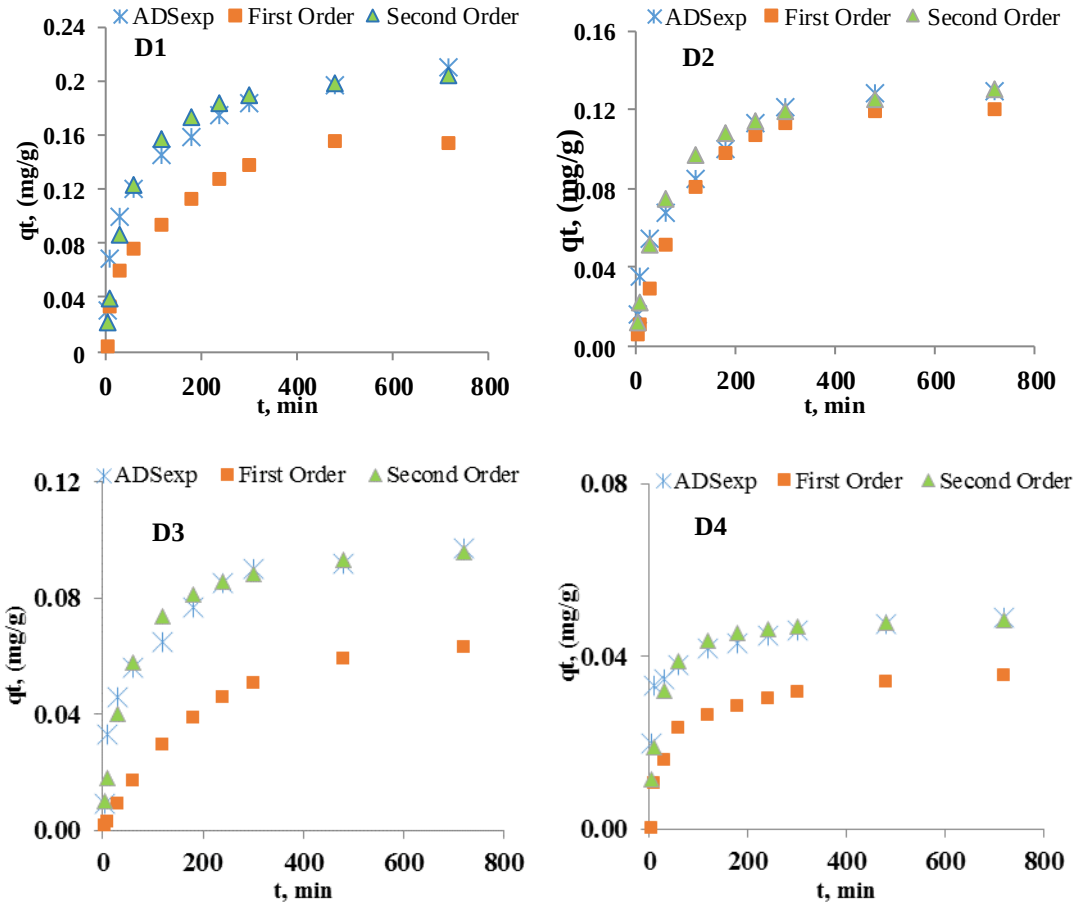

Fig. 1. Observed and predicted values of adsorbed phosphorus by first and pseudo-second order models in sediments with different particle sizes

Keywords: grain size, Karaj River, kinetic adsorption, phosphorus adsorption, sediment.

The assessment of arsenic contamination in Urmia lake sediments and its effect on human health

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Expanded Abstract

Introduction

Unfortunately, in the past decade, the growing trend of various human activities, despite the benefits, has brought major environmental challenges to humans. Among which, aquatic ecosystems are exposed to serious risks due to their higher developmental capabilities. The physical and chemical parameters of water are not suitable indicators for water quality monitoring due to their ever-changing nature. Sediments are the most important part of lithosphere, since they are final accumulation site for potentially toxic elements in aqueous ecosystems and maybe could be a source of water pollution. Therefore, sediments are suitable indicators for environmental pollution.

One of the most important international wetlands in Iran is Urmia lake. Urmia lake is one of the largest saline lakes in the world, comparable to the Great Salt Lake in the United States. However, human and natural factors have caused problems in the lake in 2 past decades. The Urmia Lake bridge, is the largest and longest bridge in Iran, and crosses Lake Urmia, connecting the provinces of East Azerbaijan and West Azerbaijan. This project was completed in November 2008. The construction of the causeway for the bridge, along with other ecological factors, will contribute to the drying up of Lake Urmia, turning it into an inland salt marsh, and adversely affecting the climate of the region. The 1,276 m gap in the causeway is not wide enough to permit and adequate flow between the two portions of the lake. Therefore, this study aimed to evaluate the arsenic contamination in Urmia Lake sediments and the possible reasons for the arsenic pollution in this valuable ecosystem.

Materials and Method

Based on distances and covering the study area, 12 stations on both sides of the highway, have been selected. Sediment samples were collected in autumn and winter at a depth of 30 cm and arsenic concentration of each sediment sample was measured. The sediment samples were collected by plastic shovel and placed in thick polyethylene plastic bags. Finally, all samples were placed in ice and transferred to the laboratory in less than 24 hours and stored in the freezer. For acidic digestion of the samples, the samples were kept at ambient temperature to freeze and dry. After the samples lost their initial moisture at laboratory temperature, an acid digestion method was used to analyze the total metal content. The concentrations of As in the standard and final sampled solutions was investigated by a Flame Atomic Absorption Spectroscopy Furnace AAS Model 67OG. The metal concentration values were corrected with respect to standard conditions using Equation 1.

Metal Concentrations Sediment Samples (mg/kg) = [Extracted solution Volume × Metal Concentrations by FAAS) / Oven-Dried Sediment]

The Geo-Accumulation Index:

The Igeo index was calculated based on Equation 1:

$$Igeo = Log_2 \left[\frac{Cn}{Bn*1.5}\right] \quad (1)$$

C_n: The measured concentration of examined metal in the sediment

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B_n: The geochemical background value in the Earth's crust: 6.8 for As, 14.8 for Pb and 0.1 for Cd
The value "1.5" is introduced to minimize the effect of the possible variations in the background values which might be attributed to lithological variations in sediment.

Contamination degree(Cd):
This method is based on the contamination degree (C_d) of each pollutant.

$$C_d = \frac{Mx}{Mb} \quad (2)$$

M_x is metal concentration in the sample and M_b is background value in the Earth's crust.

Results

The total average concentration of arsenic in the lake is 7.48 mg/kg. The average concentration of arsenic at stations 4 and 11 is significantly higher than the ISQGs standards (7.24 mg/kg).
Table 1. Muller and contamination degree results

Station	I_{geo}(autumn)	I_{geo}(winter)	C_d(autu)mn)	C_d(winter)
1	-1.52	-0.12	1.99	1.38
2	-1.35	-2.12	2.24	0.34
3	0.14	-1.31	6.28	0.60
4	0.14	0.94	6.25	2.87
5	-0.58	-0.44	3.79	1.10
6	-5.68	-4.25	0.11	0.08
7	-0.98	-0.36	2.88	1.17
8	-1.19	-0.41	2.49	1.13
9	-0.07	-0.11	5.43	1.39
10	-0.21	-0.37	4.91	1.16
11	0.07	0.22	5.96	1.75
12	-0.1	-0.99	5.31	0.75

Discussion
The average concentration of arsenic at station 4 in the central area of the lake and station 11 in the east of the lake is significantly higher than the global standard, which is about station 11, due to the estuaries of the rivers that put a significant load of pollutants to the lake. Station 4 is also located near the estuary of the western riverside. The results of the chemical indices also put stations 4 and 11 in the remarkable to very high contaminated category. Among all the stations, station 6 has the least contamination of arsenic, which can be due to being located in the central area of the lake and away from pollution sources.
More than 20 permanent and seasonal rivers and 49 river streams cross into Lake Urmia, and each year it adds a considerable amount of suspended matter with high absorption capacity which can be the main source of heavy metals concentration, including arsenic. Agricultural activities and especially fertilizers, herbicides, fungicides and insecticides containing arsenic. Also, the discharge of urban and rural sewage into the lake and the rivers can be a major factor in increasing of arsenic in sediments. In a study by the Remote Sensing Research center of Sharif University of Technology, some areas of the Urmiah lake, have been identified as potential dust centers. The center 2 in the east of Lake Urmia has overlap with east stations in the present study, especially Station 11. According to studies, the wind direction dominates from Lake Urmia towards the city of Tabriz in winter. Therefore, in the case of drought in Urmia Lake, high-concentration arsenic and other heavy metals can have unfortunate consequences for the health of the population in affected areas.
Due to the closure of the Urmia Lake, all the pollutants are accumulated in the lake. For this reason, the continuous monitoring of river water entering the Urmia Lake can be very helpful in understanding the changes in ecological status of Lake. Urmia Lake is located in Azerbaijan as the industrial-agricultural heart of Iran. Lack of standard system for wastewater treatment, use of fertilizers, herbicides, fungicides and insecticides containing arsenic in the agriculture and finally discharge of urban and rural wastewater drainage caused by leaching of land. Lake farming as well as the effluent of nearby factories into the lake and rivers leading to it can be a major contributor to the increase in arsenic in the sediments.
Urmia Lake is one of the most international wetlands also 105 important bird areas (IBA) of Iran. One of the most important values of Urmia Lake National Park is its habitat suitable for wildlife, migratory birds and

aquatic life. Urmia Lake is habitat to many aquatic birds as wintering, summering and inbreeding habitat. Heavy metals can accumulate in kidney, liver, muscle, bone, feather, blood and eggs of birds.
Various studies have shown that weight loss also reproductive, behavioral and nutritional disorders in birds are due to heavy metals. Inorganic arsenic can cause muscular dysfunction, slowness, falls and other symptoms in birds. Arsenic transfer in the form of arsenobetaine and dimethylarsinic from the female to the eggs. In addition, the negative impact of sediment heavy metals on the abundance and density of organisms as well as on the morphological characteristics of organisms have been proved. Thus, increasing the heavy metals contamination such as arsenic in sediments can be an alarm signal for the continued generation of birds and other aquatic organisms in the lake.
Then, monitoring of the rivers, prevention of overuse of fertilizers and pesticides, preventing industrial and agricultural effluents and municipal wastewater from discharging to the lake, can be used to reduce the pollution load of this valuable ecosystem.

Keywords: arsenic, Particulate matters (PMs), sediment, Urmia Lake.

A hybrid model based on neural network for indoor air quality modeling of Tabriz bazaar in terms of particulate matter

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Extended abstract

Introduction

Artificial neural networks (ANN) belong to a group of data-processing techniques, which can be used to find patterns, models or knowledge for different issues. They learn the relationship between the parameters and their responses when trained with a finite number of input data and predicts the values of response from the new set of independent variables based on its training experience. ANNs have very different models and algorithms that being used in a wide range of different problems.

Air pollution is one of the major problems of the modern world and causes long-term and short-term health effects. Due to numerous air pollution problems in large cities, outdoor and indoor air quality monitoring is very important in terms of its many effects on human life. Due to the many hours spent from each human's life in indoor spaces, it is essential to monitoring indoor air quality of places. There are various pollutants in indoor spaces, which particulate matters have attracted great attention among them because of its catastrophic effects on respiratory system and even circulatory system.

In this paper, by gathering required data from Tabriz bazaar indoor spaces, its air quality was examined in terms of particulate matters based on various neural network models. Passage's length, passage's width, proportional population density, surface material, presence or absence of ventilation, user's diversity, distance from nearby streets, roof's height, temperature and proportional humidity were obtained in 1081 various locations which 86 points of them were related to $PM_{2.5}$ and PM_{10} pollutants and were used as training data. After comparing various networks with different parameters, the optimal network was built. Then for increasing the model's performance, this optimal network was combined with LSBoost-Ensemble classifier.

Matherials and Methods

The term of neural network has evolved to encompass a large class of models and learning methods. They interpret input raw data through a kind of machine perception, labeling or clustering models. They help to group unlabeled data according to similarities among the example inputs, and they classify data when they have a labeled dataset to train on.

The neural networks consist of many layers. The layers are made of *nodes*. A node is just a place where computation happens, loosely patterned on a neuron in the human brain, which fires when it encounters sufficient stimuli. A node combines input from the data with a set of coefficients, or weights, which either amplify or dampen that input, thereby assigning significance to inputs with regard to the task the algorithm is trying to learn. These input-weight products are summed and then the sum is passed through a node's so-called activation function, to determine whether and to what extent that signal should progress further through the network to affect the ultimate outcome, say, an act of classification. If the signals pass through, the neuron has been "activated."

A node layer is a row of those neuron-like switches that turn on or off as the input is fed through the net. Each layer's output is simultaneously the subsequent layer's input, starting from an initial input layer receiving your data. Pairing the model's adjustable weights with input features is how we assign significance to those features with regard to how the neural network classifies and clusters input.

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Ensemble methods aim at improving the predictive performance of a given statistical learning or model fitting technique. The general principle of ensemble methods is to construct a linear combination of some model fitting method, instead of using a single fit of the method. Ensemble classifier has two common methods: Bagging and boosting that they are non-Bayesian procedures. They can be used to improve the accuracy of Classification & Regression Trees.

Boosting and bagging are two ensemble models capable of squeezing additional predictive accuracy out of classification algorithms. When using either method, careful tuning of the hyper-parameters should be done to find the best balance of model flexibility, efficiency & predictive improvement.

Bagging uses a simple approach that shows up in statistical analyses again and again improve the estimate of one by combining the estimates of many. Bagging constructs n classification trees using bootstrap sampling of the training data and then combines their predictions to produce a final meta-prediction. Boosting creates n base estimators, just like bagging, but does so in an iterative way as follows:

- Train base estimator #1 using normal method
- Observe the training data samples that base estimator #1 predicts incorrectly and create weight D>1.0 for these samples
- Train base estimator #2, applying weight D to samples when calculating gini/entropy measure of homogeneity
- Repeat n times.

In this way, boosting creates successive base classifiers that are told to place greater emphasis on the mis-classified samples from the training data. Like bagging, the results from all boosting base classifiers are aggregated to produce a meta-prediction. Compared to bagging, the accuracy of the boosting ensemble improves rapidly with the number of base estimators. Boosting method has many different algorithms that Least Squared Boosting (LSBoost) model was used to improve prediction model in this paper.

Discussion of Results and Conclusions

In the first step, for implementing and evaluating the research's suggested method, Tabriz bazaar was chosen as the world's biggest, most important and most complicated covered spaces. As the most important reasons for this choice, the large dimensions of this historical bazaar, its complicated structure, presence of a wide range of tradespeople and different occupiers in bazaar, citizens' and tourists' referral all year long can be mentioned.

Then different information related to Tabriz bazaar's various passages and buildings including passage's length, passage's width, proportional population density, surface material, presence or absence of ventilation, user's diversity, distance from nearby streets, roof's height, temperature and proportional humidity were recorded via field observation. Afterwards training data were collected for neural network. This was done in 86 points with different conditions by the help of a Japanese sensor named Pocket $PM_{2.5}$ sensor which can evaluate $PM_{2.5}$ and PM_{10} pollutants in the range of 0-999 ($\mu g/m^3$).

Collected data for both of the pollutants were classified based on the present standards and place's conditions in four healthy, medium, warning and dangerous classes and were shown by one to four tags. Given that determining parameters like the number of hidden layers, the number of neurons, the number of replications, the kind of transferring and tutorial functions in neural networks' utilization is very important and effective, to determine them optimally. A code in matlab coding language was used not only to check all the feasible functions and the appropriate number for neurons and layers, but also to determine their best amounts. By making multilayer neural network, it is possible to predict dispersion in various conditions of pollutants' amounts. In this paper due to users' requirement for noticing the pollutant's class and increasing accuracy, the round operator was used to classify the results to four classes one to four.

Due to the low accuracy of the results, ensemble classifier was used to improve the network. LSBoost model of Ensemble algorithm with the help of 100 boosted decision trees has obtained very appropriate results for this paper's case study with a learning rate of one (η=1). To performe the neural network in training and network creation phase, data were divided into three sections of train, validation and test data that the way of mean squared error's convergency and result's accuracy were evaluated for each of the $PM_{2.5}$ and PM_{10} pollutants. Efficient network was choosen by convegency's speed, performance and accuracy.

Due to the implementation the best network for $PM_{2.5}$ pollutant was determined by two hidden layers (first layer with 9 neurons and transfer function of poslin and second one with 5 neurons and transfer function of tansig) with traincgb's train data and general accuracy of 97.67% and MSE of 0.385. Also, for PM_{10} pollutant with a hidden layer containing four neurons, transfer function of tansig and train function of trainlm with the general accuracy of 97.67% and MSE of 0.2779 was obtained. Traincgb function of Conjugate gradient backprogation with Powell-Beale restarts and trainlm of Levenberg Marquadrat algorithm is a combination of Gauss-Newton and gradient descent which uses the ability of both algorithms and has a high speed in training.

It should be noted that in addition to the aforementioned networks, the Ensemble classification algorithm was run on this paper's data which was resulted to accuracy of 67.44% for PM_{10} and to accuracy of 68.60% for $PM_{2.5}$ indicating the optimality of the compositional approaches used in this study. In other words, by using combinational algorithm Ensemble and backpropagation multilayer neural network, the accuracy of results have been improved about 30%.
Then based on the collected data in different conditions, the training was done for $PM_{2.5}$ pollutant with the help of Newff-Ensemble neural network and for PM_{10} with the help of Feedforward-Ensemble network and prediction was done for other 995 locations of bazaar and PM zoning map was prepared. Based on these maps, it is clear that most of the center zones of Tabriz bazaar has appropriate air quality. Some sections of bazaar including bazaarche shotorban, bazaarche yakhchal, chaharsog sadegieh, bazaar dalaleh zan bozorg, raste bazaar sadegieh, karvansarayeh shazdeh bozorg, dalan khan and bazaar jambor ha were in 4^{th} class because of particulate matters and attendance of people who suffer respiratory disorders. Based on collected data for this study and by checking the results of this paper's proposed model, four criteria Passage's length, proportional population density, presence of ventilation, user type have been much more effective in increasing particulate matters' class. So, due to the obtained results from this study, areas which are located in dangerous class, effective and serious solutions should be done. For example, related to the construction of these areas, modern or classic ventilation systems can be installed to improve the quality of bazaar's indoor air.

Keywords: air pollution, ensemble methods, neural network, particulate matter, Tabriz Bazaar.

Air Pollution Tolerance Index (APTI) of three tree species of *Morus alba* L., *Ailanthus altissima* (Mill.) Swingle and *Salix babylonica* L. in different areas of Tehran city

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Extended abstract

Introduction

In recent decades, air pollution is one of the top environmental concerns and causes of death and disease. In China, air pollution has become the fourth greatest risk factor in all deaths (She et al., 2017). Experts concluded that contents of outdoor air pollution (emphasis to particulate matter) have adverse effects to human health (Carvalho-Oliveira et al., 2017).

Air pollutants in urban areas such as Particulate matters with sizes of 2.5 and 10 µm, ozone, SO_2, NO, Pb, CO cause injuries to plant leaves. The release of pollutants cause many threat for plants and other organisms (Achakzai, Khalid et al., 2017). Plants have more tolerance than other organisms (human, animal) against environmental pollutants. The sensitivity or tolerance of plants to air pollutants is evaluated by APTI (air pollution tolerance index) that consists of biochemical and physiological parameters (Achakzai, Khalid et al., 2017).

According to air quality monitoring, Particulate matters with 2.5 µm size is the main air pollutant in Tehran city. Industry emitters, high traffic of vehicles, use of low quality fuels are the main causes of air pollution in Tehran. The aim of this study is evaluating of air pollution tolerance index of three tree species such as *Morus alba* L., *Ailanthus altissima* (Mill.) Swingle, *Salix babylonica* L. in different areas of Tehran city.

Material and Methods

The city of Tehran ($35^0 35^/$ N to 35^0 $48^/$ N and 51 ^{0} $17^/$ E to 51 ^{0} 33 $^/$E, 800 km^2, Iran) has 22 urban areas. According to air quality measures, four sites including Mirdamad street (Area 3 or Site 1), Poonak (Mirzababaei Blud., Area 5 or Site 2), Enghelab (Area 6 or Site 3) and Azadi bus terminal (Area 9 or Site 4) were selected for collection of samples from *Morus alba, Ailanthus altissima*, *Salix babylonica* leaves.

Leaf samples with similar shape and age were collected on Monday, September 17, 2017 and stored in sealed plastic bags and kept in a portable ice-box and transferred to the lab for physiological and biochemical analyses. In the lab, four biochemical and physiological parameters were evaluated including total chlorophyll and ascorbic acid that were measured by spectrophotometric methods as well as the pH of the leaf sample extracts and Relative water contents (Achakzai et al., 2017).

The air pollution tolerance index of each plant species was determined according to the formula given by Singh and Rao (1983):

$APTI = ([A (T + P)] + R) / 10$

In this formula, A is the content of leaf ascorbic acid in $mg.g^{-1}Fw$; T is total leaf chlorophyll content in $mg\ g^{-1}Fw$, P is pH of the leaf extract, and R is the percentage of relative water content of leaf.

According to the criteria provided by Pandy et al. (2015) being confirmed by many researchers, plants with APTI values ranging between 17-30 , 13-16 , 13 and plants with less than 1 are considered tolerant, moderate tolerant, sensitive and very sensitive, respectively.

Results and Discussion

Total Chlorophyll Content (TCH)

The Chlorophyll content of *Morus alba* at Sites 2, 3 and 4 was significantly higher than that of Site 1. In *Ailanthus altissima*, Sites 1 and 3 were significantly higher than Sites 2 and 4. The highest chlorophyll content

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was observed at Site 2 and the lowest at Site 1. In *Salix babylonica*, there was no significant difference at Sites 1 and 2. However, Site 4 was significantly higher than Site 3. The total chlorophyll contents in the studied tree species ranged between 2.52 to 7.10 $mg.g^{-1}$ Fw.
The chlorophyll contents leaves of plants such as, *Taraxacum officinal*, *Plantago lanceolata*, *Betula pendula*, *Robinia pseudoacacia* increased in polluted sites that have heavy traffic of vehicles and industrial factories (Nadgórska–Socha et al., 2017). This research is consistent with above mentioned studies and other researches that plant with high chlorophyll content have high tolerance to pollutions (Shannigrahi et al., 2003; Prajapati & Tripathi, 2008; Rai & Panda, 2014).

Ascorbic acid

Ascorbic acid in leaves of *Morus alba*, *Ailanthus altissima* and *Salix babylonica* trees at Sites 3 and 4 was significantly higher than Sites 1 and 2. The highest levels of ascorbic acid were observed at Site 4 and the lowest at Sites 1 and 2. The *Morus alba* also showed the highest amount of ascorbic acid among the studied species at Site 4. Ascorbic acid is an important antioxidant that protect plants against environmental conditions such as air pollution (Keller & Schwager, 1977; Lima et al., 2000). Nadgórska–Socha et al. (2017) reported high amount of ascorbic acid in *Taraxacum officinale* in the high traffic of vehicles areas. The obtained results of this research are consistent with above mention studied.

Relative Water Content (RWC)

The percentage of relative water content of *Morus alba* leaves at Sites 2 and 4 was significantly higher than Sites 1 and 3. In *Ailanthus altissima*, Site 1 was not significantly different from Site 2, while Site 4 had the highest RWC. In *Salix babylonica*, Site 1 was not significantly different from site 2, while the highest percentage of leaf RWC was observed in Site 4. Plants with high RWC keep on their physiological balance and tolerance to air pollution (Verma, 2003; Rai et al., 2013). The increasing of amount of carbohydrates and other metabolites which decline of osmotic potential consensus induce the high amount of RWC (Prajapati & Tripathi, 2008; Govindaraju et al., 2012). The obtained results of RWC trait at polluted sites of these trees are consistent with the results of other researchers (Ritchie et al., 1990; Chaves et al., 2003).

pH leaf samples

In *Morus alb*, the highest pH of leaf extracts belonged to Site 4 while this parameter was not significantly different in the other three studied sites (2, 1 and 4). In *Ailanthus altissima*, Sites 1 and 3 were significantly higher than Sites 2 and 4. The highest leaf pH was observed at Site 3 and the lowest at Site 2. In *Salix babylonica*, no significant differences were found in the studied sites. pH leaf samples in three tree studied species were ranged between 4.9 to 7.4. The pH of leaf extract of specimens is regulator of conversion of hexose sugar to ascorbic acid (Swami et al., 2004; Escobedo et al., 2008; Rai et al., 2013). The results are consistent with the results of other researchers.

Air Pollution Tolerance Index (APTI)

The APTI Values of three trees increased in polluted sites such as Site 4. The sensivity or tolerance of plants evaluated by APTI value. Plants with higher APTI Value have higher tolerant to air pollution. Nadgórska–Socha et al. (2017) indicated that *P. lanceolata*, *Robinia pseudoacacia* with APTI value ranged 12-16 have moderate tolerant. The results are consistent with the results of other researchers.

Conclusions

According to the results of this study, White mulberry (*Morus alba)* with moderate tolerance seems to be a good candidate for planting in Tehran city due to its tolerance to seasonal air pollution (summer and early autumn).
In order to recommend the planting of this tree in different areas of Tehran, it is necessary to consider other criteria such as the water need for this tree, its transpiration rate, resistance to insects, such as aphids and whitefly. Also, its seedlings have to be tested for maximum tolerance to air pollution in the appropriate greenhouses.

Keywords: *Ailanthus altissima*, air pollution, Air Pollution Tolerance Index (APTI), *Morus alba*, *Salix babylonica*, Tehran city.

Ecological reclamation of distressed urban fabric through open and green space networks to enhance the urban vitality based on fraph theory and gravity models (Case of District 9, Tehran)

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Extended abstract

Introduction

Many metropolitan areas face large urban decay and distressed areas within the city fabric. The rapid growth and unleashed urban development have led to ecological transformation and landscape fragmentation during the recent decades. These resulted in the damages to the structure and function of the urban green/open spaces especially in urban fabrics; and affected the form, function and hence sustainability of urban systems. In some metropolitan areas, the driving forces for the sustainable development and improvement of the physical structures of urban areas faced great challenges and deficiency in recent decades. The inner city or central neighborhoods like any other ecosystem will change and in some cases are losing their livability and quality of life during the time. This is due to the rapid unsustainable development and lack of proper urban open/green spaces which are essential for the residents' quality of life. The process has consequently, turned into the neighborhoods' ecological and environmental deficiency, and more decays in urban fabric. These are observed to be true in some part of Tehran city. The fundamental changes in the Tehran urban fabrics are seen through fragmentation of green patches and open spaces. Some researchers have suggested that the solution to this problem is to change the attitudes of planners to create or strengthen urban green infrastructures systems. Therefore, this paper utilizes the Graph theory and Gravity model, for the analyses of green space network. These provide powerful tools and methods for analyzing and optimizing complex systems and evaluating the quality and quantity of urban green spaces, as well as developing efficient ecological landscape solutions for the efficiency, connectivity and continuity of the green space networks across the district nine neighborhood.

Materials and Methods

In this research, the district 9, Tehran city is investigated as the case study. District 9 is one of the 22 districts of Tehran with an overall area of 1966 ha, which accounts for 2.9% of Tehran's total area. The urban landscape structural elements in urban regions include Kan river- valley in the west district which is among the most prominent structural elements of the urban landscape, and a series of small– medium green spaces. The urban landscape context in district 9 constitutes of dense, fine-grained, impermeable constructed surfaces. Landscape structural spaces include private green spaces, public green spaces, brownfield spaces renovation reserved lands. Other structural elements such as faults, high pressure power lines and accessing network are considered potential for the creation of green corridors in the area. Through review of the literature the research, is aimed at identifying and analyzing the urban green space network based on the ecological landscape design framework.
By acquiring the land use map for the district 9, different information layers of the natural and artificial features were prepared including layers of river- valleys and watercourses, canal network, access network, fault, high pressure power lines, green areas, urban development lands and reserved lands for extracted, the overlapping layers and synthesis of data landscape elements, ecological network in district 9 was developed. First, at the macro level, the ecological effect of adjacent green spaces on each other in the distressed urban fabrics were calculated and variety of alternatives were presented to develop the most efficient green network in the distressed fabrics of district 9. At the micro level, the optimal connection route among the available routes were

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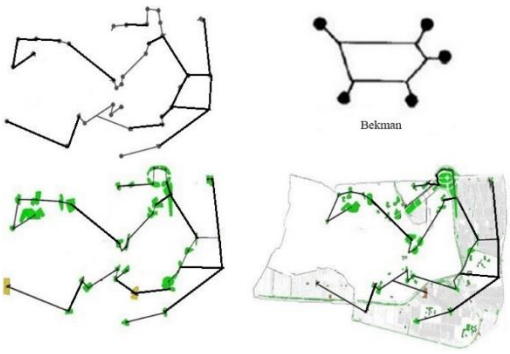
determined using the least cost route function. Weighted cost analysis for each node was performed separately by weighted cost analysis in GIS software. Subsequently, it was selected with the help of continuity indices in optimal network graph theory to develop green spaces in the distressed urban fabrics of district.
The interaction between the nodes is evaluated using the traction model. The interaction is calculated using the following formula:

$$G_{ab} = \frac{N_a N_b}{D_{ab}^2} = \frac{(\sum L)^2 LN(S_a S_b)}{L_{ab}^2 P_a P_b}$$

where G_{ab} interaction between nodes a, and b, N_a and N_b are the corresponding weights, and D_{ab} is the normalized cumulative impedance of the corridor between a, and b. L_{ab} is the cumulative impedance of the corridor L between nodes a, and b. ΣL is the sum of the cumulative impedance of the corridor between nodes.

Discussion

The results suggest the greater the area of cross-spaces and the smaller the distance between them, the greater the ecological effect of cross-spaces. By calculating the amount of interaction between the spaces and prioritizing the links, the ecological network pattern in district 9, Tehran can be developed based on graph theory and gravity model. Then, alternatives are in the form of four proposed connection patterns. By comparing these connection patterns and network, the alternative 3 (Beckman Model) found to be the most efficient option for developing green space network of ecological reclamation, having 36 spaces and 37 links to improve continuity and achieve vitality in the distressed urban fabrics of district 9, Tehran. Figure 1 shows the alternative 3 (Beckman Model) based on graph theory and gravity model.
Figure 1. The alternative3 (Beckman Model) in district 9, Tehran based on graph theory and gravity model



Some of the reasons for choosing this model are as follows:

- It can generalized and can be connected to the open and green spaces in adjacent areas in a repeatable pattern.
- The relative cost and number of connections compared to the other two models are such that it is responsive to users on the one hand, and responsive to green connections in the ecological network on the other hand.
- The project can improve the spaces and network corridor features by applying ecological principles such as maintaining the integrity and cohesion of the ecological landscape in distressed urban fabrics, which may help in strengthening the corridors and urban green infrastructure.

Conclusion

Many cities and urban areas are suffering from the expansion of distressed urban fabric in their central cores; these have led to the lack of green areas and open spaces which are essential for the urban sustainability and vitality. In this study, using concepts in graph theory and gravity modelling as well as cost analysis, the Beckman model was selected as the most efficient model in analyses and application of alternative solution in district 9 for connecting green and open spaces among four categories of connection between spaces. Each green/open spaces network will be designed according to the planner strategy, location, opportunities and constraints, taking into the account the ecological design principles of the site, as well as improving the quality of life in the distressed urban fabrics.

Keywords: distressed urban fabrics, District 9 Tehran, ecological reclamation, gravity model, graph theory, green space ecological network.

Developing a pattern for intervention in urban green infrastructures to reach urban ecological resilience to climate change (Case study: Yousef Abad neighborhood in Tehran)

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Extended abstract

Introduction

Natural disasters are considered a major challenge in the developing countries, which not only cause casualties and emotional suffering for the survivors, but also seriously damage the local economies facing the disaster and thwart the development achievements (Asian Development Bank, 2014).
Cities should be resistant to a wide range of shocks and pressures, including climate change (Leichenko, 2011). Therefore scholars and planners try to reduce the damages of natural disasters based on different approaches and patterns through the development of appropriate plans. One of these approaches is to investigate the resilience to natural disasters. Today, most natural disasters occur due to climate change. Climate change is a globally widespread phenomenon that is happening in the whole planet (Childers, 2015) and has created serious problems for humans and the environment. Resilience is a new concept that is mostly used when facing the unknowns and uncertainties such as climate change (Adhern, 2011). Resilience means that the urban system is able to withstand severe natural disasters without suffering from casualties, damages or loss of production capacity or quality of life (IPCC, 2007). The resilience regarding the climate change reduction and adaptation is addressed in this study.
Among the resilience types, what is considered in this research is the climate resilience that is a subcategory of urban ecological resilience. The climate resilience is the urban resilience to climate change (Carter et al., 2015). In this respect, the review of existing literature shows that few studies so far have addressed the concept of climate resilience, and most studies in the world and Iran, have only focused on the urban resilience and its assessment on the urban and regional scale. A very limited number of studies have addressed the resilience to climate change on other scales, especially the neighborhood scale.
As a building block of cities, neighborhood is of great importance, and a resilient city can be achieved by a resilient neighborhood. On the other hand, one of the important factors influencing the climate resilience is urban infrastructure, especially green infrastructure. However, the main question and objective of this research is how to achieve a methodology or principles to examine the current situation of the infrastructure in cities to improve and ensure the climate resilience in the neighborhood by improving such situations.
To answer the questions of this research, by selecting a case study and the GIS software to collect data about the status of vegetation and green infrastructure and to analyze the data based on the characteristics of green infrastructure's resilience potentials and by providing the base and analytical maps, it was attempted to propose and develop a method for interfering with the quantity, quality and location of green infrastructure to increase climate resilience.

Research questions

The main question here is: How are UGI and Climate resilience connected in cities? With which method or pattern can urban planners intervene urban green infrastructures in order to increase climate resilience in neighborhoods? And what are the effective urban green infrastructures, resilience potentials? The main purpose

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here is to find a method to intervene UGI's quality and quantity to increase climate resilience in neighborhoods. Also to find climate change adaptation strategies based on UGI and their effect on the city's climate resilience in order to maintain, create and increase climate resilience.

Research goals

The general purpose of this research is to extract principles of intervention or to find strategies for adaptation to climate change using green infrastructure (quality, quantity, their location) and their impact on urban climate resilience and promoting climate resilience through the green infrastructure in city and neighborhood scale by enhancing the existing UGI and also by introducing climate resilience UGI and climate resilient green species for new urban projects.

Terminology

Climate resilience in neighborhood scale

Climate resilience includes the capacity of an independent unit or a group or organization to respond to climate change in a dynamic and effective manner, while still continuing to daily activities in an acceptable level. This feature includes the resistance to change, recovery after the shock, and reorganization to prevent the destruction of the system, that is the city (Dayland & Brown, 2012). In general, 'climate resilience' is the urban resilience to climate change. Various literature has classified the climate resilience as a subcategory of urban ecological resilience.

The studies conducted by Miller et al. (2009) emphasized the importance of urban infrastructure as an effective factor in creating climate resilience. However, the importance of green urban infrastructure is also considered, which is further discussed in the following.

The climate resilience on the neighborhood scale includes the ability of the neighborhood in the physical-infrastructural, social, political and economic systems and the resistance and efficiency of settlements and buildings to tolerate the hazards of climate change to quickly return to previous situation under these tensions and pressures, and to embrace and confront future threats. One of the greatest impacts of climate change can be found in cities, and especially in neighborhoods. As one of the most important urban segments, neighborhoods are no exception to these adverse effects. As a result, it is necessary to provide solutions on neighborhood scale for dealing with the climate change (Sasanpour et al., 2015).

A resilient neighborhood is the one that can withstand the shocks and impacts of a change, so that those risks could not turn into a crisis, and also the ability or capacity to return to the previous state during and after the crisis should be institutionalized to make it possible to change and adapt after the crisis. The institutionalization of resilience in the neighborhood during the pre-disaster stage reduces vulnerability, avoids and mitigates losses, and also leads to the continued ideal conditions of the local community, as far as possible, during the drastic changes, and then, after the changes, to rehabilitate the effects of climate change (Moxham et al., 2013). In general, it can be stated that resilient neighborhoods give rise to resilient cities. Green infrastructures are the factors affecting climate resilience and urban resilience. So far, based on existing literature, the importance of urban infrastructure, including urban green infrastructure, in urban resilience was demonstrated, and it is further addressed in the sequel.

Urban green infrastructure in neighborhood

Urban green infrastructure is a type of ecological social system that results from the interactions of various elements, especially humans. The components of green urban infrastructure can be considered a combination of open and closed spaces and a mixture of natural plant habitats, which are of great ecologic, social and economic significance. As a result, the proper design in these spaces can have a profound effect on the everyday life, and resilient design is considered one of the most appropriate principles for the design of such spaces (Oliver, 2014). In general, green infrastructure includes green roofs, permeable green surfaces, green paths and streets, urban forests, public parks, neighborhood gardens, and urban wetlands (Demuzere et al., 2014).

For adaptation to climate change, the urban green infrastructure is one of the most important "strategies for adaptation to climate change". The green infrastructures can bolster the cities and reduce the impacts of climate change in the future (Foster et al., 2011). Urban green infrastructure certainly reduces the effects of heat islands in cities and the floods (Byrne et al., 2015). To create climate resilience in cities and reduce pollution, there are several solutions, one of which is the planning and design of green spaces. Various studies have explored the importance of urban green infrastructure in balancing water flows and providing the thermal comfort. Urban green infrastructure is known to reduce climate change, for example, for controlling flood flows, creating shading, reducing air temperatures, etc. On the neighborhood scale, urban green infrastructure has four important functions related to the establishment and improvement of climate resilience (Sheate et al., 2015).

Strategies for adaptation to climate change and improvement of climatic resilience using urban green infrastructure

According to the conducted studies, three strategic principles were derived to study and improve the existing and proposed green urban infrastructure: 1. Maintaining and enhancing existing vegetation, 2. Using resistant plants to climate change, 3. Using "landscape ecology" to find proper locations of vegetation in new urban projects (Gill, 2007).

1. One of the important strategies to reduce the temperature in the warm seasons is the identification and maintenance of existing vegetation, in private gardens or in public green spaces or the green spaces on the streets. However, in many urban areas, there are hard and grey infrastructures, and it is impossible to change the use and replace them with large green spaces. In such conditions, vegetation should be added to the environment with creativity and the use of specific methods. One of these methods is to use green roofs and green facades, plant rows of trees along the streets and railroads, and convert the streets into green paths.

2. Another strategy is to use plants resistant to climatic conditions, for example, resistant to drought and water shortage. Of course, drought is one of the negative effects of climate change. Under such conditions, it is effective to use the plants with lower water demand and less susceptibility to climate conditions. Some types of plants are very resistant to specific climatic conditions, including drought. The use of trees in such situations is very suitable. These plants continue to shade and evaporate under severe climatic conditions.

3. To deal with climate change, the location and arrangement of the vegetation is very important. According to Forman and Godron (1986), green infrastructure can be classified into three categories: patch, corridor and matrix. Each of these forms has the following benefits:

- Corridors are effective in storing the water from flood and controlling flood flow.
- Patches are mostly effective in storing the rainwater while the river flooding. The cooling of space through evaporation is further done by patches than matrices, and the appropriate micro-climates are also created in the patches.
- Matrixes are more effective in treating the rainwater than the patches. When the green spaces are more than one hectare, they create a good microclimate. Shading occurs in the patches and matrixes, which leads to cooling of residential areas (Forman, 1995). Generally, green space is effective in reducing the rate and amount of surface runoff in sandy soils. The creation of protected areas on such soils can be a good strategy for the areas with such soil types (Gill, 2007).

Concluding the issues raised in the theoretical section, after introducing the strategies of adaptation to climate change and enhancing the climate resilience using the city-scale urban green infrastructure, a conceptual framework of ‘intervention approaches’ was finally extracted for the green infrastructure to enhance the climate resilience on the neighborhood scale. These approaches pave the way for the present study to answer the main question, "How to develop a method for exploring and improving urban green infrastructure to achieve and enhance the climate resilience on the neighborhood scale?” In the research method, these approaches are further elaborated and the basic and analytical studies are performed using these approaches in the case study, Yousef Abad neighborhood of Tehran. Finally, a method will be developed for intervening in such infrastructure on the desired scale which can be extended to other Iranian cities with similar climate conditions.

Methodology and Results

Iran is one of many countries that has been hit by climate change negative effects in the recent years. The main climate challenges that many big cities in Iran are facing are drought, air pollution, low annual precipitation, increasing temperature especially in summer, decreasing water resources quality, water shortage and so on.

Based on these challenges, the city of Tehran was selected as one of the big cities in Iran with the most climate challenges. The main climate challenges that Tehran is facing are, air pollution, water resources contamination and shortages, drought and extreme heat in summers.

To find answers to the research’s main question, to reach the research goals and also to put to the test, the UGI climate mitigation strategies that were extracted from the literature review, ‘Yousef Abad’ neighborhood in Tehran was selected as the case study.

The method used here was, studying various library and Internet sources, books for reviewing the existing literature. After this step, GIS, field studies and aerial photography will be used as the main tool to develope different base and analytical maps such as: existing urban green and grey infrastructure maps, thermal maps of the selected neighborhood, building height and street width and direction maps, green species maps with the focus on their health and location. Also, maps of existing patch, corridor and matrix will be developed and analyzed to measure climate resilience based on landscape ecology theories.

After doing the above mentioned analysis, this research was able to achieve an extensible methodology to increase climate resilience through urban green infrastructure in the cities of Iran in the neighborhood scale to guarantee climate resiliency in the city scale.
Also, by using landscape ecology language (Patch, corridor, matrix) as a way to interpret the existing eco-resilience conditions of green infrastructures, a method was introduced and also by using this method, the ecological characteristics of specific plants were analyzed and plants with better resilience potentials to drought, heat and air pollution were suggested for the study area. This was important characteristics of green infrastructures were introduced as factors for future analysis of 'urban climate resilience' in cities.

Keywords: climate change, urban ecological resilience, urban green infrastructures, Yousef Abad neighborhood in Tehran.

Source apportionment of petroleum hydrocarbons hopane and sterane in Anzali port area- south of Caspian Sea

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Extended abstract

Introduction

This work is the first study where the contributions of major hydrocarbon sources are investigated in detail in south of Caspian Sea area. In other previous studies, the major source of polyaromatic hydrocarbons (PAHs) and other hydrocarbons in south Caspian Sea rivers and coasts were from petrogenic origin (Nemati Varnosfaderany et al., 2015; Shirneshan et al., 2016a; Azimi et al., 2017). However, the investigation of what are the main petroleum products entering into rivers and to southern coasts of Caspian Sea are still necessary. Hopanes and steranes are ubiquitous components of crude oil which are present in traffic-related sources (automobile exhaust, tires, asphalt, engine oil and fuels). They are present as homologs and stereoisomers of each other and their composition differ among crude oils depending on their source and maturation. Therefore, hopane and steranes profiles have been used to identify the sources of petroleum pollution (Zakaria et al., 2000, 2001; Shirneshan et al., 2016a, b; Volkman et al., 1997; Yunker & Macdonald., 2003; Maioli et al., 2010).
Anzali is the most important port town in the southern Caspian Sea located in the north of Iran. This is one of the densest populated cities in Iran. Abundant rainfalls (1892 mm average annual precipitation) and crossing rivers inside the city accelerate the transport of street dust particles containing petroleum hydrocarbons into Anzali international wetland and rivers by surface runoffs (Kumata et al., 2000). In the present work, identification and distribution of the main sources of petroleum hydrocarbons in the street dust, runoffs and urban river sediments of different locations of Anzali port are investigated and they are related to automobile exhaust, tires, pavement asphalt, engine oil, gasoline and diesel possible sources. In addition, the contribution of each proposed source had apportioned by PCA and MCR-ALS chemometrics assays and fingerprinting diagnostic ratios.

Materials and Methods

Sample collection procedures

Four type of receptor samples were collected and analyzed: street dust, runoff suspended sediment, runoff soluble water and river sediment samples. Street dust and Runoff samples were collected from the surface of all bridges on the urban rivers in Anzali city (8 bridges), and from the surface of the four streets with more traffic. Sampling was performed a day of sunny weather in September 2016 which was preceded by more than one week of sunny weather. Sampling of Runoff was performed in October 2016 during a rain of more than 10 mm after some days of sunny weather using a water sampler. Runoff samples were filtered by a vacuum pump which separates suspended solids from the water-soluble fraction. River sediment samples were collected from all urban rivers of Anzali city and from harbor (24 stations) utilizing Van Veen grab (50 cm×50 cm) in three replicates for every station.
Six types of specific known pollution source samples were also sampled: tires, street pavement asphalt, gasoline, diesel, engine lubricant oil, and exhaust soot.

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Sample pretreatment procedure

All solid phase samples including sediment, street dust, runoff filtered sediment, exhaust soot, tire and asphalt samples were extracted by the Soxhlet method. The Extraction and fractionation procedure is based on the method described in Zakaria et al. (2000). Petroleum hydrocarbons extraction from runoff soluble water was performed using liquid-liquid extraction, LLE, (Titato & Lancas, 2005; Okoli et al., 2011). Twenty milligrams of gasoline, diesel and engine oil samples were accurately weighed and dissolved in 2 ml DCM/n-hexane (1:3, v/v). These sample extracts were purified and fractionated using the same procedure as for the solid phase samples.
Limit of detection (LOD) and limit of quantification (LOQ) of the analytical method were 0.13-23.06 and 0.41-75.10 $ng.g^{-1}$, respectively for all hydrocarbons.

GC–MS analysis procedure

GC/MS analyses were carried out by a gas chromatograph (GC, model 7890A, Agilent Technologies, PaloAlto, CA, USA) instrument coupled to a quadrupole mass spectrometer (MS, 5975C, Agilent Technologies, PaloAlto, CA, USA).
Analytical standards were: 17a(H)-22,29,30-trisnorhopane, 17β(H), 21β(H)-hopane, diploptene (17β(H), 21β(H)-hop- 22(29)-ene), and 17α(H), 21β(H) hopanes. The sterane standard mixtures include 5α (H)-cholestane, 24-methyl- 5α (H)-cholestane, and 24-ethyl-5α (H)-cholestane. Perdeuterated n-tetracosane-d50 (m/z 66; relative concentration values) was used as standard (Yunker & Macdonald 2003; Harris et al., 2011).
Recoveries were computed by spiking a known concentration of the SIS mixture (surrogate internal standard) to the sample followed by performing the whole analytical method. Recoveries of individual constituents of the spiked SIS were more than 85% for hopanes and steranes.

Software

All data analysis was performed under MATLAB (The Mathworks, MA, USA, 2014) numerical computing, visualization and programming environment. PLS Toolbox 7.0 (Eigenvector Research Ltd., Manson, WA, USA) and MCR-ALS Toolbox (www.ub.edu/mcr) were used for chemometric data analysis.

Results and Discussion

Catagenetic hopanes composition is usually characteristic of petroleum sources, making them useful as possible molecular markers of petroleum pollution (Peters & Moldowan, 1993). The spatial distribution of catagenetic hopanes in the four type of samples, indicates the total amount of catagenic hopanes were higher in street dust and runoff (S and W) stations located in urban and populated areas with more traffic than in stations outside the city with lower traffic. Street dust particles in urban runoff act as a transport medium for pollutants such as PAH and petroleum markers (Brown & Peake, 2006; Herngren et al., 2006). Thus, these compounds arrive to the Anzali rivers and consequently to the coast of Caspian Sea and they are accumulated in river bottom sediments for a long time. In the case of river sediments also, the stations in runoff areas containing street dust and petroleum products, especially in the harbor area stations, had higher concentrations of catagenetic hopanes. Due to the closure of harbor by the artificial pier, pollutants accumulate in this area and settle in bottom sediments. In addition, in the harbor area, there are many ships and floats that release large amounts of petroleum hydrocarbons via their fuel and oil.

Chemical fingerprinting

To further investigate the distribution patterns of source-specific hydrocarbon markers, C23/C30 (ratio of C23 tricyclic terpane relative to 17α,21β(H)-hopane), Ts/Ts + Tm (ratio of 17α-22,29,30- trisnorhopane relative to 17α-22,29,30-trisnorhopane + 18α-22,29,30-trisnorhopane), C29/C30 (ratio of 17α,21β(H)-30 norhopane to 17α,21β(H)-hopane), C31HS/C31H(S + R), C32HS/C32H(S + R), ΣC31_C35/C30 (ratio of sum 17α,21β(H)–C31 homohopane to17α,21β(H)–C35 homohopane relative to 17α,21β(H)-hopane), C28 αββ/(C27 αββ + C29 αββ) and C29 αββ/(C27 αββ + C28 αββ) ratios were calculated for all the receptor samples and also for the proposed known source samples. Results show that especially in street dust and runoff samples, the relative amounts and concentration patterns of various terpanes and steranes in the street dust and runoff samples were rather similar, showing that they may have been originated from the same common sources. On the contrary, river sediment samples were confirmed to receive inputs from other unknown independent sources.

Source apportionment

According to MCR-ALS analysis, asphalt, and tire had the highest contributions (40% and 23%) to petroleum hydrocarbons in the analyzed receptor samples, and therefore, from a quantitative point of view, these two

sources should be considered to be the main sources of petroleum hydrocarbons in the receptor samples analyzed in this study. There was only a 7% of the total mass analyzed that could not be explained by the proposed receptor model.

Conclusion

Results of this work demonstrated that street dust particles are identified as a major transport medium of petroleum hydrocarbons pollution in urban runoffs. Hydrocarbons from petroleum products stick to street dust and discharge with runoffs to Anzali rivers, Anzali international wetland and then accumulate consequently at the bottom of sediments of the Caspian sea coast for a long time. The contributions of asphalt and tire known sources to petroleum hydrocarbon contamination sources were larger than from other possible investigated sources in the studied samples. Automobiles exhaust soot had also some more specific contribution. Engine oil had only a minor contribution among the studied known sources to the petroleum hydrocarbons.

Keywords: chemical fingerprinting, chemometrics, petroleum pollution, river sediment, street dust, urban runoff.