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Role of Electron Scavengers in Direct Blue 71 Removal by Nano-TiO$_2$ Immobilized on Cementitious Bed

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Expanded Abstract

Introduction

The presence of synthetic dyes in water and waste water can cause toxicity in aquatic life and bacteria and it can also change the brightness, color and clarity of the water. Common treatment methods for these compounds are not capable of complete mineralization. Therefore, new methods are needed to maximize the efficiency. Among them, Advanced Oxygen Processes (AOPs), especially Photocatalytic oxidation with nano particles such as TiO$_2$ are efficient and appropriate. According to investigations, very reactive species such as hydroxyl radicals are produced during this process to oxidize organic dyes in wastewater. According to mechanism equations 1 to 6, anatase and rutile as two phases of TiO$_2$ are activated with appropriate wavelength of 390 and 415 nm and Reactive Oxygen Species (ROSs) are made. Among them O$_2^{\bullet-}$, HO$_2^\bullet$ and OH$^\bullet$ are known as the most active radicals.

$$TiO_2 + hv \rightarrow TiO_2 \ (e_{CB}^- + h_{VB}^+) \tag{1}$$

$$OH^- + h_{VB}^+ \rightarrow OH^\bullet \tag{2}$$

$$O_2 + e_{CB}^- \rightarrow O_2^{\bullet-} \tag{3}$$

$$O_2^{\bullet-} + H^+ \rightarrow HO_2^\bullet \tag{4}$$

$$2HO_2^\bullet \rightarrow O_2 + H_2O_2 \tag{5}$$

$$H_2O_2 + O_2^{\bullet-} \rightarrow OH^- + OH^\bullet + O_2 \tag{6}$$

This method has some problems such as long irradiation time required to decompose hard degradable compounds such as azoic dye structures and rehabilitation time and expense. To reduce these problems, some methods are proposed. Some of the methods are including scavenger application and stabilization of nano particles on an inert cementitious bed to simulate real wastewater treatment plant situation. These are also examined in our investigation.

Application of scavenger compounds are necessary to elongate the immediate recombination of electron-hole pairs which are exited on irradiated TiO$_2$ surfaces with UV-C light. The scavengers are the compounds that will scavenge the electron or hole to retard the recombination of electron-hole and or bulk medium radicals to reduce interferences to make reactions faster. If they are correctly selected, with initiating the photocatalytic chain reactions they will enhance the efficiency of dye removal. With direct participation in redox reactions of colored pollutant and with elimination of ROS interaction effects in medium, it will also enhance the removal efficiency.

Therefore, in this research the application of accelerating electron scavengers H$_2$O$_2$ and NaOCl in immobilized photocatalytic process was investigated to enhance the removal of Direct Blue 71 dye as a complex triazoic compound (Figure 1and Table 1),. Immobilization of nano TiO$_2$ particles slurry on inert cementations beds did also allow easy and more frequent use of them without the need of rehabilitation.

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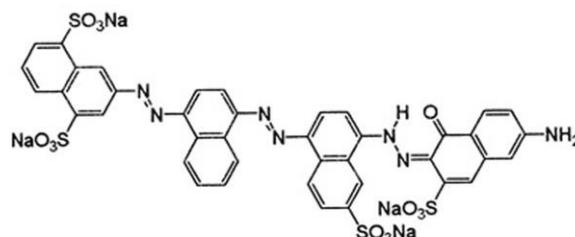
Figure 1. Direct Blue 71 Dye Structure

Table 1. Direct Blue 71 Characteristics

Characteristics	Description
Chemical Formula	$C_{40}H_{23}N_7Na_4O_{13}S_4$
Molecular Weight (gr/mol)	1029.87
Natural pH	6.7

Materials and methods

The procedure of pilot preparation makes cementitious bed with Portland cement and water and immobilization of nano aqueous TiO_2 dispersion on the cementitious bed with epoxy concrete adhesive. The main material included in Direct Blue 71 dye was obtained from Alvan Sabet Hamedan Co. and used without any purification. The nano TiO_2 powder (P25) as Photocatalyst (80:20 anatase to rutile, approximate diameter of 21 nm) was purchased from Degussa Co. and hydrogen peroxide (H_2O_2) and sodium hypochlorite (NaOCl) were also obtained from Dr. Mojallali Chemical Labs with 35% and 10-14% purity, respectively. As electron scavengers, Portland cement and water used to make cementitious beds, Epoxy concrete adhesive was obtained from chemistry concrete Best Co., Oil to make pilots greasy and deionized water to make solutions.

Equipment included are Spectrophotometer DR4000 Hach Co. to read absorption, ultrasonic cleaner UE-6SFDFungilab to disperse agglomerated nano particles, digital pH meter metrohm 691 to measure pH, digital balance PLS360-3-Kern to weigh the materials, COD reactor DRB200 Hach Co. to measure chemical oxygen demand of wastewater, 30 W low pressure mercury lamps Lumiaction brand from Taiwan to excite nano particles, magnetic stirrer RH-B2 Ika to stir up nano particles mixture to make them uniform.

To perform the experiments, a 2 cm depth cementitious bed was made of 2:1 Portland cement to water in a 23*15*4 cm framework. Afterward, it was fixed in the similar pilot to make a surface of nano TiO_2 with SSP (Separated Sealer and Photocatalyst) method on it (density=40 gr/m^2).

The experiments were carried out in a UV-C case which was covered with thick aluminum sheets and a 250 cc sample solution of synthetic wastewater with approximate 2 cm depth on pilot surface. It was irradiated under UV-C radiation. Synthetic wastewater was made of dye powder and deionized water mixture and scavenger was injected simultaneously to reach objective concentration.

In the first steps, an absorption spectrum of 20 mg/L dye solution was plotted in the range of 200-900 nm of wavelength so that the maximum absorption was obtained in 586 nm as λ_{max}. Then, a calibration curve was obtained for different dye concentrations in this wavelength with the calibration equation of Abs=0.0241*[C] and R^2=0.99 in which Abs (Absorption) is a non-dimensional parameter and [C] is dye concentration based on mg/L.

The experiments have main (control or) blank and the supplementary tests. For this reason, the impact of effective parameters on photocatalytic dye removal including scavenger concentration, pH, dye concentration and irradiation of UV-C intensity was investigated as main tests. Control tests were done in optimum conditions derived from the main tests and have Scavenger/Dye, TiO_2/Dye, TiO_2/UV-C/Dye, TiO_2/Scavenger/Dye, Scavenger/UV-C/Dye systems. In the end, COD/COD_0 trend, absorption curve of dye removal and kinetics of reactions were studied as supplementary tests.

Results and discussion

The results of this study indicated that 100 mg/L dye was decolorized in the presence of 0.006 M H_2O_2 at pH 6 under 90 W UV-C lamps irradiation in 20 minutes. However, the time required for bleaching without H_2O_2 under these conditions was 255 minutes. The concentration of 0.01 M NaOCl could also reduce the completely dye removal time of 100 mg/L dye at pH 11 and a light intensity of 90 W UV-C lamps from 255 to 15 minutes. Also, with an investigation of absorption spectrum while color removal, it was also proved that reduction in peaks of azoic bonds (586 nm) and benzene and naphthalene compounds (310 nm) was an approval of an

appropriate decomposition process progress (Figures 2, 3). The rates of color removal in presence of H_2O_2 and NaOCl via removal kinetics study of TiO_2/scavenger/UV-C/dye system were, respectively, 15 and 35 times faster than kinetics of systems of dye removal without any scavengers. All these results were an approval of accelerating effect of the used scavengers for dye removal.
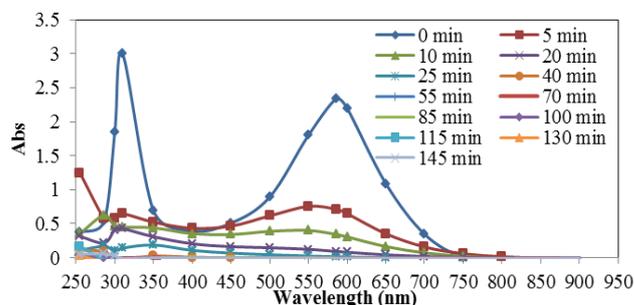
Figure 2. Absorption Curve of TiO2/H2O2/UV-C/Dye System for Dye Removal

(Dye Concentration 100 mg/L, H2O2 Concentration 0.006 M, pH 8, UV-C 90 W & Nano TiO2 Concentration 40 gr/m2)
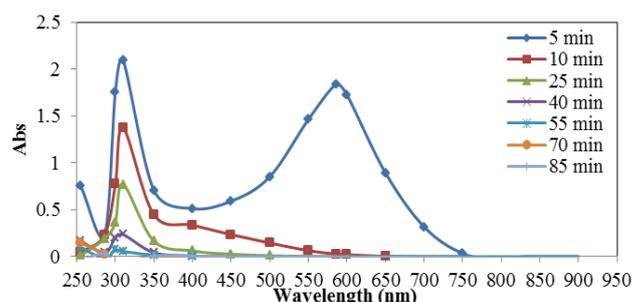
Figure 3. Absorption Curve of TiO2/NaOCl/UV-C/Dye System for Dye Removal

(Dye Concentration 100 mg/L, NaOClConcentration 0.01 M, pH 11, UV-C 90 W & Nano TiO2 Concentration 40 gr/m2)

Conclusion

According to the study of reaction kinetics, dye removal trend was based on first order reaction. Sodium hypochlorite accelerates the reaction 35 times faster than the same situation without NaOCl. The hydrogen peroxide did it 15 times faster in comparison with reaction without H_2O_2. Although sodium hypochlorite was more effective to accelerate the photocatalytic removal of Direct Blue 71 Dye in the mentioned situation because of higher scavenger power of it compared with hydrogen peroxide, but application of hydrogen peroxide as an electron scavenger in Photocatalysis made no by product but CO_2 and water which are safe for the environment. Sodium hypochlorite was combined with intermediate compounds of dye destruction to make some chlorinated products in the environment which need to be more treated. In industrial scale, 1 M sodium hypochlorite is equivalent to 10 L and this amount for hydrogen peroxide is 6 L for each cubic meter of wastewater. Therefore, this amount is more feasible according to price and accelerating rate in comparison with the sodium hypochlorite. Therefore, among these two scavengers, hydrogen peroxide was preferred with acceptable efficiency and good scavenger effect on Photocatalysis of Direct blue 71 as a model dye.

Keywords: Hydrogen Peroxide, Sodium Hypochlorite, Photocatalyst, Removal, Direct Blue 71.

Estimating the Electrical Energy in Different Processes for Nasir Abad Industrial Wastewater Treatment Plant with Emphasis on COD Removal

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Expanded Abstract

Introduction

In the wastewater treatment industry, the general attention is mostly paid to the effluent quality standards. Regardless of energy consumption, the treatment plants have been designed based on experience rather than the latest scientific findings. The treatment plants are considered as a part of energy equipment which largely consumed electrical energy. Thus, electricity is the great part of the costs of plant utilization so that 25% -40% of the total costs of the wastewater treatment process is related to energy supplies. Therefore, energy is regarded as an important factor in treatment plant costs. This has caused designers to adopt new methods to reduce energy consumption. The study in 2010 indicated that 50 – 60% of energy consumed by treatment plants is related to the aeration process. Nowadays, due to the rapid population growth along with recent advances in technology and industry, the amount of pollution has been increased. In addition, environmental standards for effluent quality and its recycling process for different utilization have become much stricter. What was mentioned above increases energy consumption. Hence, energy efficiency, effectiveness of the plan and the utilized equipment and technologies, energy recovery processes and effective cost management has been recently considered more seriously. Additionally, enhancement of energy efficiency, which means a further reduction in energy consumption, greenhouse gases production and operation costs of wastewater treatment plants, has become more important. The principal concern of the wastewater industry has always been measures to meet water quality standards in order to keep public trust. Thus, wastewater treatment plants (WWTPs) are usually designed to meet certain effluent requirements, without major energy consideration. Wastewater treatment plants are generally very energy-intensive and expensive to operate. WWTPs are hardly designed for energy efficiency in mind. Their design and operation are often based on intuition and experience, rather than on optimal trajectories or set points. The amount of energy consumed by treatment plants is counted as a major factor to determine optimum performance. Moreover, due to the fact that the treatment plant system of industrial zones is energy consuming. The energy subsidies have been cut and water and electricity tariffs have been raised, thus, energy management has become far more important. To design treatment plant equipment, it is necessary to adopt approaches which lead to reduce energy consumption and improve efficiency. Knowledge of the real operating efficiency of WWPTs is the starting point for any energy saving initiative.

A study was conducted in 2012 in Sweden on WWTPs energy consumption in which aeration was controlled to reduce energy consumption in a treatment plant to employ activated sludge which affected the amount of dissolved oxygen, the efficiency of the aeration process, and equally the results from treatment process. The amount of energy consumed by treatment plants depends on air flow rate and consequently the rate of oxygen consumption. The rate of oxygen consumption in the activated sludge system is changed by changing the concentration of ammonium or ammonia in the effluent. Therefore, reduction in the amount of ammonium in the effluent, have reduced air flow rate and consequently the rate of oxygen and the amount of electricity consumption. A study in 2011 in Spain performed on the factors affecting the plant energy consumption. The results indicated that the average amount of energy consumed by WWTPs depends on the input quality parameters, treatment technology, effluent quality and the size of the plant. Furthermore, the amount of energy consumed by smaller plants per unit area is higher compared with the larger plants.

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In an article in 2012, the amount of energy consumption was studied in each physical unit. This study found that there is a strong relationship between biological activity and demand for electricity. In 2013, a study conducted to optimize pumps performance and aeration process in treatment plants. The results suggested that the pumping stations and the aeration in activated sludge process are the most energy consuming parts in treatment plants which consume 22% and 42% of electrical energy, respectively. Thus, in order to reduce energy consumption, the pumps performance should be improved and aeration processes should be optimized.

In the present study, the wastewater treatment plant (WWTP) of industrial zone of Nasirabad was studied which works with a combination of Up flow Anaerobic Baffled Reactor (UABR) system and Integrated Fixed Activated Sludge (IFAS).

Material and methods

The aim of this paper is to calculate the electrical energy in different processes for industrial wastewater treatment plants and also to estimate effective electrical energy to remove 1 Kg COD. To this end, Nasir Abad industrial wastewater treatment plant was investigated on the basis of energy. The treatment process includes up flow Anaerobic Baffled Reactor (UABR) coupled with Intergraded Fixed/Film Activated Sludge (IFAS) reactors. The present study was conducted using statistical methods and data collection through observation and field study of wastewater treatment plant of industrial town of Nasirabad. Data were analyzed through drawing tables and charts in Excel along with making engineering judgment.

In order to study electrical energy consumption in treatment plant of the industrial zone of Nasirabad, the electricity bills for different months of 2012 and 2013 are checked. The average daily electrical energy consumptions per 1 cubic meter of wastewater as calculated during these years were 9.42Kwh and 9.73 KWh, respectively. Energy consumption varies at different times of day. Thus, electrical energy falls in three categories namely Peak Load, Medium Load, and Low Load periods. According to the table, the Peak Load was set up by the Electricity Distribution Company of Mazandaran province, Iran. Thus, 12 hours out of 24 hours a day is considered to be the Medium Load, 6 hours is considered to be the Low Load, and the remaining 6 hours is considered to be the Peak Load period. However, the beginning and ending time of the each group varies from season to season. The electrical energy consumption related to each group (Peak Load, Medium Load, and Low Load periods) is multiplied by the corresponding times and the sum is considered as the electrical energy consumption relating to the period.

Results and discussion

The electromechanical equipment of plant in each unit was examined separately and the energy consumption for each unit was evaluated. The units consist of Pumping station, Grit and grease removal tank, equalization tank, Aeration tank, sand filter, disinfectant system, sludge storage, and filter press. The electrical energy obtained from electrical bills includes the energy consumed by the treatment plant equipment, control room, laboratory, and electrical lighting. In this study, the energy used in the treatment plant units was considered as effective energy and the one used in the sections outside of the units was considered as ineffective energy. For exact specification of the energy consumed by the units (the effective energy) and ineffective energy, the electro mechanic equipment should be examined. Therefore, the field study on the treatment plant of the industrial town of Nasirabad was conducted and different treatment processes were examined. The inflow discharge entered into the treatment plant was approximately 620 m^3/ day. In order to measure the amount of electrical energy used to remove one kilogram COD, the input and output COD were achieved in mg/lit. The entire procedure of the sampling and testing was performed according to the instructions and guidelines provided in the standard methods for examination of water and wastewater. Given the fact that the average inflow discharge was in m3/day, the removed COD was defined in Kg/day and the effective energy was in Kwh/ m3, the amount of energy per 1 kilogram COD is in Kw. In this WWTP, about %32 of total electrical energy were used for aeration purposes and about %43 in sludge treatment equipment and %25 in primary treatment, disinfectant system and etc. The influent was measured 620 cubic meter for day and the pump efficiency was assumed %80. The effective daily electrical energy as the energy used in the treatment process was 5.6 Kwh. The non-effective electrical energy that used in other process in Nasirabad industrial wastewater treatment plant for the years of 2012 and 2013 were calculated 3.82Kwh and 4.13kWh. In addition, the amount of electrical energy per 1 kilogram of the removed chemical oxygen demand (COD) was obtained. The use of energy for removing 1 kg COD for the years of 2012 and 2013were equal to 2.68 Kwh and 2.5 Kwh.

Conclusion

Based on the obtained results, it can be concluded that energy consumption is not effectively managed in the treatment plant of Nasirabad and that efficient use of electrical energy, make it possible to preserve electrical energy sources as a national asset and also for considerable economization. Moreover, the effective aeration optimization of the pumps and blowers performance in the aeration basin is an important tool to minimize energy

consumption in WWPTs. This is a tool to control the aeration system for aeration is a costly process and closely linked to energy consumption. Therefore, the efforts to reduce the overall energy use in WWTPs have largely concentrated on improvement of pumping and optimization aeration. The sludge management and reduction should be considered more seriously. The electrical energy consumed in pumps and blowers has a direct relationship with the rate of aeration in the basins and the level of pressure drop. More appropriate optimization of aeration units, effective management of them and use of the methods such as employing ultrasonic waves and sending them to the wastewater treatment system, which can change the chemical structure and the size of the particulate organic matters, will increase the rate of biological treatment process and consequently the wastewater treatment. Furthermore, the rate of aeration and electrical energy consumption will be reduced. Additionally, by using these waves, a huge amount of excess sludge will be reduced and, therefore, less electrical energy will be consumed for sludge equipment. Moreover, if treatment plants designed in a way that the produced electrical energy and sludge treatment in anaerobic sector can be utilized to generate electrical energy, the treatment plants remarkably gain sufficient independence from energy sources. Thus, it can be possible to save more electrical energy. With regard to the importance of energy and its related issues, rising prices and reduction of energy supplies, the effective managerial approaches should be adopted to reduce energy consumption in wastewater treatment plants. Furthermore, experts and designers of wastewater treatment plants should more seriously consider the amount of energy wasted in the processes as well as enhance energy efficiency. Furthermore, improving energy independence in WWTPs can be effective for energy saving. It is concluded that according to usage of energy in plants equipment and increase in energy prices, management of energy consumption should be considered more seriously.

Keywords: Industrial wastewater Treatment, electrical energy consumption, COD

Specifying the Areas Suitable for Flood Spreading with the Approach of Sustainable Development of Groundwater Resources, Case Study: Sarkhoon Plain of Hormozgan

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Extended Abstract

Introduction

Increase in water demand will likely be followed by increased pressure on groundwater resources in the short term and long term. At this time, spreading floods on the aquifers is one of the appropriate methods to control and optimal use of floods and artificial recharge of groundwater resources in arid and semi-arid regions. Sarkhoon plain is one of the plains close to the center of Hormozgan Province where its groundwater has been supplying the regional needs for water, so far. A look at the hydrologic statistics of recent years indicates negative water balance in the plain. This reveals the importance of sustainable management of water in the region. The purpose of this study was to determine the importance of factors effective in identifying the areas prone to artificial recharge in Sarkhoon plain by using network process analysis and determining appropriate areas for operations of artificial recharge using GIS in combination with the network process analysis. Thus, by identifying the areas prone to spreading floods and proposal for constructing structures, the wasting of water resources in the region will be prevented. Thus, some progress can be made in planning for sustainable development of water resources.

Sarkhoon study area is located at almost 25 km from Bandar Abbas, Hormozgan Province, with an area about 11,400 ha. The estimated average annual rainfall values in the plains were 234 mm and 219 mm, respectively. The groundwater level changes in Sarkhoon plain during a period of 25 years from 1990-1991 to 2013-2014 accounted for 0.5 m of the annual drop. (pic1)
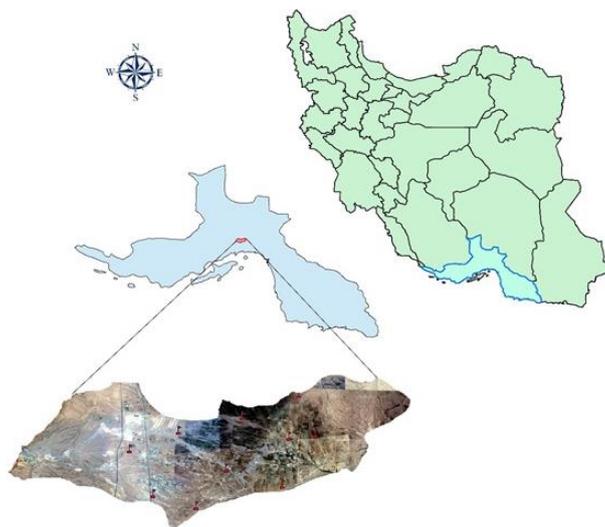
Fig 1. study area

Materials and methods

In this study, 9 influencing factors of slope, water quality, water depth, permeability rate, alluvium thickness, land use, transferability, geomorphology and the drainage density were selected and analyzed. Then, the paired comparison method to determine the weight of classes of each layer and the ANP method were used to determine the final weight of the criteria. The Super Decision software was also used to determine the weights.

After omission of the areas with limitation, the areas prone to flood spreading operation were determined. The appropriate criteria for flood spreading operation in Sarkhoon Plain are:

- Slope: To prepare the slope layer, the digital elevation model (DEM) with a pixel size of 30m is extracted from ASTER data.(pic 2)
- Geomorphology: From the morphological map of the province, the study area was separated and divided into four classifications. (pic 2)
- Water depth: Water depth map was obtained with minimum error using the 10-year average water levels data related to observation wells and generalization to the whole plain using interpolation algorithm by Kriging spherical model. (pic 2)
- Alluvium thickness: The mentioned layer was re-classified into four classes. (pic 2)
- Alluvium transferability: The water transferability map of Sarkhoon plain water was prepared according to the existing pumping test results of 10 Piezometers in the plain (Hormozgan Regional Water) with interpolation by Kriging spherical model in the ARCGIS 10 platform. (pic 2)
- Land use: The land-use layer for the study area was obtained from 1:25000 maps and updated by using ASTER satellite images combined with bands 1, 2, 3 as well as Google Earth images, and were classified into four categories. (pic 2)
- Water quality: In this study, the data of observation wells were used to provide the electrical conductivity layer of Sarkhoon plain area. (pic 2)
- Drainage density: The cumulative flow layer was extracted from regional DEM, and then, the channel density layer was obtained. It was classified into six classes.(pic 2)
- Permeability coefficient: To determine the permeability of the study area, the tests results provided by the Agricultural Research Center of Hormozgan province in 2009 were used, and the permeability layer was produced by interpolation. It was also re-classified into 5 categories.
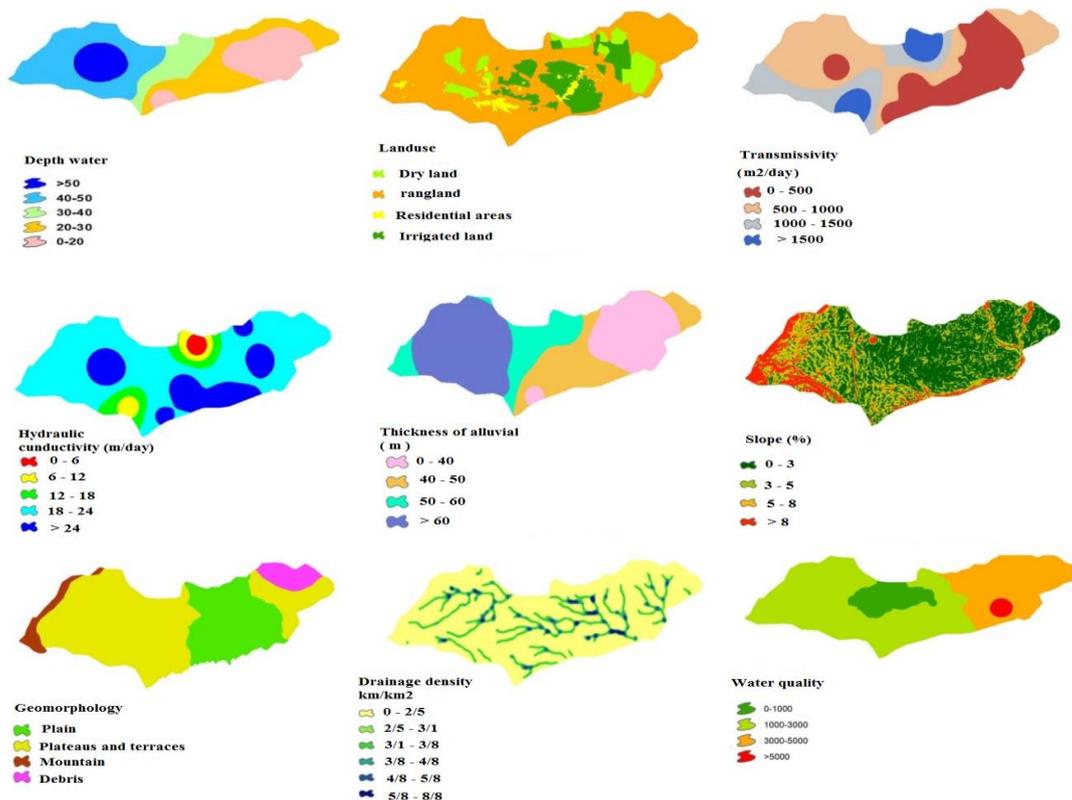
Fig 2. Criteria Layers

Identifying the areas with limitation

In the present study, according to research in this field and the region local conditions, three layers of slope, geomorphology and land use were identified as layers with limitations.

Analytic network process (ANP)

This model is one of the multi-criteria decision-making techniques classified in compensatory models series. The most important distinction between this method and the hierarchical approach is in the influence and effectiveness of criteria on one another. In this hierarchical structure model, a target or a node is initially located that finally ends to a destination node or cluster. Therefore, there is a linear structure from top to bottom and without returning from lower or higher levels. But in the network structure, the network and its clusters are not distributed on a regular basis. In addition, there should be the possibility of a cluster being influenced by itself (interdependence) or affecting another cluster (external dependency). Direct returning from the second cluster or passing through the middle cluster is possible.

Results and discussion

Examination of the weights of criteria in this study indicated that the drainage density factor with a weight equal to 0.274 is the most important factor in locating of flood spreading in Sarkhoon Plain. After integration, the value of each cell was determined. To attain better results, using the natural breaks method, the whole land was divided into five final categories based on the zoning map. From the total area of Sarkhoon plain, about 14.2576 square kilometers and 45.0283 square kilometers were determined as very suitable and suitable areas, respectively, for flood spreading operation. The results indicate that most of the perfectly suitable and suitable areas occur in the category of 0-3% and 3-5% regarding the slope. Regarding the measure of depth, the perfectly suitable and suitable areas are located at depths greater than 68 meters. Also, these areas are in accordance with the ranges with higher transmissibility rates. Regarding thickness measure, the alluvium is located in a range greater than 60 m. Also, the zones are located in the areas with higher permeability coefficients (18-24 and 24> m per day). Regarding electrical conductivity layer, the suitable and perfectly suitable areas are located within the scope with EC less than 2000 micromhos /cm. In terms of land use layer, the lands are located in the areas with pasture usage and drainage density less than 3.8 km per square kilometers.

Conclusion

Planning to use floods, meanwhile to reduce their destructive effects, will provide a new water source for the consumers. In the studies with similar research subject, the AHP method was used to determine the weights of criteria in such method. The criteria relations and their coefficient of impact are not considered to reduce the accuracy and quality of the work. Since the ANP method deals with the dependencies systematically, i.e., it considers all internal and external dependencies between the elements and clusters for analysis, but other methods consider these relationships. Thus, with the interdependence of environmental issues (including this study subject), the use of ANP method can provide the necessary supports for decision-makers and planners to solve water management issues to gain a deeper understanding of environmental issues.

Keywords: water resource, spreading floods, network analysis, Sarkhon Plain

A Hydrogeochemical Study of Golpayegan Plain Based on the Examination of Ionic Ratios and Environmental Factors Controlling the Chemical Composition of Ground Water

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Expanded Abstract

Introduction

The special regional and geographical characteristics of Iran, the flow of streams with Mediterranean regime, topographic status, and diversity of relieves have provided an extensive area for the penetration of water into the ground. All of these factors together with the shortage of ground water reservoirs have enhanced the significance of ground water in Iran. Since the volume of ground water is so limited, the management of maintenance and protection of this resource is highly significant. One of the factors which must be noted in the management and maintenance of ground water is the maintenance of the quality of this valuable resource. To accomplish this objective, first, the status of ground water must be examined so as to be able to take the proper managerial strategies based on examination of the parameters affecting the quality of ground water. The chemical composition of ground water is determined by means of factors such as the composition of rain water, the geological and mineralogical structure of catchment basins, and geological processes throughout water path. Accordingly, the reasons underlying the changes in the quality of water can be found out by studying the chemical composition of water reservoirs. To examine the chemical composition of the reservoirs, various methods have been used in different studies. Among these methods, the followings can be pointed: drawing Piper diagram to determine the type and profile of ground water, using ionic ratios to set the origin of ions, studying the environmental factors controlling the chemical composition of the ground water, and etc. Regarding the studies on the quality of ground water with an emphasis on studying the chemical composition of water reservoirs, numerous studies have been conducted in Iran and in the world. Each of the studies has examined various qualitative parameters with respect to the kind of water demand.

This study aims to examine the changes of ions dissolved in the ground water of Golpayegan Plain using ionic ratios. It also assesses environmental factors controlling the chemical composition of the ground water in the area under study.

Materials and methods

To study the quality of groundwater in the plain under study, the qualitative statistics of 32 wells related to 2010 were applied. These statistics included K, Na, Mg, Ca, EC, So_4, C1, TDS, PH, TH, and HCo_3 parameters.

The percentage of ionic balance error was used to ensure the correctness of the results from the analysis of the samples. Accordingly, estimating the percentage of ionic balance error, it was determined that the difference between cations and inions based on mEq/l in all samples was lower than the standard amount (%5). Hence, the values of the samples were reliable.

AqQA1.1 was applied to analyze and compare these parameters and draw comparative diagrams and qualitatively rank water. Due to the dispersion of measurement stations, Kriging interpolation was used to draw ionic equivalent maps suitable for heterogeneous distributions. This process was created by means of ArcGis10.1. To study the correlation between the qualitative parameters of underground water, Kendall correlation coefficient was applied in SPSS19. Ionic ratios and the diagrams of pairwise comparison between ions were used for examination of the origin of soluble substances in underground water and the existing reactions in the plain.

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Results and discussion

Hydrogeochemical studies of the plain under study were carried out using two approaches. In the first, the origin of ions in ground water was examined based on the environmental factors controlling the chemical compositions of underground waters. In the second, the origin of the ions was examined based on ionic ratios. With respect to the significance and main role of determining the type and profile of underground water and also correlation between ions in the trend of hydrogeochemical studies and finding the origin of ions existing in the underground waters, the two following stages were executed in the first step:

Type and Profile of Underground Waters: Based on Piper diagram and the distribution of anions and cations, the dominant type and profile of the ground water of the area were clorursodic. However, in some areas, other profiles including sodic bicarbonate (well No. 5), calcic bicarbonate (wells No. 1&3), and calcic sulfate (well No. 2) were also observed.

Correlation of Chemical Ions: To study correlation and determine the relationships between chemical variables, correlation coefficient was computed and correlation matrix was drawn. Based on the computation of correlation coefficients, maximum correlation value is between EC and T.D.S variables with a positive relation (direct correlation) and minimum correlation between HCO_3^- variables and Mg^{+2} with a positive relation.

Origin of Ions based on Environmental Factors Controlling the Chemical Composition of Underground Waters: Various factors like the depth of underground water, lithology, the size of particles and sediments on the path through which ground water pass and the distance travelled by this ground water have changed the amount of ions. In some areas, they have resulted in the pollution of the ground water of the area under study. In the forthcoming, the effect of each factor on the ionic changes of the ground water is explained in detail:

Distance Traveled by Ground water and the Size of Particles and Sediments on Flow Path: The effect of the distance travelled by underground water on the quality of ground water can be observed well in the northern areas of the plain (the area in Gharghab Valley where ground water exit). This is with respect to the increase in all the ions existing in water and the decrease in the quality of water. Regarding particle size factor, again, it is seen in the equivalent maps of cations and anions that the amount of all ions toward the southern area of the plain with coarser alluvial sediments is increasing toward the northern area of the plain (muddy flat area). In this area, the percentage of sand particles is low based on the surveyed geotechnical logs and field sedimentology visits. They are mostly consisted of sand and clay. The thickness of the mud layer on the ground also reaches 6m in this area. Generally, the finer the particles are, the lower the penetration will be. Principally, low penetration increases the time of the closeness of underground water to surrounding substances. As a result, underground water will be saltier due to a further chance for dissolution.

Depth of Underground Water and its Evaporation level: The shallower the underground water is located, the further it will be affected by external factors like evaporation and/or agricultural and industrial activities. The effect of this factor is highly apparent in the northern areas of the plain and in muddy flat areas. In these areas, the depth of underground water is lower as compared with the other areas of the plain. The amount of evaporation is so high. As a result, the amount of all ions in this area is so higher than other areas.

Lithology: One of the very important factors affecting the quality of the ground water is the rocks and sediments located in the path of underground water flow. In the area under study, it is approved based on Gibbs model. According to the model, based on the location of the samples of the underground water on the diagram, the main process controlling water chemistry in over %90 of the samples (except wells No. 30, 31, and 32 which are the evaporation of the main process) is the mutual reaction of water and rock (the weathering of geological formations). Hence, lithology factor has maximum effect on the quality of ground water in the area under study.

Based on the abovementioned issues and with respect to lithology factor, the origin of ions can be described as follow:

The concentration of chlorine in the plain is changing from 21.3ml/l (minimum) to 1603.18ml/l (maximum). The high anomaly of Cl (especially, in the northern areas of the plain) can be attributed to the considerable extension of metamorphosis structures; in specific, schist, phylite, and the sediments containing chlorine.

Regarding the significant role of TH and its conformity with limy outcrops in a small part from south to east of the plain, it is again possible to ascribe the origin of Ca and Mg increase in the mentioned area to the lithology factor.

Sulfate enters into ground water mainly due to the dissolution of evaporative minerals including gyps and anhydrite. In dry areas, sulfate leaping from the top layers of soil is considerable. It leads sulfate to be the main anion of ground water in those areas. The conformity of the areas containing a high anomaly of So_4 can be attributed to this issue.

Regarding the increase of Na and K ions in the northern areas of the plain (before muddy flat area), since the type of geological structures in a part of this area is igneous and pyroclastic, weathering of the igneous rocks containing sodium and potassium can be considered as the trigger for increase in these ions in this area.

Origin of Ions based on Ionic Ratios

Na/Cl, Ca/So$_4$, and Na/ So$_4$ Ionic Ratios: Based on a correlation analysis between the samples, sodium represented a very good correlation with chlorine. It can be concluded that these two elements are resulted from the same source. In this study, Na/Cl ratio in ground water was <1 for %87.5 the data. It shows the dissolution of sodium. Small amounts, about %12.5 of the sample of the ground water, had a ratio >1. Accordingly, in most areas of the plain, the origin of sodium was evaporation process, reversed water from agriculture and human activities.

The presence of a high correlation and linear relationship between two Na and Cl ions show the dissolution process of halite. The presence of a high correlation and linear relationship between two Ca and So$_4$ ions show the dissolution process of gyps in the area under study. Regarding the considerably stronger correlation between Na and Cl ions (as compared to Ca and So$_4$) and also the more linear relationship between these two ions (as compared to Ca and So$_4$), the process of halite dissolution has affected the quality of ground water in the area more than gyps dissolution process.

Cl/HCO$_3$ Ionic Ratio: If Cl/HCO$_3$>2.8, it will show serious water pollution due to the penetration of salty water and also intensive evaporation. Again, the reduction of the ratio of chlorine to bicarbonate below unity indicates the feeding of tables from limy sources. Its reversal shows an increase in salinity and the penetration of salty water front from sources like salty lakes, salt dome, chemical composts, salty geological formations, and etc. Regarding the lack of salty dome in the area under study, the increase in the above ratio can be attributed to chemical composts and/or salty geological formations (e.g. muddy flat) and also metamorphic structures.

Mg/Mg+Ca Ionic Ratio: If Mg/Mg+Ca ratio increases, it can show the exit of Ca due to calcite sedimentation. Again, if the areas with maximum index of calcite saturation do not conform to the areas where Mg/Mg+Ca ratio also increases, it will be inferred that the extra Mg of the underground water has entered into this water from another source like weathered schist. Hence, if the areas with maximum calcite saturation index do not conform to the areas where Mg/Mg+Ca ratio also increases, it will be inferred that the extra Mg of the underground water has entered into this water from another source like weathered schist. On the other hand, for the areas where Mg/Mg+Ca>0.5, the weathering of ferromagnesium minerals will be considered as the origin of the high concentrations of magnesium in underground water.

Ca/Ca+So$_4$ Ionic Ratio: If Ca/Ca+So$_4$ ratio is high yet, Ca saturation index is low, it indicates non-carbonate resources for dissolved calcium. The conformity of calcite supersaturated areas to the increase of Ca/Ca+So$_4$ ratio indicates the effect of dissolved gyps on the increase of calcite saturation index in these areas.

Conclusion

Piper diagram of the samples in the area under study shows that Cl anion and Na+Kcation are dominant in the plain. Accordingly, the type and profile of the ground water in the area are clorursodic. Based on Gibbs diagram, lithology factor is the main and most effective environmental process. Based on ionic ratio and correlation coefficients, halite dissolution process is the main chemical process affecting the ground water of the area under study. Among other factors affecting the quality of the ground water in Golpayegan Plain, the followings can be pointed: depth of underground water, size of particles and sediments on the path through which ground water move, and the distance travelled by ground water (as environmental factors), and the dissolution process of gyps and sulfates containing sodium (as chemical factors).

Keywords: Hydrochemistry, Golpayegan Plain, Ionic Ratios, Ionic Correlation, ArcGIS.

Feasibility Study for Hydraulic Connection in Azarshahr Plain Coastal Aquifer and Urmia Lake, by Geochemical Ratios and Inverse Modeling

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Expanded Abstract

Introduction

Azarshahr plain is one of the plains adjacent to the Lake Urmia that has been faced, during recent years, with over extraction of groundwater and also exposed to salinity enrichment. On the other hand, Urmia Lake with about 5000 square kilometers is the relatively vast lake with hyper-saline water as a rare biosphere resource in Iran and the world. This lake has a great economic, social and bio-spherical importance in Iran. It has faced with enormous water depletion during the recent years. Many studies has been conducted about climate change, drought, rivers discharge declining and changing in land use so far that increasing in water utilization in agricultural activities have taken into account as the most important factor in water table reduction of Urmia Lake. However, there is no study about the hydraulic connection between Lake and its adjacent aquifers.

Perception of spatial changes in groundwater components that is resulted from various inputs is a difficult work, especially if chemical composition or boundary conditions change over time, as it is popular in coastal aquifers. Utilization of geochemistry in different water resources connection has done in many studies. Geochemists generally seek to find chemical ratios such as Na^+/Cl^- , Ca^{++}/Mg^{++} , $Ca^{++}/HCO_3^- + SO_4^{--}$ and $Cl^-/HCO_3^- + CO_3^{--}$ and ^{18}O and ^2H isotopes as saltwater intrusion indicators. The present study for the first time investigates the hydraulic connection between Urmia Lake and Azarshahr plain aquifer using geochemical ratios and geochemical modeling.

Materials and methods

Urmia Lake is a kind of the widest and shallowest lakes in the world and has hyper saline water. A lot of permanent and seasonal river and streams feed the lake. Broad and unwanted changes in water and ecology of this lake have been started about 2 decade before and during this time. The water volume of the lake decreased to less than 14 billion m^3 in 2011 from about 32 billion m^3 in 1995.

Azashahr study area is considered as one of the Lake twelve adjacent aquifers that is located between 45°,46' to 45°,50' longitudinal and 37°,43' to 37°,52' latitudinal. Its total area is about 457 km^2 that its plain has an area about 124 km^2. The highest and lowest height in the study area is 3700 m and 1282 m, respectively. Its average annual precipitation is about 221.2 mm whereas the average annual evaporation is about 1579 mm. and the most important stream in Azarshahr plain is Azarshahrchai. It has a southeast- northwest trend and is eliminated to the lake because of wide agricultural usage. On the other hand, the total annual discharge of the aquifer is about 90.64 million m^3 that is one of the groundwater depletion and saltwater intrusion factors in the study area.

Groundwater Salinity is increased in Azarshahr plain aquifer because of wide discharge in one side and decrease in Urmia Lake water level on the other hand. This probably shows that saltwater intrusion to Azarshahr plain aquifer is in relation with water level decreases in Urmia Lake and consequently reveals the hydraulic connection between them. To investigate this connection, groundwater sampling and analysis were conducted and hydraulic connection evaluation was done via three steps as below.

Graphical methods

Three popular Piper, Stiff and Pie chart graphical method was selected and the samples were plotted after the analysis and were compared to Urmia Lake water samples. Star diagram also was plotted for the samples and

their map was drawn. On the other hand, pie chart that shows the percentage of water major components was calculated and their distribution in study area was plotted and compared to Urmia water component percentage.

Geochemical ratios

General status of saline water is Cl^- and Na^+ dominance with 0.86 molar ratio and of course Cl^- exceed over the alkali metals (Na^+ and K^+). Also, Mg^{++} is more than Ca^{++} absolutely (i.e. Mg^{++}/Ca^{++} =4.5-5). On the other hand, continental fresh water is known with its variable composition and its dominant anions are, Hco_3^-, So_4^- and Cl^-. Geochemists try to find also the below geochemical ratios generally for saltwater intrusion resource determination: Na^+/Cl^-, Ca^{++}/Mg^{++}, $Ca^{++}/HCO_3^- + SO_4^-$ and $Cl^-/HCO_3^- + CO_3^-$ and also some isotopes such as Boron, Oxygen and Hydrogen. In the present study, geochemical ratios were calculated and plotted in study area for saltwater intrusion resource finding and also evaluation of hydraulic connection between Urmia Lake and Azarshahr plain aquifer.

Geochemical Inverse Modeling

Hydro-geochemical modeling is an important tool for recognition of geochemical reactions in groundwater. In the modeling process, geochemical reactions during the flow path such as solution, precipitation, mixing and cation exchange are simulated and compared with final water composition.

Solute aggregation in groundwater can be supposed as a reaction of water with surrounding minerals in porous media. Hydro-geologists utilize the water chemical data for classification of various mineral balance situations. In this study, Ion Activity Product (IAP) and Balance constant (K) and also Saturation Index (SI) were used for probable minerals, composition creation and comparison with probable phases in Urmia Lake water sample.

Therefore, because of enormous volume of calculations in balance reactions and also finding the balance constant for reactions, PHREEQC computer code has been used and probable phases in groundwater mixed samples and Urmia Lake water sample were created and compared to each other. These were carried out to find if there is any chemical connection between lake and Azarshahr aquifer. The mixed samples were created in three paths near the lake. Mixing reaction was done between samples number 18 and 19, 20 and 23 and also between 25 and 22 in porous media presentation.

Results and discussion

Geochemical analysis results of groundwater samples and Urmia Lake indicated that dominant cation in Azarshar aquifer and Urmia Lake are Ca^{++} and Na^+, respectively. Also groundwater dominant anions are HCO_3^-, SO_4^- and Cl^- during the flow direction, whereas dominant anion in lake water is Cl^- that is distinct characteristic of marine composition.

Piper diagram revealed that groundwater type in study area are $Ca^{++} - Na^+ - HCO_3^-$ and $Ca^{++} - Na^+ - Cl^-$ whereas Urmia Lake water is in $Na^+ - Cl^-$ type. The nearest sample to Urmia Lake water composition is sample number 7 that is located out of aquifer domain and is affected by anthropogenic activities probably. Also stiff diagram of groundwater samples and Urmia Lake aren't similar to each other and show the different sources.

Na^+/Cl^- Ratio in saltwater intrusion is lower than marine values (i.e. Molar Ratio<0.86). On the other hand, ratio more than 1 is the indicator of anthropogenic activities such as residential area wastewater. Na^+/Cl^- Ratio distribution in the aquifer domain shows that in the northwest and west of aquifer, there is Na^+/Cl^- ratio less than marine ratio. Therefore, there is saltwater intrusion from northwest of the study area.

Also evaluation of $Ca^{++}/(HCO_3^- + SO_4^-)$ and Ca^{++}/Mg^{++} ratios revealed that, these ratios in aquifer domain are more than those in Urmia Lake water spectacularly. As it can be clearly seen, minimum value for Ca^{++}/Mg^{++} ratio in aquifer domain starts from about 29 and for $Ca^{++}/(HCO_3^- + SO_4^-)$ ratio starts from about 0.2, whereas these ratios are 0.01 and 0.03 for Urmia Lake, respectively. This shows no relation between aquifer groundwater and Urmia Lake.

Other popular geochemical ratio for saltwater intrusion is Revelle ratio explained as [$Cl^-/(HCO_3^- + CO_3^-)$]. Ratio more than 1.5 depicts the saltwater intrusion. Revelle Distribution plot represented that there is saltwater intrusion from domain northwest direction but it is not from the lake because of its direction and also South-North trend.

Hydro-geochemical modeling of different groundwater sample mixing in flow direction and the nearest distance to the lake has been indicated as a comparsion between probable phases saturation index. The results

show that mixing of samples had been done but probable phases did not, same as the probable phases in Urmia Lake water.

Conclusion

Saltwater intrusion from Urmia Lake to adjacent aquifers because of their heavy pumping rate is one of probable factors in water level depletion of Urmia Lake. On the other hand, finding the relationship between different types of water resources to each other by geochemistry is a popular way that have not been done so far in Urmia Lake. Therefore, use of geochemistry studies and its different branches were the base of this study. At last, after the use of geochemical ratios and geochemistry modeling, their results indicated that there is saltwater intrusion in Azarshahr plain aquifer, but it is not from Urmia Lake water. Probably it comes from adjacent salty pans to the aquifer. Geochemistry did not show the logical relationship between groundwater samples of aquifer and water samples of Urmia Lake. It did not find hydraulic connection between them subsequently. The geochemistry revealed that it is a applicable tool in finding the relationship between various resources of waters.

Keywords: Urmia Lake, Azarshahr, saltwater intrusion, geochemical inverse modelling, hydraulic connection.

Strategies to Promote the Environmental Quality of Informal Settlements Based on Participatory Approach, Case Study: Hesar in Hamedan

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Expended Abstract
Introduction

By the rise of new industrial and technological age, modern industries and services developed mainly in large cities and these cities absorbed massive flows of migrants from towns and villages. This trend caused population growth more than the existing service capacities and, thus, the environmental qualities of the cities were gradually undermined. Continuing this situation for some decades became the motive for low-incomes and migrants to face with difficulties in meeting their basic needs. This trend that is partially controlled in developed countries by some policies like regional planning aimed to manage the allocation of population and facilities in the region and promote the environmental quality, now is a challenge in the developing countries.

This is specially the case in Iran as a developing country in which considerable migrations to metropolitan areas have resulted in the rise of informal areas with low-income and migrant dwellers. The main problems here are in spatial structure, visual quality and provision of basic services and facilities. Hence, it's quite important to think about development of these areas environmentally. These problems along with negative impacts on the quality of life cause several social and cultural disorders. The low quality of housing, not enough access to basic services, the lack of public places and suitable streets are some of the problems which affect the quality of environment in informal areas. In addition, these settlements are different from each other economically, socially, culturally and in many other aspects that requires specific pattern of planning and policy making for each of them. In this way, because of the undeniable costs for dealing with environmental problems, it's quite required to pay enough attention to determine priorities and the best solution.

In this research, the aim is to extract and determine these priorities based on the dwellers' approach on the environmental quality. Hesar is one of these informal settlements that despite of some plans for arrangement and development of the environmental quality is still one of the low-quality neighborhoods in Hamedan city. Therefore, this research is to signify and determine the priorities for development of this area based on a participatory approach.

Materials and methods

The methodological approach here has been descriptive-analytic method and the data have also been gathered by reviewing the related documents and empirical studies. The theoretical framework which has been developed by reviewing the relevant documents has also applied as the source to determine the research approach and extract the indicators. Then, based on principal component analysis method, the importance of the indicators in development of the environmental quality has been recognized for the neighborhood under study. As the dwellers' approaches to environmental quality are one of the most important criteria in evaluation of the quality and functionality of these settlements, a questionnaire based on the indicators and in the Likert Scale of 5 alternatives has been designed and filled in by the inhabitants. The data from these 200 questionnaires (the number of questionnaires has been defined based on the Cochran's Test in the SPSS software) entered in the SPSS environment. Then, use of exploratory component analysis has resulted in extraction of main factors. This served as the intake of the next step in which the multi-variation linear regression method, the relationship between these factors and the environmental quality of the neighborhood has been measured. After all, by

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combining the importance degree obtained for each of the factors and indicators and with the average of dissatisfaction in each variable, we have determined the priorities for environmental development of Hesar.

Results and discussion

Based on the data derived from the questionnaires, in the SPSS environment we had a matrix with 200 rows (the number of questionnaires) and 27 columns (the number of variables or indicators). In the case study, the result for the variable (indicator) "the traffic of automobile and motorbikes" in the communalities table is fewer than 0.4 and so; this indicator isn't suitable for the analysis model and removed from the set of indicators. This would enhance the amount of KMO. The following table shows the tests for analysis of the suitability of the indicators (Table 1).

Table 1. Tests for analyzing the suitability of the indicators

Cronbach's Alpha		0.874
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.736
Bartlett's Test of Sphericity	Approx. Chi-Square	2015.433
	df	528
	Sig.	0.000

As the outcome of the principal component analysis, 7 factors determined the main components explaining the environmental quality of the case. The eigenvalue for all of these components are more than "1" and the percentage of variance for the first component is "13.98", for the second one is "12.13" and for the third one is "10.81" that the sum of variances for whole indicators is "66.34" percent which is acceptable for the research. Then, by rotating the matrix of factors, these component have been named based on the indicators each factor includes as "environmental arrangement", "basic services", "environmental security", "spatial structure", "welfare amenities", "adverse land-uses" and "social viability".

In the next step, it's required to measure the relationships between these components and the environmental quality of the case. The method here is the multi-variable linear regression in which, based on stepwise approach, β is determined for the each factor. The most amount of β was measured for the "basic services", "environmental arrangement", "welfare amenities" and "environmental security" that are 0.413, 0.388, 0.357, and 0.339, respectively. Then, by multiplying "Component Score Coefficient", "Beta" and the "average of dissatisfaction" (for each variable), we could determine the priority of the variables based on their scores. The priority is: "Remedial and Sanitary services", "Public and recreational spaces", "Urban furniture", "Security and safety", "quality of passages and sidewalk" and "Lightening".

Conclusion

We presented some suggestions to promote the environmental quality of Hesar based the priorities recognized in the research.

- As promotion of environmental quality requires providing diverse services and facilities by the cooperation between relevant organizations and administrative organs, it seems quite necessary to determine the priorities for each neighborhood and the tasks of these organs.
- Although informal settlements are similar to each other in many economic and social aspects, but the differences in environmental aspect make it necessary to establish appropriate plans separately for each neighborhood. In fact, using the same policies and regulations for different communities in these areas with divergent problems is one of the main reasons of inefficiency of rehabilitation plans.
- Although the government and the municipality are responsible for maintaining and meeting the requirements of the communities, but it should be noted that without responsibility of the inhabitants in maintaining urban furniture, public spaces and so on, the quality of the services provided by the government would be gradually undermined. Therefore, it is essential to make attempts for development of the participation of inhabitants in community development, promotion of the culture and educating the citizenship principals in parallel with spatial and physical development.
- As the inhabitants of these areas are mainly low-income and their houses suffer from low quality, the the facilities and services for these people are more important in comparison with other inhabitants. Indeed, urban managers should pay more attention to these neighborhoods.
- One of the existent opportunities in informal settlements is the low value of the land compared with other parts of the city. Thus, it could be suggested to use these lands for locating some of the recreational and service spaces. This would decrease the project costs in addition to support development of these neighborhoods.

One of the main problems in informal settlements -and especially in the case of this project- is "safety and security". This problem in one hand has been derived from different environmental, cultural and economic factors and on the other hand, it is one of the effective indicators in environmental quality. With this problem, it is essential not only for the community but, it is also notable because it influence nearby neighborhoods and other urban public spaces.

Keywords: informal settlements, environmental quality, marginality, Hamedan.

Application of Spatial Autocorrelation Techniques to Measure Urban Sprawl, Case Study: Gorgan City

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Expanded Abstract

Introduction

In 1950s, only 30% of the world's population lived in urban areas. By 2000, that proportion increased up to 47%, and by 2050 the estimated number will be around 72%. Urban sprawl, an undesirable type of urban growth, is one of the major concerns of the city planners and administrators. Understanding urban patterns, dynamic processes, and their relationships is a primary objective in the urban research agenda. It is benefited from a wide consensus among scientists, resource managers, and planners. The reason for this consensus is that future development and management of urban areas requires detailed information about ongoing processes and patterns. To describe these different patterns intelligently, to understand how they change over time, to compare one area with others, or to explain the variations among these patterns statistically, we need to select quantitative measures to summarize the properties of the urban areas changed during the development process. A continuous monitoring of urban growth evolution in terms of type and extent of changes over time is essential to support planners and decision makers in future urban planning.

The requirement for understanding and monitoring urban expansion processes is the availability of both (i) time-series data set and (ii) updated information related to the current urban spatial structure to define and to locate evolution trends. In this context, multi-temporal analysis based on remotely sensed data has played an important role in detection of urban growth. Remotely sensed imagery is an effective data source for urban environment analysis. It is also suitable to provide information on urban land cover characteristics and their changes over time at various spatial and temporal scales. In general, urban change detection involves the application of multi-temporal datasets to quantitatively (or visually) analyze the temporal effects of the phenomenon. Effective and sustainable urban management increasingly requires advanced techniques to obtain various and up-to-date information on the pattern, state, characteristics, and development of an urban environment. Recently, more attention has been paid to the use of spatial autocorrelation in measuring urban growth. The use of satellite imagery coupled with autocorrelation techniques can be used for monitoring and planning purposes. These enable the reporting of ongoing trends of urban growth at a detailed level. The spatial autocorrelation can be employed for measurements and analyses of the degree of dependency among observations in a geographical space. In urban studies, this often means that high values are found near other high values and low values appear in geographical proximity.

The aim of this paper is to show the potential application of the spatial autocorrelation techniques to detect fragmentation over the landscape. This study analyzes urban expansion over time using satellite images and spatial autocorrelation.

Materials and methods

The spatial autocorrelation here is separated in six sections.

Spatial autocorrelation statistics

Spatial autocorrelation: basic concepts

The concept of the spatial autocorrelation is rooted in Waldo Tobler's first law of geography: "everything is related to everything else, but near things are more related than distant things". A non-random spatial pattern

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may show either positive or negative spatial autocorrelation. In the case of positive spatial autocorrelation, the value of a variable at a given location tends to be similar to the values of that variable in nearby locations. In other words, if the value of some variable is low in a given location, the presence of positive spatial autocorrelation indicates that nearby values are also likely to be relatively low. Conversely, negative spatial autocorrelation is characterized by a tendency for dissimilar values to cluster in proximate locations. For example, the areas exhibiting low values for a particular variable may be surrounded by high values when negative spatial autocorrelation exists. The absence of spatial autocorrelation indicates that the spatial arrangement of the variable values is random.

Global indicators of spatial autocorrelation

Global indicators of autocorrelation can measure if and how much the dataset is auto-correlated throughout the study region. These indicators provide a single statistic that summarizes the spatial pattern of the region and the two main indicators are Moran I and Geary C Ratio indices. Moran's index I is defined in the following formula 1:

$$I = \frac{N \sum_i \sum_j w_{ij}(X_i - \bar{X})(X_j - \bar{X})}{(\sum_i \sum_j w_{ij}) \sum_i (X_i - \bar{X})^2} \tag{1}$$

Where N is the total pixel number, Xi and Xj are intensities in points i and j (with i / = j), $\bar{X}$ is the average value, and wij is an element of the weight matrix. Moran index shows a trend similar to the correlation coefficient, consequently it can have values d between -1 and 1.

Geary C Ratio is quite similar to Moran's I index and it is defined by the following equation 2:

$$c = \frac{(N-1)(\sum_i \sum_j w_{ij}(X_i - \bar{X})^2)}{2(\sum_i \sum_j w_{ij}) \sum_i (X_i - \bar{X})^2} \tag{2}$$

Parameters are very similar to the prior equation: the main difference is represented by the cross-product term in the numerator, which in Moran's it is calculated using deviations from the mean, while in Geary's it is directly computed. The Geary's C Ratio is ranged between 0 and 2. The values between 0 and 1 define positive autocorrelation, while those greater than 1 and smaller than 2 indicate negative autocorrelation. Value 0 represents a perfect positive autocorrelation, the same as neighboring values with cross-product equal to 0. Value 2 defines a perfect negative spatial autocorrelation.

Local indicators of spatial autocorrelation

Local indicators of the spatial autocorrelation allow us to locate clustered pixels, by measuring how much features inside the fixed neighborhood are homogeneous. In this study, we used the Getis–Ord Local Gi, as defined according to the formula:

$$G(d) = \frac{\sum \sum w_{ij}(d)x_i x_j}{\sum \sum x_i x_j} \tag{3}$$

This is very similar to Moran's index, except for wij (d) which, in this case, represents a weight that varies according to distance. The interpretation of Getis and Ord's Gi meaning is not immediate, but it needs a preliminary classification that should be done in comparison with Gi to intensity the values. In particular, a high value of the index means positive correlation for high values of intensity, while a low value of the index means positive correlation for low values of intensity.

Local versions of the spatial autocorrelation are used to measure the magnitude of the spatial autocorrelation within the immediate neighborhood. Values indicating the magnitude of the spatial association can be derived and located for each areal unit. The local version of the statistic employs distance information to identify local clusters and relies on the distance information captured in distance matrix.

The Local Indicator of Spatial Association (LISA) represents the local version of Moran's index I. It is defined by the relation 4:

$$I_i = \frac{(X_i - \bar{X})}{S_x^2} \sum_{i=1}^{N} (w_{ij}(X_i - \bar{X})) \tag{4}$$

Where X is the intensity mean of all events, Xi is the intensity of event "i", Xj is the intensity of event "j" (with j≠i), S_x^2 is the variance of all events and wij is the weight matrix.

Analysis Urban Sprawl using NDVI index

In our analysis, we adopted the Normalized Difference Vegetation Index (NDVI), which is the most widely used index for a number of different applications, ranging from vegetation monitoring to urban sprawl. The NDVI is computed using the following formula 5:

$$NDVI = \frac{R_{NIR} - R_{RED}}{R_{NIR} + R_{RED}}$$

(5)

This index was computed for the years 1986 and 2010 to emphasize on changes and improve change detection.

Results and discussion

All of the spatial autocorrelation statistics discussed so far have a common characteristic; they are global because they are summary values for the entire study region. It is reasonable to suspect that the magnitude of the spatial autocorrelation does not have to be uniform over the region (spatial homogeneity), but rather they are variable according to the location. In other words, it is likely that the magnitude of the spatial autocorrelation is high in some sub regions but low in other sub regions within the study area. It may even be possible to find positive autocorrelation in one part of the region and negative autocorrelation in another part. This phenomenon is called spatial heterogeneity. Results of the local Moran indicated that the highest spatial autocorrelation was found in forest areas. This is because of their uniformity and homogeneity compared to the other covers. Urban cover in outputs of local Moran has moderate spatial autocorrelation and it means that pixels of the built-up places have moderate similarity. The minimum spatial autocorrelation was seen in agricultural areas.

Results of Getis'sGi statistic show that forest cover has positive spatial autocorrelation and urban cover has negative spatial autocorrelation. In contrast to the local Moran's, Getis's Gi statistic, we consider low values in NDVI as negative spatial autocorrelation. The urban cover in NDVI map has low values, and outputs of Getis's Gi statistic show negative spatial autocorrelation. In general, comparison of output maps of the local Moran and Getis's Gi statistic indicated that both indices can detect and measure built-up places and forest covers but, the Getis's Gi statistic was better for measuring urban sprawl because of its capability in representation of negative values as distinct clusters.

Most studies on measurement of urban sprawl in Iran apply discrete approach or land use classification from Landsat images. According to this fact that Landsat images have moderate spatial resolution, it is necessary to evaluate the data set to detect and separate built-up areas. Spatial resolution is a function of sensor altitude, detector size, focal size and system configuration. It defines the level of spatial detail depicted in an image, and it is often related to the size of the smallest possible feature that can be detected from an image. This definition implies that only the objects larger than the spatial resolution of a sensor can be picked up from an image. Another meaning of the spatial resolution is that a ground feature should be distinguishable as a separate entity in the image. For any feature to be identifiable in an image, it should be consistent with the spatial resolution, spectral contrast, and the feature's shape. In this study, to overcome these problems, we used the local spatial autocorrelation that measure urban sprawl continuously. The NDVI map was used as input of local spatial autocorrelation statistics, outputs of local Moran's and Getis's Gi statistics were compared using kernel density graph of the indices. In general, the results of this study indicated that the use of continuous approaches to measure the growth of the city using spatial autocorrelation techniques is appropriate and efficient. Therefore, in order to survey urbanization in different areas we can use the spatial autocorrelation indices, since these indicators don't need classification of the satellite images that is very time-consuming and costly accompanied with errors and uncertainties.

Conclusion

In general, change detection of urban landscape requires multi-temporal data for quantitative analysis. Several approaches have been developed that consider this problem. Regardless of the classification methods of urban environments including pixel-based or object-based, it is believed that the classification method has major drawbacks, because the classes are separated by discrete boundaries. Thus, the process of classification of images due to the conversion of continuous data to discrete classes reduces the information. With the spatial heterogeneity of urban environments, remote sensing analysis of these areas is challenging, but still the most important study source of the urban landscape is remote sensing. In this regard, remote sensing imagery coupled with spatial autocorrelation techniques can be used for monitoring and planning purposes. These enable the reporting of ongoing trends of urban growth at a detailed level.

Evaluation of Development Scenarios of Ecological Connectivity in Ahvaz City to Improve the Ecosystem Services and Biodiversity Stage

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Extended abstract

Introduction

Ecosystem services are the benefits that human derives from the ecosystems. These are services such as goods and products (e.g., fresh water, fuel), regulation of natural processes (e.g., climate, flooding, erosion), and nonmaterial benefits (e.g., recreation, aesthetic enjoyment). Many cities are located in the important ecological areas. Currently 29 out of the 825 ecological zones of ecological areas are under urban development in the world so that more than one-third of the areas have been human constructed. It is predicted that by 2030, 15 other ecological areas of 118 vertebrate species specific and rare, at least the about 5% of the total area, will be built. On the other hand, the reflections have led to the phenomenon of urbanization in the world in terms of environmental considerations. The two look quite the opposite in such a way that they are as a challenge for the ecosystem or an opportunity.

On the one hand, this phenomenon eliminates natural ecosystems or at least makes it apart. It promotes non-native species, changes and reduces ecosystem and eventually disrupts normal diet. The urbanization can create some social and economic opportunities, connection of people and nature, unique environmental areas and increase ecosystem services based on the principles of sustainable planning and design. In the Convention of Biological Diversity (CBD), three roles have been defined for cities:

1-Maintaining ecosystem goods and services in towns and cities

2-protecting biological diversity in cities and towns and promoting sustainable planning and design at various scales to maximize self-reliance of these areas

3- Promoting effective policy to create a livable, not only for humans, but plants and animals in man-made environments. Accordingly, it can be said that urban biodiversity points to all communities, plants, animals and microorganisms that live in and around the city.

Howard achieved this goal outside of the cities and new cities. While today's computing ecosystem services and biodiversity studies are in different scales of global, national, regional, urban-rural, and even at the district levels, block design and spatial resolution has had an important role in maintaining and improving the ecological balance. To achieve a sustainable level, we consider the performance of public services, urban management.

To develop patterns that emerged from the concept of sustainable development, the New Urbanism, pedestrian areas and TOD are examples of it. The concept of ecological cities and villages were discussed as a tool to achieve sustainable development in three areas:

(A) As a tool to open the original settlement structure, increased density around the center, restoration of the natural environment and agricultural landscapes in the spaces.

(B) City network: a new model for open collaborative development in the surrounding areas that leads to the formation of the city's network and metropolitan area network. The spatial pattern, the area between the green and blue urban centers will be assigned to the matrix.

(C) In conjunction with landscape architecture and planning development ecosystem. The tools, designed by James Corner and Charles Vadhaym landscape architecture in urban scale in the United States and in Europe Krysynz expanded major role. Studies of ecosystem services and biodiversity in cities are considered in the past two decades.

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The importance of this issue in urban planning has been observed in the world major cities, including Frankfurt. The studies have been conducted in the three-phase investigation, representation, and control of the land to be annexed to the application process. A recent evaluation of policies, particularly in the area of urban green spaces, green corridors, green belts and important results in maintaining and even improving the ecosystem of valuable resources and the conservation of biodiversity are represented in urban and land use planning reform measures. As one of the most important urban green space to urban habitats, it provides humans with unique perspective to a variety of flora and fauna, as well as direct access to nature. Keeping in touch with nature citizens is a basic need and a criterion for quality of life. Ecosystem services and biodiversity are high quality urban green areas, environmental benefits, economic, and psychological offers. Studying the process of planning and development and the spread of the best practices based on the minimization of ecosystem services and urban development can be realized as two seemingly contradictory trends and competitor. Thus, an optimal choice is to provide policy development, conservation of ecosystems and biodiversity in general elections.

This research answers to three important questions.

First, what type of services does ecosystems, general in cities and specifically in urban management, have and what types of the strategies have been used to maintain and improve these services?

Second, what are the main criteria and methods of analysis of planning and design of urban development in terms of ecosystem services and biodiversity considerations?

Third, what kinds of processes in the ecological integrity of space are seen in the city of Ahvaz and what is the priority of strategic choice to increase the connectivity of the areas?

Materials and methods

There are two basic types of metrics at the patch level: (1) indices of the spatial character and context of individual patches, and (2) measures of the deviation from class and landscape norms; that is, how much the computed value of each metric for a patch deviates from the class and landscape means. The deviation statistics are useful in identifying patches with extreme values on each metric. There are two basic types of metrics at the class level: (1) indices of the amount and spatial configuration of the class, and (2) distribution statistics that provide first- and second-order statistical summaries of the patch metrics for the focal class. Like class metrics, there are two basic types of metrics at the landscape level. Landscapes are composed of elements–the spatial components that make up the landscape. A convenient and popular model to conceptualize and represent the elements in a categorical map pattern (or patch mosaic) is known as the patch-corridor-matrix model. Under this model, three major landscape elements are typically recognized, and the extent and configuration of these elements defines the pattern of the landscape.

While individual patches possess relatively few fundamental spatial characteristics (e.g., size, perimeter, and shape), collections of patches may have a variety of aggregate properties, depending on whether the aggregation is over a single class (patch type) or multiple classes, and whether the aggregation is within a specified sub-region of a landscape (e.g., the neighborhood of each focal cell) or across the entire landscape. Consequently, landscape metrics can be defined at four levels corresponding to a logical hierarchical organization of spatial heterogeneity in patch mosaics. It is important to note that while many metrics have counterparts at several levels; their interpretations may be somewhat different. Cell metrics represent the spatial context of local neighborhoods centered on each cell. Patch metrics represent the spatial character and context of individual patches. Class metrics represent the amount and spatial distribution of a single patch type and are interpreted as fragmentation indices. Landscape metrics represent the spatial pattern of the entire landscape mosaic and generally interpreted more broadly as landscape heterogeneity indices because they measure the overall landscape structure. Hence, it is important to interpret each metric in a manner appropriate to its level (cell, patch, class, or landscape).

Aggregation refers to the tendency of patch types to be spatially aggregated; that is, to occur in large, aggregated or "contagious" distributions. This property is also often referred to as landscape texture. We use the term "aggregation" as an umbrella term to describe several closely related concepts: 1) dispersion, 2) interspersion, 3) subdivision, and 4) isolation. In these exercises, future scenarios are constructed by making different assumptions on the underlying driving forces, and hence on the magnitude of land use change processes. For instance, Khajeh Borj Sefidi and colleagues built different land use scenarios by varying the rates of agricultural, river, vacant and urban expansion. Less attention has been devoted so far to the effects on ecosystem services of different spatial arrangements of land uses.

The effects of spatial patterns on ecological processes represent one of the central themes of landscape ecology. Scientists have tried to understand these effects for a broad range of ecosystem services, such as habitat provision, pollination and water purification. According to a recent article, the capacity of a land system to deliver ecosystem services is determined by the kind, magnitude and spatial patterns of land uses. Research on land use change and ecosystem services has widely addressed the first two attributes but has disregarded so far

the third one, spatial patterns. To the best of our knowledge, none of the studies presented in the literature considered scenarios that differ only in the distribution of land use types, rather than in their relative proportions.

The paper presents case-study research aimed at empirically exploring how the implementation of different land use zoning policies can affect the future supply of ecosystem services. The term 'land use zoning policy' is used here to indicate regulations concerning permitted, prohibited or preferred land uses. The design of such policies is often a core issue in spatial planning, and they represent one of the most tangible elements of a plan. The method is based on the generation of future land use scenarios that simulate the implementation of different zoning policies. The scenarios are constructed by holding constant rate of land use change processes but varying their location according to the different policies. The effects of the land use scenarios on selected ecosystem services are then modeled and compared through a set of metrics. The study area is Ahvaz (south-western Iran), a region diverse in natural resources, but affected by widespread poverty, relatively low performance in development indicators and reliance on the conservation of ecosystem services to support rural livelihoods. The application of the methodology to the case study addresses three more specific questions: What are the effects of different zoning policies on future land uses within the region? How do these affect the conservation of ecosystem services? What are the empirical patterns of trade-offs among ecosystem services associated with the different policies? By answering these questions, the paper aims also at illustrating the potential contribution of the approach to support spatial planning.

Results and discussion

Fragmentation of natural and ecological areas leads to reduction diversity of ecosystems and elimination and extinction of many species. Spatial pattern analysis of functional-habitat patches-corridor - matrix components are the basis of landscape ecology. Landscape ecologists describe the concept of a corridor connection or continuity of function and structure in terms of space and time effects. Residential development along with the development of the ecological environment hasn't been done. Degradation of agricultural land to urban uses hasn't helped integration. Actually, urban development in order to increase economies of agglomeration does not move. Despite the reduction of the green matrix during 1991 to 2006, the level of connection and integration has increased slightly. The effect of various scenarios indicated important ecological areas of the matrix green corridor along the river is much more effective than railway corridor that this matter can be considered as a space policy for the management of urban development. Corridor little effect on the overall relationship indicates that this is currently located in a highly green matrices are isolated from each other so as a result, it is recommended that the planning of large-scale green space in the city and along the corridors of the linear guide.

Conclusion

Land use policies to increase the level of biodiversity are in the following classified.

- Green space planning with strategic policy that makes these spaces connected in a set
- Development of parks on the plots larger than one hectare according to climatic conditions;
- Developments of private open spaces and more use of native plants appropriate to the climate;
- Development of blue corridors, especially in regional scales connected to the main blue corridor area (Karun River) and development of green and blue corridors in combination;
- Drawing and temporal comparison in the areas of bio-ecological information continuously;
- Planned urban park with the use of natural patterns in the region, such as the creation of artificial wetlands and coastal water;
- Development of the main areas of ecological corridors, such as river and privacy railroad connection to increase the margin of the inner built areas
- Promoting the use of semi-natural design of residential settlements such as oil town and etc.
- Integrated development of forested areas, especially in the eastern and western sides of the city and parallel and perpendicular to the river and opposite the city's development;
- Increase in the permeability of the Karun River (both in road and in the natural corridors).

Land Suitability for Urban and Industrial Development by a Proposal Model, Case Study: Jahrom Township, Iran

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Extended abstract

Introduction
Urban planning is the process of influencing, controlling or directing changes in the use of land overtime and space in an urban area. Therefore, it involves plan formulation and development control. To achieve this, concept of sustainable development must be addressed to remedy social inequities and environmental damage, while maintaining a sound economic base. The sustainable development or best use of the land will be carried out by assigning the land use zones on the basis of capability, compatibility, and use of proper technology and measures to protect environmental degradability. In the past, planners and developers were increasingly ignoring the natural environment and, thus, causing damage to it. Nowadays, the excessive pressure by human on lands is very serious problem for land degradation. For this reasons, the land must be properly planned to determine where human want to live, particularly. Hence, evaluation of urban development suitability plays a fundamental role in urban planning and enhancement. Land suitability assessment is the process which determines the fitness of a given tract of land for a defined use, usually among multiple competing uses. In addition, selection of proper method of evaluation for planning is also very important. Evaluation based on Boolean method in classic methods like the FAO model for land evaluation using maximum limitation, make the classification quite strict. In many cases, these models have been applied incorrectly and with dubious results.

The goal of current study is the implementation of Boolean ecological model and comparison to proposed quantitative methods in urban and industrial planning.

Material and methods
The study area (Jahrom Township) is located in the Fars province in the southern Iran. This township has an area of 5436 square kilometers and is placed at latitude 28° 19′ to 29° 10′ north and longitude 52° 45′ to 54° 4′. The average height is about 1050 m. The climate is warm and in mountainous areas is generally moderate. Six evaluation methods were conducted. They are including:

I. Iranian Evaluation Model of Ecological Capability by Boolean: Iranian Evaluation Model of Ecological Capability is an Iranian model for urban and industrial development use. It is formed of 3 classes that ecological potential is reduced by increasing capability number of classes.

II. Revised Iranian Evaluation Model of Ecological Capability by Boolean: In the revised method, we have defined the criteria based on Table 1.

III. Evaluation of model based on Arithmetic Mean: In the Arithmetic mean method, the scores related to the parameters were averaged.

IV. Evaluation of model based on Geometric Mean instead of Boolean logic: According to criteria, every index was given the weight between 0 to 2, that 0 states none-suitability of ecological condition and 2 shows the most suitable of ecological condition for urban planning. Then, every criterion was calculated based on geometric mean of the indicators according to Equation1:

Equation1: $Criterion\_X = [(Layer-1)*(layer-2)\ldots*(Layer-n)]^{\wedge} l/n$

Where Criterion _ X is defined as criterion, Layer is an indicator map of criterion, and n is number of used indicators. Then, the criteria were multiplied through Geometric mean (Equation2).

Equation 2: Final Criterion = [(Layer-1)*(layer-2)…*(Layer-n)] ^ l/n

Where Final Criterion is final layer of ecological capability and n is number of used criteria. Then, qualitative and suitability classes of ecological capability were defined for urban planning in the study area in a GIS (Table 2).

V. Calibration model of the last one: In order to evaluate accuracy of the obtained maps quantitatively, it is compared pixel by pixel to ground reality (current land use) in error matrix. In final step, calibration was done based on accordance to ground reality (current land use).

VI. Evaluation of industrial use based on Calibrated and limitation maps.

Table 1. Factors affecting Urban and industrial Planning

Main criteria	Indicators (Layers)
TOPOGRAPHY	Slope, Land form
CLIMATE	Precipitation, Temperature, relative humid, wind speed
SOIL	Texture, Depth, Drainage, Erosion, Gravel, percent, Granulating, Evolution
GEOLOGY	Lithology + hydrology
VEGETATION	Vegetation cover
WATER	Quantity of water

Table 2. Suitability classes in the Capability Maps and models for urban planning regarding the scores of polygons

	Suitability classes		
	Good (1)	Moderate (2)	Not suitable (3)
Their score	1.5-2	0.5 - 1.5	< 0.5

Results and discussion

In this research, suitability maps and spatial distribution derived from different models were obtained. The model by best accuracy (calibrated model) and industrial development map were indicated in figure 1. The results represented that calibrated revised method (3 classes) using Geometric Mean evaluation is the best model among the different used models (Table 3). This indicates calibrated revised method (3 classes) using geometric mean evaluation can be a useful model to find potential area for urban planning. It should be noted that the classic methods like the FAO model for land evaluation using maximum limitation make the classification quite strict. But proposed method is more flexible for evaluation regarding to kind of evaluation that it doesn't depend only on one parameter that is observed in methods using Boolean approach. Also, Geometry Mean method is reduced high impact of some factors such as the soil. Topography with two indices has a measure of weight equal to the soil factor. Additionally, the average of ecological conditions is also considered. Boolean model is based on maximum limitation.
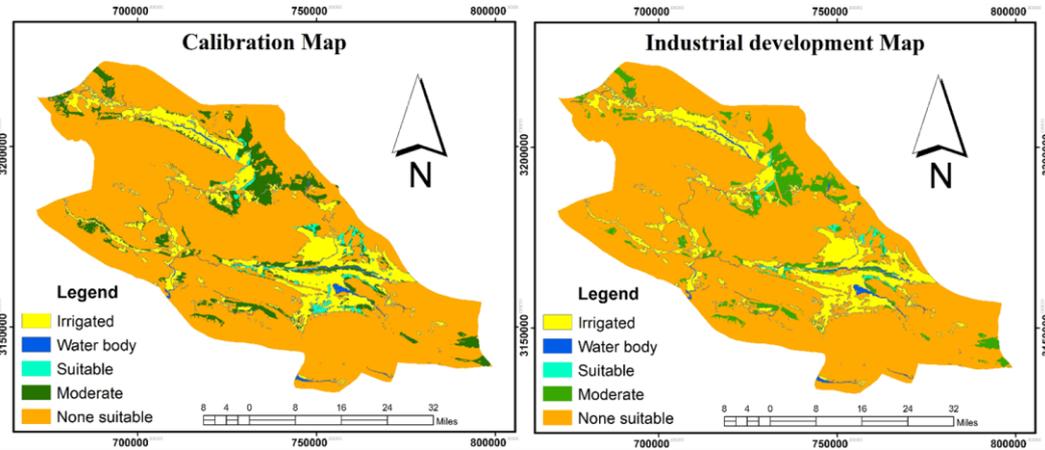
Figure1. The calibrated model by maximum accuracy and industrial development maps

Table 3. Accuracy assessment in the used models

Model Type	Iranian Evaluation Model of Ecological Capability	Revised methods (3 classes)			
		Boolean logic	Averaged based		
			Arithmetic mean	Geo_ mean	Calibration
Overall Accuracy (%)	54	54	42	86	87
Kappa Coefficient	0.32	0.32	0.24	0.75	0.77
In class Index	0	0	3.93	4.36	4.56

Conclusion

The planning of urban land uses is the most important and difficult urban programs. Thus, it changes all urban planning including future city. The GIS based multi criteria evaluation technique is very simple and flexible which can be used to analyze the potential sites for urban development. This model can also encourage public participation in the urban decision making process and assist various planners and authorities to formulate suitable plan for sustained development of the region. Hence, the results of this study are suggesting to managers and other stakeholders so approach that is scientifically complete, sound and practical.

Formulation of Design Criteria Based on Recognition and Comparison of User Patterns of Behavior, Emphasizing on the Role of Climate in Urban Public Spaces, Case Studies: Shahr-E- Kord and Bushehr

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Expanded Abstract

Introduction

Climate has always been one the main factors of designing urban spaces in Iran since past centuries. By analyzing urban spaces it can be concluded that different cities have different urban spaces due to climate differences. One of the main reasons of the differences in the type and orientation of urban spaces is the climate as one of the key factors in designing these areas. Regarding climate in designing is equivalent to involving the users of the space, basically because climate adjustments can encourage more people to use the designed spaces. Hence, it can be said that climatic spaces are humanistic spaces as well. Therefore, climate directly influence culture and plays a decisive role both in the body and behavior of the users. Thus, it could have a very effective role in how people use or how they behave in designed spaces.

Materials and methods

A mix of several methods has been used for more compatibility with research purposes. This used library documents and has a comparative-analytical method. The basic data and the research background information have been gathered through documentative method and from library resources. For the fieldwork, the descriptive method (describing the phenomenon) has been used. Then, people patterns of behaviors were studied by an interpretative-qualitative method in each climate to analyze and infer the discussions in order. And at last, a comparative method has been used to analyze the results in order to set out urban design criteria. In this comparative method, it was tried to compare people patterns of behavior in two cold- mountainous, and hot and humid climates, and to analyze its results to elicit criteria for urban space design considering the effects of climate on the user behaviors. In this research, the people behaviors were studied, analyzed and compared in two different seasons of the year (the hottest and the coldest seasons) by the use of serial photography. Thus, people different patterns of behaviors in different climates and the ways they use the spaces were investigated, by the observation a set of design criteria could be developed to be applied in the design/redesign of urban spaces to improve their qualities.

Diagram (Bahrainy, 1375)

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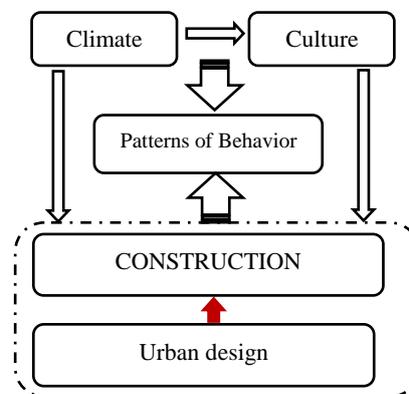
The theory

In general, people uses of urban spaces may have two stages:

1. Presence in urban space.
2. Tendency to continue to stay in the urban space.

There are two kinds of qualities in urban environment. First, the qualities which are the main requirements of people presence in public spaces, i.e. primary qualities. Second, the qualities encouraging people to stay in the space for a longer time. Meanwhile, there are some qualities like climatic comfort which play effective role in both primary and secondary qualities. This very important factor is in full adaptation with human physical characteristics and is the main requirement of people presence in the space. It also plays an undeniable role in the way people use the space and behave there. Climatic comfort can increase the number of opportunities to use the space. If the space is designed with consideration of all aspects, including the user behaviors, it can be used by all people in various periods of time during the day, and in different seasons.

Results and discussion

Design guidelines in hot and humid climate are formulated. They emphasize on the role of climate to determine people patterns of behavior.

Here, regarding the achievements of local observations and the recognition, the design criteria are proposed at two different scales, the city scale and the site scale.

A) The city scale:

Location of the space in the shade: This is the most important factor affecting the use of space in hot and humid climates. If the open space includes shaded parts, people preference to stay there will increase. Therefore, location in the shade can be considered as an important requirement for people use of space in this climate.

Other factor is natural ventilation and the space orientation parallel to the wind flows: This is the second factor affecting the use of public spaces in hot and humid climate. Natural ventilation of open spaces happens by the airflows coming from the sea. It helps the locals reduce the high unpleasant humidity in this climate, so it encourages passersby to stop and stay in the space.

B) The site scale:

*   To avoid designing vast urban open spaces in hot and humid climate.
*   Making orientation of the open spaces toward the sea to moderate the hot weather and reduce the humidity by the sea airflows. Local observations also verify that successful spaces in this climate have perpendicular orientation to the sea to benefit from its cool airflows for natural ventilation.

Formulating design guidelines in cold and mountainous climate emphasizes the role of climate to determine people pattern of behavior:

Local observations in Shahr-E- Kord show that the two fallowing factors have determined the role of people use of space in cold and mountainous climate.

1- Maximizing the direct sunshine: It is a positive point for the open spaces in the cold winter weather of mountainous climate, because it helps the space to be more welcoming and favorable for people.
2- Not to be windward: This factor also has direct effect on how people attend and behave in the space. The researcher's observations and notes in cold and mountainous climate show that the spaces which are exposed to direct wind flows are not favorable for people.

A) The city scale:

*   For designing open spaces and its proposed land uses, it is better to locate attractive uses at the southern and east-southern side of the space, because it helps to provide favorable sunlight for the space during cold winter days and facilitates the use of space for people.
*   In the cold and mountainous climate, it is better to design urban spaces in form of small squares because it reduces the entrance of wind flows and provides people with climatic comfort. It must be mentioned that vast squares in this climate can benefit from the increased direct sunlight and heat. But the effect of the increased airflows in these spaces is highly unfavorable and disturbs the climatic comfort. Thus, they are not recommended.

B) The site scale:

*   It is better to design crowded spaces as semi-open spaces, because enclosed and covered spaces are more favorable in all seasons for their shelters from the sun, wind, rain and snow.
*   In cold climates, it is important to use types of plants which prevent spaces from undesired wind, while not casting shades during cold seasons, since trees can provide favorable shades for summer time.

Conclusion

The results and findings of this research are presented in a set of operational and applicable recommendations, some of which might seem unimportant. But they are undeniably essential. Simple solutions for ordinary problems of existing urban spaces can lead to significant improvements in the space vitality and people social life. William White expresses the extract of his long term studies in one sentence: "people seat where the seating exists." This sentence might seem clear and typical, but it is very important and can notably change the life of a city. Thus, the simplicity of changes does not mean that they are inconsiderable. It might be possible to change the destination of a space simply by adding shelters and awnings or providing sunny spaces in cold and mountainous climates and shaded spaces in hot and humid ones.

Keywords: behavior patterns, climate, climatic comfort, Shahr-E-Kord, Bushehr

Evaluation of Nitrification Process in Saline Wastewater Treatment by Hybrid Reactor and Its Comparison with Conventional Activated Sludge

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Extended abstract

Introduction

Saline wastewaters contain mineral salts which are often produced by industries such as seafood processing, cannery, vegetables, and tanning. They are imported into the sewage collection network. In coastal cities, saline water consumption seems indifferent in household parts and high levels of ground water, leak saltwater, precipitation during different seasons, and sea level are the other reasons of the salinity of the wastewater. Saline wastewater biological treatment due to the harmful effects of salinity on microorganisms is difficult, because high salinity can cause cell activity reduction. Regarding this matter, biological treatment is welcomed most in comparison with chemical or physical treatment because these systems are cost-efficient and compatible with environment. In addition, they require low-waste chemical materials and can produces less solid and require less energy. In the process of biological treatment, removing ammonia from wastewater is important because if the pollutants enter the waters of the acceptor, it would create problems such as toxic to aquatic organisms, depletion of dissolved oxygen water, creation of eutrophication, and increased use of chlorine. One of the important processes of ammonia removal is nitrification or the conversion of ammonia to nitrate. This process cannot be carried out effectively in wastewater treatment by conventional activated sludge methods. Because the salt concentration affects the osmotic and ionic composition and these two physical factors play an important role in the survival and reproduction of microorganisms. On the other hand, the concentration of salt in the conventional processes would increase the buoyancy or float and removing sludge out of these systems is performed easily. Therefore, the age of proper sludge for nitrification cannot be supplied. To solve the mentioned problem, the hybrid growth method seems proper which causes the sludge to remain in the system longer, and it is expected that nitrification process works better in hybrid growth systems. Therefore, the present study is designed and performed by the aim to determine the efficiency of hybrid growth system in nitrification process in comparison with conventional activated sludge systems.

Material and methods

To perform this experimental study, a pilot in experimental scale was created and used. The features of the study are mentioned in the following. This pilot contains a raw sewage tank of 300 liters volume equipped with a stirrer and two biological unit reactors (conventional and hybrid activated sludge treatment systems), each with 34 liters volume. It also has 2 units of settling, each 19 liters volume, and flow meters to measure airflow. It also contains 2 dosing pumps for the injection of raw sewage and equipped with a compressed air compressor to supply the air required for reactors.

To accomplish this study, a real domestic sewage (wastewater treatment plant entrance martyr Beheshti town) was used. The variables involved include the concentration of ammonia, nitrate, dissolved oxygen, suspended solid in concentration of the liquid, hydraulic retention time and the rate of the incoming air. Titration method was used to measure the concentration of ammonia; Spectrophotometer was used to measure the nitrate, dissolved oxygen with help of electrode and to determine MLSS using the gravimetric method in accordance with standard procedures for testing of water and sanitation. In order to fix the rate of the flow of air in the reactor, two flow meters were used. For fixing the growth conditions of the hybrid, 45 percent of one of the reactors was covered with media polyethylene. The operation of the reactors was continuous. At the beginning of the pilot biomass of the reactors sludge return wastewater treatment plant by one-third the size of each reactor

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was catered and added to the reactor. Then, raw wastewater is inserted and when the pilot reached a stable condition, the involved variables were evaluated. In order to adjust the level of TDS in the amounts listed, pure sodium chloride was used. To determine the efficiency of the studied reactors in the nitrification process, three ammonia levels (17, 30 and 45 mg per liter) and three air intake rate (0.73,0.83 and 0.91) as well as three hydraulic retention time (5,4,3 hours) were considered. The reason for choosing three mentioned air rates is to supply the dissolved oxygen at a concentration of 3 to 4 milligrams per liter as an optimal concentration for the hybrid growth. The SPSS software was used to analyze data and Excel software was deployed to draw graphs.

Results and discussion

The results related to review of nitrification process for hybrid or conventional reactors show that in order to reach proper MLSSS concentration in reactors in conventional process of sludge return to 50 % of input rate, it was not necessary to return sludge in hybrid reactor and the proper concentration of MLSSS. Results of the present study indicate that when a hybrid system is deployed for saline wastewater treatment compared to conventional activate sludge systems, less air is required to maintain adequate dissolved oxygen concentration in the reactor. As it is shown in results (table 1), with fixed rate of input air to two reactors, dissolved oxygen concentration in hybrid reactors is higher than conventional reactors, in average 6.57. This issue in full-scale treatment plants can lead to a lot of savings in cost of air-supply, since a main part of the total cost of a municipal wastewater treatment is spent on air-supply of reactors.

Table1. The results of nitrification process in conventional and hybrid reactors

Influent			Reactor no.1:Conventional				Reactor no.2:Hybrid growth			
NH4+ (mg/l)	Q air (l/min)	HRT (h)	DO (mg/l)	NH4+ (mg/l)	NO3- (mg/l)	MLSS (mg/l)	DO (mg/l)	NH4+ (mg/l)	NO3- (mg/l)	MLSS (mg/l)
17	0.73	3	0.35	16.45	0.25	3975	2.25	0.87	31.45	3550
30	0.83	3	0.47	27.3	0.18	3120	3.12	0.93	57.64	3420
45	0.91	3	0.52	44.2	0.15	3350	4.45	1.51	84.12	3180
17	0.73	4	0.51	15.8	1.45	3150	2.96	0.22	33.77	4040
30	0.83	4	0.50	26	0.30	3550	3.26	1.4	61.41	4070
45	0.91	4	0.60	43	0.17	3000	4.81	1.25	92.5	4150
17	0.73	5	0.67	15	1.87	3450	3.13	0.75	36.2	4857
30	0.83	5	0.58	24.73	0.35	3084	3.52	0.15	64.15	4502
45	0.91	5	0.75	41.24	0.2	3818	4.97	0.95	95.74	4230

Another significant point in hybrid reactors is that although sludge does not reverse, MLSS concentration is maintained in an average of 4000 mg in per liter. While the MLSS amount in conventional reactor is supplied by the reverse of 50 percent of sludge. This issue is very significant economically because for reversing sludge to conventional treatment houses requires a lot of money for pumping sludge and for its reverse which in hybrid systems can be saved. Moreover, in order to perform nitrification process completely in wastewater treatment systems, the proper age of sludge should be supplied which it was obtained in a system with hybrid growth. In a

conventional system, due to high buoyancy and density in saline wastewater, adequate sedimentation of sludge does not occur. Therefore, in addition to the problems related to increased turbidity effluent output, adequate sludge supply is also a problem.. While in hybrid systems due to rare escape of suspended materials, supplying age of sludge is easily feasible, as this was proved in this study by the results. According to the results of the present study, nitrification process works better with hybrid system rather than conventional system. It is because of dissolved oxygen concentration and proper age of sludge. According to the results, DO concentration in hybrid systems is several times higher than conventional system. Therefore, ammonia removal and its transformation nitrate occurred successfully in hybrid systems. The reason is the prevention of present media in the system in contrast to oxygen exit out of reactor which leads to better mass transfer and maintains DO concentration in a higher level.

Conclusion

Results of the present study have indicated that nitrification process in hybrid growth system can perform better than conventional growth of activated sludge. Moreover, dissolved oxygen concentration remaining in hybrid reactor in a fixed rate of input air is higher than conventional growth. This matter can be very economical in wastewater treatment houses. In many southern cities, due to different reasons like saline water penetration into the network or saline water usage in residential units, sewage will have high dissolved solids, and nitrification process in these treatment houses faces many problems. Therefore, use of hybrid growth system is suggested in the cities for better performances.

Keywords: wastewater treatment, saline wastewater, nitrification, hybrid growth

The Role of Ecological Networks in "*Environmental Logic–Identity Forming*" Design of Urban Regions, Case Study: Isfahan Poladshahr Urban Region

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Expanded Abstract

Introduction
This study is dealt with the environmental planning from a bio-cybernetic and hierarchical systems viewpoint within the context of landscape ecology. This viewpoint requires not only knowledge of the science of ecology but also ecological wisdom in order to recognize the place of humankind in nature. The conceptual and practical approach which is provided will help landscape planners play a useful role in this process. The study looks at the concept of ecology in urban landscape of Poladshahr Newtown, Isfahan. The paper outlines some of the challenges associated with urban regions landscape development in order to achieve the following aims: (1) to apply a landscape ecology approach in conceptualizing a model of thought for urban region landscape development; and (2) to suggest strategies for the important role of networking in different levels of organizational orders in the process of designing urban region identity. The approach is based on ecological processes and mostly focuses on ecological principles which play a leading role in achieving sustainable urban region landscapes. It necessitates that any planning strategy, especially in large-scale urban region landscapes, should consider the concepts of implementing and designing complex ecological networks. In this context, multi-objective urban networks go beyond the ecological improvement of the urban region to address recreation, beautification, flood control, water quality and other infrastructures objectives. Applying the hierarchical view is suggested by the late systems philosophers to the levels of increasing coordination in interdisciplinarity to transdisciplinarity. It is regarded the latter as the highest stage of multi-level coordination towards a common purpose.

Materials and methods
The research is to address the design of the ecological networks of Poladshahr Newtown urban region. This is in order to construct a foundation applying landscape ecology in the process of developing urban region landscapes. In this way, the conditions become suitable for conserving both the identity of the urban region as well as the environmental sustainability of the landscape. Because of the increasingly population growth and construction density, the landscape of Poladshahr Newtown possesses very little natural patches, and the corridors formed through urban development have very little effects on environmental quality of the landscape. This has resulted in a condition in which the green patches of the urban structure are few and also far apart and the connecting corridors do not have any significant ecological impact. Using the landscape ecology approach, and with the aim of leaning towards the sustainability of urban region's identity, a new approach becomes necessary to achieve the design of sustainable ecological networks of the urban region. While this approach offers the possibility of utilizing the hidden potentials of natural landscapes, it also advocates the principles of environmental sustainability; the interaction between urban region and natural landscape while remaining faithful to the issue of place identity within natural and manmade ecosystems.

Poladshahr Newtown lies in the Tabas Plain, 38 km southwest of Isfahan and 5km northeast of Isfahan Steel Factory. It also lies alongside the Isfahan-Shahrekord highway. Poladshahr Newtown consists of two large

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central and northern areas, which have their own unique structure. The central area has a spiral form and the northern area has an ordered orthogonal geometry. The spatial order of the new town follows the spatial pattern of the region landscape, which has been combined with manmade and natural elements within the city to form the current urban structure.

Poladshahr began its existence in 1963 as a new town and since 1984 it has become known as a "Poladshar Newtown". The current population is over 85000 and the total area is around 7700 hectares. The proximity of the city to the capital city of the province and its easy access to big industries of the region has made the town a very suitable place for urban dwelling. Poladshahr is the oldest new town in the last 50 years in Iran and because of its important features such as unique geographical location, proximity to important transit highways, neighboring to industrial areas and unique urban fabric; it has been considered as one of the most significant new towns in Iran (Naqhsh-eh-Jahan Pars Consultant Report 1387). The Panji and Ashtarjan mountain ranges in the west and south of the city and the farming plains of Lanjan in the east are among the natural features that limit the regional landscape of the new town. New foresting in the south in the foothills of the Ashtarjan mountain range are among other natural features which have created a valuable ecological zone with high natural significance within this part of the region.

Actually when a development plan is proposed to construct an urban region landscape, it is expected that the mechanism of living processes is thoroughly questioned. Here, landscape is the total of abiotic and biotic phenomena and their interrelations in the three dimensional space on the earth surface. It can be recognized by its horizontal and vertical structure and its combination of the variation in attributes: atmosphere, rock, soil, water, vegetation, animals, and man. This holds for the material and organisms for their activities and artifacts. As a new trend in applying the principles of landscape ecology to urban region planning, the concepts of implementing and designing of the ecological networks and urban greenways are gaining increasing attention.

Nowadays, with the ever-increasing expansion of cities, larger areas of natural landscapes fall into urban limits. Maintaining the biological attributes of natural landscapes and qualifying the ecological balances of urban landscapes needs to qualify both *ecological processes of natural landscapes* and *environmental processes of urban landscape services*. The answer of landscape planners to this demand is the design of proper landscape ecological networks. This will ensure that the ecological and environmental characteristics of urban landscapes will also have the necessary qualities for conditioning human interactions. Landscapes are increasingly urban in nature and ecologically and culturally sensitive to change at local through global scales. Therefore, multiple perspectives are required to understand urban landscapes and align ecological and society values to ensure the sustainable development of place landscapes. This study brings *landscape ecology* and *place identity* together to integrate both ecological and societal processes influencing urban region landscape development. This would enhance citizens quality of life and also direct the excellence process of social programming.

The approach needs to identify the progressive cohesion and unified structural principles that are most deeply embedded in time-space dimensions of purposive and ultimate-programming bio-human systems. Such eco-environmental-societal principles govern the basic institutional orders in an urban region landscape. In this case, 'structure' is the mode in which the evolutionary urban landscape expresses itself in ultimate reproduction, and 'structural analysis' involves studying the conditions in which ideal bio-socio-spatial systems via the application of generative rules and resources are produced and reproduced in interaction.

Results and discussion

Urban regions landscape planning process consists of changing the structure and function of total visual and spatial human space while preventing the breakdown, simplification and degeneration of green and open patches of the landscape. The design should be in such a way that the diversity of activities and the density of the built environment do not cause either the natural and open patches of the landscape to be segregated or the ecological networks of landscape circle of mater, energy and specie to be disturbed. In this context, the necessity to give value to the principles of landscape ecology in assessing the state of interconnections between natural and human processes is apparent. These principles focus on structures, functions and transformations of landscapes and attempt to find patterns and interactions between landscape elements, patches, corridors, and the matrix. These principles include the principles of ecological network to integrate ecology into sustainable land development. They necessitate the need to investigate the bio-human induced causes and effects of land-use and land-cover dynamics in directing social programming as well as planning for new landscapes. The necessary cybernetic forces act via the fluxes of energy and information. They depend on the measure of isolation and connection (connectivity) between the landscape attributes, and between the mosaic patches and their composing elements.

Conclusion

The investigation of natural and manmade regional landscape of Poladshahr Newtown required some information. The information was obtained from Naghsh-e Jahan Pars Consultant Report (2008). This

information is then observed through the regional elements of the model of urban region identity components. The Eco, Built and Human logics of the component model were used to observe the Pre-programmed-Purposive-Transcendental quality of the cycle of matter and energy in management of the Eco-Environmental-Societal function of the urban region landscape. According to the principal issues related to the urban region landscapes content composition and spatial configuration, some considerations were provided for the structural and functional improvement of Poladshahr Urban Region landscape system. To determine the state of the urban region landscape, collective components of the proposed model were considered through different levels of organizational orders: 'living organism', 'built system' and 'human desire'. These levels were overlaid to provide the overall ecological-environmental-societal structure and function of Poladshar Urban Region's ecological networks. Landscapes are increasingly urban in nature and ecologically and culturally sensitive to change at local through global scales. Therefore, multiple perspectives are required to understand urban region landscapes and align ecological and societal values to ensure the sustainable development of landscapes.

Keywords: urban region identity, landscape ecology, ecological networks

Urban Landscape Perception in Relation to Collective Mentalities and Memories: Case Study: Tajrish District

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Expanded Abstract

Introduction

Collective memory is directly related to the residents of a neighborhood and city. Given the different positions of a site, various approaches are adopted to initiate or preserve memories in city. In this respect, time, socio-historical memory, traditions, myths, historical layers, the places where our memories take shape, the cultural context of city and understanding landscape gain importance as mental facts. In spite of being incomprehensible, time induces resistance in human so as to increase human's tendency to control and dominate it. The mechanisms of such a control create the need to preserve (keeping or stopping time), to accumulate, and also for projection manifesting themselves in the form of such mechanisms as "memory," "retention," "mental accumulation," "dream," "mental scenarios," "ideal," "desire," etc. in human life.

The issue at hand is how the importance of collective memory can be brought up by landscape design in the quality of life, physical quality, and urban landscape. In certain cases, the site needs to be observed by a close encounter and its residents need to be interviewed. In other cases, palimpsest tools are employed considering the urban history. Any urban space in which an event has occurred and even all symbols and elements constituting urban spaces are the places for the accumulation of our collective memories. What matter here is to identify the elements, symbols, and criteria associated with collective memories by which factors of identity, sense of place, and attachment to the residence and urban spaces can be preserved, reinforced, or created in landscape design.

The physical environment of city as the resource and the symbols of mental images and memories are especially formable. Every individual becomes attached to city given the memories one has from the urban landscape. Therefore, identifying the factors leading to the creation of memories and the relationship between urban landscapes and mental perceptions are essential ignoring which causes a cultural break. The relationship between mental perceptions, as a constant thing, and the physical structure of city, as a variable thing, creates a balanced space between city and collective memory causing people to partake in it. Hence, the urban landscape can function as a context for the formation of collective memories and the mental perceptions of its users. What matters is to identify the factors creating collective memories and its durability in environmental aspects and that whether adopting them in landscape design can prove to be effective in maintaining and enhancing cultural coherence, attachment to residence, and urban spaces. Thus, this can also improve urban landscape quality.

Materials and methods

Given the information obtained from previous research and the identification of the scope of study, certain methods were selected to achieve research objectives. Landscape is analyzed and perceived using all human senses. There are two approaches for landscape analysis, namely descriptive and perceptive. The emphasis, in this study, is placed on landscape analysis on the basis of people mental structures. Interviews were conducted in order to find out what existed in the minds of users of the space. In this regard, the landscape analysis method (using interviews and questionnaires as tools for identifying people's mental perceptions of the urban landscape as well as finding out the factors creating collective memory) was adopted. To conduct the interviews, local residents who lived in the area under study (Tajrish neighborhood) and were familiar with the history of the neighborhood were taken into consideration. Snowball sampling was used for identifying them

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Considering the landscape analysis method being perceptive and mental, six images from memorable spaces of Shemiran were prepared at first to begin working with the questionnaires. Given the studies carried out, certain components were then considered for each image in order for the viewers to score them given the impression they receive from each image (1=strongly disagree, 2=disagree, 3=no comment, 4=agree, 5=strongly agree). In doing so, the images were black and white so that visual beauty would not influence the viewers and they would answer the questions bearing in mind what the images are associated in their minds and merely through their impression of the space. The questionnaires were distributed among 30 persons who were at least 30 years old. According to the results, the factors affecting the mentalities were extracted.

Results and discussion

Given the studies and the information obtained through interviews with the sample population, a mental map was obtained for the residents of Tajrish neighborhood (Figure 1). The map shows indeed that natural, artificial, and mental elements leave durable effects on people's minds each in its own specific way. Depending on the conditions of the time and place in which a person lives, certain components are of importance. The existence of the factors can cause durable memories with attachment to place, formation of new memories, and cultural coherence.
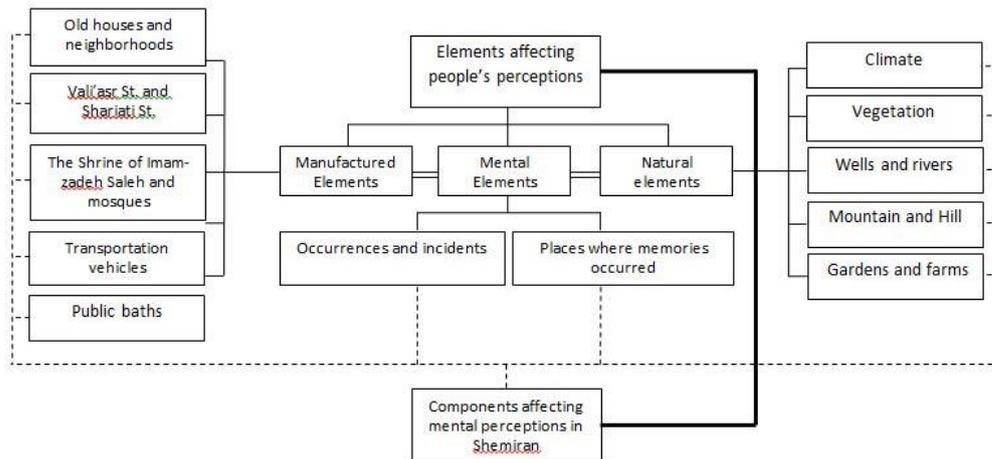

Figure 1. Mental map of the components affecting mental perception in Shemiran

On the other hand, given the analysis of the results of landscape scores, we obtained the effectiveness of each of the components on mental perception in the urban landscape of Tajrish neighborhood. On this basis, the elements and symbols existing in the landscape leave the greatest positive effect on mental perceptions compared with other factors. The most important components are gardens, buildings, and old streets with their specific vegetation with 100%, alleys within gardens with 96%, and rivers with 93% of effectiveness. In this respect, Rachel Gould and Chokor respectively consider historical symbols and pay attention to public demands as well as the symbols they have in their minds to be among the most important issues for perceiving urban landscapes. In Belanger's view, places as historical neighborhoods can be replete with symbols. This leads to the creation of collective memories that their results are the development of common values. The next factor that its components play an important role in landscape perception is attachment. This prefers a certain landscape over another with 88%, the feeling of happiness therein with 74%, recalling memories by visiting the place with 67%, a feeling of nostalgia with 54%, and convenience with 53% of effectiveness. These had the greatest effect on people mental perception and demonstrated an attachment to that landscape given the collective memories shaped in urban landscapes. In the discussion about collective memories, the last factor affecting mental perception of the space is social relations. This causes what happens to the landscape in future to be of great importance to all residents with 92% of effectiveness. Social relations take shape in spaces where there are interactions and relationships among people. In this regard, Schwartz considers the role of open spaces very important in improving the life of citizens and increased probability of memories being formed.

Conclusion

The methods adopted in this study help find a mentality in people that articulates past memories and can be utilized to arrive at a social relationship between culture, environment, and landscape at the present time. This trend brings about a mental network of public perception regarding the environment and the landscape where they live the memories are mentally valuable even if no objective symbol has remained in over the years. According to the results, collective memories are directly related to a number of factors including identity and culture, memory and time, social memories, palimpsest, urban landscape as well as its constituting elements. In view of the context in which the memories have taken shape, taking these relationships into consideration leads to the identification of mental factors and criteria that have enormously contributed to the formation of collective memories. Finally, the elements and components were obtained that were employed to achieve the best pattern to perceive the urban landscape (Tajrish neighborhood). Considering the achievements of this study and the characteristics of the site, propositions are put forward. Use of the propositions can play a significant role in increase of landscape quality, attachment, preservation of past memories, and formation of new ones in similar sites:

1. Use of elements and symbols that are effective on the formation of memories and mental perceptions. These are including use of elements such as plane tree, creation of spaces resembling fruit gardens of the past, creation of spaces for enhancing people socialization, planting plane trees in a row like Valiasr Street and the creation of a relationship between the landscape of mountain and river, use of watercourse as a natural element in design instead of hiding.

2. Creation of spaces for social interactions: These are including creation of social-gathering spaces and hangouts, creation of spaces for holding national and religious ceremonies, creation of spaces for holding seasonal exhibitions and events that attract families to urban spaces, use of appropriate urban furniture.

3. Enhancement of natural context: these are in view of the natural context of the site, considering the slope, height difference of surfaces, and the vegetation used in design, embedding a pool that initially purifies the collected runoff to some extent and then directs it toward the watercourse.

4. Enhancing the aesthetic quality of the landscape: these factors are including special attention to visual disturbances in order to alleviate them, designing passages and stoppage locations in a way that the users of the space would be in a direct relationship with different spots and landscapes, use of floor coverings with local materials that, while visually beautiful, enhance perceptive beauties owing to the past memories, demonstration of the beauties of religious, social, and natural landscapes through the presence of people and social activities in urban spaces.

Giving the possibility to the presence of pedestrians in urban spaces: Creation of theme gardens (holiness garden, light garden, secret garden, social garden, and serenity garden) based on the past events as well as people spirits and mentalities.

Wastewater Reuse, an Opportunity to Expand Nitrogen Discharge Permit Markets

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Expanded Abstract

Introduction

Water quality trading (WQT) is an economically incentive-based strategy that focuses on finding the optimal discharge permit market for surface water quality management. The amounts of traded discharge permits determine the interactions of emission sources in the market. Pollutants that are able to provide extra permits can satisfy the demands of other participants for credits. Finding appropriate permit sellers and buyers depends on their marginal costs, enthusiasm for participating in the market and the impacts on the quality of checkpoint for waste load allocation (WLA). It was recommended that the feasibility and cost-effectiveness of WQT should be analyzed in advance for practice. This needs to estimate the projected loads, environmental standard limits, the incremental and total abatement costs, and finally to optimize WLA. In addition, the assignment of total maximum daily loads (TMDLs) is required. This can be carried out through the simulation methods. However, TMDLs and WLAs with focus on limiting total nitrogen (TN) may be different to the phosphorous or biochemical oxidation demand (BOD). Therefore, the outcomes of WQT may be dependent on different factors such as the spatial location of pollutants, discharge loads, river self remediation, and economical and environmental conditions. All emphasizes on this fact that WLA using WQT requires analytical studies in different cases. This research primarily aims at finding the optimal WLA in the downstream of Sefidrud in which the trading discharge permits (TDP) based on TN may qualify the pollutants for market interactions. It intends to assess the feasibility of WQT policy and compares the analytical results to the case of Gharesoo River. Finally, the effectiveness of integrating wastewater reclamation with TDP is introduced as a solution and compared with the results of Gharesoo River.

Materials and methods

The study area is limited to the downstream catchment of Sefidrud in which it starts at the spillway of Sangar Reservoir at headwater. This ends up to the Caspian Sea after 55 km length. Here, the main pollutants are identified as domestic, agricultural and industrial sources. This area receives the effluents of 10 point sources and rice farm lands. The flow rates and the projected TN load (kg/day) discharged to the surface water are estimated using the export coefficients, typical concentrations of TN and the statistical reports of their discharges as for the Gharesoo River. These were simulated by Qual2kw and the terminus point is the checkpoint. TMDLs are calculated by limiting TN to 4.5 mg/L at checkpoint. The impacts of discharge load reduction incurred by emission sources are also determined through the sensitivity analysis and normalized as previous studies.

This research addresses the feasibility of nitrogen discharge permit market in Sefidrud and compares its effectiveness to the Gharesoo River. For this purpose, in the first scenario, the outcomes of conventional TDP policy are calculated and in the second scenario, its integration of wastewater reclamation market is examined.

Results and discussion

The simulation results reveal that the concentrations of total and organic nitrogen can be reduced from 10 and 6.6 mg/L at checkpoint to 4.5 and 1.4 mg/L, respectively. This is conducted using the TMDL policy. This

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improvement may totally cost 70 billion Rials in a year in the catchment. In this regard, if the wastewater treatment operators appropriately use the secondary units, it can be expected that the classification of river based on water quality index promotes one degree.

In order to study the feasibility of conventional TDP, the WLA is determined using the typical procedure outlined by previous studies. Allocation of abatement duties to the pollutants with lower marginal costs as permit sellers may decrease the annual TN abatement costs about 1340 million Rials. It only saves 2% in comparison with TMDL approach and may not receive significant outcomes. In contrary, the results of TDP in Gharesoo River approved its economical efficiency. Here, total savings may exceed 35%. This is discussed as a matter of difference in the total nitrogen discharged between the domestics and agricultural users. The ratios of nitrogen loads in domestic effluent to the agricultural drainage are, respectively, 0.58 and 0.71 for Sefidrud and Gharesoo Rivers. This ratio is introduced as an index to compare the feasibility of nitrogen discharge permit market. Since the point sources are typically assigned as permit sellers to supply credits for non-point sources, this index may imply that whether the trading has sufficient permits. Studying these two cases for nitrogen permit market indicated that in lower ratios, the market may find more limits to supply credits. In this regard, it is concluded that the success of market does not rely on the expansion of catchments. It mainly depends on the existence of centralized point-sources and the agricultural land uses. It is also confirmed that the balance between permit demand and supply is the key of a successful trade.

In the second scenario, this study introduces an integration of TDP and wastewater reclamation market. This intends to find an economical solution to increase the credits for trading. If the reclaimed water is used for irrigation of crop lands, about 15 credits may be added to the conventional trading. In addition, the necessity of nitrogen removal would be reduced. This is due to the fact that the agricultural users require the nutrient contents of reclaimed water and simultaneously domestic wastewater treatment plants prefer not to remove nitrogen to sell their effluents with higher values. Consequently, marginal nitrogen abatement costs are dramatically reduced. In this regard, total cost savings would be increased to 57% and 63% in Sefidrud and Gharesoo catchments, respectively. It shows that the integration of markets not only provides more flexibility to the system but also makes markets promising as an economical solution.

In the first scenario, the primary price of permits can only be determined on 150 thousands Rials. Some stakeholders and dischargers may lose their economical incentives for participation in TDP. As a result, they would leave the market and make the predicted interactions fail. In order to increase the robustness of conventional market, it is recommended that point-sources should use discount factor about 15 to 25% for credits. In this condition, the equity in benefits may increase and make market more stable. However, the shadows of unstable and breakable market turn this strategy into a challenging solution. Therefore, in the second scenario, the integration market is introduced. Regarding the analytical results, it is understood that market would be changed into a more flexible strategy that no longer is dependent on the permit price for stability. In contrary to the first scenario, the point sources are not obliged to use the discount factor. However, they would freely reduce the permit price to increase the economical incentives of the permit buyer (non-point source). It is claimed that in this scenario, the permits can be sold about 99% cheaper than the first scenario and simultaneously all sellers may use the maximum benefits obtained. These results have similarly been achieved in Gharesoo River as well.

Finally, it can be discussed that using the integrated reclaimed water and discharge permit market depends on the capabilities of wastewater treatment plants to supply permits enough in regard. In other words, a highly populated city is required in the study area to provide the secondary treated wastewater and its related permits for the integrated market. Therefore, some recent studies have introduced approaches in which they may find further flexibility and economical savings in the market. For example, using artificial aeration is recommended for small areas with permanent streams in which the dissolved oxygen and BOD concentration are the major quality problems of water. Here, the integrated market is able to fill the blanks for nitrogen control and reduce more abatement costs. The second approach is to identify the amounts of tradable permits through index like dissolved oxygen where multiple pollutants such as BOD and nitrogen have to be controlled simultaneously. For example, the dischargers who are not able to provide nitrogen limits should abate more BOD in their effluents to address DO limits instead. In TDP program, this approach can increase the flexibility for pollution abatement but has high uncertainty and complexity. This is recommended to be used only in small areas with limited non-point sources. Meanwhile, the integrated market can be associated with this approach and increase its outcomes. Third approach points to the fact that in trading between point-non point sources, the seasonal demands and supplies should be considered. Therefore, in large watersheds with high non point sources, using seasonal WLA may reduce the overall abatement costs and increase the equity. However, this depends on that wastewater treatment plants should be practically able to obey various WLA policies through different seasons. Consequently, designing operationally flexible tertiary treatment units is a key factor for successful seasonally integrated discharge permit and reclaimed water market. Therefore, it can be outlined that the integrated market can be

combined with different technical or management based approaches but needs to be studied in advance. The selection of optimal alternative and also permit pricing mat require an analysis based on game theory approach.

Conclusion

This study concluded that water quality trading strategy is not necessarily an efficient and promising practice to manage all surface waters. It depends on how much stakeholders attain economical benefits to participate in this voluntary strategy; otherwise, it would be failed. In this case, for nitrogen discharge permit market, it is recommended that the reclaimed water is used for irrigation with high content of nutrients. Therefore, the obligations to high nitrogen abatement and its management costs would be decreased. This makes the conventional market change into a more flexible strategy that is almost independent on primary permit price. As a consequence, the market shape turns into a free interaction with the lowest monitoring requirements. However, it requires further studies to analyze the details of interactions with respect to the variations of permit demands in time. In addition, the combination of different qualitative parameters such as BOD, TN and DO may change the economical outcomes.

Evaluation of the Effects of Range Management Using SHE and Diversity Indices

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Expanded Abstract

Introduction

The complexity of natural ecosystem, as the rangelands, is caused to propose the different approaches to evaluate the ecosystem on the basis of sustainable and systematic management. Study on the interaction connections between plants and biotic and abiotic factors in the rangeland ecosystem can be achieved by relations of managerial strategies in order to conduct the rangeland health. Vegetation cover, however, is disturbed based upon biotic (e.g. Climate, light, altitude, slope, and so on) and abiotic (e.g. Human and livestock) factors. If the animal disturbances continue to regressive position, ecological equilibrium and vulnerability of the ecosystem will be more changed. Overgrazing of animal affects on vegetation structures, declines the organic matters, destroys the soil and creates the erosion, increases the runoff, decreases the infiltrability, and finally decreases all kinds of diversities and richness of species. Moreover, it will also decrease the life support system such as soil, medicinal plants, producing water and oxygen and so on.

Albeit animal productions from the rangelands have highly important values, lack of desirable grazing management policy can be caused to go down the drain of biodiversity in a given area and to decrease more diversity around the water sources in the rangeland where it is called a critical area in the Range Sciences. It is claimed that with increase of the distance from the water sources and decrease of animal grazing, the species diversity, vegetation cover, vertical vegetation structure, palatable perennial grasses and forbs will be increased while the annual species will be decreased. Notwithstanding, new approaches of livestock grazing can make for the regressive species diversity. It means that omission of the grazing from the ecosystem will be decreasing in the species richness and diversity. Hence, as a vegetative management, sectional exclosure of the rangeland can make opportunities for palatable species to increase. Based upon researched data, long-term exclosure increases the palatable and native species, but it also decreases the variability of species similar to grazing areas.

Vegetation cover is the main component of biodiversity and is the key element in the rangeland function (such as production and stability). Nowadays, many researchers endeavor to evaluate the economic approaches. On the basis of the ecosystem reality, they have been considered by scientists more than ever in the species diversities, such as alpha, beta, and gamma. The alpha diversity, based upon Whittaker's definition, refers to the diversity in a given area which is generally obtained by the number of species (like species richness). If the changes of species diversity between some sites are the target, hence, the beta diversity will be achieved that is defined based upon the total amount of species at each site. The gamma diversity, however, refers to the whole amount of species at total sites in a region.

The biodiversity conservation can be obtained by drawing of the patterns and structures of the species diversity in term of the environmental changes. For instance, if the beta diversity in a given area is high level, it shows the heterogeneous habitat and it, therefore, needs separately managerial strategy. Many studies have been carried out about the patterns of species diversity with regard to gradient of environmental changes and more time focused on precipitation gradient. However, there is less studies about the effects of biotic factors, e.g. the livestock grazing, on the changes of species diversity. The research of Jouri et al. (2015) in the northern aspect of Alborz rangeland showed that the beta and gamma diversities in the Ramian rangeland were the fair condition, because of good condition of rangeland. While the rangelands of Javaherdeh and Masooleh had high levels of the alpha diversity, because of their fair condition of rangelands.

Since the alpha diversity of the species is divided into two different components such as richness (S), which mentions to the number of species in the sampling unit, and evenness (E), which refers to the distribution of the

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species individual in the sampling unit; these elements can be mixed to determine the proportion of each component which is called the SHE index. The SHE index is a simple way can be obtained based upon the diversity index of Shannon (H) that is established by Information Theory and is made feasible to determine the spatial and temporal changes of plant species. Some researchers have used this method in their studies such as investigation of the species diversity in the marshland of Carolina state, coral cliffs of shoreland, and even for archaeological studies.

Unfortunately, in the past three decades, the progressive degradation of the rangelands in Iran, because of overgrazing, is experienced unbalance in the ecological equilibrium of the rangelands. In such cases, this disturbance activity was analysed by means of the species richness and diversity, but it is not surveyed by the objective interpretation, from all kinds of diversities such as alpha, beta, and gamma or SHE index, in a field area. For instance, some studies were mentioned to the proportion of the richness component in term of the evenness index in the Mahoor rangelands of Mamasani. Another study indicated that the evenness in term of richness index have some proportions of diversity and noting else. The current research, however, has endeavored to show an objective interpretation of the diversity in the Polour rangeland close to Damavand summit.

Materials and methods

Three sites including long-term exclosure, key (is around Lar Dam and is known as Meli Park of Lar; it is 7 km far from the exclosure area), and grazing areas (it is 2 km far from the exclosure area and between the two sites) were selected. A 64 square meter grid was selected in each site where 1 square meter plots were mosaically established side by side. This grid was proposed by Adler et al (2011) who believed this method can reduce the statistical error by way of diverse calculation in rows and columns. Cover percentage, density, and frequency of each species were then recorded in each plot. It is necessary to be told that the three sites had same geomorphological and topographical conditions such as flat area. Hence, this omits the interference of runoff or moisture and organic matter gradients. The rangeland condition of each site was obtained by the Daubenmier method in six classes such as excellent (81-100), good (70-80), fair (50-69), poor (30-49), very poor (11-29), and unusable (0-11). The rangeland trend was achieved by the Trend Balance method as well.

The Alpha (Shannon index; $H' = \sum_{i=1}^{s} P_i Ln P_i$), beta ($\beta = \dfrac{S}{\alpha} - 1$) and gamma ($\lambda = \alpha + \beta$) diversities using Whitaker index, richness (Margalef index; $R_i = \dfrac{S-1}{Ln(N)}$), evenness (Sheldon index; $E = \dfrac{e^{H'}}{S}$) indices. SHE ($H' = Ln(S) + Ln(E)$) analysis were calculated in each plot using PAST software for both sites, including rows (which has been prevailing 8 rows) and columns (which has been existing 8 columns as well). Comparison of the three sites and grouping of them was respectively carried out by one way ANOVA and Duncan methods using SPSS v.22 software.

Results and discussion

Results showed that the exclosure site has the excellent range condition with 86.34 scores and equal rangeland trend. The key site has good condition with 79.91 scores, which is going to be the excellent rangeland condition and the area has positive range trend as well. The grazing area, however, has the worst condition (poor) with a 31.25 score, which is going to be a very poor condition in rangeland, and regressive range trend as well. On the basis of the ANOVA analysis, three sites have a higher difference in p<0.01. All diverse indices were high level in the key area while the diverse conditions in other sites were closely similar. Ironically, the grazing area has had more alpha and gamma diversity than the long-term exclosure area while this site has more beta diversity than the grazing site. However, the rate of all diversity indices was so less in order that the maximum level of the diverse rate was 2.477 (from gamma diversity of the grazing area). One way analysis of the SHE condition of the three sites indicated that they are also highly different from each other. The SHE analysis also represented that contribution to the diversity and richness in the key area was more than two other sites. However, the evenness condition of this site was similar to the subtractive trend of the exclusion area. The key area has high level of H diversity and LnS (as species richness), notwithstanding, this site has a quiet line oblique direction to decrease. It is obvious that the area is going to experience uniformity of species richness and diversity because the long-term grazing condition can be conducted it to homogeneity of the species and can be reduced of the species richness and diversity. The LnE and LnE/LnS rates also indicated that the exclosure site has the most LnE (evenness condition of plant spcies) and LnE/LnS on the site. The key area has the highest level of the LnE and LnE/LnS rates after the long-term exclosure area. The grazing site, as usual, has the worst condition about this matter. The rate of diversity in the long term exclosure was the least one and less than 1.5 unit while the richness was the higher level. With increase in the samples (it certainly log of the sample number in the abscissa), the changes gradient of the diversity and richness also increased while the log of samples numbers reaches to 8, this change

was going to constant form. However, it should be said that this change was not much enough because it, for the diversity, changed from 1.38 to 1.7 unit and the same way was observed for the richness index. Regarding to increasing trend of the richness and diversity, the evenness index was also decreased with a high gradient change. Finally, it was come along a quiet declining gradient. The curve of richness and diversity in the grazing area, however, had a sudden arising in the initial samples and it was stabilized in the 5.8 unit. On the other hand, the grazing area in respect to the long term exclosure needs less samples to reach the highest level of the diversity and richness. This period was observable because it changed from 1.6 to 2.4 unit in this low distance. Although the declining trend of the evenness index in the long term exclosure was less and its beginning was in the unit 3, it was happened apace in the grazing area from 2 to 4 unit. As a comparison between two mentioned sites, the long term exlosure area has more evenness that it can continue to subtractive trend and less than 1.1 unit. The SHE analysis in the key area was in a different mood. The diversity and richness indices in this site was the highest level in relation to two other sites and it started a quiet gradient from initial samples to the high level in the uint 8.5 while the evenness index was the highest level with regard to other sites and with a quiet gradient to decline.

Conclusion

Optimal condition of ecological management was falling out the key area where it was going through grazing capacity and time entrance of livestock. The grazing site did not manage the rangeland and the long-term area must terminate the excluding to improving of rangeland condition and trend as this site going toward a unique cover of few species which can make fragile the site. On the other hand, this site with long term exclosure have been formed by a few species (such as *Agropyronelongifromis*) and the grazing land has also been covered by some species because of high pressure of livestock grazing as it can be observed overstocking in this area by ranchers. Overgrazing of the site has omitted many palatable plant species, which are native to these areas, and have put back by many less-palatable and unpalatable species. They are savoury to the livestock. As a matter of fact, many palatable and native plant species are getting clear of the area because of over ranching and less monitoring of them by Natural Resources Administrative experts. All at once, it can be said that the rangeland evaluation can be achieved by means of forming components of diversity indices (SHE) and other diversity indices such as alpha, beta, and gamma indicators.

For the most part, it can be said that by the SHE analysis, which refers to components of the diversity index, all kinds of the diversities indices (alpha, beta, and gamma diverisities) can evaluate the rangeland ecosystem well. The SHE analysis can also interpret the spatial and temporal changes of the diversity, richness, and evenness which can be used to elucidate the ecological condition of the rangeland ecosystem. In the current study, the most desirable ecological condition was found in the key area where the time of livestock enterance for grazing and the capacity grazing have been observed. The grazing area has the least diversity and richness and it then has not had well management. The long term exclosure also needs to be rehabilitated with light grazing strategy. On the other side, all sorts of diversity indices, which have been applied in this research, can draw an objective figure from the reality of the rangeland area. Therefore, it can easily make the rangeland ecosystem condition using SHE and diversities analyses.

Development of the Climate Change Education Plan in Formal Education Based on Educational Process Management in the ISO 10015 Standards

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Expanded Abstract

Introduction

Climate change is a change in the statistical distribution of weather patterns when it lasts for an extended period of time. Climate change may refer to a change in average weather conditions, or in the time variation of weather around long-term average conditions. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as global warming.

Shifting temperatures are climbing and sea levels are rising. And meanwhile, our planet must still supply us and all living things with air, water, food and safe places to live. If we don't act now, climate change will rapidly alter the lands and waters we all depend upon for survival, leaving our children and grandchildren with a very different world.

The most important task of all countries in the face of climate change is to make efforts to reduce climate change and spend more time to anticipate and prevent its risks. The efforts and actions can be done in the current situation are including natural resource conservation, development of green spaces, reduction of power consumption of fossil fuels, saving in consumption, recycling and reduction of waste, sewage treatment, use of renewable energy sources and implementation of appropriate educational programs. The remarkable thing is that these actions by the government alone cannot be done and, thus, all persons in any country should play their role. This requires environmental education in the field of climate change for people to deal with these issues correctly. Thus, in last decade in various countries, study has been done in the field of education to climate change. But reviews of these studies, particularly in Iran, shows that adequate studies have not yet been done to educate climate change in the educational system. Therefore, the purpose of this study is development of the climate change education plan in the formal education system.

Materials and methods

Iran formal education system: educational system of Iran is comprised of three sections. These three sections include formal, informal and implicit. In this study, the third grade of the first period of high school is considered as a case study to develop a climate change education plan. Education in the educational process management in the ISO 10015 standard is in four steps; needs assessment, educational designing and planning, implementation, and evaluation. In the Figure (1), the educational process management is represented according to ISO 10015 standard.

Figure 1. Educational process management in the ISO 10015 standard

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Results and discussion

As mentioned above in this study, climate change education plan for third grade of the first period of high school is developed based on educational process management in the ISO 10015 standard. Education in this system in four steps includes; needs assessment, educational designing and planning, implementation, and evaluation of results.

Needs assessment

The results show that, the most important educational needs, which are obtained with Fish Bowl technique, as follows are; introduction of basic concepts, current state of climate, climate change causes, effects and impacts, solutions and strategies for prevention, and mitigation and adaptation to climate change (Table 1).

Table 1. Needs assessment of climate change education is for the third grade of first period of high school

Rows	Needs assessment
1	Introduction of basic concepts
2	Current state of climate
3	Climate change causes
4	Effects and impacts
5	Solutions and strategies for prevention, mitigation and adaptation to climate change
6	The relationship between climate change and different aspects of sustainable development

Educational designing and planning

Educational designing and planning was done in the five steps, which the goals are: Development thinking about the climate change, increase in student knowledge in this field, training of appropriate personnel to manage climate change.

Table 2. Educational designing and planning is in separation steps to climate change education

Rows	Steps of Educational designing and planning	Results
1	Goals	-Development thinking about the climate change, -Increase in students' knowledge in this field -Training appropriate personnel to manage climate change
2	Educational analysis (behavioral objectives)	-Students are acquainted with the climate, and they can explain balance in the temperature, greenhouse gases and energy. -Students can explain climate change and its causes. -Students can explain the effects of the climate changes. -Students can explain the solutions to reduce the impact of climate change and strategies for adaptation to the change.
3	Selection and organization of educational content	-Understanding basic concepts about climate, climate factors and the difference in weather and climate -Understanding the greenhouse effect and greenhouse gases -History of global warming -Study about natural and human factors of global warming -Effects of climate change on humans and natural environment
4	Determining patterns of learning and teaching.	-Basic patterns of teaching -The pre organizer pattern -Problem-Solving pattern
5	Selection the training methods and techniques	-Educational methods: memorizing and repeat, lectures, tutorials, educational media -Participatory methods: Questions and Answers, practical demonstration, role-playing, group discussion, presence in the environment

In the implementation of education, teacher is operator training and the Ministry of Education is in the form of Education Office and schools can support teachers in monitoring the implementation. In the evaluation step, the teacher in addition to the evaluation of classroom sessions should do a final evaluation. Thus, the evaluation should be a combination of formative and final assessment, which recommended the use of goal oriented Tyler pattern.

Conclusion

Accurate knowledge about the effects of climate change is essential as a key factor for conscious action and the formation of a person's determination to deal with the effects of climate change.

Studies from around the world have observed an unfortunate chain of students not being given an adequate and accurate education on climate change, of teachers not knowing how or what to teach, and of the public that is misinformed about these issues. The structure proposed in this study to climate change education determined the contents that require students to do need assessments. This is based on educational designing and planning. Therefore, the teachers with use of educational designing and planning and on the job training increase their knowledge in this field and it will teach the students.

Keywords: climate change education, formal education system, ISO 10015 standard, environmental education, climate change.