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Investigating Wastewater Treatment in MBRs Using Computational Fluid Dynamics

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Extended Abstract

Introduction

Membrane bioreactor (MBR) is an effective technology for wastewater treatment and water reuse which is becoming increasingly popular due to its numerous applications and advantages in conventional activated sludge process. This novel technology have advantages of small footprint, high concentration of mixed liquor suspended solids (MLSS), high removal efficiency of chemical oxygen demand (COD), less production of excess sludge and to be reliable and simple for operation. Membrane fouling and its consequences, regarding plant maintenance and operating costs, has gained attention in the recent years as a major obstacle for development of this technology. Various methods have been used to reduce membrane fouling and new solutions are also frequently proposed and used.

Among different operational variables, aeration is the most effective factor on membrane fouling mitigation. Despite its major role in membrane fouling reduction, the energy consumption of aeration is the main operating cost for MBRs, such that approximately 30-50% of consumed energy in a submerged MBR is used for aeration. Hence, operation improvement by optimizing hydrodynamic conditions has a high technical and economic significance.

Computational fluids dynamics (CFD) is a powerful tool for understanding the relationship between hydrodynamics and fouling in MBRs. Researches have been conducted to assess hydrodynamic and its effect on the system efficiency. Most of design, operational and geometrical variables, like bubble diameter, membranes distance, presence of baffles and walls in flat-sheet modules require evaluation and optimization. Membranes are mostly assumed to be rigid in CFD simulations of MBRs.

In this study, effects of hydrodynamic characteristics of a submerged membrane bioreactor on membrane fouling were investigated using computational fluid dynamics simulation. The effects of hydrodynamic characteristics on fouling in an airlift MBR was also investigated using CFD simulation. Three-dimensional two and three-phase simulation was implemented using Eulerian approach and k-ε turbulent model. Results indicated that by increasing air flow rate and MLSS concentration, shear stress on membrane surface increase and membrane fouling decreases. Furthermore, effect of considering population balance model in simulation was also studied. In addition, the results also indicated that using granular model in three-phase simulation would lead to a more realistic simulation results. Simulation results were in good agreement with experimental data which demonstrate the ability of this CFD approach and population balance model as an efficient tool.

Materials and Methods

Experiments were carried out in a submerged membrane bioreactor which is 70 cm in height, 23 cm in length and 21 cm in width with operating volume of 20 L for activated sludge. A flat-sheet chlorinated polyethylene membrane with mean pore size of 0.45 μm and effective membrane area of 0.11 m^2 was used. Two baffles were located at both sides of membrane. The required air was pumped through a sparger located beneath the membrane, and its flow rate was measured using a flow meter. The biomass was obtained from a municipal wastewater treatment plant in Tehran, Iran. The driving force for filtration was created by vacuum. In all experiments, the system was fed by a synthetic influent, glucose, ammonium sulfate, and ammonium phosphate

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which are the sources of carbon, nitrogen, and phosphorus, respectively. The tests were carried out at four different air flow rates of 0.2, 0.4, 0.6 and 0.8 m^3/h and at two MLSS concentrations of 8 and 12 g/L. The permeate flow rate, MLSS concentration and membrane resistance were measured. Total gas hold-up was also estimated by visual determination of bed expansion.

A three-dimensional two- and three-phase model was used to investigate the hydrodynamics of the MBR. In order to describe liquid and gas properties in multiphase flow, an Eulerian-Eulerian approach was implemented. The standard k-ε turbulent model was used for phases to model turbulence. A fine mesh was generated between the membranes. However, to decrease the number of computational cells, only a quarter of the set-up was considered as the simulation domain due to the symmetry from both sides. The projected area of the air spargers at the bottom of the system were considered as the air velocity inlet boundary condition. The boundary condition at the top of the MBR was set to open to atmosphere in order to let the air exit to the atmosphere. A bubble size distribution with ten bubble classes and the possibility of coalescence and breakage was also used in some of the simulations. In this work, phase-coupled simple with pressure based solver was applied for the Eulerian multiphase simulations. The velocities were solved coupled by phases, but in a discrete method. This method solves momentum and pressure based on continuity equations simultaneously, thus the rate of convergence is improved compared to the segregated method which solves the governing equations sequentially.

Results and Discussion

- The effect of bubble size distribution in MBR

Due to importance of bubble characteristics and their distribution in bioreactors, a simulation was performed to employ the bubble size distribution, based on experimental data. MBR was simulated at TMP of 40 kPa, MLSS concentration of 8 g/L and in four different air flow rates of 0.2, 0.4, 0.6 and 0.8 m^3/h. Thus, up to 10 bubble classes, with the possibility of accumulation and breakage, are studied.

Bubble size distribution in 5 stages of bioreactor was investigated. Results indicated that by increasing the aeration intensity, ratio of larger bubbles increases in the system. After formation of air bubbles at the sparger, their coalescence and breakage occur during their movement towards the free liquid surface and gradual increase of bubble diameter can be observed. Larger bubbles are commonly seen at higher levels, near the membrane surface and the wall. Average bubble diameter from both simulation and experimental results were compared. Simulation results are correlated with experimental data which verified bubble size distribution in simulation. Therefore, a mean bubble diameter was used in other following simulations.

- The effect of MLSS concentration and aeration intensity

In order to investigate the effect of aeration as the main effective factor in membrane fouling reduction, simulation was done at various air flow rates of 0.2, 0.4, 0.6 and 0.8 m^3/h. Gas holdup was measured experimentally and was compared with simulation results. Results demonstrate that increase in the aeration intensity and consequent growth in average bubble diameter causes a greater gas holdup in the bioreactor. Although the growth in the average bubble diameter leads to reduction of the gas holdup due to higher rise of velocity, the overall effect of increase in the aeration intensity and average bubble diameter is higher gas holdup in the system. Moreover, with as increase in MLSS concentration and consequence increase in the activated sludge viscosity, more bubbles are trapped in the riser which leads to more gas holdup.

In airlift bioreactors, flow of air is the main cause of liquid motion and circulation. Therefore, with increase in the aeration intensity, the liquid velocity is increased in both riser and down comer which leads to a greater shear stress on the membrane surface. Furthermore, at higher MLSS concentrations, which correspond to greater liquid viscosity, air and liquid shear rates are increased. However, at lower aeration intensities, change in the MLSS concentration does not make a significant change in the shear stress. This is due to the fact that aeration cannot impose the necessary rate of mixing in the bioreactor and provide the force required for particles movement. Exerting more shear stress on membrane surface in higher aeration intensity leads to a decrease in cake formation on membrane surface and membrane fouling resistance.

The gas shear stress contours on membrane surface at various air flow rates was also investigated. It was seen that a greater shear stress is exerted on the surface in the middle and upper half of the membrane which is owing to higher velocity and turbulence of gas and liquid mixture in this region. At air flow rate of 0.2 m^3/h, the maximum shear stress is exerted on a small part of the membrane surface, while by increasing the air flow rate to 0.8 m^3/h a greater surface area is exposed to the maximum shear stress.

- Validation of the model

In order to validate simulation results, gas shear stress and its effect on MBR operation and membrane resistance was studied under different conditions. Results indicate that by increasing air flow rate, resistance reaches its

lowest amount. By increasing aeration intensity stress changes resulting from gas and liquid becomes ascending. It should be mentioned that both stresses influence cake formation and total resistance on surface tension, but it cannot be specifically said which effect is more. Other studies indicate that in constant pressure systems much change is not observed after reaching semi-constant condition. As mentioned before, aeration causes cross flow on membrane in air lift bioreactor and the more aeration causes more flow circulation velocity and lifting force on particles. This leads to membrane resistance reduction. Liquid shear stress changes on membrane surface in different air flow rates and, thus, shows a similar trend.

The gas hold up was also measured experimentally and was compared with the simulation results. It was observed that the simulation results are in good agreement with experimental data which indicates model accuracy and ability of computational fluid dynamics for investigation and prediction of bioreactor hydrodynamics.

The effect and behavior of solid particles distribution

Three-phase simulation was studied in order to approach real conditions and identification of solid particles aggregation. Three-phase simulation was conducted in aeration intensity of 0.8 m^3/h and MLSS concentration of 8 g/L. Average particle diameter was determined by microscopic image of active sludge and image analysis of 6 µm. Eulerian approach was used to model the three-phase simulation.

Volume fraction distribution of solid phase particles of sludge, liquid and air were investigated. Results show that solid particles are accumulated less near membrane and are accumulated more in bottom of bioreactor due to more aeration and liquid circulation around baffles. In order to achieve more uniform distribution of solid particles, air distributor can be placed at the bottom in order to prevent particle accumulation in that area.

Conclusion

A submerged membrane bioreactor was investigated using CFD simulation. A two- and three-phase simulation was implemented using Eulerian approach. In addition, the effect of permeate flux was considered in simulation. Simulation results were validated against the experimental data. From the results reported here, the following conclusions can be drawn:

- By using bubble size distribution, bubbles behavior during their movement in system can be investigated. Results show that bubble size usually increases during their movement from sparger to free surface of liquid and bigger bubbles tend to accumulate near membrane surface and walls.
- By increasing aeration intensity and MLSS concentration in system, the gas and liquid shear stress increases on membrane surface.
- Simulation results were in good agreement with experimental data which indicates model accuracy and ability of computational fluid dynamics for investigation and prediction of bioreactor hydrodynamic.
- Application of granular model in three-phase simulations causes reactor conditions come closer to actual one. Results indicate that solid particles tend to be accumulated more in bottom of bioreactor and less near membrane and around baffles.

Keywords: computational fluid dynamics, fouling, membrane bioreactor, Wastewater treatment, water reuse.

Assessment of As, Cd, Ni and Cr Contamination in Water, Sediments and Fish of Shahid Rajaie Dam, North Iran

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Extended Abstract

Introduction

The pollution of the aquatic environment with heavy metals and trace elements has become a worldwide problem during the recent years, because they are indestructible and most of them have toxic effects on organisms. Potentially toxic elements (PTEs) added to an aquatic system by anthropogenic and natural sources are distributed during their transport between different compartments of aquatic ecosystems, such as water, sediment and biota. The main goals of present study are: 1. to determine concentrations of As, Cd, Ni and Cr in water and sediment as well as their accumulation in fishes, 2. to evaluate contamination and toxicological factor in the river and lake dam sediments and 3. to calculate monthly fish consumption limits for carcinogenic and noncarcinogenic health.

Materials and Methods

Study area

Shahid Rajaei dam is located in 40 Km south Sari City, in the north part of Iran with 160 million cubic meters capacity and approximate catchment of 1244 Km^2. It is constructed on Tajan River and its reservoir is fed by Shirinrood and Sefidrood rivers (in the confluence of these rivers, Tajan River is arisen). It was designed to provide irrigation, drinking, and industrial water for the region. The main activities in this area are agriculture, crop irrigation, and dairy activities. The main human settlements are upstream including Ferim, Afrachal, Ali-Abad, Sekuya villages with more than 10000 habitants as a total. Geological formations in the region in terms of lithology are mainly limestone, dolomitic limestone, sandstone, marl and shale (Fig. 1).

Sampling and analysis

For water quality assessment, 16 water samples were collected from the surface waters including 9 sites along the Shirinrood (Sh-1 to Sh-9) and 4 sites along Sefidrood (S-1 to S-4) rivers and 3 samples from Lake Dam (M-1 to M-3) during two periods (November 2012 and September 2013). The location of the sampling points is shown in Figure 1. The samples were kept at 4°C prior to analysis. Quantities of As, Cd, Ni and Cr were analyzed by ICP-MS in Westlab, Australia. Up to 26 Sediment samples were collected from Sefidrood and Shirinrood rivers and dam lake, using a pre-cleaned stainless steel grab sampler for Lake samples (SR-7 to SR-15) and using a plastic scoop for river samples (SR-1 to SR-6 and SR-16 to SR-26) in October 2012. Figure 2 shows the location of the sampling points. The collected samples were immediately stored in polyethylene bags and air-dried in the laboratory at room temperature. Then, gravel and plant root were removed. The samples were passed through a 63 micron steel sieve. The concentrations of the constituent potentially toxic elements (PTEs) were measured at Zar Azma Laboratory (Iran) using ICP-MS methods. Fish samples, including two species Barbel and L. cephalus of Cyprinidae family, were collected from the Lake Dam. The fish samples were washed with deionized water, packed in polyethylene bags and kept at -20°C, then, transported on ice to the laboratory. Properties of As, Cd, Cr and Ni were analyzed by atomic absorption spectrometry.

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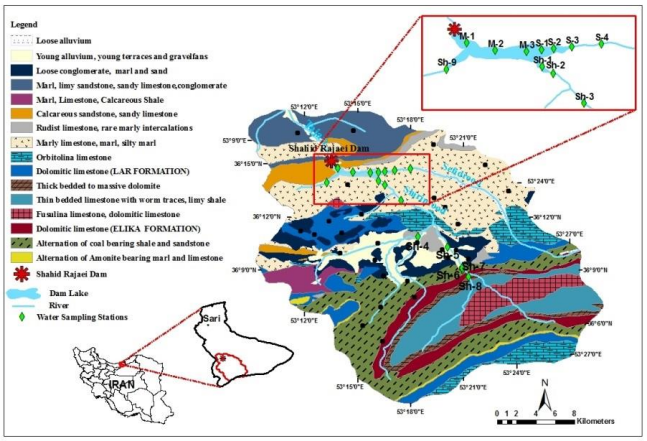

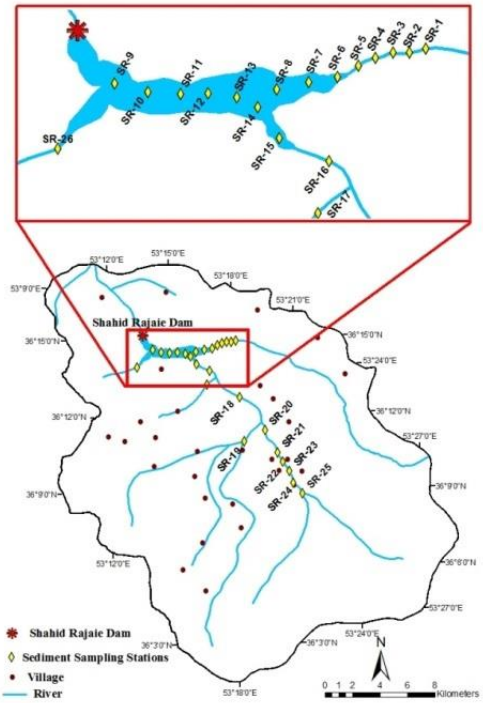

Fig. 1. Geological map of the study area and location of water sampling stations. Fig. 2: Location of sediment sampling stations

Results and Discussion

All water samples are Ca-HCO_3-SO_4 type. The average abundance order of PTEs for water samples in two periods are: Ni >Cr >As >Cd (Table 1). Concentrations of As, Cd, Cr and Ni in all the samples are less than WHO and EPA standard. The average abundance order of PTEs for sediment samples are: Cr >Ni >As >Cd (Table 2).

Table 1. Concentration of PTEs (µg/l) and Major ions (mg/l) in water

	Na^+	Mg^{++}	Ca^{++}	HCO_3^-	Cl^-	SO_4^-	As	Cr	Cd	Ni
Average	19.0	5.3	66.4	200.2	20.9	65.7	0.39	2.2	0.11	7.73
Max	61.5	11.0	123.0	283.7	30.2	177.6	0.81	4.0	0.18	9.85
Min	11.3	3.3	55.0	161.7	12.9	33.2	0.01	1.0	0.07	2.80
WHO	30-60	-	-	-	250	250	10	50	3	20
EPA	50	150	200	-	250	250	10	100	3	-

Table 2. The comparison of As, Cd, Cr and Ni concentration in sediment samples with sediment quality guidelines

PETS (mg/kg)	Cr	Ni	As	Cd
Max	81.05	57.31	10.80	0.80
Min	46.55	27	2.30	0.20
Average	68.13	37.85	7.40	0.41
PEL	90.00	36	17	3.53
Average/PEL	0.76	1.05	0.44	0.12
TEL	37.30	18	5.90	0.60
Average/TEL	1.83	2.10	1.25	0.69
ERM	370	51.60	70	9.60
Average/ERM	0.18	0.73	0.11	0.04
ERL	81	20.90	8.20	1.20
Average/ERL	0.84	1.81	0.90	0.34

The enrichment factor (EF), base of average shale was calculated with Equation 1.

$$\mathrm{EF} = \frac{[\mathrm{M}]/[\mathrm{Sc}]_{\ \mathrm{Sediment}}}{[\mathrm{M}]/[\mathrm{Sc}]_{\mathrm{Background}}} \quad (1)$$

where [M]= total trace element concentration measured in sediment sample (mg/kg) and [Sc]= total concentration of scandium as the reference element (mg/kg). Enrichment factor value for As, Ni and Cr is <2 in the sediment samples (except in SR-20 station) while, the EF value for Cd in 54% of sediment samples were >2 that reveals moderate contamination (Fig. 3).

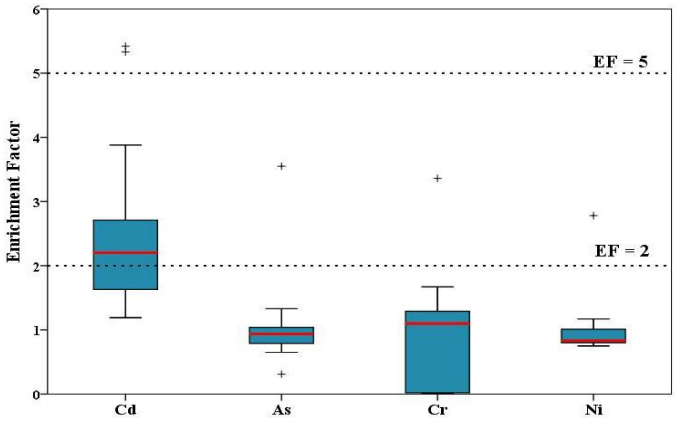

Fig. 3. Box diagram of enrichment factor for PTEs in Sediment samples

The comparison of selected elements concentration in sediment samples with sediment quality guidelines indicate that the average concentration of As, Cr and Ni in the present sediments is higher than threshold effect level (TEL). Nickel shows higher concentration than probable effect level (PEL) and effect range low (ERL) values (Table 2). These sediments based on PELQ (Equation 2) and ERMQ (Equation 3) calculations, for Cr, As, Ni and Cd indicate slightly toxic.

$$\mathrm{PELQ} = \frac{\sum_{i=1}^{n} M_i/PEL_i}{n} \quad (2) \qquad \mathrm{ELMQ} = \frac{\sum_{i=1}^{n} M_i/ELM_i}{n} \quad (3)$$

where M_i is the concentration of element *i* in sediments, ERM_i and PEL_i the guideline values for the element *i* and *n* the number of metals.

The average abundance order of PTEs contents in Barbel fish is similar to water samples, while for L. cephalus fish it is as Cr >Ni >Cd >As. Chromium reveals higher concentration than WHO standard (0.15 mg/kg) in both fish species, while Ni content in Barbel fish is higher than WHO standard (0.4 mg/kg).

To estimate the public health risk of exposure to PTEs through fish consumption, the CR_{lim} for either carcinogenic (Equation 4) or non-carcinogenic (Equation 5) health effects, were calculated.

$$\mathrm{CR}_{lim} = \frac{RfD\,.\,\mathrm{BW}}{\mathrm{C}_m} \quad (4) \qquad \mathrm{CR}_{lim} = \frac{\mathrm{ARL}\,.\,\mathrm{BW}}{\mathrm{C}_m\,.\,\mathrm{CSF}} \quad (5)$$

where CR_{lim} = maximum allowable fish consumption rate (kg/d); ARL = maximum acceptable individual lifetime risk level (unit-less); BW = consumer body weight (70kg); C_m = measured concentration of chemical contaminant m in fish (mg/kg); CSF = cancer slope factor (mg/kg-d);

RfD = oral reference dose (mg/kg-d).

Equation 6 was used to convert daily consumption limits, in kilograms, to meals consumption limits over a given time period (month) as a function of meals size

$$\mathrm{CR}_{mm} = \frac{\mathrm{CR}_{lim}\,.\,\mathrm{T}_{ap}}{\mathrm{MS}} \quad (6)$$

where CR_{mm}= maximum allowable fish consumption rate (meals/mo); T_{ap}= time averaging period (365.25 d/12 mo = 30.44 (d/mo)); MS = meals size (0.227 kg fish/meals).

The RfD values, CSF values, allowable Monthly fish consumption for As, Cd, Ni and Cr are summarized in Table 3.

Based on CR_{mm} value, maximum allowable consumption of Barbel and L. cephalus fishes for carcinogenic health of As is two meals per month (Approximately 0.5 kg).

Table 3. Monthly fish consumption limits for carcinogenic and noncarcinogenic health endpoints and other parameters of PTEs in fish species

Fish species	PTEs	C_m	RfD	CSF	Noncancer		cancer	
					CR_{lim}	CR_{mm}	CR_{lim}	CR_{mm}
Barbel	As	0.0325	0.0003	1.5	0.65	87	0.01	2
	Cd	0.018	0.001	NA	3.89	521	-	-
	Ni	1.44	0.02	NA	0.97	130	-	-
	Cr	1.39	0.02	NA	1.01	135	-	-
Leuciscus cephalus	As	0.035	0.0003	1.5	0.6	80	0.01	2
	Cd	0.04	0.001	NA	1.75	235	-	-
	Ni	0.065	0.02	NA	21.54	2888	-	-
	Cr	0.91	0.02	NA	1.54	206	-	-

Conclusions

The selected elements concentration in sediment samples with sediment quality indices revealed that the average concentration of As, Cr and Ni in the present sediments is higher than threshold effect level. Abundance of some toxic metals in water samples and fishes are similar. This represents that the contamination in water can be transferred into some fish species.

Keywords: Iran, potentially toxic elements, risk assessment, sediment quality guidelines, Shahid Rajaei Dam.

The Role of Agricultural and Residential Land-uses on Organophosphorus and Organochlorine Pesticides Residues in Water and Sediments of Siahrud River, Qaemshahr

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Extended Abstract

Introduction

Non-point source water pollution comes from a wide range of human activities in which input source pollutants are not visible and certain. It is clear that much more difficult to measure and control non-point source pollution from point sources of contamination. In many countries, all types of agricultural activities are considered as non-point sources. In the present days, there are more concerns about using pesticides and its effects on environment and human health and this concern is to some extent that needs the programs for decreasing to use pesticides as a part of the agricultural major strategy and the other uses. The lack of basic information about pesticides in environment is a limitation for determining standard values, so according it setting up the programs for decreasing to use pesticides is possible.

Materials and Methods

Pesticide standards were purchased from Sigma-Aldrich and all reagents purchased from Merck.
The area of Siahrud with its Watershed is over 10070 hectares that placed in Mazandaran province in Qaemshahr city in Iran. The length of this river is 5 km. In this research, sampling was done in three season, summer (August), autumn (November) and spring (May) 2012. For selecting sites, it was used land-use map. Each site was placed between two Land-uses and it was identified 7 site based on it (Table 1). In each site, it was taken 3 water samples, (3 replications) using horizontal water sampler and 3 sediment samples by using sediment core sampler. The sediment samples were taken from the upper 5cm of the sediment surface and all samples were placed in glass containers and were transported to the laboratory.

Table 1. Number, name, Land-use type and location of the sampling stations

sampling site num	Site name	Land-use	Location	
			Longitude	Latitude
1	Seyed Abu-Saleh	Forest	36°26'44.20"N	52°59'49.77"E
2	Kutena	Agricalture & Garden	36°26'29.07"N	52°55'1.23"E
3	Sarukola	Agricalture-1	36°26'27.96"N	52°54'5.34"E
4	Qaemshahr	Residential-1	36°29'19.19"N	52°53'28.94"E
5	The jomeh Bazar Bridge	Agricalture-2	52°55'2.29"E	36°37'26.59"N
6	Sikapol	Residential-2	52°56'6.24"E	36°38'52.38"N
7	Larim	Agricalture-3	52°57'48.07"E	36°46'2.60"N

First, samples were filtered by glass fiber filter with the spores in 0.5 µm. 500 ml was separated from each samples and 50 µlit internal standard PCNB with 5 µgr/lit concentrations added to each of them. For Extracting and pre-concentration of Organophosphorus and Organochlorine pesticides was used solid phase cartridge (TELOS SPE Column ENV 200 mg/3ml model). 500 ml water sample with flow velocity 10 ml/min was passed. Following it the solid phase was dried by sucking air inside the cartridge. Then, the cartridges were eluted with 10 ml of ethyl acetate. The extracts were reduced in volume by N2 blow-down. The last volume was reached 500

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µlit. For identifying and measuring pesticides, it was injected 1 µlit from the last extracted soluble to gas chromatography (GC).

After transferring sediments samples to laboratory, they were put to dry in the Freeze Dryer for 18 hours. Then samples were screened with 63 micro-meter sieve. 5 gr dried and sieved sample with 2 gr activated copper were mixed by using diluted Nitric acid (4%) and 1 gr Sodium sulfate (activated in 120°c for 12 hours). Then, 50 micro liters from internal standard PCNB with 5 mg/lit was added to it and then extraction was done by 100 ml from n-hexane and dichloromethane in 1:1 ratio for 40 minutes in the ambient temperature and in the ultrasonic bath. The upper solution of extracted soluble was separated by filter and for the second time, 60 ml of above mentioned solvent with the same ratio added to residue sediment, and maintained in the ultrasonic bath for more 40 minutes. The extracted soluble was added to the previous solutions and its volume was reached about 10 ml by rotary evaporator (or rotavap) then to 0.5 ml by Gentle stream of Nitrogen. For cleaning up was used florisil that was semi activated with distilled water (wt/vol 6%). 1 µlit of this soluble was injected to GC/ECD.

Identifying organophosphorus and organochlorine in water and sediment samples was done by comprising observed pick inhibitory time in chromatograph obtained from sample and injecting standard soluble. The concentration was accounted by the level below pick of samples than the internal standard and putting it in standard calibration curve equation of pesticides. The obtained LOD values in this method were 2 to 8 ng/lit for organochlorine pesticides and 1 to 5 ng/lit for organophosphorus pesticides in the water samples. The recovery percent of this method for organochlorine pesticides was among 95% to 104% and recovery percent for organophosphorus pesticides was among 90% to 110%.

Results and Discussion

For determining the relation among the forest, agriculture, gardens and residential uses with the concentration of pesticides both in the water and the sediment it was accounted the average 9 concentrations of each pesticide in each station (3 seasons and 3 replicate for each season) it was identified the effect degree of each stations and in turn each uses by statistically comparing these numbers. These relations were significant for all pesticides (excepted β-HCH and Delderin in the water) and in general, there has been an increasing trend for all pesticides (expected β-HCH and γ-HCH) the sediment along the river. As it was mentioned, every station is an agent for one uses that according to it, the results of statistical analysis has been surveyed and provided with any pesticides.

The relation of land-use with the pesticides concentration in the water by surveying relation of use with DDTs concentration (Figs. 2 to 9), it was concluded that the station N.6 related to residential use (Juibar city) has had the highest effect on the concentration of 2,4'-DDD, 2,4'-DDT, 4,4'-DDD, 4,4'-DDT, but the highest concentration increasing observed for 2,4'-DDE, 4,4'-DDE is in the agriculture area (station 5). This use has the most effectiveness area among the other stations and for this reason, the most decomposition and decay of DDTs to DDEs is occurred in this distance whether in the soil of region or in the water and in the sediment and therefore it has been seen more amount of DDE, too. Generally, the concentration of DDE than DDT and DDD is more and for describing this case, it can say when DDT degrades under aerobic conditions by microorganisms, DDE and when it degrades under anaerobic conditions, DDD are the most important compounds which obtained and so the proportion of DDE /DDD can be a good index for deformation of DDT under oxidation conditions that in this research is an indication for being dominant of aerobic conditions in order to degrading DDT along the river.

The relation of use with γ-HCH pesticide concentration is Significant in the water and is not Significant for β-HCH. The most concentration of chlorpyrifos has been 0.174 µg/lit for station 7 in the summer. In station 3 that is related to agriculture 1, it is seen increasing in chlorpyrifos, these changes in stations 4 and 5 is remained Significant, in the station 6, it is seen much more increasing for this toxic that is possibly due to intensive agriculture in the residential area of Juibar and also using this pesticide in the green spaces of city, and it must be noted that established runoff in the residential area than the other uses is much more and the lowest influence and evaporation is occurred in this use and thus in the consumption unit, naturally it has more effect on the pesticide residue in the water and sediment.

Diazinon has high consumption in the region and has the highest concentration among the other toxins both in water and sediment, of course in the summer. The amount of this toxin is changed from average 0.008 µg/l in the first station to 0.900 µg/l in stations 6 and 7. This toxin has the highest consumption in June and July months and the early August. The highest concentration is for summer and station 7 that equals to 1.867 µg/l. The lowest concentration amount observed in the forest Land-use and has had the highest effect on this pesticide concentration in station 6 and then 5. Despite of more consumption in Stations 2 and 3, this increase is not significant that it can be inferred due to the small distance of this stations from each other and less effective area of the region on the river span studied and increasing this pesticide in station 6 is due to urbanism along with agriculture of Juibar city and also it is possible to use diazinon in nonagricultural consumptions in this city.

Edifenphos has the lowest concentration amount with the average 0.212 µg/l in station 1 and the highest amount with average 0.965 µg/l. the highest concentration is observed in station 7 and summer in 1.581 µg/l. EPA of allowable limit of edifenphos was announced 0.17 µg/l in fresh water that is affected on non- pointed contaminations, so considering to it, the amount of edifenphos is more than this allowable limit in all stations.The relation of land use with pesticides concentration in sediment Considering to the results obtained from aldrin has no significant correlation. The concentration of organochlorine pesticides HCH has different trend than the other pesticides in sediment along the river and it can be mostly said had a descending trend. For the reason of decreasing concentration of these two pesticides in the sediment and along the river, it must be considered to the physicochemical characteristics β-HCH and γ-HCH in sediment. The average of β-HCH concentration was between 0.024 and 0.54 µg/gdw and the most high observed concentration for this pesticide was in the summer and in station 1 and 5 were 0.089 and 0.088 µg/gdw, respectively. The average of γ-HCH concentration was between LOD to 0.109 µg/gdw and the highest concentration is observed for this pesticide in the summer and was 0.173 µg/g dry weight in the station 1. The highest amount and descending trend toward the end of river is observed in station 1, so the last three stations were lower than the LOD limit. The highest effect of decrease was in the station 4, so its reason can be attributed to suddenly more increasing in organic materials in sediment, as it was pointed that the concentration of this pesticide and also β-HCH has a inverse correlation with organic carbon amount. The average alteration in Chlorpyrifos concentration is between 0.031 µg/gdw and 0.131 µg/gdw in the station 1. The lowest amount in the station 1 is related to forest use. It is observed a significant increase in concentration that its reason can be more consuming pesticides in Citrus groves. It is observed a significant increase in the station 5 and there is increasing trend in the stations 6 and 7 in residential 2 and agricultural 3 uses, respectively. The average concentration of diazinon is about 0.101 µg/gdw in the station 1 1.795 µg/gdw in the station 6. The highest concentration measured for this toxic was in the station 7 and summer that has been measured 3.299 µg/gdw Diazinon in the sediment. There is significant difference among the stations. It was observed a significant increase in Diazinon concentration in the station 2, so it was pointed it is due to excessive usage against garden pests in the area. Then, it was observed the gentle increasing trend in the stations 3 and 4 and again the significant increasing trend in the station 5 as it was claimed its granule was used against rice stem borer. It was observed relatively high increase in the concentration of this pesticide in its sediment in the station 6, so its reason can be attributed to agricultural usage in this land use and also against home insects, town, ornamental gardens, and healthy and animal's pests in this use. The average of edifenphos concentration among this station is 0.061 to 0.217 µg/gdw. The lowest concentration measured was in the station 1 and the highest concentration in the station 7 was 0.442 µg/g dry weight. There is to increase in concentration in sediment, but it has been Significant in the first three stations that its previous use was forest, the station 5 by agricultural Land-use 2 that its previous use was residential and the station 6.

Conclusion

In surveying the land use role on the pesticides concentration in the water and sediment, in general the highest effect was for residential 2 and agriculture 2 land uses its reason is probably more effective areas, urbanism along with agriculture and more using pesticides in agricultural and nonagricultural consumption, the highest concentration of pesticides except β-HCH and γ-HCH (in sediment) was in the station 7 and β-HCH and γ-HCH had decreasing trend in contamination of organic materials in sediment along the river. In all stations and all seasons, the concentration of organophosphorus pesticides is much due to current consumption.

Keywords: GC, organotoxin, pollution, sediment, water.

Accumulation of Mercury (*larus cachinnans*) in Bandar Mahshar and Shadegan

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Extended Abstract

Introduction

Despite the limited anthropogenic activity in Arctic regions, the levels of heavy metals are of concern and the Arctic is considered as an important global sink for mercury depletion. Mercury is not readily available to the food Web in its natural form. However, inorganic mercury is converted into organic mercury compounds by microbial processes of anaerobic organisms. MeHg is more lipophilic, highly bio-accumulative and the most toxic form of mercury. The establishment of industrial activities in the coastal zone resulted in production and release of various types of contanius into the marine environment in the neighboring areas of Khormusa to Bandar Mahshar. The petrochemical complex here could be potentially harmful for marine ecosystem in terms of Hg pollution. Birds are often the most numerous representatives of vertebrates in polar and subpolar regions as ideal bio-indicators of pollution. Marine birds are exposed to a wide range of trophic levels, and those at the top of the food chain are susceptible to bioaccumulation of pollutants. Mercury in the marine environment is examined in the study to understand the extant of Hg contamination in the marine environment and its health. Seabirds are useful as bio-indicators of coastal and marine pollution. Marine birds, defined as the birds that spend a significant proportion of their life in coastal or marine environments, are exposed to a wide range of chemicals and as they mostly occupy higher trophic levels, this make them susceptible to bioaccumulation of the pollutants. Since different families have variant life history strategies and cycles, behavior and physiology, diet, and habitat uses, their vulnerability is also different. Further, the relative proportion of time marine birds spend near shore, compared to pelagic environments, influences their exposure to the pollution. Bio-monitoring studies are necessary due to long living, staying at the top of food chain, availability and large number of yellow-legged *(larus cachinnans)* in Mahshahr area. Gull yellow leg seabirds around the world are found in Europe, Africa, Asia and the Pacific. Methyl mercury due to its great affinity to high affinity for fat and protein Rail sulfide groups in the food chain is transmitted rapidly and accumulated in organisms. In the areas fish and other marine species of food group constitutes a major source of organic mercury bioaccumulation of mercury in human tissues. This study was carried out to investigate the level of mercury accumulation in yellow gull and the amount of mercury which is transferred to the upper trophic level in Mahshar area. Since the birds are fed from the high levels of the food chain, they are often recognized ecology.

Material and Methods

Gull yellow (*larus cachinnans*) were collected from the Khormusa and Bandar Mahshar. The collection gull yellow (n=18) was used as samples. The samples were brought to the laboratory right away, birds were dissected immediately. Liver, Breast feather, kiendy, musel, heart, bone and skin were removed from the bodies of the specimens. The feathers were washed in deionized water alternatively to remove loosely adherent external contamination. All samples were wrapped in aluminum foil and stored at minimum -20ºC.The seabirds were weighed and size measured. They were, then, dried in a 50 ºC oven. The biological samples were digested by a mixture of nitric acid and patacium permanganate in a closed aqueous system in a hot plate. After pressure digestion, the biological sample was supplied with stannous chloride and hydrochloric acid to reduce the Hg in a

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sample to atomic Hg. Mercury was measured by Atomic Absorption cold vapor (AAS). The statistical analysis was carried out using SPSS application, version 16. The data normality was tested using a Kolmogorov-Smirnov test. Mercury concentration in samples was tested for mean differences among species using One-Way Analysis of Variance (ANOVA). When significant differences were observed among the species and tissues, Tuky-Kramer test was applied to determine which means were significantly different. Values are given as mean± standard errors and we considered a P <0.05 to be statistically significant.

Results and Discussions

In both sexes, the maximum Hg concentration was measured in feather (9.70±1.16 µ/g in female and 8.27±0.32 µ/g in male). The minimum Hg concentrations were observed in heart muscle (0.42±0.03 in female and 0.43±0.01 µ/g in male). A significant and positive correlation found between Hg concentration in feather and liver and total weight of the birds (P<0.05).

The maximum Hg concentration was found in the feathers either in male and females; while the minimum Hg concentration was found in heart muscle. A significant difference was found between males and females in terms of Hg concentration in feather and liver (Fig. 1). Many studies have pointed out that Hg is ussually accumulated in the bird feathers. It is suggested that feather and liver could serve as suitable bio-monitor agent for Hg a yellow leg gull. There was no significant difference between Hg concentrations in the birds belonging to different stations. This was true for both male and female birds (Fig. 2). Although the stations of study are far from each other, it is suggested that birds from both stations have a same feeding ground.

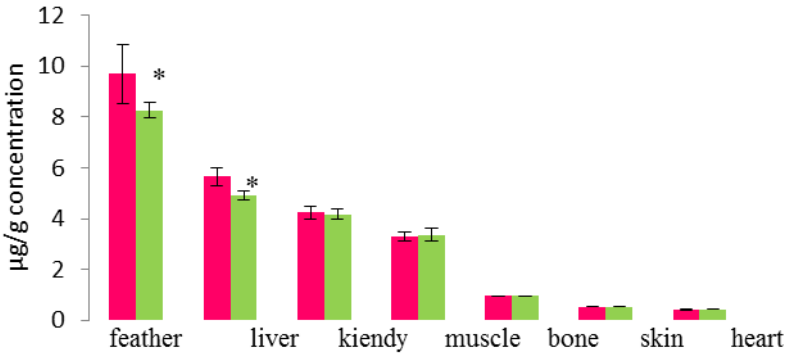

Fig. 1. Concentration of Hg in yellow gulls (male and female) in Mahsahr

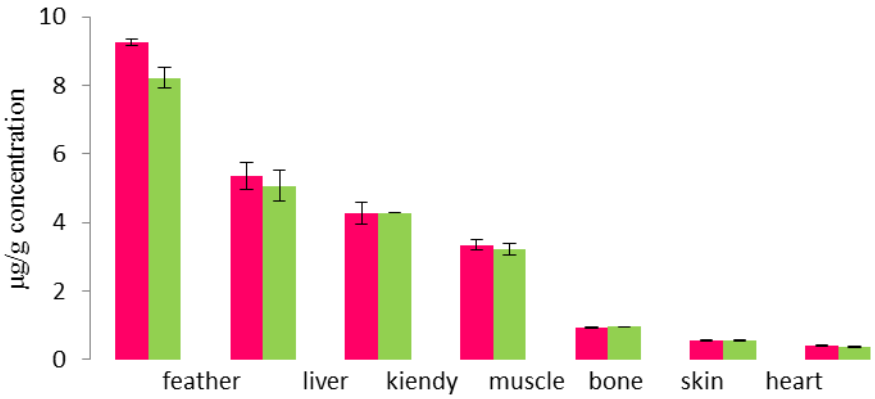

Fig. 2. concentration Hg in yellow gulls (male and female) in Aboukhozayer

Many seabirds can fly in long distances. Therefore, it is possible that Mahshar and Shadegan gulls are gathered in the same feeding ground. Comparison between Hg concentrations in different tissues of yellow

legged gull in this study with some other birds from other parts of the world demonstrated that yellow legged in this study accumulated high concentration of Hg in their tissues. This finding can alarm that management action are required to control pollution in the Mahshar area.

Significant correlation was observed between Hg concentration in different tissues and total body weight of the birds. The correlation coefficient was higher in the case of feather (Fig. 3).

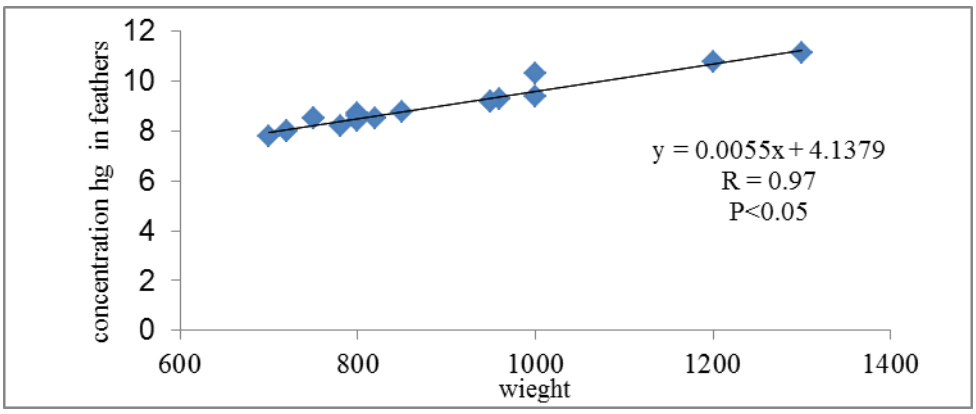

Fig. 3. Corralation between feathers and weight yellow gulls

Conclusions

Generally, it can be concluded that most of the Hg concentrations are accumulated in feathers and the contain proteins, rich of sulfur amino acid. It is suggested that yellow-legged is appropriate agent for Hg bio-monitoring in Bandar Mahshahr. The study revealed that the feather is the most suitable tissue for Hg monitoring. The comparisons of the results with standard of World Health Organization, found that mercury levels in Yellow-legged is above the mentioned standards.

Keywords: bio-monitoring, Meahshar, pollution, Yellow-legged gulls.

Investigation on Nitrate Concentrations in Groundwater Resources of Marand Plain and Groundwater Vulnerability Assessment Using AVI and GODS Methods

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Extended Abstract

Introduction

More than 90% of drinking water in cities around the world and about 40% of the agricultural water are supplied from groundwater resources. Thus, groundwater quality is considered as an inevitable issue. One of the most important parameter which can show the quality of drinking water is nitrate concentration. Nitrate enters the groundwater and surface water through the decomposition of human and livestock wastes, industrial outputs and leaching of agricultural fertilizers. Typically, the concentration of nitrate is higher in shallow groundwater and decreases with increasing depth and toward downstream due to the diffusion process, mixing and dilution with low nitrate groundwater.

Materials and Methods

Marand plain is located in East Azarbaijan Province in the northwest Iran, with an area of approximately 826 square kilometers. The plain is a part of Caspian basin. Groundwater resources of the plain have been formed in quaternary alluvial sediments. The sediments formed in the mountain range pediments are coarse and gradually the grain sizes decreases towards the central parts of the plain and turned into clay and silt at the end parts. Zilbir Chay and Zonouz Chay are important rivers in the study area. Based on the results of geophysical investigations and geological logs, there are three types of aquifers including unconfined, confined and semi-confined in the plain (Fig. 1). Unconfined aquifer is formed in ancient terraces, recent terraces, alluvial fans and fluvial sediments and the main materials of deposits are gravel, sand, silt and clay. The thickness of the unconfined aquifer varies in different parts of the plain. The southern part of the plain is made of semi-hard conglomerate with Plio-Pliostecene debris and it must be considered as low permeable and semi-permeable regions because of clay and marl layers. Confined aquifer, mostly in the form of ancient alluvial deposits, is covered by clay and marl layers with thicknesses varying from 10 to 30 m. The maximum thickness of the confined aquifer reaches 170 meters in some parts of the plain. The confined aquifer is located in the central and western parts of the plain and even in some parts of the Zilbir Chay and Zonouz Chay Rivers terraces. The semi-confined aquifer is placed in western part of the plain.

To evaluate nitrate contamination, up to 48 samples were collected from shallow and deep wells of the aquifers in July 2012. Analyzed ions are including pH, EC, major cations, anions and nitrates. Nitrate was analyzed by spectrophotometer and other cations and anions by standard methods at hydrogeology laboratory of Tabriz University. Then, the spatial distribution map of nitrate concentration was plotted using the ArcGIS10 software. Groundwater vulnerability assessment was performed by two methods including AVI (Aquifer Vulnerability Index) and GODS (Groundwater Occurrence, Overlying lithology, Depth of groundwater and Soil rates).

Results and Discussions

Nitrate contamination

Evaluation of nitrate concentrations in groundwater of the Marand Plain indicated that nitrate concentrations are over the allowable concentration in drinking water (45 mg/L) in 12 analyzed water samples (Fig. 1). Based on

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nitrate concentrations and land use map, it can be certainly stated that the nitrate concentration are well defined with land use map. However, the particle size distributions of sediments and hydrogeological conditions have a certain role in the distribution of nitrate concentrations. Nitrate concentration in the central and eastern parts of the plain is more than other places because of the active agricultural area, entrance of wastewater to groundwater, unconfined aquifer type and coarse sediments in this part of the plain. The lowest nitrate concentrations were revealed to be in west and northwest parts of the plain. This is due to the low agricultural activity in comparison with other parts of the plain, the confined aquifer condition and fine-grained sediments in this part of the plain.

The nitrate concentrations decrease with increases in the depth of wells.

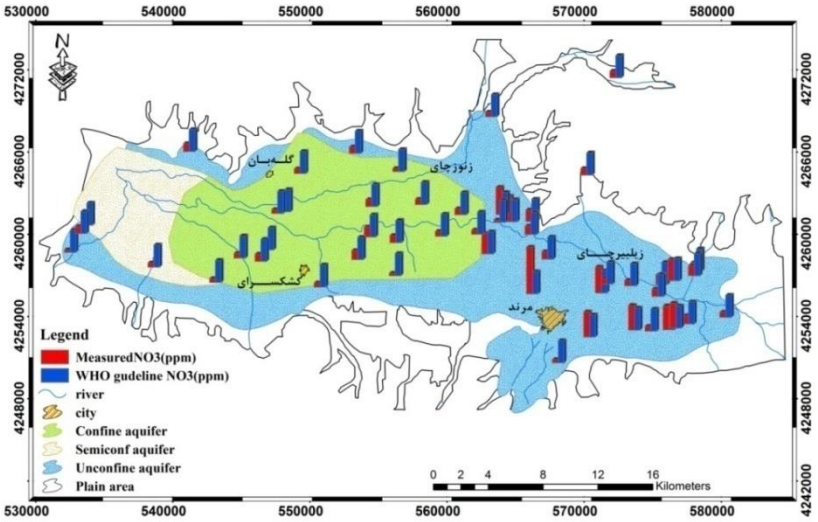

Fig 1. Spatial distribution of nitrate concentration and the maximum allowable concentration

Figure 2 shows the spatial distribution of nitrate concentration and land use map of the study area. This figure shows that the high concentrations of nitrate in the east and southeast part of the plain reflects the extent and intensity of agricultural activity and increase in agricultural fertilizers, including phosphate fertilizers, nitrogenous and potash in this regions. Moreover, unconfined aquifer type and coarse sediments result in an increase in the permeability of the aquifer and the rapid nitrate leaching from the unsaturated zone and also lead to increase in nitrate concentrations in this part of the plain. The reasons for the lower nitrate concentrations in the central and western parts of the plain are the type of the aquifer (confined aquifer), fine-grained sediments and undesirable quality of water for agricultural purposes.

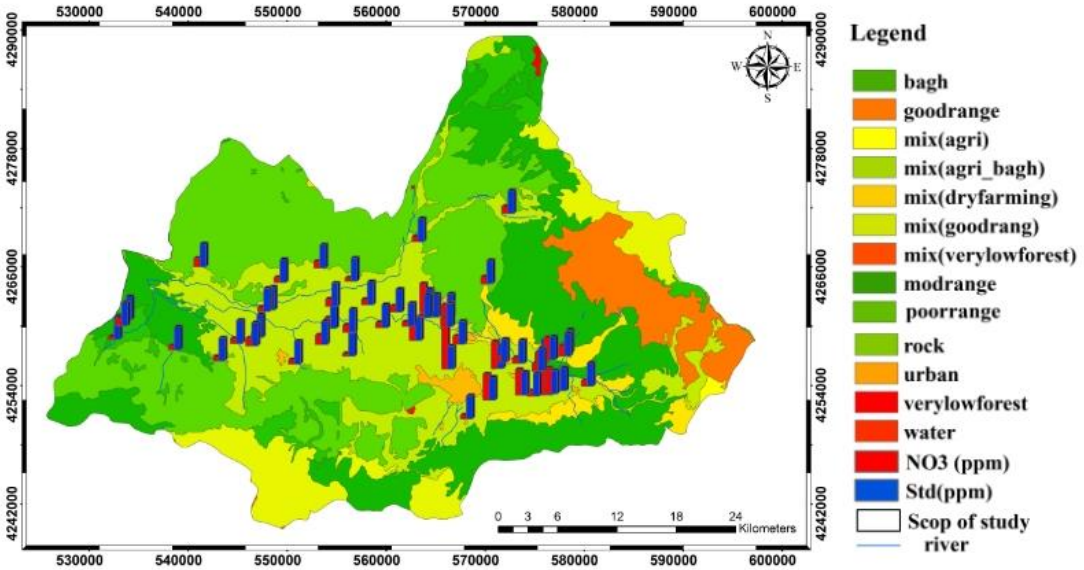

Fig. 2. Comparison of variation in nitrate concentration with land use map

Vulnerability of Marand plain groundwater

To determine the contamination potential of the plain, two vulnerability assessment methods named as AVI and GODS were used. Vulnerability mapping with AVI and GODS methods (Fig. 3a,b) show that those parts of the plain where contain unconfined aquifer type have the highest contamination potential whereas those parts of the plain containing confined aquifer condition have lowest contamination potential.

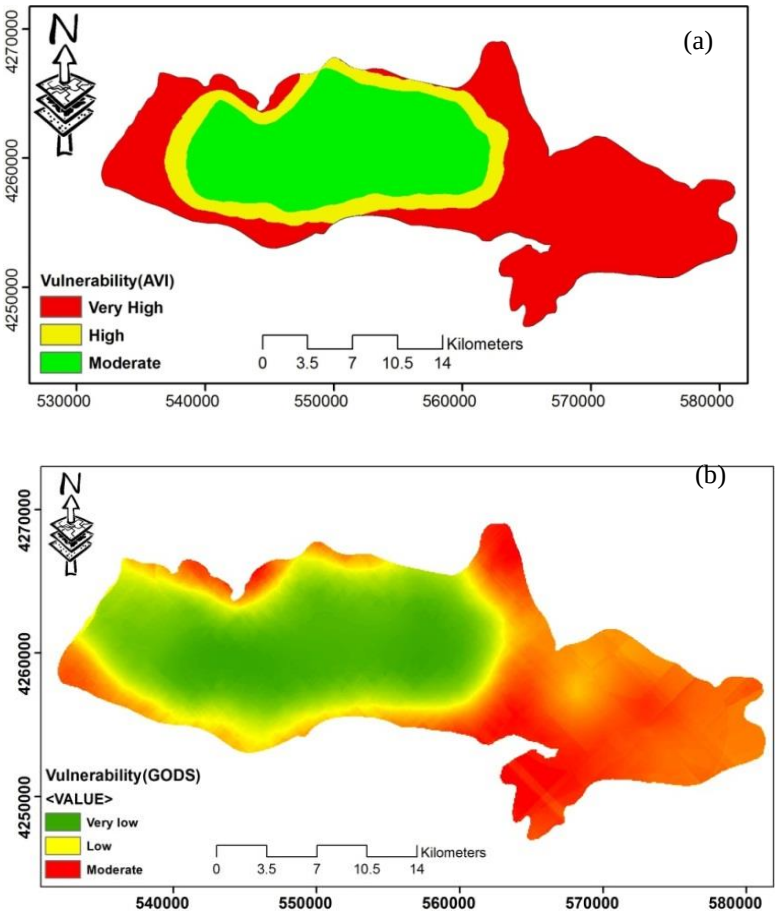

Fig. 3. Vulnerability map of a) AVI and b) GODS methods

Conclusion

It can be concluded that the concentrations of dissolved oxygen in water decrease with increase in depth, hence it is possible to enhance denitrification process and remove some amount of nitrate. The study revealed that areas with unconfined aquifer type have the highest contamination potential and the areas with aquifer condition have lowest contamination potential.

Keywords: groundwater contamination, groundwater vulnerability, Marand Plain, nitrate.

Quantitative Modeling of Nitrate Distribution in Ardabil Plain Aquifer Using Fuzzy Logic

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Extended Abstract

Introduction

Environment as a great and complex collection is composed of a process and evolution of live existences and the Ardabil Plain aquifer, with an area about 900 km^2, has high concentration of nitrate in some parts. Nowadays, nitrate pollution in groundwater due to the widespread application of fertilizers and increase of drinking water demand, has problems for consumers. The adverse health effects of high nitrate levels in drinking water have been well documented.

In the last two decades use of fuzzy logic has considered as a simulation for environmental process because of complexity in modeling domain and uncertainty in data. Most of these research studies have been profited from advantages of fuzzy logic beside other scientific methods. In previous published academic researches investigating vulnerability of aquifer by fuzzy logic, it has been concluded that data clustering and determination of bounds between these clusters is a matter of importance and the efficiency of fuzzy logic is higher than traditional methods.

Reviewing the previous records indicates that there is not any literature about modeling of nitrate in Ardabil Plain. Therefore, in this study distribution of nitrate in Ardabil plain aquifer has been estimated using fuzzy logic modeling and the performance of this method has been compared with kriging.

Material and Methods

The study area is located between latitude 38°00′ and 38°30′ and longitude 48°00′ and 48°40′ and it covers an area of approximately 900 km^2. For spatial distribution modeling of nitrate concentration in Ardabil plain, a total of 61 wells were sampled for chemical analyses on November, 2011. In this study, 75% and 25% of samples were used for calibration and verification, respectively.

Fuzzy logic

Contrary to classic sets, that their members are completely belonging to them, in fuzzy sets the members have membership grades between 0 and 1. One of the applications of fuzzy theory is modeling. In order to make modeling by fuzzy logic, the first input data are shown as fuzzy membership functions, then, these membership functions are related to output data via definition of fuzzy rules. Sugeno model is used in process of this kind of modeling which consists of three stages: 1. clustering, 2. identification of rules and 3. parameter estimation.

To determine the optimum number of clusters, the software of FuzME has been employed. After determination of classes, inputs of model were related to the outputs by definition of if-then fuzzy rules. In the last step, least square errors were minimized to calibrate the model.

Kriging

Kriging is a geostatistical interpolation method which is an efficient linear unbiased estimator. After the examination of normality of data and using normalization for data without normal distribution, the best experimental and theoretical variogram basis isotropic or anisotropic properties of data is plotted by GS+ software. As a result, the best chosen variogram was exponential with nugget effect of 0.09 and sill about 0.50.

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Results and Discussion

In this study, longitude and latitude have considered as inputs and nitrate concentrations have kept for output of model. For the reason that the UTM values were large numbers, in the beginning the inputs normalized between 0 and 1, then, they were classified in six clusters by fuzzy c-mean clustering method. Since the number of rules in this type of modeling is equal to the clusters, therefore, the set of inputs was related to the set of outputs via defining six rules. The parameters of model were also estimated by the running of the model. The calibrated parameters of input and output membership functions are given in Table 1.

Table 1. Optimized parameters of input membership functions and output linear functions

cluster	input1		input2		output		
	σ	c	σ	c	α	β	ε
1	0.1672	0.3313	0.1768	0.6902	44.83	9.937	-3.126
2	0.1256	0.5027	0.1243	0.5807	566.4	-317.8	-119.4
3	0.1287	0.6495	0.2049	0.4377	-19.18	66.09	16.72
4	0.1143	0.4066	0.1598	0.6709	127.6	-319.4	242.1
5	0.1369	0.6086	0.1599	0.5013	132.5	-121.5	-105.9
6	0.0492	0.5478	0.08954	0.8856	-244	-265.1	392.4

To verify the model, a total of 16 separated samples were used and its results were compared with that of kriging method. For this purpose, root mean square error (RMSE), mean absolute error (MAE) and coefficient of determination (R^2) were computed. These are presented in Table 2.

Table 2. Statistical characteristics of the data used for verification

Model	mean	std	MAE	RMSE	R^2
Fuzzy logic	7.99	5.063	1.3982	1.6940	0.916
Kriging	5.82	2.594	2.9677	4.3549	0.517
measured	8.65	5.57	-	-	-

According to reported results in Table 2, purposed model showed better results than kriging method. Therefore, to generate the nitrate distribution map, the verified fuzzy model was run and final result is shown in Figure 1.

Conclusion

The reliability of spatial distribution maps of pollutants is very important in water resource management. Basically, the geostatistics interpolation methods, especially kriging, are used to generate spatial distribution data. According to the results, the used fuzzy model was very efficient in estimation of the nitrate concentrations in the study area.

The final output of the model shows that the nitrate concentrations in some areas in north and southwest parts of the plain is higher than 10 mg which these parts occupied about 17% of aquifer area.

The places with high amounts of nitrate around Ardabil city had full conformity with urban waste water. Therefore, it is highly likely that the nitrate pollution could be related to urban waste water. Furthermore, high concentrations of nitrate in the north margin of the plain are in conformity with landfill that can be considered as cause of nitrate pollution at that area.

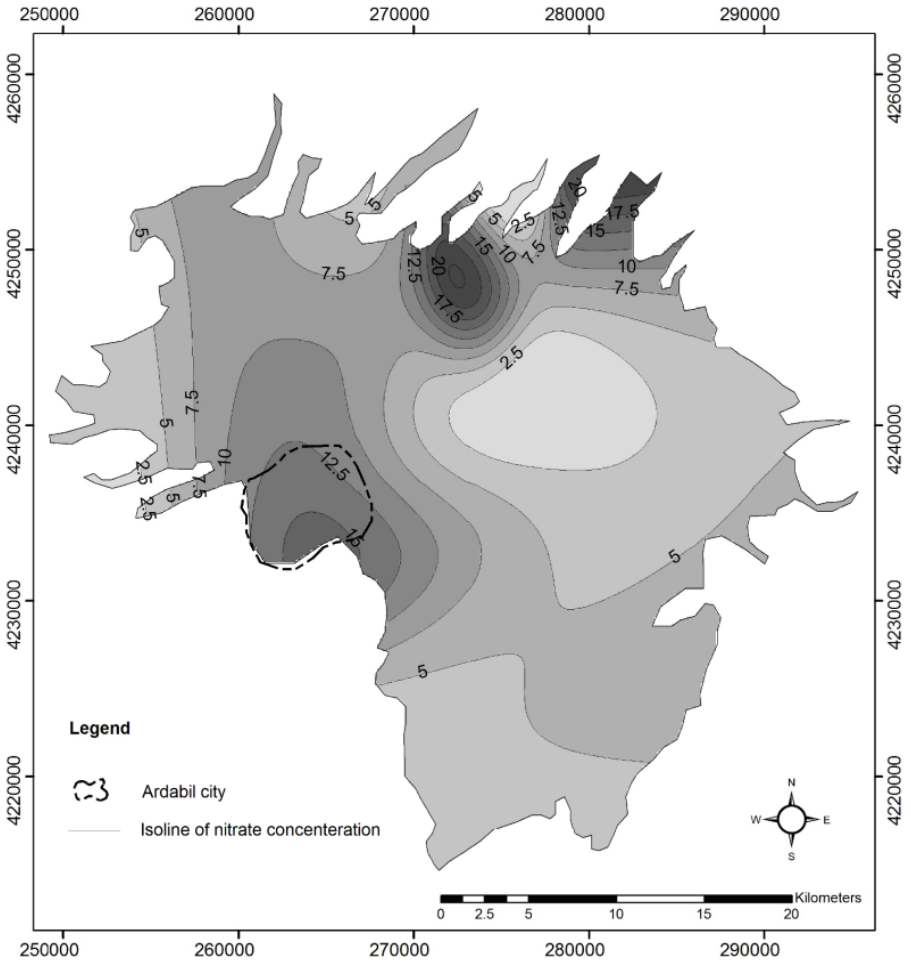

Fig. 1. Spatial distribution map of nitrate in Ardabil Plain aquifer

Keywords: clustering, fuzzy logic, groundwater, nitrate.

Environmental Hydro-Geochemistry of Groundwater Resources in Ravar Plain, Northern Kerman Province, Iran

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Extended Abstract

Introduction

Groundwater resources in arid-semiarid areas in the entire world are suffering from problems of over-abstraction and decline of water tables. In addition to the issues related to quantity, degradation of groundwater quality is now of major importance in the arid and semiarid regions. In such areas, natural factors such as the low precipitation, combined with high evapotranspiration, result in higher changes in groundwater composition. Besides the natural factors, a range of human related factors might influence the chemical quality of the groundwater. For this reason, hydro-chemical evaluation of groundwater resources, particularly in arid and semiarid regions, is of great importance. Ravar Plain located in Kerman province is a typical arid region with high evaporation rate and low annual rainfall. Another important feature of this area is abundance of evaporative rock units which are important in terms of quality of groundwater. Groundwater is the only source of water for drinking and irrigation purposes in the plain. The objective of the present study is to evaluate the environmental and hydro-chemical properties of these resources and to determine the natural or anthropogenic factors influencing the groundwater quality.

Materials and Methods

Study area

The Ravar region with an area of 4080 square kilometers is located in north part of Kerman province, between longitudes 57°30′56″E and latitudes 31°30′31″N (Fig. 1). The average elevation (altitude) of the study area is 1,170 m above sea level. Due to proximity of Ravar plain to the Lut Desert, it has a desert climate condition that is characterized by low mean annual precipitation (47 mm) and high evaporation rate (approximately 3,766 mm). Geologically, the study area falls in the central zone of Iran. The geologic formations exposed in the study area are ranged in age from Precambrian to Quaternary and include sedimentary (chiefly evaporative in nature) and igneous rocks and unconsolidated materials (Quaternary deposits).

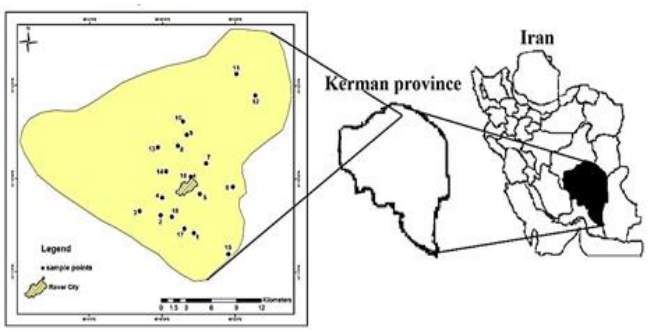

Fig. 1. the map shows Ravar plain and groundwater sampling points

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Groundwater sampling

Eighteen groundwater samples were collected from abstraction wells throughout the plain (Fig. 1). Samples were analyzed in the laboratory for the major ion chemistry and heavy metals by means of standard methods. The pH and Electrical Conductivity (EC) were measured using calibrated pH and EC meters. Calcium and chloride (Cl^-) and bicarbonate (HCO_3^-) were also determined using titration method. Mg was determined by subtracting the hardness from the Ca content. Sodium was also measured by flame photometry. Sulphate (SO_4^{-2}) and nitrate (NO_3^-) were also determined by gravimeter and spectrophotometer, respectively. Total dissolved solids (TDS) were computed by multiplying the EC by a factor of 0.65. Heavy metals were measured by atomic absorption spectrophotometer (AAS) equipped with a graphite furnace. To get a better understanding of hydro-chemical mechanisms controlling the groundwater composition, multivariate statistical techniques were applied to hydro-chemical data. The measured hydro-chemical parameters were also compared to permissible limits set by World Health Organization (WHO) for drinking water purposes. Graphical methods were used to analyze the hydro-chemical data and to determine the groundwater chemical evaluation.

Results and Discussion

Variations of major ion concentrations and some physicochemical parameters in the Ravar groundwater resource

According to the spatial distribution map of pH values, the maximum level of this parameter is observed near the recharge area. Toward the discharge area, chloride and sulfate become gradually dominant. EC level also tends to increase from the recharge area toward discharge area in the direction of the groundwater flow path. It seems that high rates of evaporation, followed by dissolution of evaporated minerals are the most important hydro-chemical factors controlling the variations of ion concentrations and some physicochemical parameters of water samples. Although anthropogenic sources such as irrigation-return flow and leaching of domestic wastewater can increase the content of sulfate, nitrate and bicarbonate in the groundwater resources, the effect of natural processes (i.e. evaporation and dissolution of evaporative rocks) on variation of ion concentrations is more obvious and effective. The chemical composition of water samples from the study area is plotted on the Piper diagram. According to this diagram, the hydro-chemical types of groundwater samples are typically Na-SO4-Cl.

Effect of evaporation process on hydro-chemical quality of groundwater resources of the Ravar plain

In order to explore the effect of evaporation on quality of the Ravar groundwater resources, the mean of parameters measured in the recharge and discharge areas were mutually compared. As it was expected, levels of TDS, EC and major ions such as sodium, chloride, sulfate, calcium and magnesium measured in the discharge area is approximately 5 times higher than their corresponding parameters measured in the recharge area. Therefore, it can be stated that levels of hydro-chemical parameters of local groundwater resources are significantly controlled by evaporation process. It can be also possible that some anthropogenic activities might influence the groundwater quality via irrigation-return flow. However, the impact of anthropic activities on the groundwater composition is negligible when compared to natural process that control hydro-chemical characteristics of local groundwater.

Concentration and origin of heavy metals in groundwater resources of the Ravar plain

Generally, concentration of heavy metals in the groundwater resources of the study area is low and almost all measured metals (except for Pb) are within the permissible limits for drinking water. It is also found that anthropogenic sources such as road traffic can be responsible for high concentrations of lead in the some groundwater samples. Generally, the origin of heavy metals in the groundwater resources can be related to coal-bearing black shales units exposed in the study area. Related to arsenic, it can be inferred that the alkaline prevailing in the groundwater, the As can be as released and occurred as soluble ions in the groundwater composition.

Multivariate statistical analysis

Results obtained from principal component analysis (PCA) indicated that investigated metals are grouped into three principal components. The first component, explaining the highest percentage of the total variance, has strong positive loadings on TDS, TH, EC, SO_4^{-2}, Mg^{+2}, Ca^{+2}, NO_3^-, Cl^- and Na^+ and this indicates dissolution of evaporate minerals. This component represents the role of evaporation in variation of groundwater quality. The first component shows strong negative loadings on Pb and Se, indicating the same source (coal-bearing black shales) for these elements. The second component is associated with the As and pH suggesting that As release are associated with increase in water pH. HCO_3 and Pb have also strong positive loadings in this component which can explain correlation of lead with pH. The component 3 accounts for 20 % of the total variance. This shows strong positive loadings on Mn and Cd indicating again similar origin for these two elements (coal-bearing black shales). These findings are consistent with the results obtained from cluster analysis.

Conclusion

Evaporation process, followed by dissolution of evaporite minerals are the most important factors controlling the chemistry of groundwater in the Ravar plain. Anthropogenic activities such as agricultural activities and road traffic are also responsible for high concentrations of some constituents (e.g. nitrate, bicarbonate and some heavy metals) in the groundwater samples. Based on the results of T multivariate statistical analysis, the origin of heavy metals in the groundwater resources of the study area is found geogenic (natural), probably related to coal-bearing black shales units in the study area.

Keywords: groundwater resources, heavy metals, hydro-geochemistry, Kerman, Ravar plain.

Risk Assessment Modeling of Air Pollutants Emissions in Beihaghi Terminal

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Extended Abstract

Introduction

Public transportation system is a suitable solution to organize transportation in urban areas. This system reduces the demand for private car or taxi for economic savings. Public transport will not only reduce the use of private vehicles, but it will also reduce traffic and air pollution. The public transportation system of buses seems to be the excellent as one of the most efficient form of the public transportation systems. Bus terminals play an important role in the regulation of urban transportation. However, these terminals have the potential to become sources of air pollution.

The mathematical model can easily estimate emissions of terminal vehicles and concentrations of pollutants. By alternative methods of sampling and measurement model, it can be possible to review existing situation and to anticipate the future in a more quick and costless way. If needed, it can be subject to examination and sampling. The purpose of this study is to assess the risks the persons in those terminals are faced with. These persons are including drivers, office workers and travelers to the area. The air pollutants CO, NO_2, and SO_2 are presented at the terminals by modeling and PM_{10} Payments.

Materials and Methods

IVE model is designed to estimate emissions from motor vehicles. The purpose of the model is to control strategies and transportation planning, to predict how different strategies will affect local emissions, and to measure progresses for reduction of emissions over time. Input data of this model are vehicle types, number of vehicles, their presence time in terminal, engine type, age, exhaust control technology, fuel type and speed. Moreover, other data are the essential geographical and meteorological information collected by documents review, questionnaires and statistical modeling. According to the traffic in the terminal and at different hours of the day, the average amount of estimated emissions of air for NO_2, PM_{10}, CO and SO_2 were determined. This is one of the BREEZE AERMOD inputs. Terminal resource modeling for air pollutants to a level that is unevenly spread is also considered. In this way, surface coordinates and the release of three terminals are needed.

Some field works were required for more accurate determination of concentrations of air pollutants concentration. Concentrations of air pollutants in the desired period of time were estimated without taking into account the effects of air pollutants at the terminal air pollution monitoring stations near the terminals. Exposure to the range of terminal points was needed to determine how the output data set is analyzed. Finally, the required parameters and output were set in a given period of time. After completing all the input data, the model was run with known concentrations of air pollutants.

Two groups of people were directly exposed to air pollutants in the terminal. A group was the drivers and terminal staff that were highly subject to the air pollutants and the other group was the passengers with different patterns of exposure to air pollutants. In this research, we used risk assessment method of RAIS from USEPA.

Results and Discussion

Emissions of air pollutants and their concentrations in the IVE model and BREEZE AERMOD model have been used for risk assessment. Air pollution emissions are calculated by IVE model. The output data of IVE model is used as the input data for the BREEZE AERMOD model which estimates the concentration of pollutants. Finally, the cancer and non-cancer risk of CO, NO_2, SO_2 and PM_{10} concentrations is calculated by the RAIS,

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which is achieved by the use of non-cancer and cancer risk assessment of pollutants, quantitative assessment of risks from inhaled pollutants and persons that are affected. Searches performed for the pollutants of NO_2, CO and SO_2 gradients cancer is currently not available. Only the cancer risk of PM_{10} has been calculated by its cancer slope factor. After calculation of the cancer risk for the population, the cancer risk is multiplied by the number of people in contact. Inhalation of hazardous air pollutants per passenger in Beihaghi Terminal and HQ_{inhale} results for the different groups are shown in Table 1.

Table 1. Cancer and non-cancer risk assessment of air pollutants in the Beihaghi Terminal

	Chemical	**Chronic RfC (mg/m^3)**	**Concentration (ug/m^3)**	**Inhalation Ambient Air Non-carcinogenic CDI**	**Inhalation Ambient Air Carcinogenic CDI**	**Inhalation Ambient Air HQ**	**Inhalation Ambient Air Risk**
Drivers	CO	0.023	2500	0.6850	294	1.32	-
	NO_2	0.047	923	0.1610	69.2	2.38	-
	SO_2	0.262	80	0.0219	9.39	0.0369	-
	PM_{10}	5.000	170	0.0466	20	0.0041	0.00264
Site Personnel	CO	0.023	2360	0.6470	277	2.81	-
	NO_2	0.047	333	0.0912	39.1	1.94	-
	SO_2	0.262	80	0.0219	9.39	0.0837	-
	PM_{10}	5.000	80	0.0219	9.39	0.0044	0.00282
Official Personnel	CO	0.023	2360	0.49600	212	2.16	-
	NO_2	0.047	333	0.06990	30	1.49	-
	SO_2	0.262	80	0.01680	7.2	0.0641	-
	PM_{10}	5.000	80	0.01680	7.2	0.0034	0.00216
Passenger	CO	0.023	2360	0.0269	3.85	0.117	-
	NO_2	0.047	333	0.0038	0.54	0.0809	-
	SO_2	0.262	80	0.0009	0.13	0.0035	-
	PM_{10}	5.000	80	0.0009	0.13	0.0002	0000390.

The non-carcinogenic hazard quotient estimated for CO express that the most HQ is for site personnel with 2.81, this exceed the unit. If the quotient is less than 1, then the systemic effects are assumed not to be of concern; if the hazard quotient is greater than 1, then the systemic effects are assumed to be of concern. HQ for official personnel is 2.16 and for drivers is 1.32, both more than unit. Therefore, these three groups of people are in risk of CO inhalation. The HQ estimated for passengers is 0.117 which is less than unity and they are not in risk of CO inhalation. The NO_2 HQ estimated for drivers is 2.367 who are in the most risk in comparison to the other groups. The HQ for site personnel is 1.94 and for official personnel 1.49, which is more than unity. Thus, these people are in risk for NO_2 inhalation in the passenger terminal. The SO_2 HQ for drivers is estimated about 0.0369, for site personnel 0.0837, for official personnel 0.0641, and for the passengers 0.0035. These are less than unity for all groups of people. None of people in the passenger terminal are in the risk for SO_2 inhalation and non-carcinogenic risk. The PM_{10} hazard quotient for all groups of people is less than unity and no one is in the non-carcinogenic risk of this pollutant.

The hazard index is the sum of hazard quotients. Hazard Index is calculated by adding hazard quotients for each chemical across all exposure routes. Hazard index for the drivers is 3.737, for site personnel 4.838, for official personnel 3.718, and for passengers 0.202. Consequently, the site personnel are in great risk in this transportation terminal. This population is in the open area and exposed to vehicle exhaust emissions. The

official personnel and drivers are also prone to the effects of non-carcinogenic risks of these contaminants. Drivers have the same situation to the site personnel but with the different frequency of contact. Official personnel at the terminal work 8 hours a day in the buildings, but due to indirect emissions from vehicles. The risk Index indicates a low risk of inhalation of air pollutants for passengers in the terminal. The CO pollutant has the greatest share of risk which is 58 percent and then the NO_2 with 40 percent in the passenger terminal.

Conclusion

In this research, risk assessment based on concentrations of inhaled air pollutants is modeled by BREEZE AERMOD. Hazard index for drivers of all air pollutants is the most for site personnel and the least for passengers 0.202. The risk inhalation of air pollutants is minimal for passengers in the terminal. Most persons working in the Beihaghi Terminal and the drivers are at the non-cancer risks. Pollutants are the greatest share of the risks are emissions of NO_2 and CO. Share of NO_2 emissions is 64 percent and share of CO emission is 35 percent of the whole pollution in the Terminal.

Cancer risk assessment using cancer slope is appeared only for particulate matter emission. Carcinogenic risk assessment for PM_{10} is estimated to be for the population inhaled. The risk of PM_{10} inhalation for the drivers is high, meaning that 3 of them may suffer from cancer in their lifetime. There is also risk for carcinogen illnesses for one of the site personnel and of the passengers in their lifetime. Therefore, the drivers are exposed to most of the cancer risks. In general, in this terminal the risk of cancer is highly increased.

Keywords: AERMOD model, air pollution, city terminal, IVE model, risk assessment.

Investigation on the Factors Affecting Air Pollution Emissions in Caspian Sea Countries: Panel Spatial Durbin Model

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Extended Abstract

Introduction

Under the principles of international law, no state has the right to use or permit the use of its territory in such a manner as to cause damage to the environment of other states. Spatial econometrics provides a powerful instrument to assess the influence of the pollution of neighboring countries on a country's pollution level. Spatial spillover effects play a significant role in assessing the impact of economic growth on environmental quality, because some environmental phenomena have inherently spatial characteristic. These are flowing of polluted water, atmospheric pollution and the spread of epidemic phenomena causing spatial autocorrelation in analysis of spatial econometrics. Moreover, countries can interact strongly with each other through channels such as trade, technological diffusion, capital inflows, and common political, economic and environmental policies. The Environmental Kuznets Curve (EKC) hypothesis assumes that there is an inverted-U-shaped relationship between emissions and per capita income; In other words, emissions increases up to a certain level as income goes up; after turning point, it decreases. Some studies have suggested that the shape of the EKC is a consequence of high-income countries in effect exporting their pollution to lower-income countries through international trade. In such cases, externalities can spillover the limits among countries, contributing in the explanation of environmental effects of economic growth. According to the empirical studies ignoring spatial autocorrelation and spatial heterogeneity in econometrics analysis will lead to false statistical inference. In new conception of common environment, planet earth composed inseparable environment which all the elements are correlated together and, therefore, damage to the environment and state responsibility in this regard should not be strictly limited to national borders and territories under them. After the collapse of the USSR and the emergence of new states in the Caspian coastal area, this unique sea is affected by various pollutants. Sensitive and fragile environment of the Caspian Sea due to its situation as a closed sea and accumulation of pollutants have confronted this sea by ecological crisis.

With regard to the outline mentioned above, the main objective of this paper is to investigate the factors influencing CO_2 emissions among 11 Caspian Sea countries based on the spatial form in "STIRPAT" model. STIRPAT is summarized form of *"Stochastic Impacts by Regression on Population, Affluence and Technology"*. To examine the hypothesis of Environmental Kuznets Curve, square of per capita income is also considered in the model. The results show a significant impact of energy intensity and urbanization on the level of per capita carbon dioxide emissions in the presence of positive spatial spillover effects of pollution and energy intensity (proxy of technology). The contributions of this study are: (a) method of estimation; (b) stipulated model; and (c) considering contiguity and inverse-distance spatial matrices to estimate the spillover effects.

Materials and Method

General specification for the spatial panel data models is:

$$y_{it}=\tau y_{it-1}+\rho W y_{it}+X_{it}\beta+\theta D X_{it}+a_i+\gamma_t+v_{it}$$
$$v_{it}=\lambda E v_{it}+u_{it} \quad (1)$$

where u_{it} is a normally distributed error term, W is the spatial matrix for the autoregressive component, D the spatial matrix for the spatially lagged independent variables, E the spatial matrix for the idiosyncratic

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error component. a_i is the individual fixed or random effect and γ_t is the time effect. Depending on conditions, the following nested models are:

i) The Spatial Autoregressive Model (SAR) with lagged dependent variable ($\theta=\lambda=0$)
ii) The Spatial Durbin Model (SDM) with lagged dependent variable ($\lambda=0$)
iii) The Spatial Autocorrelation (SAC) Model ($\theta=\tau=0$)
iv) The Spatial Error Model (SEM) ($\rho=\theta=\tau=0$)
v) The Generalized Spatial Panel Random Effects (GSPRE) Model ($\rho=\theta=\tau=0$).

As the standard SAR and SDM models are obtained by setting $\tau=0$ (or when panel is static). The spatial panel Durbin model occupies an interesting position in Spatial panel Econometrics. Spatial Durbin model allows simultaneously spatial interactions for dependent variable and explanatory variables. In other words, the main feature of SDM relative to other spatial models (such as; SAR and SEM) is simultaneous input of spatial lag of dependent variable and spatial lags of explanatory variables as new explanatory variables in the model. In this paper, we stipulated spatial Durbin form of "STIRPAT" model as follows:

$$I=F(A, T, U, WI, DT) \quad (2)$$

where I is Influence (per capita CO_2 emissions), A is Affluence (per capita income), T is Technology (energy intensity as proxy), U is Urbanization Degree (% of urban population in total population), WI is spatial weighted of emissions and DT is spatial weighted of technology. W and D are row standardized contiguity and inverse-distance spatial matrices, respectively. In contiguity matrix, Element ij of W is 1 if points i and j are neighbors and is 0 otherwise. But in inverse-distance matrix, element ij of D contains the inverse of the distance between points i and j calculated from the coordinate variables (longitude and latitude). Dimensions of matrices W and D are 11×11. Since all the variables are expressed in natural logarithm, the coefficients will be representing the elasticity. Furthermore, to examine Environmental Kuznets Curve hypothesis we stipulated the following model:

$$I=F(A, A^2, T, U, WI, DT) \quad (3)$$

where A^2 is square of Affluence (per capita income). If the estimated values of coefficients of A and A^2 were positive and negative, respectively, and also statistically significant, EKC hypothesis will be accepted for the countries of Caspian Sea region. The data of this paper are obtained from World Development Indicators CD-ROM of World Bank and online database of U.S. Energy Information Administration (EIA). The 11 countries under review are: Iran, Turkey, and Russia, Central Asian countries (Tajikistan, Turkmenistan, Uzbekistan, Kyrgyzstan and Kazakhstan) and Caucasus countries (Azerbaijan, Armenia and Georgia). Empirical model has been estimated by using *Stata / SE 12.0* and *Eviews 7.0* Softwares. Also, In order to determine the latitude and longitude coordinates for inverse-distance spatial weighted matrix and contiguity matrix, Geographic Information System (GIS) has been used.

Results and Discussions

Like most of the empirical researches in economics, we start with unit root tests. The LLC and IPS panel unit root tests were run for each series. These tests were run with a constant, and constant and trend term and an automatic lags election process using the AIC with a maximum of five lags. According to LLC, all variables are stationary in level with constant value and trend. In order to investigate panel unit root test in the presence of spatial dependence, panel unit root test with cross-sectional dependence was run. In the latter panel unit root test null hypothesis is homogeneous non-stationary and alternative is heterogeneous stationary. According to both panel unit root tests all variables are stationary in level and regression will not be spurious. Then, Panel-level heteroskedasticity and autocorrelation test were run. According to Hausman test result, spatial fixed effects are more efficient than random effect. According to Equation (2) with maximum likelihood method and the fixed effect, elasticity of emissions with respect to per capita income, energy intensity and urbanization were estimated to be 0.77, 0.46 and 1.97, respectively. Spatial autoregressive elasticity and spatial elasticity of emissions with respect to energy intensity were estimated to be 0.22 and 0.31, respectively. According to Equation (3), spatial environmental Kuznets curve phenomenon has been confirmed in these countries. Thus, increase in per capita income will initially increase per capita CO_2 emission, but after a certain threshold of per capita income, per capita CO_2 emissions will continue to decrease, given that we control effects of explanatory variables.

Positive spatial spillover of pollution is confirming this issue that it is required to take steps to decrease regional pollution, because a part of this pollution is influenced by contaminations in neighboring countries. This action is only solved by collaboration and obligation of regional countries for cutting down the emissions of pollutions. The magnitude of elasticity of per capita CO_2 emissions with respect to degree of urbanization in both models (1.97, 2.19) can also show a important point that most of the emissions air pollution are explained by urbanization movements. Therefore, urban policy makers should consider this vital issue. According to the Wald test and Likelihood Ratio (LR) test, the spatial coefficients are significant at 1% level and Spatial Durbin Model has correctly stipulated.

Conclusion

In this study, by the use of spatial panel Durbin model, the impact of per capita income, energy intensity and urbanization on per capita CO_2 emissions are assessed in the presence of spatial spillovers of pollution and technology among 11 countries around Caspian Sea during 1992-2010. The results of this study are consistent with those of similar studies that per capita CO_2 has spatial dependence and follow an inverted U pattern known as EKC (Environmental Kuznets Curve).

The Caspian Sea region has dimensions of geopolitics, geostrategic and geo-economics. These factors augmented the importance of regionalism and integration in order to achieve sustainable development in this area. There are the most important political advices for regional countries, such as the environmental common concept in the form of Caspian treaty convention (Tehran) and environmental treaties in the form of ECO (Economic Cooperation Organization). In addition to increase in per capita income, it is important that regional countries provide the substantial basis for decreasing the per capita CO_2 emissions through the rising of energy efficiency (reducing energy intensity) and improvements of urban infrastructures. Technical collaboration, especially in energy sector can be culminated in Synergy in sustainable economical development and decrease in emissions of pollutants in regional countries.

Keywords: Caspian Sea, EKC Hypothesis, JEL Classification: C23, Q53, Q14, R11, Q43, spatial Durbin model, spatial spillovers.

Introduction of a System Approach for Environmental Planning of Air Pollution Using Driving force- Pressure- State- Impact-Response (DPSIR) Framework (Case Study: Tehran)

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Extended Abstract

Introduction

Air pollution is one of the major environmental issues in industrial cities such as Tehran, in such a way that in a certain time this city was announced as the second polluted city in the world after New Delhi. Geographical location of this city develops a situation that air pollution does not find a way for dilution. Therefore, air pollution and its reduction to an acceptable level is a very important and complicated issue in Tehran, in which several factors play different roles. Thus, in order to obtain a better identification and management of factors affecting this phenomenon, a holistic and integrated method is needed. Cause- effect models with systemic structures are suitable for studying environmental issues as well as the interactions between different parts of the environmental systems which help the environmental planners and decision makers to get to an appropriate solution. Driving force-Pressure-State-Impact-Response (DPSIR) framework is a system approach for identifying key interactions between human and environment and can be used to relate the environmental issues with political levels. This tool integrates socio- economic and natural factors in one framework and makes a basis for more detail analysis. Its main goal is to introduce policy options and evaluate the efficiency of suggested measures for solving environmental problems. This research is a part of the second State of Environment (SoE) report for city of Tehran (Air pollution section). In this study, using the (DPSIR) framework, different components of air pollution in Tehran are analyzed and then proper responses are suggested.

Materials and Methods

In DPSIR framework used in this research, driving forces are human related factors that cause an environmental issue or problem. These factors are generally related to socio-economic developments that need to use environmental resources and will lead to production of pollution or waste and, therefore, cause a load or pressure on the environment. This pressure can end in a change in environmental parameters state which causes a negative impact on ecosystem and human welfare. Therefore, efficient solutions or responses are needed to address these problems. Responses can go back to every part of the DPSIR chain, but desirable and efficient responses are those that go back to the beginning of the framework, or the driving forces.

In this paper, the DPSIR framework is used to analyze different factors of air parameter in city of Tehran in form of quantitative indices and then using this conceptual model, appropriate responses are presented for each component of the model. Different components of this framework are presented in Figure 1.

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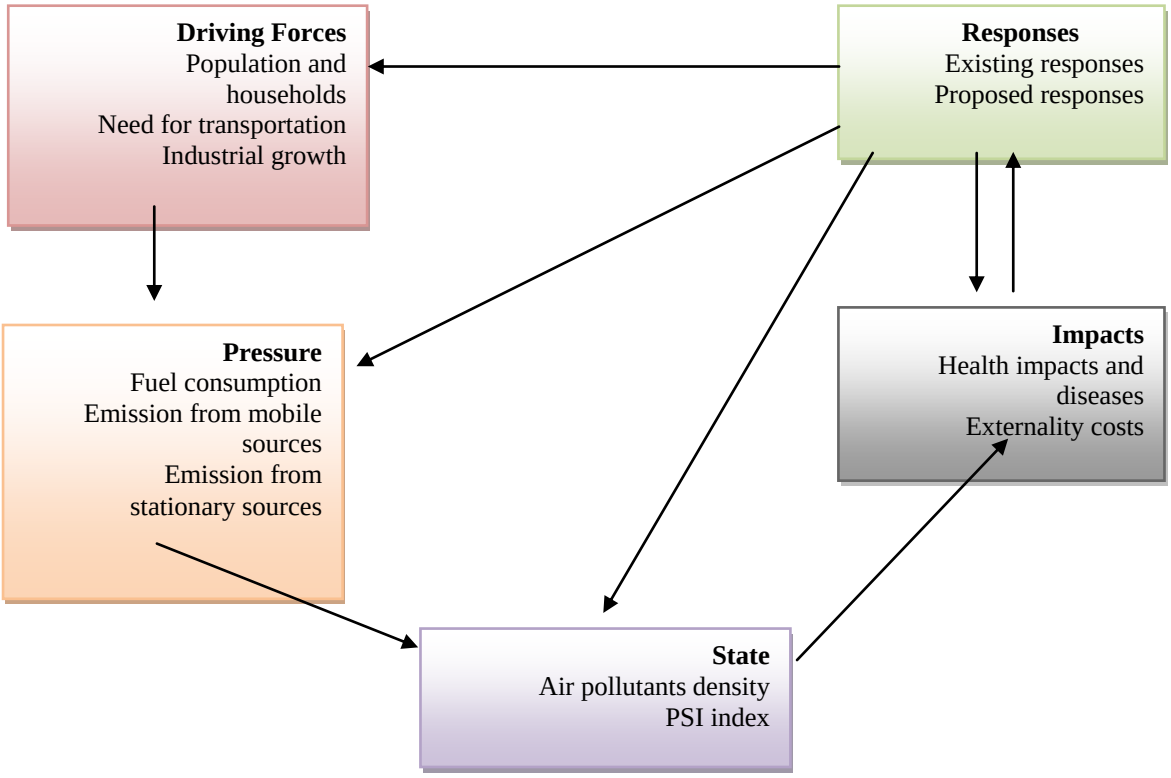

Fig. 1. DPSIR model of air pollution in the city of Tehran

Results and Discussion

According to DPSIR model, population density and intensity and the need for transportation are two main driving forces that cause increase in fossil fuel consumption which shows a considerable rise in the period of investigation. The number of vehicles presented in the city is also one of the main factors affecting the air pollution. Investigation showed that there were a number of 4130044 motor vehicles in city of Tehran in 2010. This means 0.51 motor vehicles for every citizen of Tehran.

In addition to the vehicles used by the residents of Tehran which are possibly driven in the city and creating their share of air pollution, there are other vehicles which are driven to and from Tehran by those passing from the road in other cities. The Karaj freeway with more than 18% of such a traffic load carries the highest number of cars coming and leaving Tehran.

Share of mobile source in Tehran's air pollution, which is classified as a pressure indicator, is increased in the period of investigation.

The high volume of road traffic, and also air transportation in Tehran metropolitan in the period of this investigation has been the major source of air pollutions. Therefore, the major cause of air pollution is still the mobile sources. The percent share of mobile source of pollution has increased from 91.34% in 2008 to 92.73% in 2010. The most important fuel from the aspect of share in mobile source air pollution has also been gas.

In state section, statistics show a decrease in days with healthy air condition, especially in 2010. As it is shown in Figure 2, the highest concentration of air pollutants such as NOx and particulate matters are found in central and southern parts of city of Tehran.

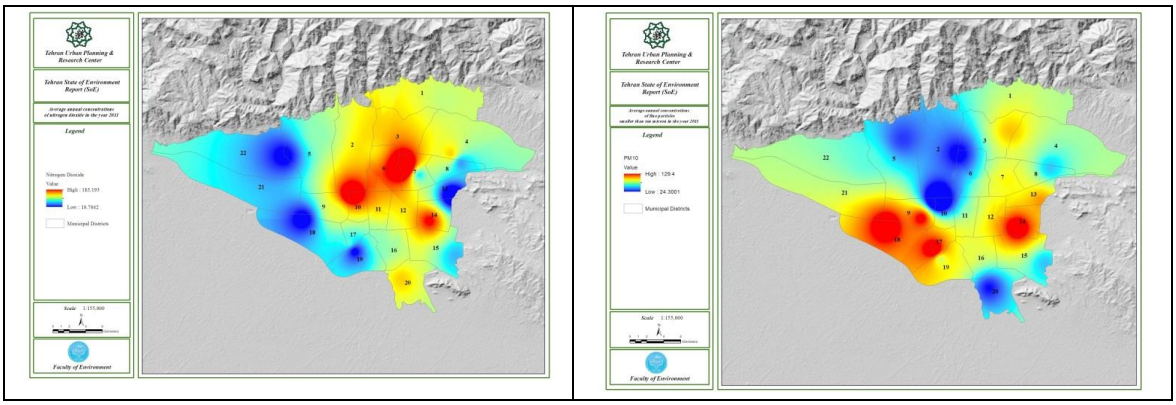

Fig. 2. Maps of NOx and PM10 average concentrations in Tehran in period of investigation

In impact section, it is stated that air pollution has very negative consequences on human health so that 45.5 percent of death in Tehran has been related to heart and respiratory diseases, relevant to air pollution. It also poses a huge external cost on the economy which has been calculated 16111 billion Rials for the year 2010 with an increase of 460 billion Rials in comparison to the beginning year of the investigation.

In response section, at first, actions and responses from different organization in charge of air pollution is assessed and then suggested solutions are proposed. This research showed that not only the state of air pollution in Tehran in time of investigation has become worse, but also the mitigation measures taken were not successful in improving the situation. This is due to the fact that the preventive measures did not address the correct palace in the casual chain of creating air pollution in Tehran, that is decentralization and moving the population gradually from Tehran. Therefore, in response section, using DPSIR framework, suggested mitigation measures were presented for every part of the casual chain, from which decentralization and reducing the population of Tehran and its adjacent areas are the major solutions. Other responses include improving public transportation, improving the green spaces with particular attention to ecological network and green infrastructure and increasing public awareness in order to reduce the use of private vehicles.

Keywords: air pollution, Driving force- Pressure- State- Impact- Response (DPSIR) model, system approach in environmental planning.

Review and Analysis of Effective Components for Improvement of Environmental Quality by Analytic Network Process (Case Study: Saqez City)

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Introduction

Cities and neighborhoods in Iran could not adjust themselves to quick changes in the recent decades and they have lost their quality in many aspects. Due to poor planning and governance at the regional and urban design on physical function, rapid growth of large-scale migrations and inefficient policies and procedures in dealing with urban neighborhoods as well as constructive role in promoting social identity, and economic, physical situation of urban areas, the neighborhoods problems have somehow unprecedented appearance. Vision of neighborhood sustainable development strengthened new approach to urban problems that return to the concept that imagined neighborhoods as cells in urban living. One of the approaches that emerged from increasing urbanization is environmental quality: as an approach that seeking "urban favorable living". The present research is based on share point of two topics: "neighborhood sustainable development" and "environment quality". Because of deep study, this research is also based on resident's satisfaction and non-satisfaction about neighborhood quality. Finally, in finding the criteria to neighborhood sustainably assessment, we proposed the process to the decision makers and managers to prioritize actions for improving environment quality consistent with sustainable development process. This paper intends to promote the environmental quality and people satisfaction of living in neighborhood by recognizing and prioritizing the main environmental quality factors which have effects on the satisfaction of living in neighborhood. Neighborhoods of Saqez are selected for this study. Thus, in this paper, the environmental quality of urban planning in neighborhoods of Saqez City was evaluated from resident's perspective. Hence, this study is to pursue the following objectives: evaluation of urban environmental quality of Saqez neighborhoods; identification of the effective factors on quality of urban environment in the neighborhood.

Materials and Methods

According to the research objectives and components, the type of this research is practical and the methodology is descriptive- analytical. A survey was performed of 6 neighborhoods in Saqez, according to the administrative division. The sampling method was multi-stage: stage one was cluster sampling and stage two was simple random sampling. First, the number of samples was specified based on the total population. Cronbach's alpha was used to obtain the reliability of the research instrument. The value of 0.86 for the tool suggests that this tool has very good reliability. To obtain validity of the questionnaire, we used factor analysis by KMO. KMO value of 0.75 for this tool indicates a good level of validity. Some of the information has been gathered from the Population Census of Housing, data from annals, organizations, and institutions concerned. For data analysis, ANP model was used to evaluate the ability of neighborhoods of Saqez City.

The statistical population was 38,749 people according to the 2011 census data. Cochran's formula was used to determine sample size. The sample size was 380 questionnaires with 95% of confidence. This number is collected as a percentage of the neighborhoods population.

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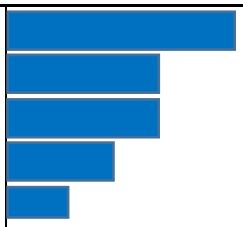
Table 1. Specifications and sample size of neighborhoods elected

Sample Size	Population neighborhoods	Number of households	neighborhoods	area	sample size	Population neighborhoods	Number of households	neighborhoods	area
53	5367	1239	Koshtargah	4	41	4178	1112	Bazar	1
113	11538	2533	Baharestan Pain	5	39	4011	921	Tape Malan	2
41	4270	995	Shahrak Daneshgah	6	93	9385	2102	Shanaz	3
Questionnaires total 380					total population 38749				

Results and Discussions

Model of assessment of environmental quality is based on special –physical, social- cultural, economic, environmental, management- governance components in hierarchical methods. Table 2 indicated priority components involved of assessment of environmental quality in the vision of the citizens and city managers. These two groups show the most important issues lower environmental quality neighborhoods Saqez City in economic, management- governance aspects.

Table 2. Prioritizing clusters of assessment in Environmental Quality for neighborhoods of Saqez City

The inconsistency index is 0.0162. It is desirable to have a value of less than 0.1		
Environmental		0.3644
special –physical (objective)		0.2007
special –physical (Subjective – Functional)		0.2004
social- cultural		0.0939
Economic		0.0588
management- governance		0.0411

Based on the results obtained from the network based model, final weights of the clusters are presented. The cluster environmental factor has the weight of 0.364, and special–physical the weight of 0.220 as more deference compared with other components, and economic cluster has the weight of 0.058, and the management-governance has also the weight of0.041 asnon- suitable situation with relative deference. Accordingly, by comparing results of clusters and nodes priorities for solutions, favorable environment areas were found in the neighborhoods of the Saqez City.

As shown in the Table 3, normal column, in fact priority of each option based on the pairwise comparisons is displayed and the most common method is to view the results. Ideal column values by dividing each of the numbers by normal column upon the largest number of columns are achieved. The value number of the selected option is always one. Weak column values are directly received from the super matrix.

According to Table 3, Shahrak Daneshgah neighborhood is has the weight of 0.305 and in the first priority, Shanaz neighborhood with the weight of 0.297 is in the second priority, and Bazar neighborhood with the weight of 0.143 is also in the third priority. Tape Malan neighborhood is on the final priorities by rating the importance in 0.057. It can be deduced that ANP method is more accurate and could be the basis for prioritization purposes. The results of this process are coincident with the results of intuitive insight.

According to the results, central neighborhood (Bazar, Shanaz, Koshtargah) have more suitable and environmental sustainability than marginal neighborhoods (Tape Malan Baharestan Pain, Shahrak Daneshgah), except Shahrak Daneshgah. According to the index Shahrak Daneshgah with ideal weight of 1.000 is in the best situation and high environmental quality than other neighborhoods and Tape Malan with the ideal weight of 0.187 is in the lowest level and environmental quality.

Table 3. Results of the analytic network process for assessments of environmental quality in urban neighborhoods of Saqez City

Name	Graphic	Ideals	Normal	Raw
Shahrak Daneshgah		1.0000	0.3057	0.0085
Shanaz		0.9716	0.2970	0.0082
Bazar		0.4681	0.1431	0.0039
Koshtargah		0.3835	0.1172	0.0032
Baharestan Pain		0.2606	0.0796	0.0022
Tape Malan		0.1870	0.0571	0.0015

Conclusions

The results of the comparative analysis in each of the six dimensions of the environmental quality in the neighborhoods suggest that the Shahrak Daneshgah has more suitability condition than Tape Malan. Tape Malan Neighborhood Priority action plan aimed at improving the quality of the environment. On the other hand, environmental quality has direct relationship with satisfaction of living in the neighborhoods. For prioritization of the indicators ANP quotient which was used to show the proportion of each factor on the environment quality. Then, ‹by multiplying the ANP quotient by the proportion of each indicator in their factor the impact of each indicator was recognized in the environment quality. In the next step, the arrangement of the priority of indicators for promotion of environment quality can be achieved by living in neighborhoods. At the end, for promotion of the environmental qualities, some solutions were recommended. The main special –physical indicators that should be considered to promote the environmental qualities are including neighborhood that is well-connected with important parts of the city aesthetic aspects of the neighborhood mixed use neighborhood center and sense of central location. The main social indicators are residents' responsibility for social interaction and participation in public activities and interaction with city managers.

Keywords: Analytic Network Process (ANP), environmental qualities, neighborhood sustainable development, Saqez city, urban environment.

Self-Organized Vegetation Patterns: Early Warning Signals for Prediction of Ecosystem Transitions

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Extended Abstract

Introduction

The significance of spatial heterogeneity in understanding ecological processes has been recognized long ago. One of the earliest expressions of this recognition is the habitat heterogeneity hypothesis that links spatial heterogeneity to niche vegetation patterns formation and species coexistence. Yet, an important if not crucial aspect of landscape heterogeneity has escaped deep consideration, that is, the possible occurrence of spatial instabilities leading to self-organized heterogeneity. Self-organized heterogeneity or pattern formation is ubiquitous in the nature. In theory, spatial patterns may provide more powerful leading indicators, as they contain more information than a single data point in a time-series. For systems that have self-organized patterns formation, there are specific signals. However, these signals tend to be specific to the particular mechanism involved and cannot be generalized to other systems. The interaction between vegetation and hydrologic processes is particularly tight in water-limited environments where a positive feedback links water redistribution and vegetation. The vegetation of these systems is commonly patterned, that is, arranged in a two phase mosaic composed of patches with high biomass cover interspersed within a low-cover or bare soil component. These patterns are strongly linked to the redistribution of runoff and resources from source areas (bare patches) to sink areas (vegetation patches) and play an important role in controlling erosion (runoff-run-on mechanism). Disturbances of such overgrazing or aridity, can alter the structure of vegetation patterns and reduce its density and size which leads to a "leaky" system. A leaky system is less efficient at trapping runoff and sediments and loses of valuable water and nutrient resources. This induces a positive-feedback loop that reinforces the degradation process. The most common vegetation pattern found in arid and semi-arid ecosystems is usually referred to as spotted or stippled and consists of dense vegetation clusters that are irregular in shape and surrounded by bare soil. Another common pattern is banded vegetation, also known as "tiger bush", in which the dense biomass patches form bands, stripes or arcs. Banded vegetation is usually aligned along contour lines and is effective in limiting hillslope erosion. Banded patterns commonly act as closed hydrological systems, with little net outflow and sediment coming out of the system. The effect of spotted vegetation on erosion is more complex and depends greatly on the connectivity of the bare soil areas. Depending on the spatial mechanisms dominated in arid ecosystems, particular changes in spatial patterns may signal whether vegetation is close to collapse into bare ground. During the past few decades, mathematical countinume models have been employed for evaluation tend of vegetation pattern as, an early warning signal for prediction of desertification transitions in the arid ecosystems. In the present paper, we describe interaction between vegetations nonlinear dynamics, environmental disturbances and different vegetation patterns according to countinume model of GILAD. Analysis of vegetation patterns can be helpful in understanding desertification.

Materials and Methods

Vegetation dynamic Models

There is a variety of models for the simulation of vegetation dynamics in water-limited ecosystems. The recent models that capture the interaction between spatial water redistribution and vegetation patterns can be divided into two main groups: the first models are discrete or individual-based models and the second are continuum models or partial-differential-equations (PDEs) models. Discrete models are numerical algorithms that go down to the level of individual plants and often describe them in great details. Continuum models are consisted of

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spatially continuous variables satisfying sets of coupled PDEs. These models are capable of describing continuous processes such as overland water flow, soil-water dynamics, erosion-deposition processes, and etc. PDE models are reaction – diffusion equations, that is, systems of PDE that combine linear diffusion with nonlinear interactions. From the implementation point of view, discrete models are formulated in terms of algorithms that are executed by numerical computations, whereas continuum PDEs models are amenable to mathematical analysis besides numerical computations. The continuum PDEs models are powerful tools for investigation of pattern formation theory.

Vegetation Pattern formation based on the GILAD model

Vegetation pattern formation based on the GILAD model is a result of positive feedbacks operating at local scale. We focus here on two important feedbacks. The first is a positive feedback between above-ground and below-ground biomass (hereafter the root-augmentation feedback) and is related to the root-to-shoot ratio, a characteristic trait of plant species (Fig. 1a). As a plant grows, its root zone extends to new soil regions where water can be taken up from. As a result, the amount of water available to the plant increases and the plant grows even further. The second feedback is a positive feedback between biomass and water (hereafter the infiltration feedback) (Fig. 2b). Bare soils in arid regions are often covered by biological soil crusts reducing the infiltration rate of surface water into the soil relative to the infiltration rate in vegetation patches. As a consequence, vegetation patches act as sinks for runoff water generated by their crusted neighborhoods. This accelerates their growth, sharpens the infiltration contrast and increase even further the soil moisture in the patch areas. Soil erosion in bare areas and deposition in vegetation patches is another mechanism that can induce or enhance infiltration contrast.

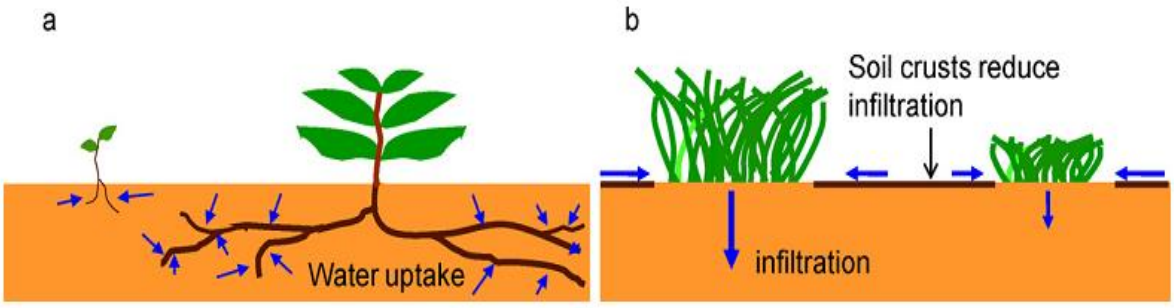

Fig. 1. Schematic illustrations of the root-augmentation feedback (a) and the infiltration feedback (b).

Results and Discussion

The model discussed in this article shows that the resource concentration mechanism predicts global bistability associated with catastrophic shifts at large spatial scales and self-organized patterns. A variety of mechanisms in ecosystems lead to resource concentration through consumer-resource feedback. The consumers, harvest resources from their surroundings and harvest are facilitated by mass flow of resources toward consumers, triggered by the consumers themselves. Furthermore, consumers spread relatively slowly as compared to flow of resources. A general pattern emerging from these interactions is that consumers are positively associated with resource abundance at short spatial range, but negatively at long spatial range. Thus, a common principle applies to these locally reinforced consumers, in that there is a positive feedback effect that is short-ranged and a negative feedback effect that is long-ranged. This is a necessary condition for self-organized patterns to form. Such scale-dependent feedback can explain a diversity of patterns in ecosystems. The differences in structure and scale of patterns are the result of varying strengths and scales of feedback influence, illustrating the general nature of the underlying scale-dependent mechanisms explaining self-organized patterns in ecosystems. The notion of scale-dependent feedback controlled by the resource concentration mechanism is crucial for a predictive theory of catastrophic shifts in ecosystems. This suggests that catastrophic shifts can be predicted by self-organized patterns. Therefore, the concepts of catastrophic shifts and self-organized patterns are tightly linked, whereby a scale-dependent feedback is triggered by resource concentration. This mechanism predicts global bistability and catastrophic shifts between spotted and uniform states. Vegetation pattern formation theory and appearance of spatially mixed and intermediate patterns in bistability systems of uniform and spatially periodic states (multitude of intermediate states in the bistability range of bare soil and a periodic spot pattern) according to GILAD model, suggests that desertification may not necessarily be abrupt, but rather a gradual process.

Conclutions

Geomorphic systems are typically nonlinear, owing largely to their threshold-dominated nature. Nonlinear geomorphic systems may exhibit complex behaviors not possible in linear systems, including dynamical instability and deterministic chaos. Linking self-organized patterns with catastrophic shifts by the resource concentration mechanism may help bridge the present gaps among theory, observation, and management. The self-organized patterns may indicate imminent shifts if resource input is decreased in time. For instance, the spotted state may be developed only when resource input is decreased, not when it is increased. This means that a snapshot in time of a spotted state would already indicate imminent catastrophic shift. Applications of the pattern formation approach to water-limited landscapes predict the possible emergence of spatial heterogeneity as a self-organization phenomenon. The predicted spatial patterns can be periodic (spots, stripes and gaps), irregular with a characteristic length scale, or scale free. The pattern formation approach provides clear criteria for the realizations of these different pattern types in terms of environmental conditions, such as precipitation rate, infiltration rate, water-ground friction force, topography and disturbances, and in terms of species traits, such as biomass growth rate, uptake rate and root-to-shoot ratio. Three values of the pattern formation modeling approach have been emphasized: 1. It reveals universal elements such as instabilities, bistability ranges, and resonant responses, for which a great deal of knowledge is already available; 2. It captures processes across different length scales and organization levels and adaptive response to environmental changes; 3. It provides an integrative framework for studying problems in spatial ecology, coupling aspects of landscape, population, community and restoration ecology.

Keywords: bistability, continume models, desert transition, early warning signals, vegetation patterns.

Developing a Pattern for Ecological Monitoring in Central Zagros Forests (Case Study: Helen Protected Forest)

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Extended Abstract

Introduction

Forest ecosystems have continuously downgraded due to every environmental pressure including climate change, aerosols deposits, industrial pollutions and other degradation factors. The output soon or late would be a different forest. Forest monitoring is a well-regulated and usually long running procedure, which has the ability to detect these phenomena and reactions based on the aims it perceives and the principals it pursues. In international agreements, the ecological forest monitoring programs, which scheduled in twenty-first agenda of biodiversity convention, titled "continuous monitoring". As a result, countries have to commence initial studies as a duty toward international obligations.

Unquestionable ecological assignment of Zagros oak forests (preservation of biodiversity, soil and water) and their socio-economic and cultural features compels due to a sustainable management plan. To do that, present and futuristic information about the structure and function of these ecosystems is in need. As long as ecological monitoring of these forests implemented, the possibility of providing this information for sustainable forest management would be possible. Therefore, in this article based on an ecological monitoring program, we attempted to run a conceptual model to illustrate the expression, structure and function of the Central Zagros forests. The fulfillment of the model creates a framework for a long term planning and brings about the necessary information for ideal and sustainable management.

Material and Methods

Helen Protected Forest with an area about 40131 ha is located in Chaharmahal-va-Bakhtiari Province in Iran. The topography of the area is mountainous and altitudes are ranged from 1168 m in Paule Armand up to 3225 m in mountain peaks. The Climate is semi-humid with hot-dry summers and cold winters with average annual rainfall of 800-400 mm and mean annual temperature of 14°C. Range and forest lands covers 30 and 10 thousand hectares of Helen Protected Forest, respectively. The dominant tree species in the region is oak, but other trees and shrubs like Astragalus, Daphne and hawthorn can be seen. Human populations inside and around the region, are comprised of 12870 people which are settled in 31 villages.

The research has carried out in two stages, including the formulation of conceptual model and fulfilling the ecosystem-monitoring program. A combination of library searches as well as field excursions generating an acceptable understanding of the region and clarifying the project goals. With the prevailing conditions in the region, in the second stage, descriptive and comparative analysis formulated the appropriate model.

In the design phase of the program, monitoring and component determination have been carried out based on successful studies in other countries. Regardless of the type of the source, ecological monitoring program in general is consisted of target determination, monitoring indices and stations. In this study, with respect to the issue of forest monitoring, several stations have been assigned and implemented, as it illustrated in Figure 1 and Table 1 to determine the matching and other components.

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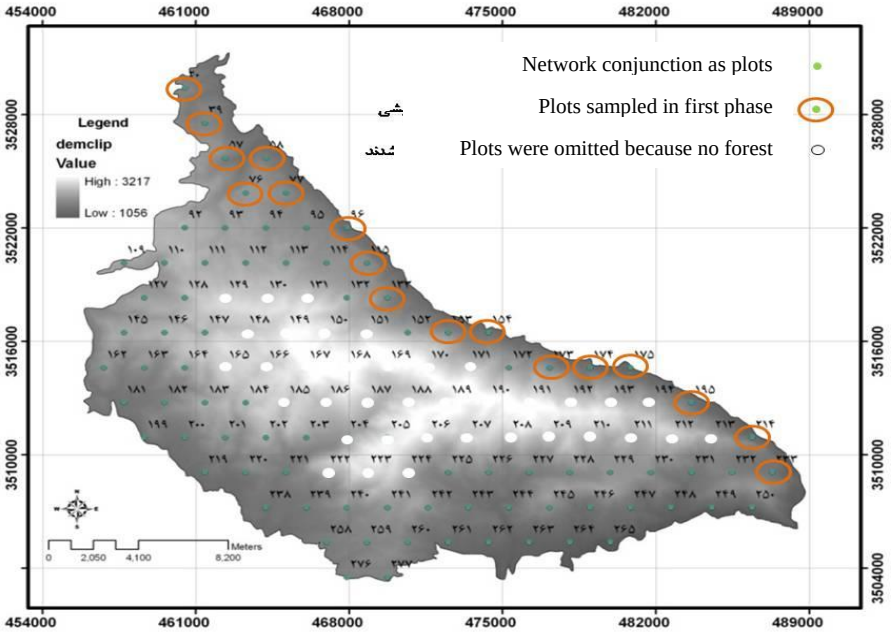

Fig.1. Locations of monitoring stations in the first stage of the forest survey

Table 1. Components of ecological monitoring of Helen Protected Forest based on different targets

Monitoring targets	Monitoring indices	Monitoring methodology	Monitoring Frequency
Forest area change	Common metrics in landscape scale (number of patches, patch average size, patch penetration and scattering)	The appropriate remote sensing images (Landsat) and use of software FRAGSTAS	Every four years
Changes in forest density	Plant indices, such as NDVI and MSAVI	The appropriate remote sensing images (Landsat)	Annually
	Tree number per area unit	Direct tally in plot	Annually
Forest health	Infested tree number in plot	Direct tally of infested trees in plot	Annually
Forest biodiversity	-Tree species richness and abundance of herbaceous, shrub, and forest floor plants -Ground insect species richness and abundance –Forest birds species richness and abundance	-List of tree and shrub species and their abundance in plot -List of herbaceous plant and their frequency in micro-plot	Annually
Forest growth and yield	-Diameter at breast height and crown diameter -Volume in hectare	Caliper and tape	Every four years

Results and Discussion

Based on the socio-economic and ecological conditions, prevailing in the region, a conceptual model is formulated for Helen Protected Forest. The dominant functional relationship between the various components and their monitoring programs is expressed in accordance with the plot locations and the indicators. Due to lack of repetition, these may not be the actual monitoring results, but as a pilot for the original calibration program are quite useful to understand the status quo. Surface area, density and health of canopy measurements showed a density of seven trees per plot and 25% foliage cover. In addition, 10 out of 17 plots had signs of infestation,

which were mainly because of oak leaf eating caterpillars. In average, 55% of the oak trees were infected to ticks, aphids or cicadas.

The numerical value of the tree and shrub species diversity, in accordance with the index of Shannon-Wiener, was equivalent to 0.4 and correspondent value for bushy and herbaceous species was 3.4.

The rate of growth and the production of trees and forests can be established by measuring changes in breast height diameter and the tree crown diameter until the next monitoring period. This is done by special relationships. Based on the monitoring pilot phase, what can now be said is that the 46.62 percentage of diameter 10-35.4 cm class implies that forest has been under pressure of clear cutting in the past.

Long term ecological monitoring in Zagros landscapes creates a promising opportunity for managers, decision makers and researchers in the field of natural resources to collect and verify data for dynamic environmental policies. Since there are records of numerous failures in long term monitoring in landscape scales, the necessity of proper understanding, especially in inter-components competence, is inevitable to avoid unwanted costs. Although the results in this study come from a portion of the protected forest where was more reachable, but the model outcome showed that destructive factors like understory cultivation create a hostile conditions for forest dynamic growth. Overgrazing and charcoal exploitation are the problems everywhere in the region. Therefore, the study recommends the expansion of the ecological monitoring to all over the protected area.

Keywords: conceptual model, Chaharmahal va Bakhtiary Province, ecological monitoring, Helen Protected Forest.

The effect of Grazing Management on Carbon Sequestration Astragalus Species (*Astragalus peristerus*) in the Fasham Pastures of Tehran

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Extended Abstract

Introduction

The phenomenon of climate change is one of the most important challenges in sustainable development, which has a negative impact on aquatic and terrestrial ecosystems. This will change rainfall patterns the power to increase hurricane and the risk of drought, flood and will strengthen pressure on water resources. Therefore, in order to reduce atmospheric carbon dioxide and greenhouse gas content balance, Atmospheric carbon should be absorbed and sequestration in various form. Our country pastures options for research on carbon sequestration projects are. Because on the one hand, many pastures in arid and semi -arid region is located which covers an area of about 90 million hectares to be included. On the other hand, according to the UNDP, the areas capable of storing approximately one billion tons of organic carbon. In recent years, the role of grasslands as a basis for reducing atmospheric carbon dioxide and carbon sequestration more important than ever given, but far more important is not a lot of research on the effects of grazing management on carbon sequestration. The present study examined the effect of management grazing and enclosure of the *A. peristerus* carbon sequestration.

Material and Methods

The study area is approximately 24 km from city Shamiran located in the North East of Tehran. The study area is 314.5 hectares. 159 hectares to preserve plant and animal species enclosure, and the levels of that is 155.5 hectares of grazing it takes. Based on rainfall data recorded can be seen that the average rainfall system Fasham station 696.2 mm. Average maximum and minimum average annual rainfall is 1321 mm and 248.5. The average annual temperature of 15.2°C, the warmest and coldest months of the year an average of 28.4 and 1.7, respectively, July and December were. The registered absolute maximum and minimum temperatures are also mentioned belong to two months and 39.8 and -11.4C. The prevailing wind in the area southwest and the average annual wind speed is 3.6 nots. The direction and speed of wind worst annual western and is 47 nots. Generally the bare earth or very shallow gravel soils with moderate to heavy texture. Soil acidity in the area between the 7.2-7.5.

After preliminary identification and demarcation of the area under study, in order to study vegetation variables, the systematic sampling was used. So that in each of the treatments (grazing and enclosoure) two transects the length of 100 m (a transect in the direction perpendicular to the slope and a transect of the slope) and along each transect, 10 plots of one square meter (based on the plants pattern) was established. To determine the percentage of dominant canopy species, a list of plants in each plot and cover plants species were assessed separately. In order to estimate above-ground biomass include plant shoots direct measurement method (cutting and weighing) was used. To determine underground biomass the root to shoot ratio were these. To this end, 10 of these were selected by the digging of the soil to the depth of root biomass was harvested roots. Then, with the total weight of the plant biomass (above-ground biomass + underground biomass) above-ground biomass and underground biomass ratio was determined. Then, with the total weight of the plant biomass (above-ground biomass+ underground biomass) above-ground biomass underground biomass ratio was determined. In order to determine the carbon conversion efficiency above-ground and underground organic carbon, the combustion method was used. For this purpose, plant samples were dried in the oven completely milled and from each of

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species, three samples (each 5 g) were taken. The samples were then weighed and electric oven at 550°C for 5 hours was. Samples (organic matter or ash) after leaving the electric furnace and cooling were weighed by desiccator. Finally, with a weight (5 g) and the amount of organic carbon, according to Equation (1), organic carbon conversion coefficient was calculated for above-ground and underground.

$$\mathrm{COC}\,\frac{\mathrm{OC(gr)}}{\mathrm{Wp}} = \mathrm{COC} \quad (1)$$

By multiplying the conversion coefficient of organic carbon in the above-ground and ground fresh weight of each species according to (2), the total weight of carbon sequestration , respectively (g per square meter).

$$\mathrm{CS}\ \ \mathrm{COC} \times \mathrm{W_p} = \mathrm{CS} \quad (2)$$

The study was a randomized complete block design. Initially, data normality by the Kolmogorov- Smirnov and homogeneity of variances was checked by the Leven test. To compare the weight of plant biomass, conversion coefficient and carbon sequestration plant in the area of enclosure and grazing were used as t-Test.

Results and Conclusions

Weight of biomass

The mean weight of above- ground and underground biomass of the species are significant differences in the two areas of enclosure and grazing there .But the biomass plant of this kind in the region, there is no significant difference. ($P<0.05$)

Conversion coefficient biomass

By comparing conversion coefficient the above- ground and underground biomass in the pasture grazing and enclosure of *A. peristerus* species has revealed that no significant difference between the conversion coefficient ratio of two organ in the region. ($P<0.05$)

Carbon sequestration

Above-ground biomass and plant biomass carbon sequestration *A. peristerus* species no significant difference in the two areas. But carbon sequestration underground biomass, a significant difference. ($P<0.05$).

Carbon distribution

In both grazed and enclosure rangeland carbon underground organ is more.

Conclusions

The management tools that influence carbon levels in rangeland ecosystems are: the intensity and frequency of grazing livestock that through grazing systems applied. Plant biomass *A. peristerus* species is allocated to a greater degree of enclosure area. Mr. Mohseni Fashamy with study carbon storage in the central Alborz concluded that enclosure the development of perennial plants and reduced annual plants is too early. Compared to carbon ratio in the treatment of enclosure and grazing *A. peristerus* not show any significant difference in the region. Livestock grazing is likely to have profound effects on the ability to store carbon in plant species *A. peristerus* is not. Conversion coefficient Carbon in underground parts ground due to more wood and less body water underground is more. This plant is one of the perennial plants. That is why it is natural that the enclosure increase of underground plant biomass and thus increase carbon sequestration more. Distribution of carbon in biomass underground *A. peristerus*, it was more than the above ground biomass. Large amounts of organic matter inputs to the soil the land grazed by organs located under the soil (such as root). Effect the upper floor disorders such as grazing, fires, etc. on the underside of soil organic matter, indirect. In general we can say, rangeland management should be multilateral management. Means a manager, maximum rangeland production, maximum animal production, sustainable use, management of soil erosion and the carbon sequestration should also consider and coverage range will lead to the side that won all of the above at the same time. If biomass is increased with moderate grazing, due to higher amounts of organic matter to the soil system will increase the carbon in pasture. After the conclusion, a balanced grazing capacity is the best option for pasture management as with the exploitation of the natural resources, the benefits of carbon storage and carbon sequestration and the mitigation of global warming benefit. It should be noted that the enclosure of soil and vegetation in pastures that are in the waney, it can be effective to deploy and protect the soil until later in the pasture ready for principles operation.

Keywords: *Astragalus peristerus*, carbon sequestration, enclosure, fasham pasture, grazing.

Spatio-Temporal Analysis of Environment Quality of Ecotonal Zones in Iranian Central Plateau Using Landscape Ecological Metrics

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Extended Abstract

Introduction

Environmental changes can be monitored at many scales but the scale of landscape and region has more information in support of sustainable spatial planning. The availability of remote sensing imagery provides multi-scale observation with periodic repetitions over time. Landscape and regional scales are adequately covered by satellite images. Remote sensing images provide non-average and dis-aggregated data suitable for sustainable environmental planning. The spatial arrangement of elements influences horizontal flows and movements across land mosaics. Hence, modification of landscape affects directly the ecological processes, flows and movement. Coarse-scale monitoring focuses on the structural composition and spatial configuration at the scale of landscape or region.

Advances of environmental planning and management in the last decades can be described as two dimensions: 1. theoretical shift that has happened in the methodologies of the study of natural and cultural systems. Systems approach and nested hierarchical organization are the core concepts of this novel paradigm. Moving across scales is the most important strategy to cope with complexity, nonlinearity, and copious feedback loops of ecological systems. 2. The technological developments that have enhanced the efficiency of data collection, surveying, analysis and synthesis. Remote sensing and satellite imagery technology have granted synoptic and updated digital data and improved availability and accessibility of materials for spatial and temporal investigations. GIS and spatial information systems have promoted the application of techniques of analysis, simulation and modeling.

Spatial indices are quantitative tools for detection of structural pattern of land mosaics. The indices indicate three main aspects of landscape transformation, including loss, degradation and fragmentation. The structural pattern of the landscape can be measured in two main dimensions, i.e. composition and configuration. Composition indices quantify number, type and extent of elements, but the configuration indices measure spatially-explicit attributes, namely arrangement and layout of elements in the mosaic. The temporal dynamics of land mosaics could be monitored by means of a comparative approach and variability of the landscape indices. The variability of the indices over space-time dimensions could serve as a bridge between spatial pattern and ecological functioning.

The spatial-temporal monitoring of landscape can act as a decision support system and is a prerequisite for diagnosis of adaptivity and resilience. Coarse scale monitoring of heterogeneous environment by measuring landscape ecological indices can help enhance the efficiency and the effectiveness of land use decisions.

Iranian landscapes

The high and arid plateau of Iran is composed of diverse and contrasting environments. Iran's diversity in climatic conditions and its rich biodiversity and ecosystems are rooted in its unique geography. Iran is a typical high mountain country situated within the dry belt of Asia. Half of Iran is composed of high mountains. The Iranian high mountains are a rather continuous chain especially at the Elburz and Zagros which enclose Iran in northwest-northeast and northwest- southeast directions. The temperature in Iran is characterized by relatively large annual range about 22°C to 26°C. The rainy period in most of the country is from November to May

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followed by dry period between May and October with rare precipitation. The average annual rainfall of the entire country is about 240 mm.

Objectives

The mountainous matrix in Iran has created specific conditions, constraints, opportunities and advantages. Sequence of different altitude zones in the upland to lowland (or mountain to desert) continuum can be regarded as an association of landscapes. Most human settlements and large metropolitan areas are placed on the mid-altitudes between mountain and desert. Current share of urbanization in Iran is more than 71.4 percent and the annual growth rate of urban population in the last decade was 4.69 %. Urbanization growth has caused the sprawl of urban areas upwardly into the ecotonal foothills (the zone between high- and mid- lands) and has transformed the structure and function of this strategic zone. These Foothill zones connect mountains in the upland to the plains in the midlands. This ecotonal band serves as an interrelation joint between high and mid altitudes. The main goal of this study is to investigate the ways of connection, relations and changes in this ecotonal strip. However, Specific objectives of this study are: 1. applying landscape ecological concepts in evaluation of the ecotonal environment; 2. retrieval of land covers using Landsat images of 2000 and 2013; 3. calculation of spatial indices of landscape and analysis of spatial distribution of patches mosaic; and 4. monitoring and tracking the landscape changes over time by means of spatial indices.

Materials and Methods

Study area

Study area of this research is the ecotonal zone between up-land mountainous areas and mid-land plain in the southern slopes of the central Elburz region. Tehran-Karaj region placed on the southern slopes.

Data

Two satellite images of Landsat 8 OLI (2013) and two images of Landsat 7 ETM+ (2000) are used to capture land cover classes. Considering natural conditions and urbanization impacts, the ecotone strip is longitudinally divided into four zones: (1) north Tehran to Kan River; (2) Kan River to Karaj River; (3) Karaj River to Kordan River; and (4) Kordan River to Abyek. Analysis is performed zone-specifically using ArcMap (Version 9.3, ESRI) Zonal Statistics in Spatial Analyst Extension.

Land cover classification

We classified land covers into four main groups: vegetation covers, anthropogenic impervious surfaces, open spaces, and water bodies. The supervised method with maximum likelihood is applied to classify the satellite images.

Calculation of landscape indices

We used the eight landscape indices to quantify the spatial pattern of the ecotone zone in the southern slope of Elburz. This study considers each land cover as a patch. Landscape indices are as follows: NP (number of patches), CAP (class area proportion), MPS (mean patch size), AW-MPS (area-weighted mean patch size), TE (total edge), PARA (perimeter to area ratio) and MNND (mean nearest neighbor distance).

Results and Discussion

Our results indicate the measurement of indices for the years 2000 and 2013 in total landscape and sub-landscape as well as class levels. At the 13-years period from 2000 to 2013, land covers in the ecotonal belt have been changed as follows: vegetation changed from 12.8 to 8.53 percent; open class from 51.43 to 38.55 percent; and built class from 28.73 to 52.59 percent. Class area proportion of vegetation (*CAP_Veg*) in the entire area declined by 2000 to 2013.The same trend has also occurred in all other zones. Maximum and minimum changes of vegetation class have taken place, respectively, in zone 1 (North of Tehran) with 22.61 % and zone 4 (Suburb of Karaj-Qazvin) with 14.07%.

Total *NP_Bui* increased from 636 to 1155 during the period of 13 years. Interesting point was the reduction of *NP_Bui* in the zone 1 (from 202 in 2000 to 140 in 2013), contrary to the general trend of increase in other zones. This is due to the expansion of the built patches and then joining them together. This change is called a transformation of the contextual matrix. The highest value of *NP_Bui* was in zone 4 (212 for 2000 and 737 for 2013).

The mean patch size (MPS) is calculated as the division of the total area to the number of patches. Throughout the area, MPS descended from 36.97 in 2000 to 19.62 hectares in 2013, which are a result of the elevated numbers and the declined areas of patches. These are also signs of fragmentation process.

The arithmetic mean patch size (MPS) carries the same weight for all patches, but the area-weighted mean

patch size (AW_MPS) exerts the weight of each patch through the ratio of the patch area to the total area. When the variance of sizes is high, arithmetic mean cannot be a good description of the actual condition, but area-weighted mean can offer the better understanding of the landscape state. AW_MPS in the entire area was 8998.87 ha in 2000 and increased to 16685.13 ha in 2013. The extremes of AW_MPS in 2000, in order, were zone 4 (with a value of 13328.09 ha) and zone 2 (2915.71 ha), which changed to zone 1 (with a value of 11104 ha) and zone 2 (with 3476.89 ha) in 2013.

Conclusion

Generally, the landscape *indices of NP, CAP_Bui, AW-MPS, TE, PARA* and *MNND* had increasing trend during this period, but *MPS, MNND, CAP_Veg* and *CAP_Opn* declined from 2000 to 2013. *MNND_Veg* and *MNND_Opn* rose over time. This indicates the highest degree of fragmentation, but *MNND_Bui* is decreased showing that connectivity is increased. In the whole area *NP_Veg, NP_Opn* and *NP_Bui* had increased value between 2000 and 2013, which is a sign of fragmenting.

The results of this research show that 32.93 percent of the ecotonal zone has changed during 13 years (2000 to 2013). Vegetation covers and open spaces were the main source of land cover conversions and built area was the ultimate sink of conversions. The explosive trend of urbanization in the ecotonal zone signifies that regional inter-relations have been altered within upland-lowlands continuum.

Local scale changes could only be perceived if the wider geographical context and its choric relations are taken into account. Broad scale monitoring with satellite images can be linked to a local scale monitoring to form a monitoring network of environment on many scales. Monitoring of landscape condition and its changes over time is a necessary tool for land use decision and spatial planning. Determining the state and trends of landscape elements are necessary for a better understanding of the ecological resources.

The ecotonal zone between two major landscapes (mountain and glacis) along highland-lowland continuum system acts as an intermediate connector. This has many ecological services at several scales. Ecotones are ecologically significant area for monitoring of environmental quality. Ecotonal belt formed at the foot of the mountain is more diverse than the surrounding context and have to be treated as a strategic location for monitoring of environmental quality.

Keywords: Geographical Information System (GIS), landscape ecology, remote sensing, urban region of Tehran-Karaj.

Classification of Bio-Pollution Caused by *Mnemiopsis leidyi* on Habitat Traits in Southern Parts of Caspian Sea

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Extended Abstract

Introduction

Since 1980s, the *Mnemiopsis leidyi* (*M. leidyi*) was affected on the Black Sea ecosystems. This invasive species has a negative impact on many fish biomass of the Black Sea due to competition feeding on edible zooplankton and fish eggs and larvae of Anchovies. At the same time, the possibility of arriving was estimated into the sensitive ecosystems such as the Caspian Sea. Then, this species was observed in the Caspian Sea during November in 1999. In the Black Sea, some details of impact of *M. leidyi* were studied on communities, habitats and ecosystems and ultimately "biological pollution levels (Bio-Pollution Level, BPL) during arrival, establishment, and expansion and adjustment process from1980 to 2000. In this assessment, impact of invasive species on communities, habitats and ecosystems were classified into five groups (no effect, weak, moderate, strong and extreme). In the recent years, *M. leidyi* was making problems such as reducing the amount of zooplankton, an increase of nutrients at water column and snow bed (Eutrophication). However, no quantitative estimation has been done for ranking the impacts in the Iranian basin of Caspian Sea. Therefore, this study is conducted to evaluate the impact of *M. leidyi* on habitat in term of environment parameters.

Materials and Methods

Data of physic-chemical parameters (as habitat straits) from 1996 to 2011were applied in this research. These years were classified into two groups: before introduction of ctenophore (1996-2000) and after introduction of ctenophore (2001-2011) and also these two periods were grouped into three assessment periods which included the years of 1996-2000, 2008-2011 and 2008-11, respectively. In this study, the years before the introduction of ctenophore is considered as a un-disturb ecosystem and the data for these years used as reference data (Reference Value). The maximum studied depth was also 20 meter; it is because of the high density of ctenophore which was recorded up to 20 m deep.

A variety of habitat modification activities of alien species may be ranked from no noticeable alterations in benthic or pelagic environment to massive impacts causing irreversible changes. These are classified into five groups: no habitat alteration (H0), alteration of a habitat (s) but no reduction of spatial extent of a habitat(s) (H1), alteration and reduction of spatial extent of a habitat(s) (H2), alteration of a key habitat, severe reduction of spatial extent of habitat(s); loss of habitat(s) within a small area of the assessment unit (H3) and loss of habitats in most or the entire assessment unit, loss of a key habitat.

Results and Discussion

Since the late 1960s, like many marine environments, increasing anthropogenic activities has been a major cause of instability and disturbance in the Caspian Sea environment, therefore, the *M. leidyi* restructured not only increase in its distribution in the Caspian Sea but also it sometimes will have high abundance. The present paper was conducted to change habitat of the Caspian Sea, namely in terms of physicochemical parameters and

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nutrient in the south Caspian Sea region over coastal areas of Iran which are examined quantitatively (numerical).

Environment parameters showed obvious changes after introduction of *M. leidyi* to the reference value (years before introduction into the Caspian Sea). The statistical analyses showed the significant difference among mean values of physico-chemical parameters ($P<0.05$) during 3 defined periods. Meanwhile, in T-test, significant difference of parameters is observed between before/after introduction of *M. leidyi* into the Caspian Sea. The excretion of nutrients and secretion of mucus by *M. leidyi* could increase the nutrient content of Caspian Sea. However, the nutrient content (except organic nitrogen) showed decreasing trend from 2008-2011. It was due to consumption of the nutrient by massive phytoplankton reproduction in the years. High abundance of primary producer and photocentetic organisms increased the water oxygen dissolved and carbon dioxide. However, pH of water didn't change significantly due to high buffered water of Caspian Sea. Large part of excretion material by *M. leidyi* is contained of dissolved organic carbon and nitrogen and a little part is from organic phosphorus. Meanwhile, rate of phosphorus turnover is faster than carbon and nitrogen elements. Thus, as it was expected, inorganic phosphorus decreased and organic nitrogen increased from 1998 to 2011. *M. leidyi* can affect quality both in water and sediment and change the habitats. Meanwhile, these two habitats (water and sediment) have mutual effects.

The expected levels of organic matter was increased in the bed with a bed of snow (create mucus from *M. leidyi*). Although, the information related to the percent of the total organic matter was not completed and there is a lack of information especially in the early years of the second period (the years 2001 and 2002), but its percentage increase since 1998 (the first period) to the year 2003 (second period). Although, compared to the year 2003 a decline is observed, but the data are not substantially decreasing relative to the reference values.

In fact, slope of trend lines showed slow changes in each parameter in figures, but comparative values of the environmental parameters changes more clearly in the year before introduction of *M. leidyi* (Reference value). Impact on habitats and ecosystem process became evident at later stages of an invasion. As the results showed, even at the presence and bloom of ctenophore the impact on habitat is classified in H0 during 2001-02. Evidences of impact on habitat is increased over the years and shifted to the ranks H2, H3 and finally H4 during 2005-06. Even in this period, biomass of big eyes and anchovies of fishes are severely destroyed. In the adaptation phase (2008-2010), habitat changes were classified from H2 to H3 according to the decreasing of ctenophore density.

Evaluation of South-Eastern and Eastern regions of the Caspian Sea indicated that this part of the sea based on habitat features. It was ranked H0-H4 in 2004, and the effects of *M. leidyi* were multiple levels and it was the expression of biological contamination. Similar condition showed that the stage adaptation of the Black Sea occurred in 2000 about 20 years after the introduction of the *M. leidyi* in the Black Sea. Also, because of differences between the Black Sea and the Caspian Sea such strong predatory *Beroe ovate* are feeding *M. leidyi* a significant decrease since 1997 in the Black Sea. The abundance of *M. leidyi* was reached the maximum level in the Caspian Sea until 2002. The maximum level of *M. leidyi* was registered about 7 years after the first observation of invasive comb jelly in the Black Sea, while this condition was happened about 3 years after the first introduction of *M. leidyi* in the Caspian Sea.

Some studies showed that the maximum rate of invasive *M. leidyi* in the Black Sea in 1989 is coincided with the expansion of the fourth level of pollution or habitat (H4), respectively. The fourth level of pollution (H4) in the Caspian Sea in 2006 was calculated about four years after the expansion of the *M. leidyi* (in 2001 and 2002).

Shorter time to reach various stages of habitat pollutions and the biological contamination level (BPL) in the Caspian Sea compared to the Black Sea indicates that the Caspian ecosystem is very fragile due to its semi-enclosed compared to the Black Sea which is connected to open Seas.

Conclusion

There are some evidence about the increases of eutrophic level (from oligotrophy to meso-eutrophy), increases of dissolved oxygen, algal bloom, increases/decrease of Shannon diversity index in phytoplankton/ zooplankton and increase of sediment-feeders of macro-benthos in different years of third period of study (2007-10). This indicates the stress and disturbance in Caspian Sea environment. The engineering of these events was mainly by M. *leidyi.* In Caspian Sea, maximum abundance of M. *leidyi is* observed in 2001-2 (about 3 years after the introduction of the invader) and class H4 is calculated for years of 2005-6, approximately 4 years after *M. leidyi* blooming in 2001-2. While in the Black Sea, the maximum abundance of *M. leidyi* and class H4 of the impact were happened 7 years after arrival of the invader into the ecosystem. It seems that the semi-closed system of the Caspian Sea is more sensitive than Black Sea.

Finally, there are other factors of impacts including an increase of sea level, river flows fluctuation, oil and gas production, chemical pollution, eutrophication, and other biological invasion, diseases, natural tectonic

activity and climate changes on habitats and ecosystem of Caspian Sea. These factors have overlap with the biological invasion of *M. leidyi.* Therefore, the scaling of these factors and determination of their weights in impact process is key tasks of a regional habitat protection of the Caspian Sea.

Keywords: Caspian Sea, ctenophore invader, habitat, Iranian coast, physico-chemical parameters.

Comparative Study of the Environmental Challenges in Core Areas, Medial and Periphery Cities (Case Study: Two Regions, 11 and 22 in Tehran)

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Extended Abstract

Introduction

The current environmental challenges one of the main concern of is humanity. The issue of when more added concern has been associated with complications. Research suggests the environmental challenges are rooted in factors in the different levels of global, regional and local levels are considered. In this case although many studies have been in different aspects of urban environment is done, but a new look spatial and geographical view could be new dimension of factors and environmental impact it makes evident.

Extent of existing pollution, in the urban areas of boundaries traditional pollution exceeded. Today in the environmental science of pollution study of the due to advances in industry and technology as has become the most important issues of the day. It seems, the different urban spheres (center, intermediate tissue or periphery areas) In Tehran with different degrees of invasion of the adverse environmental effects and risks have been, so that residents and the physical body exposed to damage and injuries are placed unwanted. Tehran city one of the most polluted cities in the world. In the current situation of country which Tehran as mastermind behind and management country is considered and pollution Tehran has become a regional and national issue. It cleans the air not only the health of in Tehran but also increases the country health.

The aim of the present paper compares the environmental challenges in tissues of central, intermediate and peripheral in the metropolis of Tehran.

Materials and Methods

Research Methodology In this study, a descriptive study - analytical and research type applications and approach of, it is both quantitatively and qualitatively. Data collection research needed of through studies of library and use of documents the data collected by field by the relevant organizations and also the use of Projects was carried out the relevant in the three regions (2-11-22) in Tehran.

Assess environmental challenges mentioned areas in three phases hierarchically and systematically is done, is provided below. It is notable that the three stages of the form expanded in the section analysis have been expressed.

Stage First: determine the parameters types of pollution (air, water, soil and noise) and weighting their importance

Stage Second: normalizing and determine the severity of the amount of pollutant parameters in the three regions

Step Three: Determine the relative intensities the amount of pollutant parameters and calculate the final score in three regions

Results and Discussion

For a better understanding of the environmental challenges in the three regions (2-11-22) Tehran, Type of pollutants Mentioned areas individually, based on the source and origin of pollution (natural– human), Causes of aggravating of the pollution the effects of pollution on various factors like humans, plants, animals, and the urban fabric (buildings) are described.

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Based on the results of the calculations, the final score Air Pollution in the zone 11, weighing 409.34 Than Zone 2 and 22 Has the greatest pollution. Regions 2 and 22 Respectively 316.76 and 273.90 with weights have acquired. Region 2 Also air pollution is high. But Region 22 Better conditions than other two regions. But the main factor of Higher air pollution in the Region 11 Caused by There are extensive sources of carbon monoxide, sulfur dioxide and industrial workshops, The high production rate and attraction trip And so is above area.

In terms of pollution of water and soil, Region 11 with a score of 553.8 most contaminated Shows, Region 2 with a score of 304.0 in the second row And Region 22 with a weight of 142.2 the lowest of pollution is placed in the third level.

In terms of noise pollution, at Region 11 with a score of 492.88 from most Noise pollution indicate, Region 2 and 22 respectively with scores of 305.06 and 202.06 in the next rows are placed. The main causes of Cars More traffic because the focus of medical centers, educational, administrative and commercial 11 regions is (Fig. 1.)

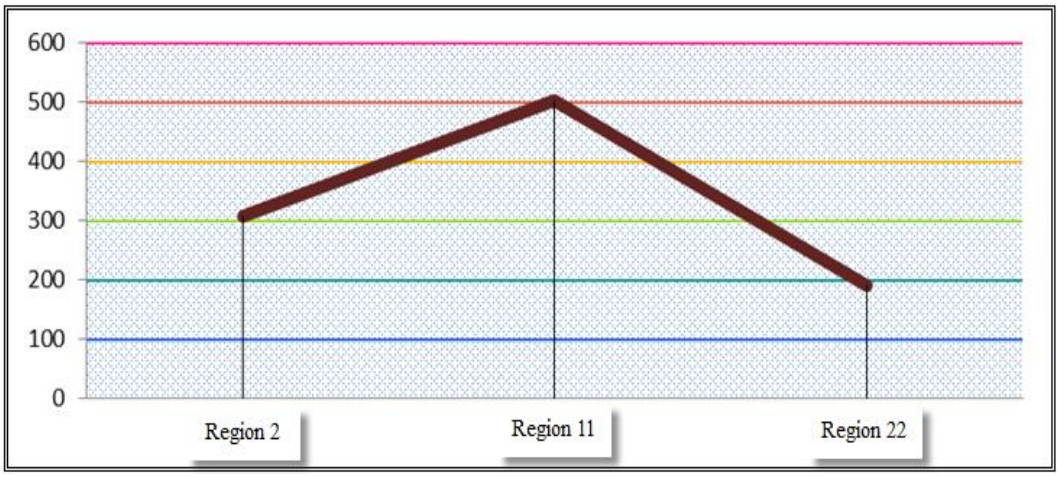

Fig. 1. Average weight challenges of biological (air, water, soil and noise) of the triple (2-11-22) in Tehran

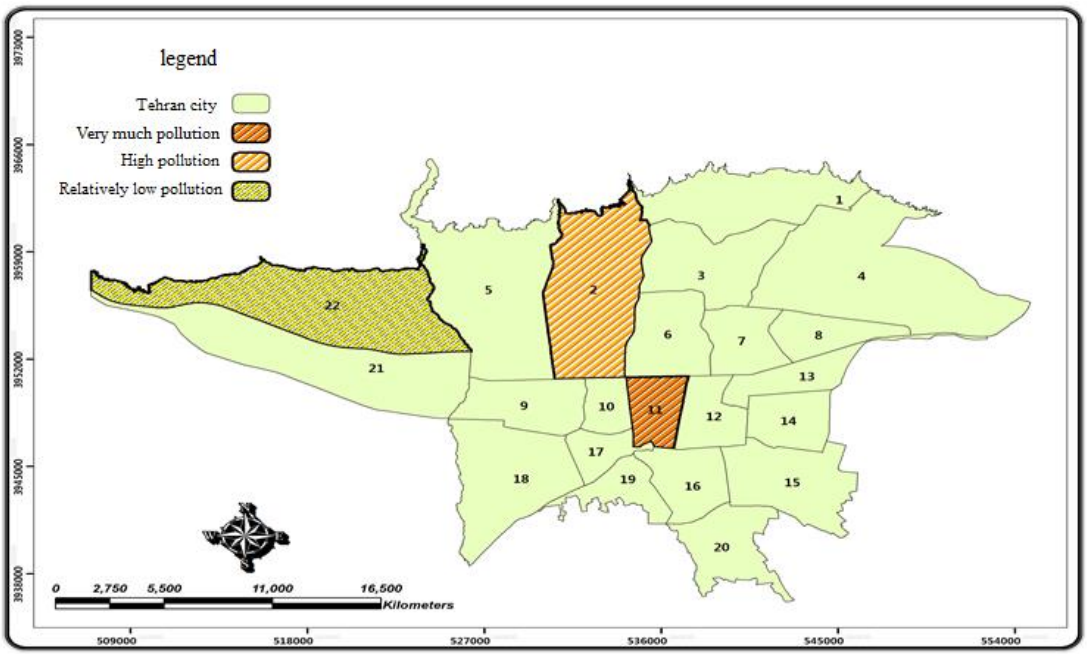

Fig. 2. Status of challenges of biological in the triple (2-11-22) Tehran

Conclusion

The growth urbanization and excessive use of fossil fuels in cars industries in the city become to intensify environmental crises in urban areas. Currently, environmental challenges one of the most fundamental concerns of urban human society especially for urban specialists is considered. Thus, studying the environmental challenges of urban community one of the necessities understanding urban issues the current situation is. With a vision and a deep understanding from situation in urban environment more fundamental steps to fix environmental challenges to achieve a city high environmental quality to be removed.

The results of this research show the region 11 with the acquisition the highest final score the 502.455 environmental pollutions most is. Region 2, with a final score of 307.455 with the a small distance in the second row and district 22 with the final score of 190.09 in the third row takes place The district 22 Relatively favorable conditions of environmental is.

Most causes of contaminants region 11 in Tehran than regions 2 and 22, due to exposure in a specific geographical location and establishment of the central part of the urban and followed the presence of high levels of pollutants such as produced and attracted high of travel, most industrial workshops, production of aerosols, production of carbon monoxide and other polluting sources of direct and indirect The essential role of in the environment it is undesirable to play. Actually region 11 than the 2 and 22 per unit area most pollution of air, water, soil and noise in Tehran is produce.

Keywords: comparative study, environmental challenges, source pollutants, Tehran, urban regions

Definition Expression on the Concept of Urban Ecotourism through Theoretical Review of Related Challenges

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Extended Abstract

Introduction

To explore the basis of ecotourism, we should look for the basis of literature concerning the tourism development and emersion of sustainability though it. Tourism planning has progressed over this period after the WWII, with a detonation of economic and marketing ideas coming to tourism planning. Thus, it is called "Boosterism" which we cannot consider it as a model of planning at all and model of "Mass tourism" with the belief of "the more is the better" was the best idea for its tourism development. Economic approach, with marketing techniques as its tolls is the next step in tourism development. During the 1970s, the results of tourism development proceeded, was an uneven distribution of benefits, and recognition of multitude of negative tourism's impacts became more evident, so the question of development raised up as "growth paradigm" which referred "cautionary perspective" to this school of thought which this perspective might be considered as the physical/spatial planning tradition. The summery of evolution in the Think/Idea, Model and Tools in Tourism development after WWII are mentioned in Table 1.

Table 1. Evolution in the Think/Idea, Model and Tool in tourism development after World War II

	After WWII and 1960's	1970's	1980's	1990's	After 2000
Type of Idea and Think	• Boosterism	• Paradigm of growth	• Ecology and economic interaction	• Environmental concerns as development indicator	• Sustainable development
Tourism Model	• Mass tourism	• cautionary perspective	• Soft tourism	• Sustainable nature-based tourism • Sustainable tourism	• Sustainable tourism
Development Tool	• Marketing • Development in more tourism construction	• Physical / spatial planning tradition	• considering instead development in weak social areas	• Small scale development in social, cultural and nature oriented	• Education, nature conservation and local/regional market empowerment
Position of ecotourism in this stage	instead of mass tourism in reducing impact on the environment, maximum social respect, economic revenue			As a special type of tourism with local social structure and environmental preservation and also previous definitions.	

During the 80's decades there are a great discussion between the tourism planning literature and language of marketing to prolong the destination's growth stage. In late 1980, the theorizers described the model of "soft tourism" and considered it as the new development model instead of mass tourism. Also during this period "responsible tourism", "green tourism", and "appropriate tourism" introduced as new terms. The concept of

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sustainable tourism was bring together in the late 1980's by the tourism industry's reaction to the Brundtland report on sustainable development following the WCED in 1987. Some explains that conference report "Our Common Future" as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

All above discussions and critics replaced by the Rio Earth Summit in 1992, that marked the beginning of a worldwide commitment which replaced Sustainable development (as a right in Agenda 21) must be applied in a way that respond to the social and environmental needs of current and future generation. But the problem was it is ignored on the working agenda and three pillars. In Barbados Conference it was for the first time that "sustainable tourism" and "nature based tourism" recognized as the branch of the sustainable development in final dissertation and action plans, and also ecotourism, economic growth and environmental preservation introduced as sustainable tourism development elements in all conference branches.

Discussion and Results

The article, explore the discussion on ecotourism through an expansion of its meaning starts from the Hetzer states about "ecological tourism" and then other theorizers, and then explore discussion about "the concept of ecotourism" through the viewpoints of some critic. They all can be concluded as below items:

- Sustainable use of biodiversity and natural resources;
- Impact minimisation, both upon the natural and socio-cultural environment, especially in therms of climate change energy, energy consumption and traditional cultures;
- Empowerment and fully informed participation of local stakeholders, particularly local communities and indigenous peoples;
- Awarness-raising and environmental education of all stakeholders, especially travellers and hosts;
- Lasting economic benefits for all actors.

In comparison of the meaning and concept of ecotourism, we have one important question: why "small scale" and "the exact location-the location where action of ecotourism occurs" is not mentioned in above five elements? By literature review, it is obviously that although there is no great dissension between theorizers but there is not any common agreement on the discussion about that question too. There is a discussion about comparison of the mass tourism and soft tourism and he conclude that mass tourism ought to be useful for preserved areas, so it can be rejected the small scale. Also it can be drawn two polar of extremes for continuum of ecotourism paradigm. One pole is the view that all tourism (including ecotourism) has negative impacts on the nature...Conversely in the other pole, human are viewed as living creatures (as it called fauna) – whose behavior and activities is inevitably "natural" … so therefore human behavior is "natural". As the human is part of the "natural process" and, as a result, they are literally unable and powerless to act and behave unnaturally. Therefore, no differention between ecotourism and other models of tourism in terms of their "naturalness" and thus, all ecotourism is tourism and conversely. This argument shows that there are no common agreements on the scale of ecotourism. So as it concluded in article three items can be considered as the common agreement on the concept of ecotourism:

- Environmental/Biodiversity conservation and reduction of travel and development impacts;
- Local economic empowerment;
- Education through ecological and cultural Travel and experience.

After 1990's decade correlated with the world acceptation on the definitions of ecotourism, the experimental activities tried to implement the concept of ecotourism in the urban area. This pragmatically activity starts with the activities of Green Tourism Association (GTA) in the city of Toronto in 1996. The next important step was the first international Urban Ecotourism Conference hold in in 2004, in its declaration, it respect Urban Ecotourism as an ongoing opportunity to conserve biological and social diversity, create new jobs and improve the quality of life and delivered declaration by these four goal as it deliberately defined by Planeta:

- Restoring and conserving natural and cultural heritage including natural landscapes and biodiversity, and indigenous cultures;
- Maximizing local benefits and engaging the local community as owners, investors, hosts and guides;
- Educating visitors and residents on environmental matters, heritage resources, sustainability;
- Reducing our ecological footprint.

In the article it discussed ideas and implemented project according to the urban ecotourism. All those projects have this hypothesis that urban ecotourism is an applied idea so all of them try to implement their ideas by experiment them in a real urban region. According to all of them, urban ecotourism is an opportunity to conserve our urban areas and make it more sustainable. Some experimental articles is tried to define the dimension of urban ecotourism using fuzzy numbers construction. They tried to introduce an alternative approach, the fuzzy number construction approach, to construct Sustainable Urban Ecotourism Indicators System (SUEIS), which

may contribute to the understanding of urban ecotourism, and to excavate the discrepancies of urban ecotourism and traditional ecotourism. The most important thing is that a relative unanimity is in the urban ecotourism theorizers article and case study. Constituents of their principles includes the concept of ecotourism which deployed expressions like these in their work. The concept of urban ecotourism consequence of the experimented and discussion can be draw in a diagram as below:

Fig. 1. Dimension of urban ecotourism

Conclusion

Most of the theorizers believe that urban ecotourism is a Contradiction in term. In this regard there are some practitioners who implemented the ecotourism in an urban region. Conversely, the group believed in urban ecotourism, predicate others as “traditional ecotourism” and try to deduce theirselves. In this article by discussion on evolutionary configuring the concept of ecotourism, it tries to consequence that there is no differention between two groups. In the other hand, the urban ecotourism is not a new paradigm and according to their pragmatist approaches it depends on the three main concept which those are as same as the ecotourism. While urban ecotourism is a burgeoning subject in the research of ecotourism, more attempts are needed to interpret the contents of urban ecotourism.

Keywords: urban ecotourism, urban planning, sustainable development, tourism planning, urban ecology.

Relations between Climate and Human Comfort in Urban Environment Using Neurotic Pressure Index (Case study: Tehran City)

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Extended Abstract

Introduction

Climate affects, more than any other factors, the type and form of human life, so that many cities that have been made or developed regardless of climatic properties are suffering from weather-related problems such as air pollution, water supply, flooding and etc. Using the meteorological information in designing new cities as well as developing old cities can reduce many climate related problems. Human comfort condition, based on the definition, is a thermal condition comfortable for at least 80% of people. Regarding the high impact of climate on human comfort, the humankind has always been looking for a suitable usage of the local climate. There were many researches about the comfort conditions in different cities of Iran. It was investigated about the effective bioclimatic indices over human comfort in Shiraz City. The results of the research showed that Shiraz with various bioclimatic conditions holds a warm to very cold climatic conditions throughout the year. Some attempt was made to study the climatic comfort index in Boushehr City. The findings of the study from THI index indicated that the months of April, May, November, December, January, February and March are appropriate in terms of climate comfort for human. Investigation on the thermal comfort was made in Shahrud-Semnan from military viewpoint. In addition, the effect of climate on the architecture of Qom City was also carried out by attempts to classify the climate based on effective parameters on life quality in Markazi province. Therefore, with high impact of climate on the human comfort as well as the spread of urbanization, the comfort conditions are studied in the megalopolis city of Tehran in this research.

Materials and Methods

Tehran city, in terms of climatic classification, possesses a warm and dry climate with an annual mean precipitation of approximately 250 mm. The Figure 1 shows the location of the study area and indicates climatology stations used for the investigation.

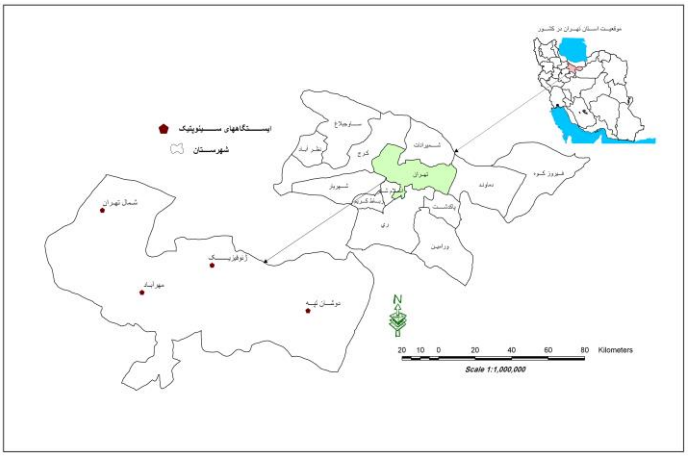

Fig. 1. Geographical position of Tehran City and the stations under study

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In this research, the relations between three elements of temperature, relative humidity and wind speed is identified for 2 periods of 15-years from 1976 to 2005 for the selected stations in Tehran. These data are studied using neurotic pressure index. This index is aimed to explain the level of comfort using temperature, humidity and wind. The index is stated as follows:

$$C_I = I - d_I$$

where C_I is the digital index for comfort; I is the effective temperature and humidity index supposing a calm weather; d_I is an index that adds up the effect of the surplus coldness resulting from the air motion

I and d_I are obtained from the following equations:

$$I = (0.5 + U^2 \times 10^{-4}) \times (T - 80 + 0.11U)$$

$$d_I = -0.35V^{0.5}(20 + 0.5U - 0.2T)$$

where T is temperature in Fahrenheit; U is relative humidity in %; V is the speed of wind in knots.

After obtaining digital index for comfort (C_I) from the above relations for finding the heating rate, the Table 1 will be used.

Table 1. Grading index for comfort related to humid in warm climate

index for comfort (CI)	Heating rate
Below -5	Cool climate with uncomfortable condition
Between -5 and -1	Cool climate
0	Comfortable condition
Between 1 and 5	Warm with comfortable condition
Between 6 and 10	Warm with uncomfortable condition
Between 11 and 15	Uncomfortable condition
Above 15	Fully uncomfortable condition

After estimation of the coefficients of the neurotic pressure index, a zonation was carried out for better indicating of the variation of the heating index for comfort in Tehran. With this objective in this research, the existing methods including spatial interpolation, spatial analysis for data related to stations and Inverse Distance Weighting (IDW) were used. Similarly in this methodology after defining the coefficients of the neurotic pressure index for the two 15 periods including warm and cooling conditions, the index for comfort was extended to surface level and finally by using map of comfort variation by GIS software (Arc Map). The zoning map was developed as indicated in Figures 2-5.

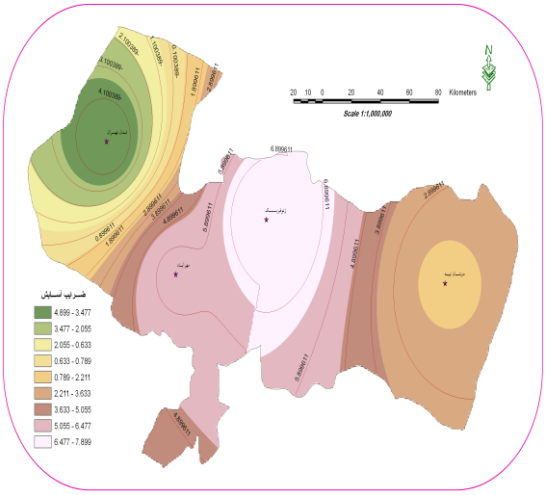

Fig. 2. zoning of the coefficients of the neurotic pressure index for first warm period

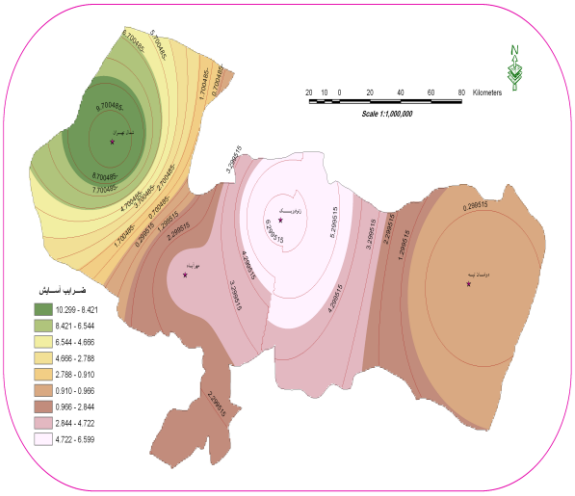

Fig. 3. zoning of the coefficients of the neurotic pressure index for second warm period

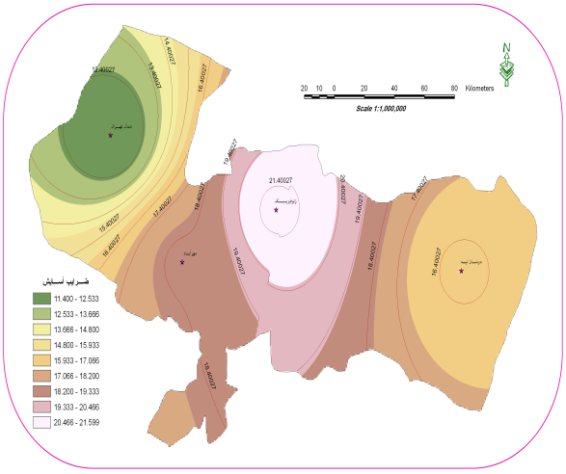

Fig. 4. zoning of the coefficients of the neurotic pressure index for first cooling period

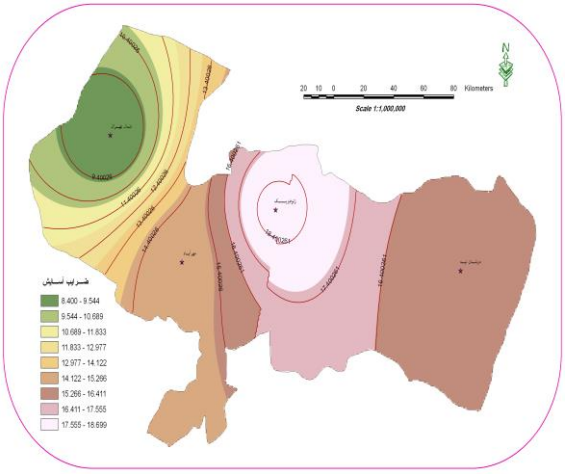

Fig. 5. zoning of the coefficients of the neurotic pressure index for second cooling period

Results and Discussion

The coefficients of the neurotic pressure index were evaluated for the selected stations for a 2-period of 15-years in different months of the year. The findings indicated that during the first period the thermal phase in the months of January, February and December was cold and with lack of comfort, so that the stations in the North of Tehran didn't have comfort conditions during the cold period of the year. In addition, during the hot periods of the year the months of May, June, July, August and September also possessed a thermal phase with a lack of comfort to absolutely lack of comfort. Meanwhile, the months of March and October hold the best comfort condition as well as among the stations, Mehrabad, in comparison with other stations, was recognized as the best station in terms of climate comfort.

Conclusions

Generally, the results for the second period also showed that these coefficients had an ascending trend in most of the months. On the other hand, the condition from a cold thermal comfort turned into a hot thermal comfort, which indicates an increase in the local temperature due to climate change in the study area. The results of interpolation by GIS also indicated that in the cold period, there is strong lack of comfort in the northern areas of Tehran and that an appropriate comfort condition was replaced during the hot period. But for the southern areas of the city, there is an appropriate thermal comfort condition during the cold period and a lack of comfort is replaced during the hot period.

Keywords: climate, comfort, neurotic pressure index, Tehran, urbanization.

Comparative Investigation about the Quality of Urban Streets of Tehran Based on the Criteria of Excellent Streets (Case Study: Enghelab, Keshavarz and Fatemi Streets)

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Extended Abstract

Introduction

The increasing growth of urbanization in the recent decades and occurrence of most of the economic and social activities of human being in urban environments made the cities as a place in which a citizen spends much time and it is also one of the effective and important places in which the majority of memories, experiences, and emotions are formed. Thus, cities play important role in cultural construction and formation of individual and social personality of human being. Public spaces of city as composed of two elements of street and square are considered as the most important part of cities in which most routine activities of people are occurred and they play the important role in formation of their social personality. As urban streets cover 75% of cities, they are raised as the cultural symbol and defining the economic, social and cultural structure of city. Sometimes, they are the civil life position of city and occurrence of social activities of citizens in urban life and they are of great importance. Thus, organized design and their development make the social and cultural life quality of people more enriched. Today, the role of urban streets is weakened as a place for social interactions, visits, contacts and the gathering place of citizens. This is due to the development of motorized vehicles. This also turned streets into vehicle-based streets and they play the role of communicative space. To evaluate the quality of urban streets, based on the effective factors from the view of urban planners and considerable studies in this regard and the views of experts, Delphi method is applied to collect their views. This attempts to measure 4 indices and 16 components as the criterion of selection of components, their share components from the view of theorists in this study. These indices and components are shown in Table 1.

Table 1. Effective indices and components to create excellent street

Service and welfare	Environmental	Social and cultural	Aesthetic principles	Indices
Furniture	Vegetation	People-based	Lighting	
Availability	Climatic comfort	Safety and security	Vitality	
Hygiene	Environment-friendly materials	Identity and belonging	Perception	**Components**
Comfort	Appropriate disposal of runoff	Iranian-Islamic symbols	Alignment	

Study area

Enghelab, the distance between England square to Valiasr intersection, Fatemi streets, the distance between Fatemi square to Fatemi intersection and Kargar Shomali and Keshavarz, the distance between Valiasr square to

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Keshavarz intersection and Kargar Shomali are located in one of the most crowded townships of Tehran City. Suitable design and improvement of these regions and also design and improvement of urban street consistent with the designing principles can meet the economic demands by increasing competitive capability of the city from economic aspects and absorbing the investors. Also, it is a key factor to improve the emotions and morale of the residents (increasing life quality) and it is an exact criterion for pathology of urban development and it has necessary requirements as the case sample to be investigated.

Methods

The method of the study is descriptive-analytic with field work. At first, the theoretical framework of this study is based on data collection of library resources, article and internet references. To identify the studied site, field study is performed by aerial images and maps. To complete the required information, the existing condition (environmental, structural and perspective) is recognized by observation and questionnaire. This study applied AHP method to determine the weights of indices and effective components to achieve excellent street in urban space by Delphi method. Then, 11 Expert choices were used for data analysis. For data collection, the pairwise comparison of the indices and components is done through 34 faculty members and experts specialized in urban planning, environment design, green space design and environment engineering. Their valuation is based on their experiences and studies. Later, these indices and components are evaluated by citizens including pedestrians and shop owners in three streets of Enghelab, Fatemi and Keshavarz.

To evaluate the effective factors on creating excellent streets, a questionnaire is distributed among the samples. In each of 3 streets, 100 questionnaires and totally 300 questionnaires are distributed randomly among the citizens in spring. The number consist 5% of the population of users and employees to compare these three streets with the criteria of urban excellent streets.

It can be said the scores are given to 30 questions designed by Likert design from the citizens. The items are consisting very low, low, average, good and very good to evaluate the questions. Then, to compute and summarize the scores, the following formula is used.

$$N = \frac{\frac{\sum_{i=1}^{n=100}}{n} \times \sum_{i=1}^{n=4} (k_i \times s)}{k}$$

N = The sum of score of each index

$\frac{\sum_{i=1}^{n=100}}{n}$ = The mean of scores of 100 questionnaires

k_i = *Component weight*

S = Index weight

K = Number of components

Finally, the sum of the mean of scores is added and again averaging is achieved to perform the prioritization of each of the streets based on their score mean.

Results and Discussion

After the investigation of the indices and components by 34 experts, field study is performed for the case samples. Later, the results of the survey and information are analyzed. By the sum of the views from 100 respondents in each street, Keshavaraz Street by the mean score of 0.207 had good quality compared with Fatemi Street with mean score of 0.165 and Enghelab Street with mean score of 0.154. The analysis of social and cultural component of the streets showed that Keshavarz Street with mean score of 0.282 compared to Fatemi and Enghelab streets with those of 0.219 and 0.196, respectively, had relative superiority. Based on the results, the service and welfare component of Keshavarz Street with the mean score of 0.278 showed high values compared with Enghelab Street with mean score of 0.228 and Fatemi Street with 0.219. Here, environmental component of Keshavarz street with mean score 0.163 compared to Fatemi and Enghleab streets with the mean scores of 0.150 and 0.116 had relative superiority. Finally, aesthetic component showed that Keshavarz Street with mean score of 0.084 compared to Enghelab with mean score of 0.077 and Fatemi with mean score of 0.075 had better condition. The results of these evaluations in three streets of Keshavarz, Fatemi and Enghelab showed that Keshavarz street with the mean score 0.207 compared to Fatemi streets with the mean score 0.165 and Enghelab with mean score 0.154 had good quality

Conclusion

Generally, in this study, at first the effective factors on quality of urban streets are investigated, then, they are evaluated in three streets of Keshavarz, Fatemi and Enghelab. Finally, social and cultural indices in four

components in these three streets were not in good quality and by improving the quality of these components, they are considered as the most important components to create excellent urban streets. According to the welfare services index, Enghelab and Fatemi streets had problems in three components of hygiene, furniture and comfort and by improving their quality, we can be hopeful about the total improvement of quality of these three streets. With environmental index, Enghelab and Fatemi streets had not good quality in four components. By improving their quality, we can increase the quality of these two streets. On the other hand, Keshavarz Street has good quality in terms of vegetation and climatic comfort and by improving the appropriate disposal of runoff. Using environment-friendly materials in this street, we can increase its quality. With aesthetics, all components had low quality in the three streets and to increase the quality of these streets, we should improve them.

Keywords: AHP method, excellent streets, life quality, Likert scale, urban street.