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Spontaneous and Purposeful Shaping of Cities in the Modern and Postmodern Paradigms

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Expanded Abstract

Introduction

Three types of city models may be identified in terms of type and level of intervention in their forms: 1. the"shaping" city, 2. the "shaped" city, and 3. the city where its form is a combination of "shaping" and "shaped". Obviously, the quantity (numbers) of the three model types are by no means the same, i.e. it varies greatly from time to time, system to system, as well as from region to region. From the time when urban design was officially recognized as an academic field and a profession, up to now, in the middle of the last century, a question has always been seriously addressed by philosophers, intellectuals and urban design professionals. The question is that what level of intervention in the form of city is truly logical and reasonable. We have been witnessing the creation of two entirely opposite poles [no intervention at all (pre and post-modern) to full intervention (in the modern era)]. Undoubtedly, each of these models has been based on a specific paradigm and worldview.

Materials and Methods

In this study, the two modern and post-modern paradigms associated with the concept of city form are analyzed in a philosophical /epistemological framework of modernity debate; followed by an analysis of the three cities including Brasilia (purposeful shaping), Yazd (spontaneous shaping), and the *Safavid's* Isfahan (a combination of the two concepts), and a comparison of the features of each introduced model. Finally, with the current conditions of the contemporary city, it is concluded that the desirable form of intervention in the contemporary city should shuttle back and forth on the basis of integration between the two above paradigms. This is as an interaction between the two above opposite positions such that the result would be a combination of "shaped" and "shaping", or whether control it or not, and ultimately, direct or indirect design of the city.

Obviously, the main objective in urban design has, from the beginning, been to somehow intervene in the natural process of urban growth and move it towards desirable quantitative, qualitative, and purposeful development. This is in order to prevent uncontrolled and inappropriate development. However, the significant question unanswered yet and has caused great uncertainties in the design career and discipline activities is the desired level of intervention, its type and the related paradigm.

Philosophical framework of this research starts with an in-depth study of modernity, modernism and post-modernism concepts. The relationship between modernity and modernism may be so described that one of them is paradigm (modernism in the scale of several decades) and the other one super-paradigm (modernity in the scale of several centuries); they are usually divided into three periods: the pre-paradigm, paradigm, and post-paradigm. While modernity was a long-term project beginning in the renaissance era, but gradually took power by criticizing the works of Dilti and Bergson, and phenomenology, in general.

Super-paradigm as modernity declined over the course of the 20th century and entered into its post-paradigm stage. Thus, the modernism at its peak paradigm age (early to mid-twentieth century) is related to the pre-paradigm stage of the modernity, and post-modern has been present in the background as an agent to awaken the inactive part of the modernity's lateral dimension.

It may generally be said that "purposeful shaping" or full intervention in the city form is typically a manifestation of modernism. The shaped city largely conforms to the modernism urban development ideas. But, on the other hand, influenced by cultural analysis of the Post-modern, the" spontaneous shaping" paradigm importance has been enhanced.

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Modernism philosophy which is based on the ideas of Descartes, Ramos and other thoughts has resulted in emergence of urban development movements like industrial city, utopia, metropolis and ultimately anti-urbanization ideas. The post-modernism philosophy has roots in the Heidegger's critical thinking, the Frankfurt cult, and the George Simmel ideas, which seriously questioned the certainty (or pragmatism) of the city form, derived from the emergence of conflicts within modernism and during the post-paradigm modernity.

In studying the three cities of Brasilia, Yazd and Isfahan, the following results may be obtained. The new Brasilia City was built in 1957 with an urban design by Luceo Costa. Brasilia sought to be devoid of any history and identity and wished to manifest as a viable city with a series of large-scale highways and skyscrapers and with special geometric design, without looking back at its indigenous roots and background settings. The orderly, dry, and symmetrical plan of the Brasilia was never fully materialized, as was envisaged; in that, there are today 16 satellite towns (slums, often dubbed the "anti Brasilia") around the city with a population of about 3.1 million. This is, in fact, the example contrasting to the natural growth of a city.

Factors such as climatic conditions, qanats (subterranean waterways), social characteristics, necessity to defend and economic activities are influential in forming of the Yazd city. Spatial variations of the Yazd city have always been a function of gradual and endogenous needs of the living environment. Formation of the Yazd city is the consequence and the result of various forces that existed in the area at that time, without a pre-thought plan, designer, or any special entity to supervise formation and shaping activities.

Developments are divided into several periods in the Isfahan city. But the most significant transformation of the city was the change of the city center from the old square to the Naghsh-e-Jahan Square, which changed direction of the city main body (or Roon) from Mecca direction to the river and scenery direction. Naghsh-e-Jahan Square is situated in the right direction in terms of climate and air currents; consequently, the core body of the new urban area around it, with histological regular and geometric texture is spread in the Roon direction. The Zayandeh Roud River axis, around which the city has expanded, in one hand serves as a separator edge of the town and the other, manifests itself a city with regulator of important market rows. Finally, the structure of the city is formed in relation to the area of the old city. The Safavid Urban development is assigned to soft elements such as water and trees so that the main body would be a combination of gardens and settlement areas. The result is a structured configuration in relation to the old city arrangement. The configuration organizes the life of the city in a semi-stable or unstable balance, which is always maintained by the time element.

Discussion and Results

The philosophical conflict between modernism and post-modernism in the city may be analyzed and summarized in the context of the following fields.

- **Order/ disorder axis**, which includes a range that begins with change, softness, anarchy and chaos state (or pole) and ends into the systematic, clarity and conceptual analysis one.
- **Static/ dynamic axis**, with stability and lack of change in one pole, but movement and clarity in general on the other one.
- **Continuity/ discontinuity axis**, which includes a range in between universality, integrity, and unity on one hand, and diversity, separation and rupture gap on the other.
- **Inner/ outer axis**, which includes a range between demand to enter into the personally experienced phenomena and a desire to show their consent to a foreign perspective expressing them.
- **Micro–precise/ macro–general**, where the contrast between the clear and precise experiences verses general and threshold ones.
- **This world/ other world**, which includes acceptance of the self- expressing world belief in contrast to the rejection of that belief; and accepting the fact that here and now is in contrast to another time and place.
- **Spontaneous/ process-based,** one border of this lays the stronger component of occurrence and innovation, and other border is an equally strong belief in the "control / management of events".

Numerous experiences in the past one hundred years in the Brasilia city suggests that this type of intervention in the city form, which is the first range of the axes, has never been able to guarantee the creation of a perfect, dynamic, lively and flexible environment for human civic life. On the other hand, in analyzing the formation process of Yazd in connection with these axes, there is no doubt that the complex conditions of today's life makes it neither conceivable nor favorable to escrow the entire city to the ruling forces without formation control or interference. It seems, therefore, that among the three analyzed models of the cities, it is the Isfahan city that can determine the type and the extent of intervention in the cities of nowadays; a model that can combine shaped and shaping together into a state of equilibrium.

Integrating the shaping and shaped changes the contemporary urban planning approach from "urban development" to "urban studies", and alters the intervention in the city in the following way:

1. Understanding the city as a product of a massive network of processes

City is the resultant of different political, religious, social, functional, economic, cognitive, environmental,

and other forces. Meanwhile, respective to time and place, one or few forces act more powerful. Regarding emergence of the city, ecosystem will have special influence on the main body and in the case of neighborhoods, social component of behavior patterns in the public arena will have its impact on both cases, as economics is the determinant factor.

2. Creation of new constructions with the aim of establishing continuous structure of micro processes around it.
   In the combinational perspective with scale in the city growth process, different degrees may be allotted to space, which can fit in both in the existing configuration and also provide the possibility for future growth.
3. Livelihood and continuity of city growth
   Growth through dynamic performance in the market and religion has been decisive in this matter, in Iran; the Imam Square in Isfahan is a good example of relations to the old market.

Conclusion

In this research, three approaches: absolute intervention (spontaneous shaping), Brasilia example, non-interference (purposeful shaping), Yazd example, and a combination of these two approaches, Isfahan example, were studied in urban design within the perspective of samples in the two modern and post-modern dominant paradigms.

Hence, it is undoubtedly the urban designers' task to assume direct control of the main physical, social and economic structure of the city. In fact, this structure is a spatial network that puts together the different and even opposite forces in a way which we conceive the city as a cellular, linear and spatial system. This is while other parts of the city that are the live and transforming tissues should be controlled indirectly, using rules and regulations prepared for this purpose. These parts have, to some extent, freedom of action, and their residents have the authority to shape their activity space, within a general formulated framework.

Keywords: modernism, post-modernism, purposeful shaping, spontaneous shaping, urban design.

Environmental Design for Ecological Infrastructure of Urban Landscape through Aggregate with Outlier Principle (AWOP) in Order to Enhance the Quality of Urban Life (Case of District Two, Tehran City)

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Expanded Abstract

Introduction

The urban population experienced rapid growth in the recent decades, particularly between 1975 and 2000 when it has reached from 1.5 to more than 2 billion people. By turn of the century; half of the world's populations are concentrated in cities. This would severely affect the quality of life in urban areas. Accordingly, cities will be faced with significant challenges in infrastructure and environmental issues to support urban population growth. At present, there is no balance between urban and natural patterns, and urban networks are immensely dominating ecological networks.

There are many researches indicating the critical role of cities and their environmental impacts on their natural resources due to cumulative effects of the above issues. Tehran, the capital city of Iran is no exemption; it is seen as a metropolis dealing with many environmental problems; that keeps it far from sustainability indices. To provide the cities with urban improvement, there is a general consensus among the international community about new theories of urban development within the framework of sustainable development as new solutions. These solutions are supported by the world's metropolises network as the major solution to encourage global participation and efforts to reduce the negative impacts of urbanization and population expansion.

In parallel, the concepts such as urban green networks and ecological urban networks have attracted considerable attention. Urban ecology as a scientific discipline is rapidly developing throughout the world to discuss the possible environmentally sound solutions for the design and management of cities to move them towards sustainability. Hence, the urban ecology theory is turned to the Eco-city concept by some architects and urban planners. The core idea here is that it is necessary to provide the city with economical spatial infrastructures to make them more compatible with environmental concerns or natural characteristics of the cities. As many researches in the past, focused on the ecology of the city based on the concepts of ecosystems, more recently the role of landscape ecology within and beyond the city are emphasized in this field.

Much attention, therefore, has been given to landscape ecology approaches to improve the quality of urban environment in different cities around the world. This study is discussing and presenting the new strategies for eco-city infrastructures, through landscape ecology approach based on the AWOP (Aggregate-with-outliers principle). This is to investigate the design of urban ecological infrastructure networks to protect and enhance natural aspects in urban landscapes and provide the sustainable development of urban areas. In this research the district number two of Tehran city is examined as the study area in terms of these approaches.

Materials and Methods

The study area in the present research is Tehran district number 2 as the most developed zones located in center and north of Tehran city. Natural landforms of Alborz Mountain Chain are the most significant aspect of structural elements in this district. There are five major river valleys in Tehran City and two of the valleys (Darakeh and Farahzad rivers) are located in this district. Natural features such as river valleys and streams, network access as air circulation corridors and existence of faults and power lines as the potential to create green corridors, play significant role in sustainable development and design of ecological infrastructure networks in district 2. A large area of urban constructions involves dense and fine-grained textures as the other features of the district.

To formulate the theoretical framework and principles of the present research, the required data have been

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collected and analyzed through literature and library documents. After reviewing the theoretical literature, urban ecological infrastructure network has been analyzed to find a conceptual framework on the basis of ecological landscape design.

Forman and Godron introduced concepts such as patches, corridors and matrices as basic elements in landscape ecology. Some layers of district land use map including, river valleys, streams network, access network, faults and power lines, green spaces, semi-private green spaces and reserve lands are required for development and urban renewal. The required data have been derived from preparation of land-use mapping using GIS application.

Using Aggregate with Outlier Principle, landscape ecological infrastructure network in district 2 has been designed. The principle, offered by Forman, proposes the optimum arrangement for land use in landscape. AWOP also emphasizes on appropriateness of the distribution, composition and extent of open and green spaces as structural landscape in urban areas. In addition, a range of direct benefits to humans is suggested by such spatial approach.

Ecological infrastructure network is obtained through an overlaid patches and corridors (as facilities layers) and urban construction (as limitations layer). Finally, using the results of field study, some strategies and measures have been formulated within the framework of designing urban infrastructures in various ground of this network.

Discussion and Results

Using GIS, maps for landscape structural elements in district 2 have been derived from land use map as follows:

1. Patches of Landscape Structure: the patches include green spaces, semi-private green spaces and reserve lands for development and urban renewal.
2. Corridors of landscape structure:

   Generally, two types of corridors in district 2 can be classified as follows:

   - Corridors of water flow, which include Darakeh and Farahzad river valleys, west flood inversion channel and ground water corridor network (Aqueducts network).
   - Corridors of energy flow and humans' and other organisms' movement that includes network access (humans and other organisms movement) and faults and power lines (energy flow).
3. Matrix of landscape structure:

   Matrix is a homogeneous mass that involves different and small structural elements and included more than half of the land. Thus, dense, fine-grained and impermeable urban construction which comprises a large area of the study area forms urban landscape matrix.

After identifying the ecological landscape elements (corridors, patches and matrix), and representing them as distinct layers, network formation requires the overlaying of them. Identified patches and corridors are considered the facilities of designing ecological infrastructure network and landscape matrix layer as limitations of forming the network.

After overlaying the layers, 5 critical ecologic areas have been determined in network (Fig. 1).

Fig. 1. Five major zones were identified after overlaying the layers

Following the field studies and observations, the required strategies and measures within the realm of improvement, conservation, optimization and restoration have been formulated in these zones. Finally, using AWOP, ecological infrastructure network as a method to design network of ecological infrastructure in Tehran's district two has been established (Fig. 2) as follows:

1. According to this principle, natural corridors of Darakeh River Valley (1) and Farahzad River Valley (2) have been preserved as the main components of the network structure.
2. Large patches of vegetation (Pardisan Park) (3) were included in the network as a vast and central green patch.
3. Small natural patches such as Tarasht gardens (4) and Farahzad gardens (5), located in developed urban areas, have also been included in the network.
4. To provide more than one large patch of vegetation, natural garden patches of vegetation have been connected to a large green patch (Pardisan Park).
5. Semi-private green patches have been included in the network as small vegetation patches and connected to large patches of vegetation.

Conclusions

The increase in population of the world and subsequently increase in urban population has led to an imbalance between nature and cities, which caused numerous environmental problems such as air pollution, lack of vitality, contaminated water, soil and public environment pollution. Therefore, attention to the quality of urban life and its promotion with regard to urban population is also necessary.

The aim of this study is to design ecological infrastructure of landscape in district number 2 of Tehran City in order to enhance the quality of urban life. Thus, to conclud this research, the spatial structure and function of the study area are examined and categorized based on the patch-corridor-matrix.

Based on the landscape ecology approach, the other natural patches and corridors in the urban environment are to be preserved and restored to increase their ecological functions in the city so that natural flows can continue and penetrate into the built environment and built patches. These are the most influential factors in the densely built-up and high populated city regions.

Using the principles of landscape ecology framework, AWOP and land use map, matrix, patches and corridors, the study area has been recognized and by using GIS application the necessary factors have been extracted as separate layers. After overlaying the layers of facilities (patches and corridors) and removing in limitation layer (urban construction matrix), five major zones have been identified in the final maps as fallowing: Darakeh and Farahzad River Valleys, Pardisan Park, West flood inversion channel and Tarasht gardens.

Design strategies and basic environmental initiatives in the areas of promotion, protection, rehabilitation and restoration of the network have been introduced in order to protect the integrity between structural elements and preserve the original patterns of ecological networks. Finally, landscape design of ecological infrastructure network in district number 2 is also presented (Fig. 2).

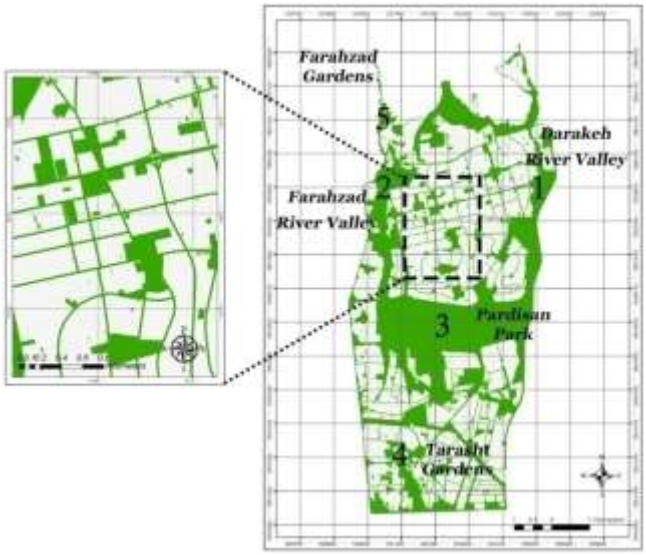

Fig. 2. Landscape ecological infrastructure network in District 2
Part A demonstrates how semi-private green spaces have been connected to the network.

Keywords: aggregate with outlier principle, district number 2 of Tehran city, ecological design, ecological infrastructure, landscape, quality of urban life.

Optimal Site Selection of Green Spaces in Rural Settlements (Case study: Villages of Khaf County)

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Extended Abstract

Introduction

The distribution and dispersion of parks and green spaces is of paramount importance in urban and rural areas. As an indicator in development of nations, green space has environmental, social, cultural, economic and physical dimensions. To be able to perform its roles and functions successfully, green space needs to be properly positioned. This requires spatial suitability analysis. By analyzing the factors affecting the location and position of green space as well as presenting a proper model, this study seeks to examine the distribution of green space in the sample rural areas of Khaf using Geographical Information System (GIS).

The main objectives of urban and rural planning are health and beauty. The correct localization of green space as one of the most important elements of the environment is essential for management of utility space and amenities. Therefore, the ultimate goal of this research is to perform a spatial analysis, using GIS technology and analytic hierarchy model to determine the factors affecting the location of parks and green spaces, parks and countryside, and also to find a model for locating of the study area in a rural landscape.

According to the previous studies on the literature, we can say that no research has, so far, been done about the location of green space in rural settlements. At the conclusion, the factors that influence the location of urban green spaces, such as slope, accessibility, consistency, texture components, users and etc. are mentioned. Therefore, in this study we have tried to look for the past research in urban areas, factors that have been studied and found thanks to GIS capabilities in the information layer in rural environments. Finally, with the help of hierarchical analysis in a GIS environment to choose the suitable zones should be taken into account for the construction of green space in rural areas. Another secondary objective of this study was to compare the results of the hierarchical analysis in GIS output on green spaces in rural areas and rural pilot projects.

Range Study

Khaf is the border area with geographic coordinates 59°, 28' to 60°, 55' east longitude and 34°, 1' to 34°, 59' north latitude, about 250 km in southeast Mashhad and Iran's eastern border with Afghanistan Country on a relatively broad plain. According to the 2011 census, Khaf County had a rural population of 65,494, in 86 rural settlements. Rural Guidance Plan has been implemented 21 villages in and our statistical population is consisted of 10 rural settlements of the County. Rural Guidance Plans have been completed and they took almost 10 years to complete, since its implementation.

Materials and Methods

This research has used as applied method based on descriptive - analytic nature. In this paper, status quo analysis and data modeling procedures have been used. To do this, spatial data (Neighborhood, area, availability, price, land use, etc.) of 10 Villages of Khaf City (with an approved pilot plan) and also descriptive data have been prepared to create database of GIS consisting of spatial data and descriptive data in form of algorithms. Then, a questionnaire has been designed and completed by 30 people including three groups of university professors, consultant engineers of rural pilot projects, and the experts of Housing Foundation of Islamic Revolution of Iran. Ultimately, through weighting the layers by AHP model, and GIS databases with overlapping operations of different maps, rural green spaces have been identified compared with the current and proposed location of (approved by Guidance Plan) rural waste disposal areas.

The main research question of the present study is that what factors influence the location of rural green spaces? And to what extent the current and proposed rural green spaces in the villages under study is in compliance with positioning in GIS environment?

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Discussion

Parks and green space, as one of the most important centers and recreational services in addition to medical and psychological aspects are important for the sustainable development of rural areas. Thus, the importance of green space is undeniable in the physical and social impact and sustainability of rural systems. For this reason, use of green space in the rural areas, according to location is assigned based on the needs of the rural population as one of the basic issues in the planning and management practices.

Several factors make the land suitable for the construction of green space, but here five factors haves been used as data layers. These are experimental measures, compatibility, availability, landuse, price and area.

The aim of the present study is to find the optimal location of green spaces in the sample villages of Khaf County. This was using the measurement of five layers, re-classification maps prepared for the model and the weight of each layer. In the final stage, the layers have been combined in the ArcGIS application the final map is classified in five categories of quite suitable, suitable, moderately suitable and unsuitable. The output of this model represents the optimal location for parks and green spaces in sample villages. In the evaluation, land prices by a factor of 0.351 have the greatest impact on localization of green spaces and rural area by a factor of 0.077 has had the least impact (Table 1).

Table 1. The importance of criteria and sub criteria in the location of green spaces

Factors	Weight of the layer	Classification	Description of layer	Relative weight of each category	Absolute weight of each category
Compatibility	0.155	Quite suitable,	Education - Cultural	0.502	0.0788
		suitable,	Residential - River	0.257	0.0398
		relatively suitable	Health - Therapy - Religious	0.166	0.0257
		unsuitable	Administrative - industrial - installations - commercial and other	0.075	0.0116
Availability	0.260	quite suitable	One degree Main	0.565	0.1469
		suitable,	One degree Subsidiary	0.262	0.0681
		relatively suitable	Two degree Subsidiary	0.118	0.0307
		unsuitable	Access	0.055	0.0143
Landuse	0.157	quite suitable	Bayer	0.496	0.0779
		suitable,	Agriculture	0.294	0.0462
		relatively suitable	Dilapidated of residential	0.152	0.0239
		unsuitable	Cemetery	0.058	0.0091
Price	0.351	quite suitable	Cheap	0.565	0.1983
		suitable,	Relatively cheap	0.262	0.0920
		relatively suitable	Median	0.118	0.0414
		unsuitable	Expensive	0.055	0.0193
Area	0.077	quite suitable	More than 2500	0.547	0.0421
		suitable,	1000-2500	0.270	0.0208
		relatively suitable	500-1000	0.124	0.0095
		unsuitable	Less than 500	0.059	0.0045

Selection and location of the main issues should be considered by the Geographic Information System to investigate and to determine the extent to which areas are consistent with the facts. For this purpose, field studies and library reviews have been conducted to select the accurate location. In order to implement the results of the model presented for rural green space location with the existing realities of the study area, the map of the proposed land uses in rural guidance plan and rural land uses has been prepared and the results obtained from the model are reflected in the final evaluation plan. The comparison between the existing green spaces in rural

locations with optimum positioning of the model indicate that the location of parks and green spaces in Chamanabad-Valiabad, Sedeh, Tizab and Zuzan aqua are perfectly suitable for the rest of the villages. The area is relatively suitable and unsuitable (Table 2).

Table 2. Comparative study between the proposed and existing green space in the village with results

Row	Village name	Present location of green space ✡	Proposed location of green space ★
1	Chamanabad-Valiabad	Quite suitable area	Quite suitable area
2	Sijavand	Suitable area	Suitable area
3	Sedeh	Quite suitable area	Quite suitable area
4	Razdab	–	Suitable area
5	Khargerd	–	Relatively suitable and appropriate area
6	Tizab	Quite suitable and appropriate area	Quite suitable and appropriate area
7	Mehrabad	Suitable area	Suitable area
8	Barabad	Suitable area	Suitable area
9	Zoozan	Quite suitable area	Suitable area
10	Chahzool	–	Quite suitable area

Conclusion and Suggestion

This research results indicate that using this method multi-options and a large number of criteria the final option can accurately be selected. Logical and accurate weighting should be done for criteria and options to select the ultimate site and make a prioritization of green space. The results can be used in regional planning to minimize damages in urban and rural settlements. The results of this research can be used with environmental and socio-economic perspectives and considerations to achieve the sustainable development.

According to the studies and the results obtained during the research process, the following suggestions can be offered:

- To identify suitable green spaces in the rural areas, one of the best models is AHP. This model along with other models (ANP) and using ArcGIS play an important role in making decisions and guiding future development in rural areas;
- The spatial characteristics are location, social (demographic) and ecological suitability analysis in site selection for rural parks;
- The location of parks and analysis of the appropriateness of various villagers in rural areas (based on the circumstances of the village), and the general classification for the different conditions and analysis methods are quite different.

Keywords: accessibility, adaptation, AHP, GIS, land use, price.

The Relationship between Consumer Life Style and Ecological Footprint

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Expanded Abstract

Introduction

Development of studies on the urban, environment and conservation of natural resources, due to increase of urbanization as common lifestyles of citizens, has improved the sustainable urbanization approach that tries to improve human interaction with nature for sound behavior. Cities are the origins of consumerism and consequently irregular use of natural resources and energies. The consumerism also leads to the production of waste and garbage that goes beyond recycling and reconstruction tolerance of the environment. The origin of this idea is that consumer habits and the used technologies affect the environment. Ecological footprint represents the difference between what nature offers us to use for live, and what we consumes.

Concept of re-loaded resources presented by ecological footprint approach is a key factor in sustainable development of human societies. Increasing instability due to changes in natural resources is a serious threat to the ecosystems because they lose the ability and opportunity to rebuild and re-load.

Through this approach we are able to do individual and collective actions for environmental conservation and responsible behavior about it. Each person can control their usage and reduce the amount of ecological footprint. This case requires sufficient knowledge about the environment and the impact of human behaviors on. The behavior based on environment protection, including consumer behavior to create a lifestyle, involves a pattern of behavior that has been coordinated with ecosystems and will not disrupt the natural cycles.

Total average per capita ecological footprint (EF) is calculated by adding all the ecosystem areas assigned for each individual to fill his/her annual shopping basket of consumption goods and services. Ultimately, the ecological footprint of the study population (EFp) is obtained by multiplying the average per capita footprint in population size (N).

Due to the differences in styles, habits and generally the lifestyle of people around the world it is not easily possible to provide a global standard questionnaire to calculate the footprint. Thus, researchers according to the lifestyle of people in different countries have designed questions to measure this indicator.

Materials and Methods

Tabriz is the largest city in the west and northwest of Iran. Due to its political and industrial centrality and its focus on economic, industry, university, high level of expertise and service and free trade zones, Tabriz City has a wide sphere of influence on the region.

Despite natural limitations to provide the population of Tabriz, as the only metropolitan area in northwest Iran with the required resources, the borders of the city have expanded more than five times in the recent decades. This rapid growth in the past decades has led to unsustainable urban development. The available physical and natural pressures and various types of pollutions as the most threatening environmental hazards in this region with some conditions such as population density, mass consumption, rubbish production, and a lot of different lifestyles has made this city a suitable case for the study of sustainable urbanization.

This research has an applied method and statistical population is Tabriz citizens between 15 to 75 years old; data was collected by questionnaire with the samples selected by utilizing multi step cluster sampling.

The dependent variable was measured by the questionnaire designed for calculating personal ecological footprint according to the characteristics and living conditions of the people in Middle East and the Mediterranean basin. The variable of consumption and its constructive components were extracted based on dignity consumption, craving consumption and consumption.

Reliability and validity measured by the coefficient of KMO and Cronbach's Alpha have appropriate values. The results of this test for dependent variable show KMO = 0.761, with sig=0.000. This KMO value indicates

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that the number of items and their classification based on factor analysis can be appropriate for this variable. The value of variable based on calculated variance was 53.58 percent. This index for the consumption was KMO =0.912, with sig =0.000. Cronbach's coefficient was calculated for studying the reliability of survey instrument, its amount for dependent variable is α= 0.780 and is α= 0.891, for independent variable.

Results

Pearson correlation coefficient was calculated to test the relationship between ecological footprint and consumption. The results show that the calculated correlation coefficient is 0.664 and significant at 99% of confidence level. This means that there is a positive correlation between the ecological footprint and consumption. The results also show that there is significant and positive relationship between the independent variable and components of dependent variable. There is a strong relationship between consumer lifestyles and consumption. Pearson correlation coefficient calculated for this component was 0.578 and significant at 99% of confidence level.

Regression analysis was used to determine the contribution of lifestyle as the independent variable to explain and predict its effects on dependent variable and also explain the contribution of independent variable to predict changes in the ecological footprints components. The results also indicate that the consumer lifestyle affect all the components of ecological footprint. The most impact is observed on the good consumption, services and then transportation component.

Conclusion

The results show that the EF mean of Tabriz citizens is 58.66 percent of defined scale, which is slightly more than the average value. Investigating the constructive components of the dependent variable showed that the studied citizens obtained 80 percent of score in the component of reusable consumption goods have left the largest value of EF in not using the reusable goods. Obviously recycling the reusable goods decrease the amount of consumption and ultimately leads to less use of natural resources and the environmental damage.

In transportation aspect, Tabriz citizens obtained 70 percent of the maximum obtainable score on the defined scale in this component. This has a relatively high footprint, leading to air pollution due to the production and distribution of emissions from fossil fuel consumption. Public transportation sector has a dominant role in fuel consumption and air pollution in cities. In other aspects of consumption, such as food and energy consumption, the obtained scores were higher than the obtainable mean for each component. It seems that the private car attraction and becoming a kind of social status on the one hand and the serious shortcomings in public transportation system, on the other hand, are the main reasons for this approach.

Consumer behavior creates a lifestyle that can be preserve or harm to the environment. Environmental lifestyle includes patterns of behavior that are harmonious with the environment and do not disrupt the environmental cycles**.** The main issue is that such actions require the more environmental cognation and more environmental beliefs and knowledge about environmental subjects. In this case, most people will be careful of individual actions to deal effectively with the environment.

Recommendations

Based on these findings, it is recommended as following: use of durable goods, which are frequently consumed, should be promoted to reduce the demand for consumption. The quantity and quality of public transport must be increased to reduce uses of personal vehicle and special paths should be designed to promote biking and walking. Small and medium-sized areas with a variety of urban tissues have to be designed for reducing the needs for motorized transportation within the urban areas, and establishing a responsible behavior towards environment protection in the higher classes. This should lead to emulating of these behaviors of the lower classes to affect the reduction of ecological footprint. It can be lead to decreases in non-responsible behavior towards the environment and decreases in ecological footprint.

Keywords: ecological footprint, conservation of environment, consumer pattern, sustainable urbanization.

Investigation about the Environmental Effects of Mehr Housing Project in Mahmoodabad, Mazandaran

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Expanded Abstract

Introduction

Mahmoodabad county is located at the coastal region of the country, and it is neighbor of coastal areas where are full of tourism and entertainment applications. This has led to intense development towards suburbs and human domiciles in this county. The 432-unit of Mehr Housing project in the Mahmoodabad, Mazandaran Province, Iran, is located at the 52° 11' to 52° 29' east and 36° 31' to 36° 41' north at the southern coast of the Caspian Sea. This project is bounded to the Caspian Sea in the vicinity of road and in the most equipped touristic-entertainment region (the Sarzamin Royaha funfair). But, perhaps the main reason for calling this project "the diamond of the all under-constructing project" is the divine endowment, i.e. the sea in the northern border a position which differentiates it from all other Mehr projects across the country.

Materials and Methods

Collecting library information: looking for library evidence in the library of Environment Protection Organization of Mazandaran located in Sari city, the library of the Faculty of Environment, Tarbiat Modaress University, the library of environment in Azad University (Science and research branch). Collecting valid reports, documents, evidences and magazines related to the subject matter. The internet searching, conducting field study in the region and on this project. The experts and academics in the main institutes including Environment Organization in Sari city, Housing and Urbanization Organization of the Mahmoodabad County, and the professors of Azad University, the Science and Research Brach have also been interviewed. Sound-level measuring equipments "LSI" for measuring CO, NOX and SO_2, and measuring the floating suspended particles have been carried out in four seasons and three stations. Measuring sound level has been conducted across four seasons and in three stations to measure Lmax, Leq, and SPL. The resulted LEQ from noise measuring has been compared with the Iranian Noise Standards, using the SPSS application. The resulted parameters of Air pollution sampling (Co, NO2, SO2, and PM10) have been compared with the Clean Air table, using the SPSS. The Pastakia has been employed to evaluate the effects of two phases: construction and commissioning. AHP method has been applied for weighting and prioritizing the criteria and evaluation of checklist.

Results

The operation effects on the environment were studied across two phases, using the Pastakia Matrix. One of the advantages of this method is time-efficiency. Presenting the results graphically facilitates comparison of the results.

Identifying the negative and positive effects and proposing the correction approaches were evaluated using the Pastakia matrix on the environmental effects of the project. In this project sub-operations and their effects on physical, biological, economic, social, cultural and technical aspects of the environment were determined. This indicates that the negative and positive effects of the construction phase scores were 19 and 8 respectively; and the negative and positive effects of the commissioning phase scores were 21 and 14 respectively. But, because the effects of the construction are temporary and short term, so their effects is negligible; but, on the other hand, the commissioning phase effects are standing and long term, so cause specific effects on the environment. According to the scores it can be stated that the construction phase of the project affect the environment slightly, but its effects are more extensive and impressive in its commissioning phase, which can be amended by observing environmental measures. Then, the data for the primary criteria were collected for the pretest, through studying the references and analyzing the retrospective studies. Determining the criteria, the developed list was

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transformed into a questionnaire and it was administrated to a group of the experts of different fields related to environment including environment, urban development, civil construction and etc.

In this regard, at the first stage, the hierarchy process was constructed, analyzing the environmental effects of the Mehr housing Project in Mahmoodabad County. Physicochemical, biological, economic, social and technical effects on the environment of the county were selected as the criteria of the second level of the hierarchy process. The sub-criteria of the three spheres were placed in the third level, and factors of the selected sub-criteria are placed in the last level. At the second stage, the hierarchy process was constructed by analyzing the environmental effects. Three spheres including physicochemical, biological-economic, and social were selected as the main criteria for analyzing the environmental effects of the Mehr housing Project on the environment of Mahmoodabad. Then, the sub-criteria of the hierarchy process in the physicochemical sphere are classified into pollution factors and hydrology; biological sphere was classified as wild life; and the economic and social sphere was classified into cultural, technical, economic, and social factors. These were conducted by comparison matrix of the main Criteria. Across the physicochemical sphere, the pollution factors including noise, soil, waste, and the hydrology parameters including above- and underground water were performed by pairvise comparison. Across the biological sphere, the wild life parameters including birds and the fishes were weighted and compared. Across the social sphere, the population and migration factors and across the economic sphere the parameters of employment, real state price, and across the cultural sphere the landscape beauty and land use, and across the technical sphere, accessing urban services and accessing urban infrastructure were weighed through pairvise comparisons.

Then, at the forth level, the sub-criteria of physic-chemical sphere including noise parameters (noise at the construction and commission phases); air (CO, NOx, SO_2, suspended particle); soil (erosion, soil characteristics); wastes (construction and human residues); hydrology including above-ground water (ecology- quality) and underground-water (quantity, quality); biological sphere including birds (protected species, food chain), fishes (population-food chain); economic-social sphere including (size , class variety) migration(internal, external), employment (side-local), real state price (residential, commercial), land use(agricultural, residential), landscape beauty (visual effect, land shape); accessing urban services (educational, health), and accessing urban infrastructure (electricity and gas, access road security) were weighted through pairvise comparisons.

In the next stage, weight of each index was calculated against the higher-level index (relative weight) through the equivector method, using the Expert Choice (EC), which incorporates them with the relative weights, as the final weight determined. Finally, a total priority vector is obtained, which shows the effect and significance of the lower elements. The score which obtain higher weight is more significant compared to the others.

The economic-social, physic-chemical and biological spheres gained scores of 0.699, 0.237 and 0.064, respectively. As a result, the greatest weight was attributed to economic-social sphere because of its significance. The geometrical matrix of the physicochemical sphere was developed, considering the AHP questionnaire. The weights of air pollution criteria were 0.167, and those of the hydrology were 0.833. The pollutant had bigger scores than the hydrology. The geometrical matrix of the biological sphere was developed, considering the AHP questionnaire. The wild life was weighted 0.875 for the fishes and 0.125 for the birds.

The geometrical matrix of the economic-social sphere was developed, considering the AHP questionnaire. The economic, social, technical and cultural criteria were also weighted 0.53, 0.225, 0.178 and 0.067, respectively.

After weighting the criteria and the options according to the AHP method and determining the priorities of them, the weights were incorporated into the alignment evaluation checklist. It was done as follow: first, the weights criteria were inserted. Then, the option weight compared to the each criterion was inserted in the raw data column. Then, determining the scale of criteria in every option, the raw data of every option was divided in the highest score of the raw data of the criteria. Then, the weighted criteria of each option was obtained from the multiplying the weight of criterion by its scale. Finally, the total index was determined by summing the products of criteria weight multiplied by criteria scale.

Conclusion

The intense expansion of Mehr housing construction in the Mazandaran Province and its rapid implementation at the suburb and their consequences and environmental outcomes because of population aggregation, may seem unimportant from the decision-maker point of view. But a glance at the current problems of big residential areas around the cities or the new cities several years after construction and occupation, lack of necessary infrastructures for fresh water, sewage and waste management reveal that residential construction, without considering environmental facts will lead to serious problems. Problems which don't show themselves in light of establishing the most basic forms of facilities are worsening as the other side of the coin. Nevertheless, paying no serious attention to these problems in common house construction and rapid extensive construction of the housing projects without considering the most important problems "ecological capacity for construction" and occupying human population "more than the bio-capacity" will cause many serious problems.

This paper aimed at aforementioned objects to study the environmental effects of the Mehr housing Project, using various methods. Then, the weighted criteria were incorporated into the alignment evaluation checklist, and the total index obtained. The checklist results show that the criteria including urban infrastructure (1.002) in the technical sphere; the scape beauty (0.951) in the cultural sphere; the real state price (0.99) in the economic sphere; the population (1.02) in the social sphere; the fishes (0.99) in the biological sphere; the under-groundwater (0.951) in the physicochemical; and the noise (0.649) in the pollutants sphere, all gained the highest indices. According to the matrix results, the project operations include 9 positive effects and 19 negative effects in building phase, and 14 positive effects and 21 negative effects in the commissioning phase. This shows that the construction phase of the project affect the environment slightly, but its effects are more extensive and impressive in its commissioning phase. This can be amended observing environmental measures. Thus, the quantitative results indicate the fact that implementing the project while administrating environmental management will guide the region to economic and environmental boom.

Keywords: Analytical Hierarchy Process (AHP), checklist, environmental effects, Mehr Housing, Rapid Impact Assessment Method (RIAM).

Improvement of Environmental Impact Assessment Using Dempster-Shafer Theory (Case Study: Binalud County, Khorasan Razavi)

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Expended Abstract

Introduction

Environmental impact assessment is a systematic process to identify, predict and evaluate the environmental effects of proposed actions and projects. This process is applied prior to major decisions and commitments being made. Environment, social, cultural and health effects are considered as an integral part of EIA. Particular attention is paid to EIA practice for preventing, mitigating, and offsetting the significant adverse effects of proposed actions. Uncertainty is present when the knowledge about future conditions is incomplete or lacking and also the possibility to make precise decisions about these conditions is low. Using the theory of Dempster-Shafer is a novel methodology for decision-making under uncertain conditions in environmental assessment as we try to examine with insufficient, fuzzy and uncertain data. This theory provides a mathematical framework for describing incomplete and inadequate data.

Materials and Methods

The Dempster-Shafer theory has an advantage over the Bayesian probability theory. In Bayesian probability theory, only singleton hypotheses are recognized and assumed to be exhaustive. Thus, ignorance is not recognized, and lack of evidence for a hypothesis constitutes evidence against that hypothesis. These requirements and assumptions are often not warranted in real-world decision situations. In contrast to this, the logic of Dempster-Shafer theory can express the degree to which the state of one's knowledge does not distinguish between the hypotheses. This is known as ignorance. Ignorance expresses the incompleteness of one's knowledge as a measure of the degree to which we cannot distinguish between any of the hypotheses. The basic assumptions of Dempster-Shafer theory are that ignorance exists in the body of knowledge, and that belief for a hypothesis is not necessarily the complement of the belief for its negation. A belief function can be viewed as a generalized probability function and the belief and plausibility measures can be regarded as lower and upper bounds for the probability of an event. To express the concept in mathematical terms, let $\Theta = \{H_1, H_2, \ldots, H_N\}$ be a collectively exhaustive and mutually exclusive set of hypotheses or propositions, which is called the frame of discernment. A basic probability assignment (bpa) is a function m: 2^{Θ} [0,1], which is called a mass function, satisfying:

$$m(\Phi) = 0 \quad (1)$$

and $\sum_{A\subseteq\Theta} m(A) = 1,$

where, Φ is an empty set, A is any subset of Θ, and 2^{Θ} is the power set of Θ, which consists of all the subsets of Θ, i.e.

$$2^{\Theta} = \{\Phi, \{H_1\}, \ldots, , , \{H_N\}, \{H_1, H_2\}, \{H_1, H_N\}, \ldots, \Theta\} \quad (2)$$

The assigned probability (also called probability mass) m(A) measures the belief exactly assigned to A and represents how strongly the evidence supports A. All the assigned probabilities sum to unity and there is no belief in the empty set (Φ). The assigned probability to Θ, i.e. m(Θ), is called the degree of ignorance. Each subset $A \subseteq \Theta$ such that m(A)> 0 is called a focal element of m. All the related focal elements are collectively called the body of evidence.

Associated with each bpa is the belief measure, Bel, and the plausibility measure, Pl, which are both

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functions: 2^{Θ} [0, 1], and given by Bel(A) = $\sum_{B \subseteq A} m(B)$ and Pl(A) =$\sum_{A \cap B \neq \emptyset} m(B)$, where A and B are subsets of Θ. Bel(A) represents the exact support to A, i.e. the belief of the hypothesis A being true; Pl(A) represents the possible support to A, i.e. the total amount of belief that could be potentially placed in A. [Bel(A), Pl(A)] constitutes the interval of support to A and can be seen as the lower and upper bounds of the probability to which A is supported. The two functions are related to each other by Pl(A) = 1- Bel($\bar{A}$), where $\bar{A}$ denotes the complement of A. The difference between the belief and the plausibility of a set A describes the ignorance of the assessment for the set A.

Belief represents the total support for an hypothesis, and will be drawn from the BPAs for all subsets of that hypothesis, i.e.,:

BEL(X) = $\sum$ m(Y) when $Y \subseteq X$

In contrast to belief, plausibility represents the degree to which a hypothesis cannot be disbelieved. Unlike the case in Bayesian probability theory, disbelief is not automatically the complement of belief, but rather, represents the degree of support for all hypotheses that do not intersect with that hypothesis. Thus:

PL(X) = 1- BEL(X) where X = not $\underline{X}$

Thus, PL(X) = $\sum$m(Y) when $Y \cap X \neq \varphi$

Interpreting these constructs, we can say that while belief represents the degree of hard evidence in support of a hypothesis, plausibility indicates the degree to which the conditions appear to be right for that hypothesis, even though hard evidence is lacking. For each hypothesis, then, belief is the lower boundary of our commitment to that hypothesis, and plausibility represents the upper boundary. The range between the two is called the belief interval, and represents the degree of uncertainty in establishing the presence or absence of that hypothesis. As a result, areas with a high belief interval are those in which new evidence will supply the greatest degree of information. Dempster-Shafer is thus very useful in establishing the value of information and in designing a data gathering strategy that is most effective in reducing uncertainty. The Belief module can be used to implement the Dempster-Shafer logic. The Belief module has a wide variety of applications, as it can aggregate many different sources of information to predict the probability that any phenomenon might occur. Therefore, all assessment information, quantitative or qualitative, complete or incomplete, and precise or imprecise, can be modeled using a unified framework of a belief structure. Therefore, Dempster-Shafer Weight-of-Evidence modeling has been chosen as efficient method for the aggregation of data in tourism impact assessment. The tourism impact assessment by using Dempster-Shafer theory comprises multiple steps, in this research. In the first step, we identify the criteria for tourism impact assessment. Complex decision-making problems are usually modeled in terms of a number of decisive variables that are related hierarchically. Pieces of evidence are aggregated in a bottom-up way to determine the final decision goal. In the second step, we collect data from multiple information sources like human experts, questionnaire, models, etc. on the selected criteria for evaluation purposes. In the third step, the information from multiple data sources is combined using Dempster-Shafer theory and the impact assessment of Binalud region for tourism is estimated. Performing risk analysis can be a challenging task for complex systems due to the lack of data and insufficient understanding of the failure mechanisms. Thus, in this study the D-S Theory is used because of its ability to deal with ignorance and missing information which is very likely in realistic tourism development impact assessment and also its ability to deal with multiple decision makers and heterogeneous data types. Basically, the Dempster-Shafer theory is well-known for its usefulness to express uncertain judgments of experts. On the other hand, our evaluation about the information and land resources is basically based on the expert judgments.

Results and Discussion

Data and maps of important factors for tourism development in the present study were gathered and converted to raster format. Then, the fuzzy raster maps were treated for their ecological suitability or lack of suitability for recreation in the impact assessment of the suggested tourism and ecotourism for the area of study. In the next step, each map was introduced to the belief procedure. After entering all information, the process divided all the evidence based on the underlying hypotheses (appropriate, inappropriate, appropriate- inappropriate) and combined them to produce three images of belief, plausibility and belief interval. The image of the region recreational impact assessment using the fuzzy and multi-criteria evaluation method was also prepared and compared with the belief image.

Conclusions

The results showed that the belief procedure has produced a more reliable result for the tourism development and its impact assessment. The implementation of the theory in a region can present better results. The decision making process can be improved by Dempster-Shafer theory.

Keywords: Binalud County, Dempster-Shafer theory, impact assessment.

Assessment of the Trends of Land Use and Climate Changes in Choghakhor Wetland Landscape Emphasizing on Environmental Impacts

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Expanded Abstract

Introduction

Land use change and climate change are the major concerns in the global environment. Many environmental parameters affect the behavior of the earth's climate system and its terrestrial components. Effects of land use and land cover changes have direct influences on climate changes. Now, climate change is known widely as a global health problem that has adverse impacts on natural and man-made environments. Assessment of the trend of land use changes is a process that leads to understanding the interaction between humans and the environment. This problem is more important in the sensitive areas and spatially on wetlands. The hydrological and bio-geological functions of many wetlands depend on ground and surface water ecosystems as well as its place in landscape. Therefore, the development and changes in contiguous ecosystems particularly change in water flow can cause damage and even destroy the wetland. This study aims to identify and analyze the environmental changes and pressures on Choghakhor Wetland landscape. This wetland is located between 50° 52′ to 50° 56′E and 31° 54′ to 31° 56′N in height 2270 meters above mean sea level. Choghakhor Wetland located in Zagros Mountains, with area of 1600 hectares, has freshwater resources. It is located in non-protected area in prohibited hunting zone that 2500 ha proposed for refugee site.

Materials and Methods

In order to assess the trends of changes in this study, land use changes and Climate change parameters were investigated in a period of ten years. Then, by environmental pressures analysis, some strategies are presented to reduce environmental impacts. In Fig. 1 stages of the research are presented and described in the following.

- **Step 1.** Use of the Landsat-7 satellite images (ETM+) with suitable timely coincidence in 2003 and 2013 for land use/cover change assessment.
- **Step 2.** Application of the maximum likelihood classification and assessment of classification accuracy with kappa and overall accuracy in ENVI 4.7.
- **Step 3.** Evaluation of the trend of climate change factors such as, the average amount of annual precipitation and temperature. Characterizing the drought degrees with the Standardized Precipitation Index (SPI) by data of effective stations in the study area.
- **Step 4.** Analysis of the environmental changes and pressures by considering the results of climatic trend and land use changes.
- **Step 5.** Presenting management strategies to reduce environmental impacts of land use change and climate change on wetland landscape and its surrounding environment.

Results and Discussion

The aforementioned steps were performed for landscape of Choghakhor Wetland. Detecting the land use and land cover changes in 2003 and 2013 indicate five distinct classes, including: pasture and forest (cultivated and non-cultivated), bare land, man-made (settlements and roads) and water (snow and water) results (Fig. 2 and 3).

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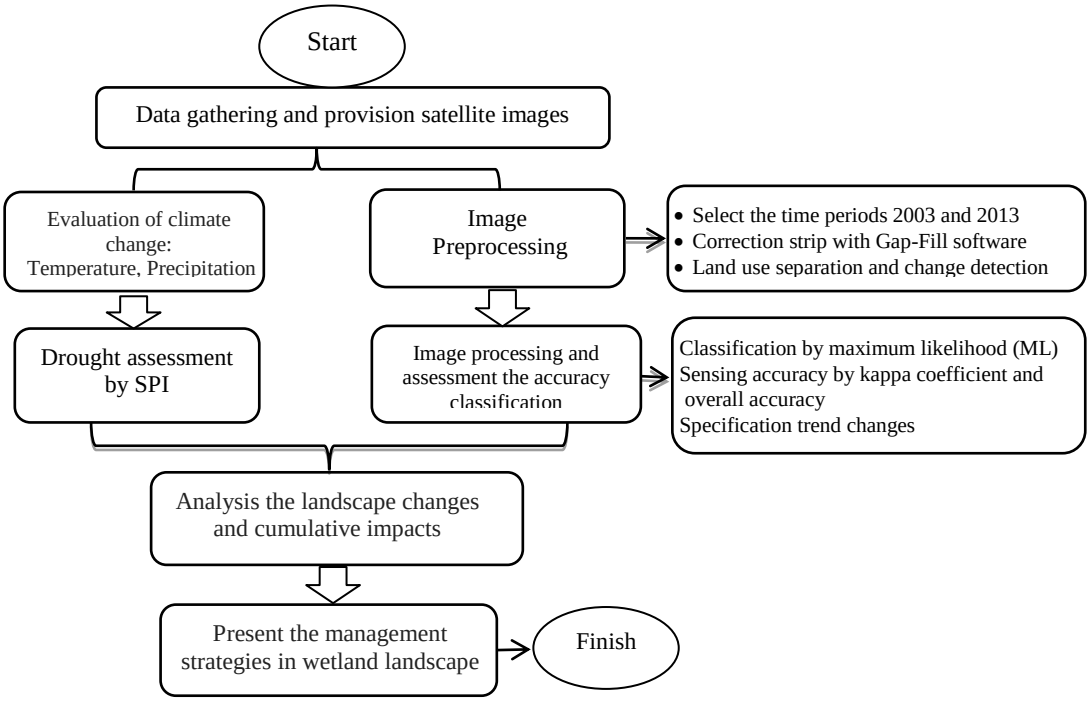

Fig. 1. Process of land use/cover and climate changes assessment in this study

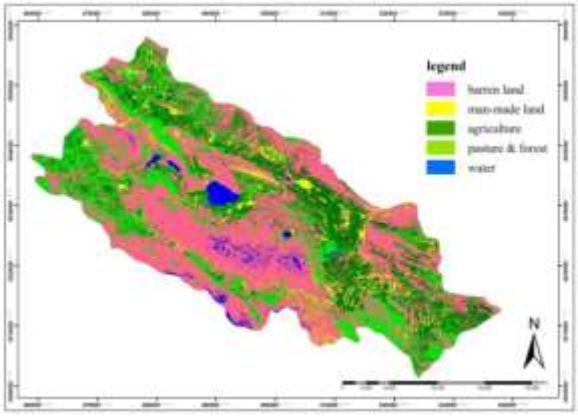

Fig. 2. Classified image of study area in 2003

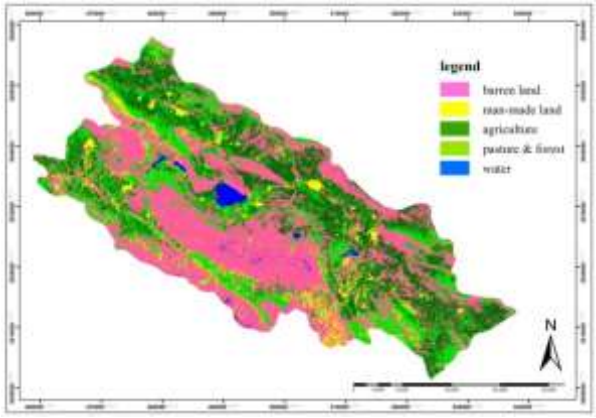

Fig. 3. Classified image of study area in 2013

The results of image classification and remote sensing process in 2003 and 2013 are presented in Table 1. Data processing in this period represent that increase in area of cultivated and man-made lands are 18 and 26.3 percent and decrease in water body, pasture and forest and bare lands are 51.4, 4.2, and 2 percent. The results of the classification accuracy measurement were estimated on 89% and 64% in 2003 and 93% and 68% in 2013 for overall accuracy and Kappa coefficient, respectively. The most effective meteorology data (Overgan Station records) in wetland area in 2012 illustrated that the amount of standard precipitation index is -0.89, which confirmed occurrence of a drought. The probability of drought occurrence is predicted by 41.7% which is in accordance with previous year records. The investigation on climatic change elements showed an increasing trend in average annual temperature with a sharp and irregular fluctuation of rainfall in the recent years.

Conclusions

Investigation on the trend of thirty-year records of climatic elements and the obtained results by satellite monitoring of landscape illustrated 50% decline in water resources amount. Declining rainfalls, rise of a few degrees in the annual average temperatures in the region, and the recent drought, as confirmed by the remote sensing processing result, show water shortage is in expended trend. Despite, land use changes played an important role in the situation during water shortage period. The agriculture development has imposed an enormous environmental pressure by excessive consumption of water, fertilizers and pesticides. Then, drying of springs, reduction of groundwater level, increase in organic and inorganic contaminants, and finally enrichment

Table 1. Results of image classification

Land cover classes	2003		2013		Relative changes (growth rate)	
	Area (%)	Area (km^2)	Area (%)	Area (km^2)	Area (%)	Area (km^2)
Pasture and forest	20.6	388.98	19.7	372.53	-4.2	-16.22
Agriculture	22.8	430.77	26.9	508.68	18	77.51
Barren land	47.5	898.98	43.84	829.01	-2	-69.6
Man-made land	6.6	125.00	8.35	157.90	26.3	32.94
Water	2.5	47.28	1.21	22.88	-51.24	-24.33
Total	100	1891	100	1891	–	–

and declining of dissolved oxygen in wetlands is a description of the occurred situation due to cascading effects of land use change simultaneously with the climate change which could be effective on ecosystem functions of wetland, such as water purification and regulation.

Increase in man-made areas in terms of urban settlements and tourist areas indicated that some pressures have led to decline in permeable surfaces and groundwater recharge, habitat loss, and reduction in control ability of hazardous pollution and detoxification could raise some disorders in exposition of this wetland ecosystem functions. While increasing pressure is occurred, climate change set regional water resources in critical condition and land use change add an irrational severity by such effects. According to adverse changes of Choghakhor wetland landscape, if the current situation trend continues, the wetland will be faced with some irreparable threats. In such a situation, it seems necessary to ponder to proper programs for logically exit from current crisis and preventing the environmental diminish. Leaning the performed analysis, the strategies to reduce environmental impacts and mitigation of drought in the study area are provided as follows:

- Developing the conservation plan and combining them with the integrated wetland management plan in National Development Plans in order to preserve wetland ecosystem functions,
- Modifying the cultivation methods, reducing the consumption of chemical fertilizers and pesticides and awareness about the proper way in their use, using the efficient irrigation systems, licensing the drilling and operation wells with accurate specialized measurements, and awareness about their environmental effects,
- Identifying the natural drainage paths and leaving open the permeable parts in residential areas, in order to reduce the probability of flooding in cities and preservation of hydrologic balance in the drainage basin,
- Dealing with drought losses and declining its effects by applying strategies such as optimum selection and land use change, modifying the culture alternation system, and groundwater levels control.

Keywords: Choghakhor Wetland, climate change, environmental pressures, land use change, remote sensing.

Using the Strategic Environmental Assessment for Compilation Polices of Sustainable Development Plan in Lake Urmia

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Introduction

Average per-capita renewable water of Iran is decreasing strongly. In near future water wars in the Middle East are predictable. Exploitation of land resource has the most significant impact on wetlands. Wetlands degradation is the serious warning to unsustainable development. Despite that the Lake Urmia is recorded in conservation lists as Iranian national parks, Ramsar sites and UNESCO biosphere reserves, over the past decade, change detection in this land indicates the regression of water level. Geology studies such as sediment, pale limnology and hydro geochemistry have shown the role of climate in drying of Urmia Lake with serious uncertainty. Testimonies indicate that Urmia Lake during the Holocene wasn't dry except in shoreline. Unsustainable future for environmental and socio-economic dimensions of this land is predictable. Thus, investigation about the ways of utilization water resources in basic needs (especially water and soil) in Urmia watershed seems necessary. In macroscopic and coarse scales, sustainable development policy making needs Strategic Environmental Assessment (SEA) approach. Integrated management plan for watershed of Lake Urmia is single plan in Urmia basin scale. This plan doesn't have necessary strategies for resource management and has a lot of ambiguities and faults. Moreover, resource management of this land didn't have requisite strategies. This study will identify causal chains of land degradation with driving force-pressure-state-impact-response (DPSIR) model. Then, policies are collected in order to protect natural resources, the area, and the profits of local residual and future generations with SEA approach. SEA studies have just begun in Iran, so this study has much educational and investigative value.

Materials and Methods

Urmia Lake is located at the end of closed endorheic basin of Urmia in North West Iranian plateau. This basin has nine watersheds. Two watersheds are situated on ecological zone. This study is based on description and systematic analysis by using quantitative and qualitative data in SEA framework and policy making category. Screening and scoping stages are noted to understand state of environment and completion of socio-economic baseline studies. Screening stage is noted to initial environmental evaluation by using DPSIR model. This model defines the association between environmental processes and environmental impact with human activities.

In scoping stage, important scales, variable ecological components, and variable social components have been distinguished. Type of these variable components is descriptive indicator. Then, preconditions of participation have been mentioned. In this stage, long-term strategic goals (responding to driving forces in basin scale) with vision outlining (1415) and middle-term strategic goals (responding to pressure in watershed scale and responding to state of ecological zone) with vision outlining (1405) has been determined in order to specify sustainable development planning in this land. In evaluation stage, priority of watersheds has been determined for related policies according to variable components. Appropriate strategies for decision making and monitoring process have been proposed. Finally, optimum mixture of policies has been suggested for sustainable development of this land.

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Discussion and Results

The role of human activities in degradation of this land (Urmia basin) is indisputable. Land degradation driving forces are as follows:

1. The rapid growth of urban population, 2. Lack of appropriate planning to meet population needs, 3. Major and nonproductive employment in agricultural sector, 4. Low literacy and old age in farmers with lands reformation and consequently patches fragmentation and decreasing production efficiency, 5. focus on water supply approach and dam making in water resource management, 6. Government incumbency and facilitating in distribution of agricultural inputs, particularly watersector such as hidden subsidies of government for water supply by lack of proper water pricing, 7. lack of participation of agricultural land use integrated management due to participation preconditions in Iran (government reliance on oil revenue), thus decision making for using land resource is merely government-owned.

The most important pressure of human activity is also as follows:

1. Construction of road through the middle of the lake and consequently water flow disorder. 2. Irregular dam making and consequently silent rivers. 3. Land cover changes and land use conversions. 4. Changes in cultivation pattern and consequently consuming more water. 5. Serious irrigation deficiency. 6. Drilling numerous wells and exploitation of underground water beyond the limit of the water tables. 7. Non principal faulty salt exploitation and consequently dust aggravation.

Conclusion

These pressures lead to dominant positive feedbacks, climatic disturbances and weather quality decadence, quality and quantity of water resource and decreasing and degradation of natural habitats. Finally, this land degradation will lead to increase in unemployment, immigration, social insecurity and protestation and diseases.

This study by using SEA in Urmia watershed, has compiled sustainable development policies. The main advantage of this study is incorporation of the results of SEA and DPSIR. Completion of the method used and the result can be a guide for upstream document compilation for sustainable development planning and

Table 1. Middle-term strategies and policies in order to respond to state of Lake Urmia ecological zone

Title of strategy	Policies
Basic measures for lake restoration	1.Finalizing bounds of ecological zone for bathymetry and zoning lake-bed 2. Routing steepest path for salt removing in order to prevent evaporation and water delivery to the lake in selected routes
Infrastructural solutions to get back water into the lake	3. Removing barriers and dredging paths on the rivers and lake-bed 4. Feasibility study for recovering water flow in middle lake by road qualifying
Land uses and human activities adjusting	5. Removing unauthorized activities 6. Integrated ecotourism planning 7. Planning for conversation of the wetlands and ecological zones with participation of inhabitants as salaries 8. Breeding artemia by inhabitants and exporting from the region

Table 2. Mid-term strategies and policies for responding to pressures on land in catchment scale

water delivery to the lake and wetlands from reservoir of dams and feasibility study for dam removal
Underground water restoration by seriously limiting exploitation of wells and aqueduct revival
Promoting irrigation efficiency- removing irrigated agriculture in lands without potential ecological ability
Restoring, recycling and reusing from municipal- industrial wastewater
Completing and updating cadastral map- correct management for committing agricultural inputs Improving cultivation pattern- participatory agriculture extension
business, industry and services development with establishment HSE-MS Integrated tourism management out of ecological zone
Protection and restoring damaged pastures according to potential ecological ability

Table 3. Long-term strategies and policies for responding to degradation driving force in basin scale

Title of strategy	Policies
land use planning revision	✓ According to all of the potentials and relative advantages
economic system reformation for participation in decision making and how to use resources	✓ Establishment of modern taxation system and reduction of oil revenues ✓ Reduction of government incumbency in distribution agricultural inputs ✓ Measures in order to coordinate governmental and private stakeholders ✓ Organizing interdisciplinary research teams from elite professionals ✓ Using all the appropriate capacities and experiences and cooperations between universities and non-governmental sector in order to promote indigenous knowledge and sustainable approaches for water and energy
Redefining the role of water	✓ attention to conservation and allocation approaches and avoiding supply-based approaches especially dam making and wells drilling
agricultural self sufficiency revision	✓ completing studies of cultivation pattern by virtual water calculation
Completing and amending environmental laws and rights	✓ Measures in order to promote the strength of environmental protection agency ✓ Focus more on market base approach and externalities ✓ accurate determining of wetlands water rights and standard of dams ✓ Accurate accounting of water supplying to agricultural consumers
Public education	✓ Environmental ethics and sustainable and participatory agriculture
Monitoring by elite interdisciplinary research team	✓ Establishment of interactive database and its completion and updating in decision support system by fine scale monitoring, course scale monitoring and determining limits to acceptable changes

programming in this study area. Also this is a proper model for compilation of upstream documents of management in other ecosystems and wetland areas. Final outcomes of this study are optimum integration of strategies and policies for responding to state, pressures and drivers.

Keywords: DPSIR model, Lake Urmia, policies, SEA.

Salt Lake Maharlu Monitoring by Multi-spectral Satellite Image Processing Techniques

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Expended Abstract

Introduction

Monitoring of salt lake arid areas of sustainable development and environmental protection is an important parameter. Monitoring of this phenomenon, for extraction and thematic maps at different times is necessary. Remote Sensing is Powerful tool of the earth's different ecosystems, such as Playa environments to produce valuable and useful data. Such major causes of male widespread applications of remote sensing data are simple, fast and useful and valuable research done by the data in a variety of indoor environments. Despite the still images using geomorphological phenomena in a variety of fields Such Playa salt lakes in arid and semiarid areas are very limited. Limitations on the use of satellite data to map the areas affected by the salts depends on the spatial distribution of salts on the surface, the changes in salinity, vegetation as a barrier and spectral mixing with other levels of the ground. Some compounds are mixed with saline Playa lakes of the problems that separate the salt basin using satellite images processing difficulties making. In low humidity conditions, the amount of land affected by salt range reflects more visible light and low reflectivity, especially water show takes place in the mid-infrared bands. In order to reduce the adverse effects on salt and increasing information about them, at least two bands of the sensor can be combined to create the composition and formulation. In order to reduce the adverse effects on salt and increasing information about them, at least two bands of the sensor can be combined to create the composition and formulation. The simplest way to interpret the results of visual computing is the threshold. The boundary threshold below which the spectral space of a few pixels is supposed to enter a class and the class of the pixels are assigned to unknown or non-categorized The main purpose of this study was to assess common methods and provide a novel method for extracting the salt lakes in the satellite images to monitor the occurrence of spatial extent of Playa. Given the importance of salt Playa lakes in this area of research, monitoring salt Maharlu the ASTER images using TERRA satellite was placed in 2010.

Materials and Methods

The ASTER image data used in this study is 2010. According to a study that evaluates conventional separation methods Salt Lake Maharlu and thematic mapping using satellite image processing, the proposed method in this paper include visual interpretation of false color composition, the ratio between the band and threshold on the histogram of the image. Due to the complex interaction of a range of other phenomena in Salt Lake Playa Maharlu and requires high precision in the final output, the performance of each of the above methods were proposed. Primary method of generating pseudo-color composition (FCC) with the optimal combination of bands (OIF) and its visual interpretation is done. By combining different bands of the ASTER software ILWIS, a large number of false-color image are that Salt Lake is the best color combination for the separation of the combined color bands 4,3,2(243RGB), while that between Salt Lake and other phenomena are better, Color combination is also very close to the true ground. After producing the best color combination, the different detection techniques developed by Linear histogram and edge detection filter, the contrast between Salt Lake and other phenomena, increased range, and images were suitable for visual interpretation And then using the basic elements of visual interpretation (such as texture, tone, shape, color, function, shadows, location, etc.) Salt Lake boundaries were determined visually using the image. The second way to distinguish the threshold on Runway 5 Salt Lake takes advantage of other phenomena. The Salt Lake monitoring with satellite imagery of where the pixels of pure salt must be separated from the other pixels in different bands, so the images were used for the

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resolution. Given that most of the other bands in the visible bands due to salt lakes are affected by the surface properties of salt, pure salt to separate the pixels do not seem very good. But mid-infrared bands of the area more sensitive than salt water and salts are absorbed by water molecules rapidly than the visible bands are influenced by the surface properties of salt in the dry areas, so the bands of pure salt isolation of pixels from other pixels are better. Thus the separation of pure salts pixels from other pixels, the area of salt as they are not as Playa non salt, so the ASTER band 5 was chosen as the runway for extracting salt lake. In the third method of operation rating the ASTER spectral bands were used to extract the salt lake. The spectral characteristics of salt lakes with mean brightness values of image pixels can be mapped spectral reflection curves of the salt lakes and the formulas obtained and the desired parameters can be extracted. . Most bands that define the parameters used are salt lakes, in the range of visible and infrared bands are intermediate. The reason salt lake reflects the strong absorption in the visible and mid-infrared portion of the electromagnetic spectrum is so severe they had to be able to provide information parameters to increase the salt lakes. In this study, two of the indicators, new indicators of lake salt ratio (RSCI) and indicators of lake salt differential normalized (NDSCI) the characteristics of the ASTER dry and arid desert to distinguish this phenomenon from satellite images are presented, each characteristic, weaknesses and special abilities of their own. To evaluate the resulting maps, as a ground truth map for the semi-automatic method for measuring the accuracy of the map was produced, thus creating a ground truth image, the overall accuracy of the map was generated calculated. This accurately reflects accurately defined threshold for regional-scale studies of salt.

Discussion and Conclusions

The results showed that, depending on the satellite image of the imaging phenomena, the spatial resolution is less possible in mixed pixels increases, Therefore, the high spatial resolution of the image can be more accurately position the salt lakes in arid regions can be extracted reliably and accurately. Method of visual interpretation of satellite images, especially color composite images using different bands will be a quick and comprehensive view, In this way an accurate depiction of salt lakes, especially in the border areas with varying combinations of vegetation and soil types are difficult and complex And identify the precise location of the boundary line of salt lakes are typically associated with errors. One of the fundamental problems with this approach, the boundary pixels are correctly detected This can be a major cause of medium or low spatial resolution sensors are used, as this would lead to mixed pixels. Threshold on the histogram using the methods is that can be extracted from satellite imagery of the salt lakes. This is a reflection of the salt compared to other phenomena in the mid-infrared bands, and very small allotment is close to zero; therefore to extract the salt lakes, on the threshold of the action takes place in the middle infrared bands. Although this method has high accuracy, but it can be easily extracted automatically and quickly raised. Use the bands to extract the salt lakes is also difficult because of the different coatings than in places where the ground does not have an acceptable result. Due to the complex nature of this study provide a new way to Playa Maharlu and tested. This method is based on the combination of the two thresholds and ratio between the bands. The results clearly show that by using simple visual computing easily is extracted useful information from satellite images.

This study detected Salt Lake Playa Maharlu with the ASTER 2010images were processed, It was found that both the band and threshold rating range of the resulting image histogram for monitoring and mapping of salt lakes in arid areas is practiced. The results also showed that the overall accuracy indices NDSCI & RSCI and respectively 0.87 and 0.92 in saline lakes in arid and monitor resolution satellite imagery are effective.

Keywords: Maharlu Salt Lake, satellite images, threshold.

Good Governance and the Unified Management of Coastal Regions of the Caspian Sea

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Expanded Abstract

Introduction

A considerable percentage of the world's population is living in the coastal areas. Thus, there are many different kinds of problems in these regions. Because of the large amount of the people in these areas, their ecosystems are confronted with huge and serious problems. There are different types of arrangements for preventing destruction of ecosystems around the seas. Unified management in coastal states and regions, not only helps decrease ecosystem's difficulties of the sea and its surrounding areas, but also help implement good governance in these regions. Good governance is a new concept for management in all the duties of the states. During last two decades, many international institutions and organizations are interested in this approach. Based on positive experiences of many countries in using the model of good governance, it can be helpful both for states and people to remove many obstacles in the attempt for democratization and sustainable development. Since 1990s, the World Bank and its advisors have concentrated on the fruits and benefits of good governance. This method is based on openness, responsibility and observation of all the political and economic activities in a country. For many researches in different countries, implementation of the criteria of the good governance lead to improvement in the general condition of people in these countries and progress in the path of protecting their ecosystem and sustainable development.

This approach of governing can well combine all the efforts of the civil society with the government bodies. Civil society institutions help governmental branches to protect the ecosystem. Cooperation of social and state energy in these countries will diminish the strong flow of pollution in these regions. Many interest groups and also political parties may be active in this occasion. In this pattern constructive mutual efforts of the people with the governmental executive branches help them to proceed toward sustainable development. In many cases the coastal states are confronting with serious pollution both in the land and the sea. It is very natural that these pollutions are stemmed from a variety of sources in the countries around the sea. Coastal problems will not be solved, but via the public efforts, comprehensive programs, and participation of all interest groups. But these factors have not real influence on many coastal countries of the world. Unified management approach has been proposed from 1970s, on the base of the good governance principles, to remove these problems in coastal areas. In the largest lake of the world, which is confronted with serious environmental problems, this approach can help harmonize the activities of different administrative bodies, which are working in this region.

Materials and Methods

The Caspian Sea is one of the most polluted lakes of the world. There are different sources of pollution both from the land and the sea. After the collapse of the Soviet Union, the number of coastal states increased around the borders of the lake. Instead of one country Russia, Kazakhstan, Azerbaijan Republic, Turkmenistan, and Iran are the coastal states of the Caspian Sea, with different management approaches. Very soon they showed different attitudes toward the Caspian Sea's legal Regime. The I. R. of Iran permanently focuses on the legitimacy of the Soviet era treaties between Iran and the Soviet Union. However, I. R. of Iran and other countries of this region have signed the Convention of Tehran to protect this sea's environment. This convention can help decrease the huge amount of pollution in this lake. The Caspian Sea has a unique ecosystem and it is the place of living for many special kinds of the migrant birds. Unified management of the coastal regions of the Caspian Sea has a positive relation with good governance, not ruling. In the complicated structures of these regions, coastal states are only one of the players, which have to harmonize all the other players, but they are active in the region. To achieve the goals of sustainable development, this kind of cooperation is necessary. This

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method can be analyzed in three stages: national, regional, and international. In the national stage, mobilization of all the civil society institutions that made them active to implement approved program, can help governmental bodies to make their works more efficient.

Harmonizing among the different parties of the governmental bodies and social groups can help them actualize their goals. In the regional level, cooperation among the coastal states helps stop the process of degradation of regional ecosystem. In the international level, the amount of the conventions and the agreements also shows the general consensus on the necessities of unified management of different matters of the world. However, there are different types of perceptions about the range of priorities in different regions. The authors have used the descriptive - analytical method for this research.

Discussion of Results

Based on the findings of this research and with regard to the pollution of the coastal regions, it seems that unified management of the regions using the good governance approach can help cease the damaging process of destroying the ecosystem of the Caspian Sea. All the national, regional, and international evidences make it necessary to expand collaboration among civil and political institutions of the coastal state on the path of revival of this region's ecosystem. There are real threats for the people of this region. This threat can only be removed by this critical cooperation. With inceasing the population of the coastal region, the amount of difficulties of these region can also be accumulated. Based on numerous experiences, unified management of the coastal regions helps remove many critical ecosystems problems. It can be one of the best options to solve ecological pollutions. Demand to unified management of the coastal areas is increasingly recognized in many countries that witness the ecological crisis.

This approach has been expanded in the United States of America from 1970s and had been considered as a new pattern to manage environmental crisis. From the first years of this decade many countries had confronted with huge pollution in their coastal regions and had employed different methods to deal with these issues. The unified management of the coastal regions is a dynamic mechanism that by taking an over- sectoral strategy can create harmony among the socio- economic and environmental activities to reach the aim of environmental protection and sustainable development. The goal of unified management of coastal regions is to decline the contradictory activities of all the institutions and beneficial entities in the regions. In many conferences and meetings of the United Nations and its specialized agencies, the littoral states had been asked to consider suitable and consistent patterns of behavior to actualize this method. There are also many international documents to encourage this mechanism.

Unified management of coastal regions concentrate on these goals and standards: considering economic growth of coastal areas with protection of precious natural resources of the sea and the coasts, management of human activities in these regions to consolidate and keep the environment, maximizing usage of coastal resources with their protection, consolidating the sustainable development in these areas, and easy access of all the people to the coastal regions. In this regard all the state bodies should cooperate closely with civil society institutions. Unified management of coastal areas needs understanding connections between human activities and these regions environment, with all the interest groups in these areas. This is a comprehensive, multi disciplinary, dynamic and sustainable approach. The main goal is preventing devastation of the coastal areas and seas and stopping sectoral policies and behavior. The distinction between the unified management of coastal areas in these regions with coastal management is creating the capacity of a system of unified governance in these regions. The capacity can work through harmonized activities of different branches of the state organs.

This approach can successfully be confronted with unpredicted events and developments in coastal regions and the seas. This is with adjusting all the state and non-state organizations and has a very efficient and influential role in crisis situation. Civil society institutions cooperation is a very important element in this approach. It is very useful to use confrontation of ecological crisis in the coastal areas of the Caspian Sea. In 1992 about 188 projects of unified management of coastal regions had been implemented in 44 countries around the world. In 2005, about 622 projects of unified management of coastal regions had been implemented in 145 countries. Approval of the Ramsar Convention in 1971 was the first global act to start this approach. Since 1990s, unified management has become a common behavior in the international level and in many coastal countries that have followed its principles to contain environmental and security threats.

Conclusions

Unified management of the coastal region of the Caspian Sea should consider the entire ecosystem and social and economic aspects of this region. This has different interactions and creates harmony in national, regional and international levels of the issues. In national level all the formal and informal sectors must cooperate to prevent expansion of pollution in the sea and the coastal regions. There is no doubt that implementation of projects to engage civil society in protection of the ecosystem is a vital approach. However, in these countries the NGOs are

not very active and powerful and the ruling political systems in the region have not positive attitude about them. In regional level all the littoral states have signed Tehran Convention to protect the unique ecosystem of the Caspian Sea. They have understood that expanding cooperation with international organizations can help them to better deal with different threats in this sea and the coastal regions. But it seems that this process is not easy and smooth.

All these regional states need to organize systematic help and cooperation of private and public sectors. None of them can solve the ecological problem lonely; they need internal, regional and international programs to stop the process of degradation of the Caspian Sea ecosystem. Good governance principles, transparency, civil society cooperation, and unified management of the countries of the coastal region can lead to protection of the damaged ecosystem of this region. Many successful experiences of the coastal countries proved that this approach can help revive the polluted regions.

Keywords: Caspian Sea, environment, good governance, Tehran Convention, unified management.

Environmental Noise Pollution Level at Birjand City Using Statistical and GIS Techniques

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Introduction

Noise pollution is one of the environmental pollution that threats public health to the survival of organisms. Urban traffic causes noise pollution as a major factor of air pollution. This is one of the problems of urban citizens. This is also a growing problem that has a potential impact on public health, which is mainly resulted from transport vehicles in the cities and the residential environments.

In most developed and developing countries, the problems of noise pollution have been considered through legislative measures to reduce or eliminate it. The effects of noise pollution on human being do not arise direct or immediate in human body. Physiological and psychological effects of the pollution on humans are usually appeared gradually and have long-term direct impact on the human nervous system, general health and may hearing loss.

In the past, it was thought that the major noise pollution can just be caused by traffic congestion in large cities, thus, most studies about the problem have been conducted in metropolitan cities. While evidence showed that the cities like Yazd with low number of motorcycles has high level of noise pollution. Studies that have been conducted in various parts of Tehran metropolis can express excessive amounts of noise exceeding standard levels in different regions so that most citizens have expressed annoying. Assessment of the noise pollution of Mashhad city showed the highest level of noise in the morning on Bahar Street and in the afternoon and night times in Kohsangi Street. Most of the street traffic noises at all times were reported on Nakhrisi Street. Evaluation of noise pollution in Zanjan City also showed that this pollution in residential and commercial areas was exceeded the threshold limit and there are significant difference among the morning, afternoon and evening times. Noise pollution monitoring results for Yasuj City also indicated that the most crowded stations at all hours of the day and night noise levels is exceeded the standards. Equivalent sound level measured at 13 different stations in Kerman also approved that the levels of noise pollution in most of the stations are higher than the threshold limit. Studies in the most countries outside of Iran suggest that the noise level is far beyond standards limit which can be attributed to the development of urban poor and inefficient management and cultural issues.

Traffic of vehicles is one of the factors that may give rise to noise pollution in the society. Considering the high levels of noise pollution can have a significant effect on public health. The record shows that most of the noise pollution from traffic has been done in major cities such as Tehran, and there is no enough research in the city of Birjand. On the other hand, the increasing physical expansion of the city and establishment of industrial center in the city and also progressive and significant increase of vehicles and other sources of noise pollution make conduction of this research necessary. This study aimed at evaluating the comparative study of noise pollution levels in Birjand city in morning, noon and night times has been carried out using statistical techniques and GIS.

Material and Methods

In this study, the Casellacel, model Cel450 noise pollution meter was used in accordance with international standards. Primarily through field visits and interviews with the people and authorities, the noise pollution sources were identified. 43 points were selected. They were particularly on squares, intersections and crossroads. The specified locations were identified on the map and with help of maps and GPS to find the desired location and raw collect the data. In this study, the standard time of 30 min to measure the noise levels were considered. To do these measurements, the sample times at intervals of 8 to 10:30, 11 to 12:30, 20:30 to 18 are selected. According to World Health Organization standards, Sound Level Meter was placed 3.5 m from the wall and 0.5

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m from streets and station locations were selected close to standard conditions. Sound level meter was calibrated before each measurement with frequency of 1 kHz for 114 dB. In order to obtain more than 95% of CI, 774 samples were measured. As, 3 times in each station throughout the winter and spring seasons were selected in the three periods, 8 to 10:30 am, 11 to 12:30pm noon and, 18 to 20:30 pm night, due to the traffic level. The collected data were stored in Excel and then using the SPSS application for statistical analysis techniques such as frequency and correlation coefficient. ILWIS Academic 3.2 Software was applied to draw the geographical distribution of noise and traffic of the city in three different periods in the morning, noon and night.

Results and Discussion

The results showed that in the morning period the stations 7, 8, 15, 18, 20 to 37, 39 and 43 and in the afternoon period the stations 1,4, 6, 7, 11, 13, 15, 16, 18, 20, 21, 23- 39, 42 and 43 and also in the evening period the stations 2,4, 6, 7, 8, 9, 12, 15, 16, 17, 18, 20, 30, 32 - 39, 42 and 43 have equivalent sound level more than 70 dB. According to the results, almost in all of the stations noise pollution level were more than 70 dB at the night period. It revealed that sources of noise pollution in this period are more and also in the morning is more than noon. This is resulted from the distribution of vehicles numbers. A survey conducted in the holy city of Mashhad showed that the majority of the stations along with increasing the number of vehicles had the highest level of noise pollution at night.

Most of the street width is between 20-40 m with an average 28.67m. Only in 2 stations the streets are more than 50 m wide. Since the traffic is distributed irregularly in the city, in most cases, widening of the roads is not based on traffic volume. Consequently, there is no significant relationship between street width and the amount of traffic which is the main cause of noise pollution in the city. The research that has been done in the Bushehr City also find no significant relationship between the width of the street and traffic volume.

As Table 1 show, there is no significant difference between the widths of the streets and no other measured parameters.

Table 1. Pearson correlation coefficient between mean noise pollution level, traffic and street width

	Noise level in morning	Noise level in noon	Noise level in night	Traffic in morning	Traffic in noon	Traffi c in night	Street width
Noise level in morning	1						
Noise level in noon	0.618**	1					
Noise level in night	0.503**	0.453**	1				
Traffic in noon	0.279	0.325*	0.512**	1			
Traffic in noon	0.300	0.350*	0.514**	0.988**	1		
Traffic in night	0.263	0.291	0.518**	0.994**	0.969**	1	
Street width	–0.103	0.022	0.266	0.250	0.207	0.265	1

The width of the street is not affected by noise pollution level. It may be due to speed of cars on the more deserted streets which causing the amount of noise increases rapidly. The mean level of noise pollution in the morning time shows not significantly correlated with traffic volume. The mean level of noise pollution at various time intervals was significant at 1% level. This means that in most areas with high levels of noise pollution during the morning or noon, at night, the same process is followed. The strongest correlations were found between the different measured parameters with the traffic in time morning, noon and night. The results of this study this can be concluded that the traffic volume has a direct effect on the noise pollution levels. There is direct relationship between the number of vehicles, vehicle types and levels of noise pollution, a more significant role in this regard for motorcycles.

According to the Iranian standard, the noise limits in the open air during the day are as following: residential areas (55dB), commercial- residential (60dB), commercial (65dB), industrial-residential (70dB) and industrial areas (75dB), considering the noise threshold limit for residential areas is 55 dB. Noise pollution levels for many different areas, including residential and commercial, is exceeded from limited values. For example, in terms of commercial- residential areas only station No. 5 (intersection of 15 Khordad Street and Tohid Street), have a mean contamination level of 30.58 dB which is acceptable in the period of morning while other stations are beyond the standard level.

In terms of commercial in the morning period, Station No. 5 for the Noon period, Station No. 17 (intersection of Tohid Street and Mosa Sadr Street) and Station No. 12 (Sajad Shahr- Imam Sadegh Square) for the night

period, Station No. 1 (Madras Street- Jamaran square), Station No.40 (Adel Street- 19th Alley) and Station No. 41 (Adel Street- 10th Alley) in the morning were in the standard level. Results of other investigators also represent the noise level exceeded standards in different regions in different towns.

With the growing trend of modernization and population increase traffic noise pollution is avoidable. In the near future noise pollution levels in the city at all hours of the day will exceed the standard values, as serious danger to public health. Therefore, it is important to take the appropriate measure to reduce and control these pollutants. Methods to deal with noise pollution in cities can be named such as; urban land suitable site selection in a comprehensive and detailed designs, manufactures standard and vehicles standard, restrictions on movement of vehicles and motorcycles, speed limits, traffic improvement and expansion of public transport. As well as building of acoustic walls around roads, using sound-absorbing materials in residential and commercial buildings and application of green space on the edge of residential areas and roads will reduce noise pollution in the city. The appropriate number of noise measurement stations, land use and acoustic zoning maps of the city is integral to any planning for the city.

Conclusion

Noise pollution is one of the most important environmental problems of today society and is considered as a potential danger to human health. In this study, 43 sites were selected to evaluate and measure the noise level. Statistical analysis revealed that there is no significant relationship between the width of the streets and traffic volume and noise level. The results of the present study was that the traffic volume and noise levels mapping alignment for three different periods in the morning, noon and night were plotted using GIS. This indicates direct effect of the traffic volume at noise pollution level. The level of noise pollution of Birjand in different stations was compared with standard level of noise in Iran. This revealed that almost all of the residential stations have exceeded the values of standard and puts public health at risk, Therefore, the appropriate measures must be taken to reduce and control these pollutants.

Using urban land suitable site selection in comprehensive and detailed designs, manufactures standard and low-volume vehicles, cars and motorcycles restrictions on traffic, speed limits, traffic culture and expansion and encourage of public transportation are the suggestions to deal with noise pollution in cities. The construction of sound walls around roads and application of sound absorbing materials in residential and commercial buildings and also use of green space on the sidelines of residential houses or roads can help reduce the pollution. Presence of a good number of noise measuring stations is a prerequisite for any plan in the city.

Keywords: Birjand City, GIS maps, noise pollution, statistical analysis.

The Comparison of Fuzzy Drastic Model and Conventional Drastic Model to Determine the Most Appropriate Indicator of Ground Water Vulnerability (Case Study: Sarkhoon Plain Aquifer)

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Expanded Abstract

Introduction

Drastic model is an index and overlapping model that has been designed for producing vulnerability scores for different points by combining several thematic layers. Overlapping distinguished methods are the most applicable methods for evaluating vulnerability of aquifers because they are cheap, they can directly reach a defined goal, the used data in the methods are accessible or can be estimated, their final results can easily be described, and they are suitable for managerial decision making. However, ranking system of parameters of this method is an irrational and unreliable system. These classifications are based on Boolean method. If classification is done based on Boolean method, it will cause a zone to displace a story to a higher or lower score with little change which is not acceptable and justifiable. But it seems that one can present a suitable method for classification and ranking using fuzzy theoretical fundamentals compared with Boolean method. In that fuzzy method gives a membership to each theme. This research has been conducted to utilize fuzzy theoretical fundamentals in modeling of drastic hydrogeology parameters. These parameters have inherent uncertainty to determine fuzzy drastic index and compare it with conventional drastic index to obtain the most accurate and suitable inherent vulnerability evaluation index. In this study this index can be evaluated for Sarkhon Zone to find vulnerability evaluation as a guide for managers and authorities as an efficient instrument for taking suitable measures. In this research, the studied zone is aquifer of Sarkhon Plain located in Hormozgan province.

Materials and Methods

Study area

The studied zone is Sarkhon in approximate distance of 25 km from Bandar Abbas in eastern-northeastern range of Geno Mountain. This basin with area of 1046 sq km is located in latitudes of 27°,9′ to 27°,33′ and longitudes of 56°,7′ to 56°,33′ in Sarkhon drainage basin (Fig. 1).

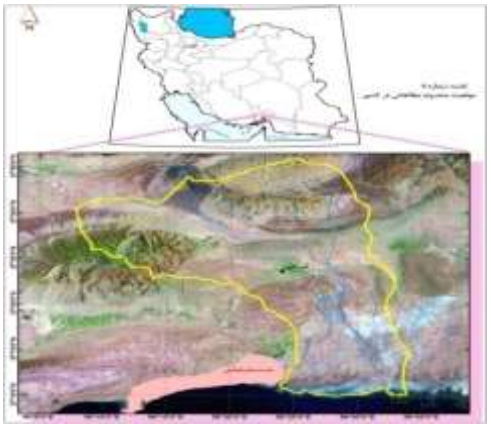

Fig. 1. The study area, Sarkhon Aquifer

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Drastic Index

It is calculated using seven factors affecting potential of groundwater pollution. These factors include depth of water table, net recharge, aquifer media, soil, slope, impact of vadose zone, and hydraulic conductivity. The rank of each parameter varies between 1 and 10 and weight of each parameter varies between 1 and 5 considering its importance. Vulnerability index in this method is obtained by multiplying weight by rank of seven parameters according to Equation 1.

$$Di = \sum_{j=1}^{7} (Wi \times Rj) \quad (1)$$

Di = Drastic Index

Wi =weight factor i

Rj= j rank factor

Fuzzy logic

The use of fuzzy logic has been expanded in many branches of sciences which require classification of information. Since classification of information and demarcation of these classes are of special importance in evaluation of groundwater vulnerability, fuzzy logic can evaluate vulnerability better than the conventional methods.

Fuzzy *Inference System Formation Stages*

1. Determining a ***Fuzzy Rule System based on observational data***
2. Fuzzifying prior and posterior section using fuzzy membership functions
3. Combining different parts of prior section of each rule and determining intensity and impact of the mentioned rule on final output of the system
4. Combining posterior section of rules to obtain final output of system as a fuzzy set
5. Converting final output of system to a classic number using defuzzification method (if necessary, output of the system is expressed as a classic number).

Use of Software

Data were analyzed and the models were applied in ARCGIS 9/3 application. Ranking of the parameters was corrected from fuzzy menu of MATLAB and SPSS 14 application was used to verify the model and statistical analyses.

Results and Discussion

Preparing a plan for ranking the index parameters and databases were prepared in EXCEL application considering the required information of the desired index and parameter. Then, the database was converted into the format applicable in ArcGIS.

Fuzzification of Input Values

The first stage of creating fuzzy system is definition of inputs and membership functions. Input parameters are including depth of water table, net recharge, topographic slope, and hydraulic conductivity. Because other three parameters of the drastic model lack intermediate values, they cannot be fuzzified. Gaussian membership function was used to fuzzify the parameters. Each parameter was independently fuzzified in Matlab application.

After fuzzy input parameters, fuzzy rules base is made. Fuzzy rules are expressed with if-then structure and in each of these rules combined effects of the indices are used from the desired viewpoint.

In this research, Sogno Fuzzy Inference Model was used considering the fixed ranks in each of the rules. In this regard, 100 points were separately drawn in a shape file format. Using Extract Values to Points Tool, values of depth of water table, hydraulic conductivity, net recharge, and slope of these points were assigned to them. The resulted table was transferred out of software as an excel file to determine utmx and utmy coordinates of these points.

Gaussian Membership Function was used for input fuzzy sets; constant membership function was used for output fuzzy sets and ***weighted*** averaging method and Sogno Fuzzy Inference Model for defuzzification in this model. At the end, outputs which are real ranks of these values were obtained based on non-fuzzy inputs which are values of the above layers. Finally, table which has been formed from points with coordinates and ranks were entered into GIS software. Using IDW method, the ranked points were interpolated to obtain ranks of all pixels and plans for ranking of the above parameters.

In Boolean logic which is based on drastic method, many vulnerable zones is with very low and very high potential values. They have been neglected and these zones are considered in fuzzy logic and have gained real and suitable percent of vulnerability.

What is observed in inherent vulnerability zoning map of Sarkhon Plain Aquifer with fuzzy drastic method is that the zone inherent vulnerability index varies from 70 to 127 which is included in low and medium vulnerability classes. About 7.8% of the zone has low vulnerability and 92.2% has medium one.

To verify fuzzy drastic model and conventional drastic model, factor of salinity which is one of the most important factors affecting quality of the aquifer of interest was used as pollution index. The higher the quality of water, the more vulnerable the groundwater to pollutants will be. Negative correlation coefficient also confirms this fact. Correlation coefficient is -0.526 in fuzzy drastic model and -0.066 in drastic model. In fuzzy drastic model, we will have lower EC in case of higher vulnerability which shows fuzzy verification. It can be concluded that drastic fuzzy model is more accurate than conventional drastic model.

At the end, fuzzy model was used as top option of inherent vulnerability of the studied zone and there are low vulnerability of 7.8% and medium vulnerability of 92.2% in two classes. Generally, the results of this research confirm fuzzy modeling of hydro geologic parameters which have inherent uncertainly.

Keywords: drastic, fuzzy theory, overlapping index, spearman correlation, vulnerability assessment.

Determination of the Spatial and Temporal Variation of SO_2, NO_2 and Particulate Matter Using GIS Techniques and Estimation of Concentration Modeling with LUR Method (Case Study: Tehran City)

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Expanded Abstract

Introduction

Studies about the health effects of long-term average exposure to outdoor air pollution have played an important role in the recent health impact assessments. Exposure assessment for epidemiological studies of long-term exposure to ambient air pollution remains a difficult challenge because of substantial small-scale spatial variation. Current approaches for assessing intra-urban air pollution contrasts include the use of exposure indicator variables, interpolation methods, dispersion models and land-use regression (LUR) models. LUR models have been increasingly used in the past few years. Land-use regression combines monitoring of air pollution at typically 20-100 locations, spread over the study area, and development of stochastic models using predictor variables usually obtained through Geographic Information Systems (GIS). Significant predictor variables include various traffic representations, population density, land use, physical geography (e.g. altitude) and climate. Land-use regression methods have generally been applied successfully to model annual mean concentrations of SO_2, NO_2, PM_{10}, $PM_{2.5}$, the soot content of PM and VOCs in different environments, including European and North-American cities. The performance of the method in urban areas is typically better or equivalent to geo-statistical methods, such as kriging, and dispersion models. Further developments of the land-use regression method have more focus on developing models. This can be transferred to other areas and include of additional predictor variables such as wind direction or emission data and further exploration of focal sum methods. Models that include a spatial and a temporal component are of interest for (e.g. birth cohort) the studies that require exposure variables on a finer temporal scale. There is a strong need for validation of LUR models with personal exposure monitoring.

Materials and Methods

This study developed average exposure estimates of one season for Sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and Particulate Matter (PM) in Tehran in 1391. The averages exposures were constructed by first developing land use regression (LUR) models of spatial variation in annual average PM, SO_2 and NO_2. Data were collected from 42 locations in the Tehran City Community Air Survey and emissions source data near monitors. The annual average concentrations from the spatial models were adjusted to account for city-wide temporal trends using the time series derived from regulatory monitors. Models were developed using season 1 data and validated using season 2 data. Average exposures were then estimated for three buffers of maternal address and were averaged into the last four weeks, the trimesters, and the entire period of gestation. We characterized temporal variation of exposure estimates, correlation between PM, NO_2, SO_2 and the correlation of exposures across trimesters.

Results and Discussion

The LUR models of average annual concentrations explained a substantial amount of the spatial variation (R^2 = 0.47 for SO_2), (R^2 = 0.51 for NO_2), (R^2 = 0.71 for PM_{10}) and (R^2 = 0.47 for $PM_{2.5}$). The relative contribution of temporal versus spatial variations in the estimated exposures is varied by time window. The difference in seasonal cycle of these pollutants resulted in different patterns of correlations in the estimated exposures across trimesters. Table 1 shows Spearrman correlation results with wind direction, wind velocity and temperature.

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Table 1. Spearrman's correlation results

Wind direction	Wind velocity	Temperature	Pollutant
-0.085	-0.081	-0.083	SO_2
0.05	0.05	0.05	sig.
-0.98	-0.302	-0.320	NO_2
0.041	0.000	0.000	sig.
-0.008	-0.012	0.055	PM_{10}
0.131	0.000	0.319	sig.
-0.002	-0.05	-0.109	$PM_{2.5}$
0.731	0.361	0.49	sig.

The three levels of spatial buffers did not make a substantive difference in estimated exposures. The combination of spatially resolved monitoring data, LUR models and temporal adjustment using regulatory monitoring data yielded exposure estimates for PM that performed well in validation tests. Table 2 shows RMSE of spline method results. The interaction between seasonality of air pollution and exposure intervals during pregnancy needs to be considered in the future studies.

Table 2. Spline method results

RMSE	Neighbor points	Method RBF	Pollutant	RMSE	Neighbor points	Method RBF	Pollutant
29.51	42	Completely Regularized Spline	NO_2	23.46	42	Completely Regularized Spline	SO_2
29.40	42	Spline with Tension		22.22	42	Spline with Tension	
30.15	42	Multiquadric		33	42	Multiquadric	
29.20	42	Inverse Multiquadric		25.61	42	Inverse Multiquadric	
32	42	Thin Plate Spline		31	42	Thin Plate Spline	
16.50	42	Completely Regularized Spline	$PM_{2.5}$	30.30	42	Completely Regularized Spline	PM_{10}
17.20	42	Spline with Tension		31.25	42	Spline with Tension	
17.90	42	Multiquadric		32.17	42	Multiquadric	
17.50	42	Inverse Multiquadric		32.25	42	Inverse Multiquadric	
16.80	42	Thin Plate Spline		31.89	42	Thin Plate Spline	

Conclusions

Land-use regression methods have generally been applied successfully to model the annual mean concentrations of SO_2, NO_2, PM_{10}, and $PM_{2.5}$. Land-use regression methods can also be benefited from a more systematic selection and description of monitoring locations and monitoring periods. More attention to the precision of geographic data is also important. A model strategy incorporating greater knowledge of the factors related to spatial variation and focusing less on maximizing the percentage of the explained variability would probably result in the models that can more readily be transferred to other areas. Where purpose-designed monitoring is included, the cost of monitoring could probably be reduced if models were transferable. Promising new developments include the use of additional predictor variables such as wind direction data or emission data and the use of the raster GIS environment – for example, to apply focal sum methods. Models that include both a spatial and a temporal component are also of interest for studies that need exposure variables on a more detailed scale. However, it remains to be seen whether these LUR models can outperform dispersion models for shorter averaging periods. Finally, an area of interest for epidemiological research is the need for validation of LUR models with personal monitoring. The combination of spatially resolved monitoring data, LUR models and temporal adjustment using regulatory monitoring data yielded exposure estimates for PM_{10}, $PM_{2.5}$, SO_2 and NO_2. This is performed well in validation tests. The interaction between seasonality of air pollution and exposure intervals during pregnancy needs to be considered in the future studies.

Keywords: air pollution, GIS, land use regression, particulate matter.

Application of Magnetic Hydroxyapatite Nanoparticles for Removal of Cd^{2+} from Aqueous Solutions

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Expanded Abstract

Introduction

Environmental pollution by heavy metals is one of the most commonly-encountered problems in many areas in which biological controls have not been implemented. As these metals are non-biodegradable, they remain in the nature for a long time, and through deep percolation into underground water they can cause degradation of ecosystems. The uptake of these elements by plants and their inclusion in the chain of human and animal food is a great risk for the environment and the human being health. Due to non-biodegradable property of Cadmium and some other toxic heavy metals, these metals remain in the environment for a long time. Cadmium is one of the most toxic heavy metals and it has been reported to cause renal dysfunction, hyper-tension, lung insufficiency, bone lesions, cancer, and etc. The principal industrial sources of Cd in the environment are electroplating, smelting, alloy manufacturing, pigments, plastic, battery, mining and refining processes. In the recent years there have been some reports on the use of inorganic absorbents for separating and removing heavy metals from aqueous solutions. Due to the availability, cost-effectiveness, stability against oxidation and reduction conditions and the possibility of recycling, inorganic adsorbents are economically viable. Traditional inorganic adsorbents with a low surface area lose their ability to absorb. Thus, making high capacity adsorbents for fast and easy removal of contaminants is a necessary step. One of the outstanding characteristics of fast-emerging nanotechnology studies is the high surface area to volume ratio of nanomaterials. Because of these outstanding features and other unique properties, nanoparticles may have potential to absorb pollutants from contaminated environments. So far, many technologies to remove heavy metals from aqueous solutions including chemical precipitation, ion exchange, membrane technologies, electrodialysis, and biosorption have been developed. Many of these methods have disadvantages such as high cost of operation, the high sludge, and secondary contamination. Nanoparticles with extremely small size and high ratio of surface-area to volume, provide better kinetics for the adsorption of metal ions from aqueous solutions. Hydroxyapatite as one of the major components of bones and teeth are widely used in biomedical and dental applications, drug delivery, and waste water remediation because of biocompatibility, low solubility, ion exchange and high sorption capacity of heavy metals. Magnetic separation technology as an efficient, fast and economical method for separating magnetic materials has been widely used in textile, biology, and environmental protection. In this study, magnetic hydroxyapatite nanoparticles were synthesized by co-precipitation method. The nanoparticles were characterized by x-ray diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM), Fourier Transform Infrared spectroscopy (FT-IR), Vibrating Sample Magnetometer (VSM). Finally, the produced nanoparticles were used as adsorbents for the removal of cadmium ions from aqueous solutions. In batch experiments, the effects of pH, evaluation time and initial concentration of Cd^{2+} ions on adsorption were investigated.

Materials and Methods

$FeCl_2 \cdot 4H_2O$, $FeCl_3 \cdot 6H_2O$, NH_4OH (25%), Ca (NO3) $2 \cdot 4H_2O$ and $(NH_4)_2HPO_4$ were purchased from Merck. All the solutions for the metal adsorption experiments were prepared using their nitrate salts. The amount of $FeCl_2 \cdot 4H_2O$ (1.85 mmol) and $FeCl_3 \cdot 6H_2O$ (3.7 mmol) was dissolved in 30mL of deoxygenated water under nitrogen atmosphere at room temperature, and then 10mL of NH_4OH solution was added to the resulting solution

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under vigorous mechanical stirring (300 rpm). A black precipitate was produced instantly. After 15 min, up to 50mL of $Ca(NO_3)_2 \cdot 4H_2O$ (33.7 mmol) and 50mL of $(NH_4)_2HPO_4$ (20 mmol) solutions whose pH were all adjusted to 11 were drop wise added, simultaneously to the obtained precipitate solution for 30 min with mechanical stirring. The resulting puce suspension was heated at 110 ˚C for 2 h and then the mixture was cooled to room temperature and aged for 24 h without stirring. The obtained precipitate was separated by a magnet, washed repeatedly with deionized water till neutrality, dried in the drying oven at 110◦C, and grinded with mortar. The final products were the prepared magnetic hydroxyapatite nanoparticles adsorbents. The adsorption behavior of the magnetic hydroxyapatite nanoparticles for Cd^{2+}ions was investigated by means of the batch experiments at 24±1°C. A known amount of magnetic hydroxyapatite nanoparticles was mixed with 50 mL of the corresponding Cd^{2+} solution over a period of time on a shaker at 150rpm. After that, the aqueous phase was separated by magnetic decantation; the concentration of Cd^{2+} in the solution was determined by using an atomic absorption spectrometer. In order to determine the optimum of pH, 0.05g of magnetic hydroxyapatite nanoparticles were added to 8 flask containing cadmium and under different pH conditions, the removal efficiency of cadmium ions by the adsorbent was detected**.** To evaluate the optimum dosage of magnetic hydroxyapatite nanoparticles adsorbent, 3–10 mg of freshly prepared magnetic hydroxyapatite nanoparticles was added to 50.0mL of aqueous solution containing 50.0mg/L Cd^{2+}. The results showed that increasing the amount of adsorbent, the adsorption efficiency of Cd^{2+} due to increased absorption of available sites, has increased the effect of contact time on the adsorption of Cd^{2+} by magnetic hydroxyapatite nanoparticles (pH of the solution: 5.5, amount of adsorbent: 0.1g, Cd^{2+} concentration 50 ppm; temperature: 25±1°C). Sorption isotherms were obtained by equilibrating magnetic hydroxyapatite nanoparticles with metal solutions of different initial concentrations: 10-300 mg/l for 30 min. After separation, the final concentrations of metal in the solutions were measured. The adsorption capacity was calculated according to the following equation:

$$qe = (C0 - Ce)V/m$$

The removal efficiency of lead ions was calculated by the difference of lead ion concentrations in aqueous solution using the equation expressed as follows:

$$R\% = (C0 - Ce)/C0 \times 100$$

where, qe (mg/g) is the amount of lead ions adsorbed onto the unit amount of the adsorbent, C0 (mg/L) is the initial lead ion concentration, Ce (mg/L) is the final or equilibrium lead ion concentration, V (L) is the volume of the solution, and m (g) is the adsorbent weight in dry form. The Langmuir and Freundlich models were used to describe the relationship between the absorbed amount of Cd^{2+} and its equilibrium concentration in solution. To determine whether the Cd^{2+} adsorption process by magnetic hydroxyapatite nanoparticles is favorable or unfavorable for the Langmuir type adsorption process, the isotherm shape can be classified by a term "RL". RL values are ranged from 0 to 1 and indicate favorable adsorption, while RL >1, RL =1, and RL =0 indicate unfavorable, linear, and irreversible adsorption isotherms. Phase composition of the samples were characterized using a X-ray diffractmeter (XRD, Model pw-18/40, Philips, Germany) with CuKα (λ = 1.5418 Å) incident radiation over the 2θ range of 10–80◦ at room temperature with a step size of 0.02◦. The morphology of particles was investigated by scanning electron microscopy (SEM, Model VEGAII, XMU, Tescan, Czech Republic). To study the chemical structure of samples, Fourier Transform Infrared spectroscopy (FTIR, Model: EQUINOX55, Bruker, Germany) was used. For this, the samples prepared from 1:80 magnetic hydroxyapatite nanoparticles - KBr mixtures (by weight) were compacted into pellet form and then scanned from 4000 to 400 cm^{-1}. The magnetization measurements were performed at room temperature using vibrating magnetometer. The concentration of Cd^{2+} in the solution was determined by using an atomic absorption spectrometer (Analytic jena-verio6).

Conclusions

In this study, magnetic hydroxyapatite nanoparticles were synthesized by co- precipitation method, and the adsorption potential of nanoparticles for the removal of Cd^{2+} from aqueous solutions was investigated**.** The experimental results confirm that this adsorbent has the potential application for removal of Cd^{2+} from aqueous solution. The nanoparticles were characterized by x-ray diffraction, Field emission scanning electron microscopy, FTIR, and vibrating sample magnetometer. The effect of contact time, initial metal ions concentrations, pH, adsorbent dosage was discussed. The XRD patterns of samples confirm the hexagonal structure of hydroxyapatite and tetragonal structure of maghemite. This pattern indicates that the diffraction peaks are in agreement with the standard card (0566-074-01 ICSD) of hydroxyapatite and (0566-013-01 ICSD) of the tetragonal of maghemite. FESEM image of the nanoparticles showed almost spherical shape. The average size of nanoparticles was 19±2. FTIR spectroscopy reveals expected bonds formation. Magnetic properties of nanoparticles prepared at room temperature were studied in the range of 10000 ± Oe. Hysteresis curves of nanoparticles showed that the saturation magnetization and coercivity of the nanoparticles was 2.8 emu/g and 0 Oe, respectively. The nanoparticles indicate super-paramagnetic behavior. The super-paramagnetic property of

the magnetic hydroxyapatite nanoparticles is critical for their application in industrial catalysis, environmental protection, biomedical and bioengineering field, which prevents them from aggregation and enables them to re-disperse rapidly when the magnetic field is removed. Finally, the produced nanoparticles were used as adsorbents for the removal of Cd^{2+} from aqueous solutions. In batch experiments, the effects of pH, evaluation time, adsorbent dosage and initial concentration of Cd^{2+} ions on adsorption were investigated. The highest removal efficiency of Cd^{2+} was in the range pH = 5-7. The removal efficiency increases with time in the first 30 min. Then, the adsorption curve reached equilibrium after this time. Removal efficiency increased as the adsorbent dosage was raised. When a dosage of 0.1 g was used, the removal efficiency reached 96%, indicating that the composite adsorbent magnetic hydroxyapatite nanoparticles showed strong affinity to Cd^{2+}. The adsorption was relatively fast and the equilibrium was established within 30 min to be considered the adsorption isotherm data could be well described by Longmuir equation. The R_L values in this study were in the range from 0.045 to 0.488 which indicated the favorable adsorption between Cd^{2+} and magnetic hydroxyapatite nanoparticles sorbent. Maximum adsorption capacities of Cd^{2+} were 84.746 mg/g. The results of adsorption experiments indicated that magnetic hydroxyapatite nanoparticles have high adsorption efficiency with short reaction time (30 min) and can be very effective to remove Cd^{2+} ions from aqueous solution. The most prominent advantage of prepared magnetic hydroxyapatite nanoparticles adsorbents with super-paramagnetism and adsorption capacities was the separation convenience from aqueous solutions.

Keywords: aqueous solutions, cadmium, co-precipitation method, hydroxyapatite, magnetic nanoparticles.

Application of Indicator and Ordinary Kringing for Modeling of Groundwater Chloride

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Expanded Abstract

Introduction

The main problems relating to water quality for agriculture are salinity, soil infiltration and specific ions toxicity. Accumulation of the specific ions from the irrigation water in the plants reduces crop yields. One of the most common specific ions toxicities results from high concentration of chloride (Cl) ion. Knowledge of the spatial distribution of Cl concentration in groundwater is needed for a better management of the groundwater resources. As limited number of sample data is often available, some appropriate interpolation methods are needed to interpolate between the sample points. Ordinary Kringing (OK) is a geostatistical estimation method which uses a semivariogram model to predict the unknown values. However, it cannot predict properly the spatial distribution pattern of a highly skewed data. Besides, OK estimation variance is not a perfect measure of local uncertainty because it only depends on data configuration not data values. Unlike OK, indicator Kriging (IK) is a distribution-free approach, which has the ability to model local uncertainty of the estimated values through estimating a conditional cumulative distribution function (ccdf) corresponding to each point. Although this method has been used by many researchers for mapping and modeling local uncertainty of various environmental variables such as groundwater Cl and other groundwater quality parameters, in Iran it has not been employed for such purposes much. The objective of this study is, therefore, to model the local uncertainty of groundwater chloride over Kerman plain using IK. The performance of IK is compared with the traditionally used OK (with and without data logarithms).

Materials and Methods

Study area and sample data

This study is performed in Kerman plain. The study area is located in a semiarid and arid region. Its average elevation above Sea level is 1755 m. Because of the lack of surface water resources, groundwater resources are the main water resources for agricultural purposes in this area. Due to the importance of specific ions toxicity, the groundwater samples were collected from 76 agricultural wells and Cl concentration were measured in laboratory.

Geostatistical analysis

First of all, experimental (indicator) semivariograms are calculated to investigate the spatial variability of (within class) Cl data. A suitable theoretical model is then fitted to the experimental values for kringing modeling of Cl. Then IK is used to map groundwater Cl and to evaluate the uncertainty attached to the estimates. The results were compared with those achieved from OK and log-kringing (LOK). The probability maps of not exceeding two threshold values 10 and 20 meq/lit were generated for Cl by IK. These two threshold values are selected according to the irrigation water quality standard proposed by Ayres and Westcot in 1989. In the following the geostatistical tools and methods used in this study are briefly described:

Semivariogram

The semivariogram quantifies the dissimilarity between observed values as the separation distance between the sample points increases. In practice, experimental semivariogram, $\gamma^*(h)$, is computed for two values separated by a lag distance h as following:

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$$\gamma^*(h) = \frac{1}{2N}\sum_{i=1}^{N}\left[z(x_i) - z(x_i + h)\right]^2 \quad (1)$$

where, N is the total number of data pairs of observations $z(x_i)$ and $z(x_i+h)$ separated by a distance h for a specific direction. Kringing needs the semivariogram values for any given lag, therefore, a theoretical model may be fitted to the experimental values and the characteristics of this model can be used.

Ordinary Kringing

In OK, the values at unsampled locations are determined by a linear weighted moving averaging of values at sampled locations as:

$$z^*(x_0) = \sum_{i=1}^{n}\lambda_i \cdot z(x_i) \qquad \text{with} \qquad \sum_{i=1}^{n}\lambda_i = 1 \quad (2)$$

where $z^*(x_0)$ is the estimated value of variable of interest at unsampled location x_0, λ_i is the weight assigned to the known value of variable at location x_i determined based on a semivariogram model and n is the number of neighboring observations. OK produces an estimation variance attached to every estimate, which can be used to generate a confidence interval for each estimate assuming a normal distribution of errors. OK performed on lognormal transformed data is called Lognormal Ordinary Kringing (LOK). The estimates have to be back-transformed to the original space at the end.

Indicator Kringing

Indicator Kringing (IK) is based on the coding of the random function $Z(x)$ into a set of K indicator random function $I(x, z_k)$ corresponding to different cutoffs z_k:

$$I(x; z_k) = \begin{cases} 1 & \text{if } Z(x) \le z_k \\ 0 & \text{otherwise} \end{cases}, \qquad k = 1, \ldots, K \quad (3)$$

After transforming the observed data to a new set of indicator variables, the experimental semivariogram is calculated for every set of indicators at each cutoff z_k. The conditional cumulative distribution function (ccdf) at each unsampled location, e.g. x_0, is then obtained by the IK estimator:

$$F(x_0; z_k \,|(n)) = I^*(x_0; z_k) = \sum_{i=1}^{n}\lambda_i I(x_i; z_k) \quad (4)$$

where $I^*(x_0; z_k)$ is the estimated indicator transform at unsampled location x_0 and λ_i are the weights assigned to the indicator transform I at location x_i. These discrete probability functions must be interpolated within each class and extrapolated beyond the minimum and maximum values to provide a continuous ccdf, which covers all possible range of the variable. E-type estimates, which are comparable with OK estimates, may be computed through post processing IK-based ccdfs. Local uncertainty measures, e.g. conditional variance and probability maps are also produced through post processing of IK-based ccdfs. In this study kringing methods are performed using the software package GSLIB.

Evaluation of the results

A cross-validation technique with comparison criteria Mean Error (ME), Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) is used to evaluate the performance of the methods. The most accurate method is the one with the smallest amount of MAE and RMSE and with a MBE close to zero.

Results and Discussion

Statistical analysis shows that Cl data distribution is strongly positively skewed. A logarithm transform is used to provide a normal frequency distribution of data. Experimental semivariograms are calculated for the raw and log-transformed data. For IK, nine thresholds 1.3, 2.4, 3.4, 4.4, 5, 7.4, 12.7, 18 and 24 (meq/lit) corresponding to 10, 20, 30, 40, 50, 60, 70, 80 and 90 percent of Cl cumulative frequency distribution functions are selected. Then, the observation of Cl data is coded according to these selected thresholds and the indicator semivariograms were computed afterwards.

The results of semivariogram analysis show that chloride data values and its logarithms are strongly

correlated in space and the best fitted semivariogram model is spherical with a range of influence of 42 and 72 km, respectively. However, according to the results, a higher spatial correlation is seen for log-transformed data. Cl data had a moderate to strong within class spatial correlation and indicator semivariograms often follow a spherical structure. Furthermore, the cross-validation results indicate that LOK with the smaller amounts of RMSE and MAE and a higher amount of correlation coefficient, R, are more accurate than IK for estimating groundwater chloride.

Beside estimation, one of the main aims of this study is to model local uncertainty of Cl data over the study area. Both OK and LOK provide the uncertainty attached to each Cl estimate by calculating its estimation variance. Thus, where the estimation variance or standard deviation is smaller, the estimated value of Cl is more certain. The results show that OK and LOK estimation variance is more related to sampling configuration not to the actual values. In contrast IK conditional variance shows some relation with the sample data in addition to sampling location.

Besides, IK conditional variance was more appropriate for representing the estimation error than the OK (and LOK) variance. Moreover, the produced probability maps showed that the probability of chloride exceeding critical thresholds 10 and 20 meq/lit is higher in the northwest and west of the study area.

Conclusion

In this study non-linear indicator kringing is used to model the local uncertainty attached to Cl concentration estimates. Ordinariy (log) kringing is used to map the spatial distribution of Cl estimates. The results show that ordinary log kringing, which is faster and mathematically simpler than indicator kringing, provide more accurate results of Cl estimates. The correlation between indicator kringing conditional variance and estimation error is stronger than the correlation between ordinary (log) kringing variance and estimation error. This means that IK conditional IK produces the probability map of not exceeding a critical threshold for Cl concentration. These maps can be useful in many decision-making processes, e.g. water resource management.

Keywords: Chloride toxicity, estimation uncertainty, estimation variance, indicator kringing, probability map.

Determination of Organochlorine Pesticides in River Waters by GC-ECD after Solid Phase Extraction, Mazandaran

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Expanded Abstract

Introduction

Several hundred pesticides of different chemical compositions are currently used for agricultural and vector control purposes all over the world. Because of their extensive use, they are detected in various environmental matrices, such as soil, water, and air. Due to their lipophilic nature, hydrophobicity, and low chemical and biological degradation rates, organochlorine pesticides (OCPs) have led to their accumulation in the biological tissues and subsequent magnification of concentrations in the organisms due to the progress up the food chain.

The organochlorine pesticides group includes DDT (dichlorodiphenyl trichloroethane), methoxychlor, aldrin, dieldrin, chlordane, toxaphene, endrin, heptachlor, and lindane (gamma isomer of benzene hexachloride (BHC)). These are trade names for closely related hydrocarbon compounds to which several chlorine atoms have been joined.

Residues of OCPs were detected in almost all environmental compartments, including water bodies, food, fish, and milk as well as in human beings.

Materials and Methods

In this study, the residue levels of 20 organochlorine pesticides (OCPs) were found in the river water samples obtained from the different regions of Mazandaran province, Iran. Total water samples, from 6 sampling sites, were collected every two months between 2010 and 2011.

For this study, a total of 56 water samples from 6 sampling sites were collected. All the water samples were collected in high purity glass bottles and immediately transported to the laboratory. After this, the samples were stored at +4°C and extraction of the OCPs was performed within 48 h.

Some instruments were used for this experiment. 5.0 mL LiChrolut® EN cartridges were purchased from Merk, Germany. The vacuum assembly was homemade and the vacuum was generated by the homemade vacuum pump. The analysis of the reported OCPs after extraction was carried out by gas chromatography. Gas chromatograph used was of Agilent GC 6890 N with an electron capture detector (GC-ECD). The column used was HP-5 (30 m x 0.32 mm, IP 0.25 µm) and obtained from Sigma Chemical Co., USA.

Solid Phase Extraction **(**SPE) methodology was developed by spiking of 1.0 mL of organochlorine pesticides mixture of 1.0 mg/mL concentration each (in methanol-water) in 499.0 mL tap water. This mixture was shaken for about 30 minutes. The spiked water sample was kept at room temperature overnight. C18 Cartridge was pre-conditioned by using methanol (10.0 mL) followed by water (10.0 mL). After equilibrium, 0.5 L of the spiked water was passed through this cartridge at 10.0 mL/min flow rates. The elution of OCPs was carried out by using ethyleacetate at different flow rates 1.0 mL/min. This methodology was applied to the natural conditions by replacing spiked water by Telar and Tajan rivers water and the results were compared.

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Results and Discussion

The separations of these pesticides in a water sample are shown in Fig. 1.

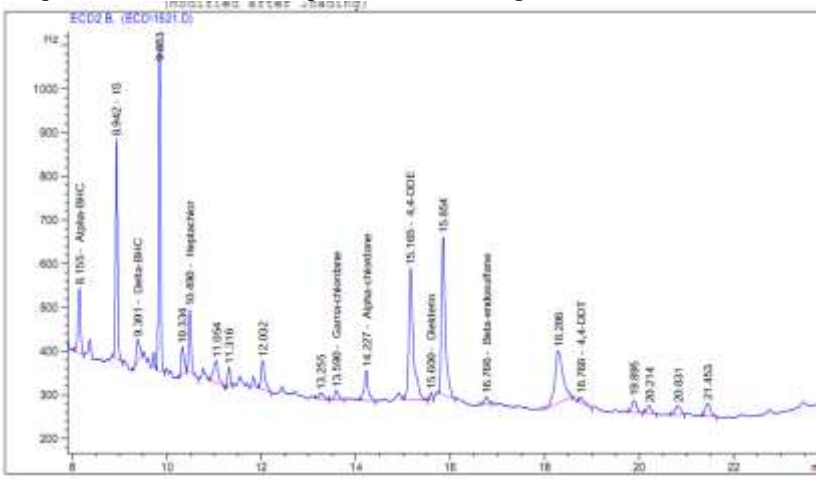

Fig. 1. GC Chromatograms of organochlorine pesticides in a water sample

The developed SPE and GC methodologies were applied for the analysis of organochlorine pesticides in the Telar and Tajan rivers. For this purpose, river water samples were collected from the Telar and Tajan rivers at 6 different sites. The values of concentration of the organochlorine pesticides observed are given in Table 1.

Table 1. Concentration of organochlorine pesticides in the Telar and Tajan rivers

pesticides	Amount (ng/ml)						
Station number	1	2	3	4	5	6	maximum residue limit established by FAO/WHO
α-BHC β-BHC γ-BHC δ-BHC	0. 180	0.195	0.160	0.103	0.099	0.108	$\sum_{BHC}$ 4 ng/ml
Heptachlor heptachlor epoxide	0.038	0.036	0.034	0.031	0.038	0.041	$\sum_{hep}$ 10 ng/ml
aldrin dieldrin	0.012	0.014	0.008	0.010	0.010	0.009	$\sum_{di+al}$ 30 ng/ml
γ -chlordane α -chlordane	0.008	0.011	0.018	0.006	0.007	0.025	$\sum_{\gamma+\alpha}$30 ng/ml
endosulfan I, II , sulfate	0.022	0.040	0.027	0.021	0.037	0.018	$\sum_{enП+I}$30ng/ml
4,4'-DDE 4,4'-DDD 4,4'-DDT	0.060	0.056	0.055	0.082	0.146	0.034	$\sum_{DD}$100 ng/ml
endrin endrin ketone endrin aldehyde	0.060	0.034	0.038	0.065	0.064	0.076	$\sum_{en}$ 20 ng/ml
methoxychlor	0.003	0.005	0.007	0.003	0.015	0.002	40 ng/ml

Conclusions

The developed SPE and GC methods were used for the separation, identification, and quantification of organochlorine pesticides in the water of Telar and Tajan rivers. The reported values of pesticides in the Telar and Tajan rivers water indicates that the rivers aren't polluted. Besides, these methodologies are rapid, selective

and reproducible. The percentage extractions of organochlorine pesticides are quite good. Therefore, these methods can be used for the analysis of organochlorine pesticides in waste, surface, ground and mineral water samples.

Keywords: chromatography, organochlorine pesticide, pesticide, solid phase extraction.

Quality Management of Groundwater Resources in Aghala

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Expanded Abstract

Introduction

Water quality refers to the chemical, physical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality are related to health of ecosystems, safety of human contact and drinking water. Some studies have focused only on chlorides alone without considering the nitrates. Reports of harmful effects for human health have been reported only for nitrates. Therefore, reducing nitrates level below the specifications of WHO may yield ‘‘healthy’’ water. On the other hand, high levels of chlorides may render the water undrinkable due to its salinity. In other words, focusing only on chlorides would not solve the problem since people would rather drink non-salty water than water with high level of nitrates which is proved to be dangerous in terms of health. This research considers both nitrates and chlorides using goal programming, which provides a way of striving toward more than one objective function simultaneously. It seeks to establish a specific numeric goal for each of the objectives, and then seeks for a solution that minimizes the weighted sum of deviations of objective functions from their corresponding goals. The purpose of this study is to achieve an optimal combination for drinking water according to the World Health Organization standards and the maximum desirable standard of groundwater in the study area of Aghala using weighted goal programming model.

Goal programming formulation: Assuming that we have (n) wells, the amount of chlorides in the i^{th} well is (CL_i) mg/l and the amount of nitrates is (N_i) mg/l. Moreover, the i^{th} well can discharge the amount of S_i (m^3/ year) at a given operational level. Since the levels of nitrates and chlorides are high in some wells and low in others, it is known that mixing of certain proportions from given wells will help achieve the required objective. It is also assumed that there are (m) reservoirs (destinations) each of which can accommodate a certain amount of water that satisfies the demand of the specific region. Let (D_j) represent the demand required for reservoir (j) and (X_{ij})the amount of water (m^3/year) discharged from well (i) to reservoir (j). The maximum allowable amount of chlorides per liter (WHO standard) is (CL_{max}), while the maximum allowable amount of nitrates according to WHO standards is (N_{max}). Therefore, the writers formulated a goal programming model of optimal water allocation in Aghala region as follows (All the symbols are difided in the first table of the text):

a) Objective function

$$\text{Min} \sum_{j=1}^{j=6} p_{jCL} + \sum_{j=1}^{j=6} p_{jN}$$

b) Well capacity constraints

$$\sum_{j \in Ur^{FW} \cup Ar^{FW}} X_{ij} \le S_i, \qquad \forall i \in W$$

c) Reservoirs capacity and demand constraints

$$X_{ij} \ge TD_j^{D^{FAr}} \qquad \forall i \in AR, \ \forall j \in D^{FAr}$$

$$X_{ij} \ge TD_j^{D^{FUr}} \qquad \forall i \in Ur, \ \forall j \in D^{FUr}$$

d) Balance constraint amoang the nodes

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$$\sum_{i\in Ur^{To:W}} X_{ij} - \sum_{i\in D^{FArFUr}} X_{ij} = 0 \quad \forall j \in Ar^{FUr}$$

$$\sum_{i\in W^{TAr}} X_{ij} - \sum_{i\in D^{FArFW}} X_{ji} = 0, \quad \forall j \in Ar^{FW}$$

$$\sum_{i\in Ur^{FW}} X_{ij} - \sum_{i\in Ar^{FUr}\cup D^{FUr}} X_{ij} = 0 \qquad \forall j \in Ur^{FUrFW}$$

e) Groundwater reservoirs capacity

$$\sum_{i\in W} X_{ij} \le CUr_j^{FW} \quad \forall j \in Ur^{FW}$$

$$\sum_{i\in Ur^{FW}} X_{ij} \le CUr_j^{FUrFW} \qquad \forall j \in Ur^{FW}$$

f) Air reservoirs capacity

$$\sum_{i\in W^{TUr}} X_{ij} \le CAr_j^{FW} \qquad \forall j \in Ur^{FW}$$

$$\sum_{i\in Ur} X_{ij} \le CAr_j^{FUr} \qquad \forall j \in Ar^{FUr}\ )$$

g) Chlorides balance constraints

$$\sum_{i\in W^{ToUr}} X_{ij} CL_i - \sum_{i\in W^{TUr}} X_{ij} CL_{Max} + n_{jCL} - p_{jCL} = 0 \qquad \forall j \in Ar^{FW}$$

h) Nitrates balance constraints

$$\sum_{i\in W^{TUr}} X_{ij} N_i - \sum_{i\in W^{TUr}} X_{ij} N_{Max} + n_{jN} - p_{jN} = 0 \qquad \forall j \in Ar^{FW}$$

i) All variables are ≥ 0.

The set of constraints in Eq. (b) guarantees that the total amount of the discharged water from certain wells does not exceed their capacity. While the constraints in Eq. (c) require that the amount of water supplied to a given reservoir from given wells does not exceed the capacity of that reservoir. Eq. (d) represents balance constraint among the nodes. Eqs. (e) and (f), respectively, represent groundwater and air reservoir capacity in the case study area. Eqs. (g) and (h), respectively, also represent the chlorides and nitrates balance before and after mixing. The assumption in the (chlorides/nitrates) balance constraints is that there are no reactions due to water mixing which may decrease the amounts of both elements under study. Therefore, this assumption, though approximate, guarantees that the levels of nitrates and chlorides can always be equal to or less than the amount determined by World Health Organization (WHO). Moreover, it is assumed that the system experiences no loss of nitrates as shown by preliminary experiments. In other words, the results will always be on the conservative side. Solution of the above model results in obtaining combination of wells and the amounts of water from each well.

Results and Discussion

This research describes a mathematic programming model dealing with achieving an optimum mixture of water from different underground wells, each having different amounts of nitrates and chlorides. The amounts of chlorides and nitrates in each of the wells may be higher or lower than the World Health Organization (WHO) standards. Therefore, the optimum mixture would be the one that meets WHO standard which is 250 mg/l for chlorides and 50 mg/l for nitrates. A goal programming model was developed to identify the combination of wells along with the amounts of water from each well that upon mixing would result in minimizing the deviation of the amounts of chlorides and nitrates from the standards of WHO. Application of the proposed model to the real case example (Aghala region) demonstrates the reliability and flexibility of the model. The most important results of this study showed that according to the WHO standards and the difference elements of each the wells, water withdrawal of the combination of the wells is an appropriate way to allocation of reservoir water. The purpose of this study is to achieve an optimal combination for drinking water according to the WHO standards and the maximum desirable standards of groundwater in the Aghala region using weighted goal programming model. In this region, there are 4 groundwater wells, 6 air reservoir and 2 ground reservoir (to save and transport water to the air reservoir) to supply drinking water for 17 villages. The results of this study also showed that the amount of water withdrawal in the wells in the WHO standard and maximum desirable standard is different. The most water withdrawal in the condition of WHO standards and maximum acceptable standard is belonging to well number 3 and the least withdrawal amount is belonging to well number 1 due to high concentration of nitrate in this well. According to the results in the maximum acceptable standard, there was not water withdrawal of well number 3 because of the high concentration of nitrate in this well. Therefore, according to the WHO standards and the difference elements of each the wells, water withdrawal of the combination of the wells is recommended. Finally, wells with levels of nitrates and chlorides that are highly intolerable can be used for drinking purposes upon mixing.

Keywords: chloride, goal programming, groundwater, nitrate, water quality.

Selecting the Optimal Urban Wastewater Treatment Process in the Various Climates by Using Analytic Hierarchy Process (AHP)

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Expanded Abstract

Introduction

Along with expanding urban population and development of cities, and resulting increase in demand for water, in recent years production of municipal wastewater has grown drastically. On the other hand, enhanced public awareness about the water pollution problems has mandated stricter environmental rules and penalties concerning wastewater discharge. These have led to rapid the construction and installation of urban Waste water treatment plants. Now production of significant volumes of domestic wastewater and uncontrolled discharge into receptive and underground water resources, faced the planners of the national projects with serious problems. Such that predictions indicate until the year 1400 about 800 urban wastewater treatment plants are obligatory in the country that necessitate enormous financial and human resources investment. Such an investment entails conscious selection of treating process according to the economical and engineering criteria. In recent years, many studies and optimization models are considered to choose the best wastewater treatment process. Although, most of them have only regarded the financial costs of the investment and operation, while the best option is not always the cheapest one. Selection of the optimized process of municipal wastewater treatment is an important and multi-dimensional issue. If we regard outcomes of a failed plan and wasted investment, the essence of satisfaction of environmental standards based on a systematic and scientific procedure to select the treatment process will be multifold. Such a process should maintain minimal environmental effects and economic feasibility together. In selecting the appropriate option for wastewater treatment, adoption of primary factors and decision criteria require close attention as well. Since most of these factors are complexly interrelated, i.e. change in one parameter nonlinearly affect rest of the parameters, setting up a decision-making model and interpolating it with a set of effective and independent parameters is challenging. Hence, the use of Multi-Criteria Decision-Making (MCDM) techniques would be helpful. Several MCDM methods are presented up to now, such as weighted sum model, the TOPSIS method and Analytic Hierarchy Process (AHP). AHP is a useful method while working with multiple and probably opposing criteria and objectives. Adoption of AHP enables us to evaluate the different objectives and to determine differences between two options by "priority vectors". The ultimate goal of this approach is to identify the best option and also sort all possible options according to compatibility with all decision criteria simultaneously.

Materials and Methods

Present contribution is an analytical- descriptive study that is conducted in 1392 in order to select the optimal municipal wastewater treatment process and to evaluate the adequacy of wastewater treatment processes based on the results from five categories sorted by climates of the country. The population of this study includes municipal wastewater treatment plants (both operational or under construction) existing in the country according to the latest statistics released by the National Water and Wastewater Engineering Company in 1389.

Climatic division of the country

To prepare any research proposal, gathering information about the target area is important. In other words, if

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information concerning the area is collected precisely, estimations of the plan will be more appropriate and during execution fewer problems will arise. In this research, due to the unique climatic diversity of the country and to decide the optimal process of wastewater treatment in these different climates, the country is divided into five categories of mountainous, Khazari, Mediterranean, semi-desert and desert climates. This division is adopted according to the climatic classification in Publication No. 117-3 (revised in 1392).

Treatment alternatives

According to available statistics and information, currently the most common methods in municipal wastewater treatment in the country are: activated sludge, stabilization pond, aerated lagoon and trickling filter methods. More than 90 percent of the municipal wastewater treatment plants in the country utilize one of these four processes. Then these four processes seem to be appropriate candidates for treatment options in different operating areas. In addition to popularity of these methods, another reason to choose them as optimal treatment processes is that facilities and most of the equipment needed during these processes are produced inside the country, and also underlying technologies are accessible in the country. In present situation that the country is under different sanctions, inaccessibility to a technology or its inherent equipment, will take it out of the possible implementation list. Therefore, different and innovative processes (such as membranous processes) that are currently implemented in developed countries, were not in our list of the appropriate treatment process choices.

Decision criteria

According to conducted studies and data gatherings, selection of the appropriate treatment process for each basin is regarded in terms of environmental, economic and technical criteria. Also because of extensive range of each of the mentioned criteria, sub-criteria were defined for each to achieve reliable results**.**

Data collection and evaluation of the parameters

In order to collect data and comments to resident experts in each climate category, five types of questionnaires were prepared. Each of the questionnaires consisted of two sections. In first part, criterion and sub-criterion priorities was investigated in target climates with the help of paired comparison matrices and in the second part, significance of each treatment option is evaluated relative to respective criterion and sub-criterion. After data collecting by questionnaires, obtained information are reviewed and analyzed by a team of experts.

Results

In order to choose the optimal wastewater treatment process in the five climate categories, four popular processes were regarded, *i.e.,* activated sludge, aerated lagoon, stabilization pond and trickling filter, in current study. Considering environmental, economic and technical factors and respective sub-criteria the mentioned options are sorted by feasibility for each category utilizing AHP.

In the mountainous climate, activated sludge, aerated lagoons, stabilization ponds and trickling filter processes have obtained these weights: 0.347, 0.269, 0.209 and 0.174 respectively. Also in this climate, among the deciding factors, environmental criterion with a weight of 0.558 has greatest importance. Technical criterion (0.320) lies in second place of importance.

In the Khazari climate, activated sludge, trickling filter, aerated lagoons and stabilization ponds obtained these weights: 0.340, 0.273, 0.204 and 0.183 respectively. Also in this climate, among the main factors, environmental (0.683) and technical (0.200) criteria are most affective factors.

In the Mediterranean climate, activated sludge, aerated lagoons, trickling filter and stabilization ponds possess weights of 0.334, 0.234, 0.231 and 0.201 respectively. Also in this climate, among the deciding criteria, environmental criterion with 0.540 weight is more important and technical criterion lies in second place of importance with a weight of 0.297.

In the semi-desert climate of the country, stabilization ponds, activated sludge, trickling filter and aerated lagoons processes showed these weights: 0.276, 0.273, 0.270 and 0.181 respectively. Also in this climate environmental criterion with 0.493 weight, technical criteria with 0.311 weight are the most important factors.

In the desert climate of the country, stabilization ponds, trickling filter, activated sludge and aerated lagoons processes are sorted by their weights of 0.292, 0.266, 0.247 and 0.195 respectively. Among the affecting criteria, environmental criterion has a greater contribution (0.493) while economic criterion takes the second place with a weight of 0.311.

Discussion and Conclusions

According to the results of Analytical Hierarchy Process to select the optimal urban wastewater treatment procedure for different climates, environmental criterion is the most important among the three mentioned criteria in all climates and its highest weight is obtained for the Khazari climate (0.683) and the lowest weight is in the desert and semi-desert climates (0.493). the high priority of environmental criterion for the Khazari

climate can be explained due to natural conditions of mentioned region and factors such as tourism industry, high groundwater levels, numerous rivers and other environment-related factors to the of region. Also, technical criterion is in second place of importance in four categories: mountainous, Khazari, Mediterranean and semi-desert climates. Its highest weight is observed in the mountainous climate (0.320) and the lowest weight in the desert climate (0.196). The priority of technical criterion in the mountainous climate is a result of the sensitive ecological conditions and poor performance of the most wastewater treatment processes in cold weather.

Based on the results in three climates of mountainous, Khazari and Mediterranean activated sludge process is observed as the most appropriate treatment option. Its highest weight is in the mountainous climate (0.347) and the lowest weight is in the desert climate (0.247). Also, in desert and semi-desert climates stabilization pond is obtained to be the most appropriate treatment option. The highest observed weight for this process is in the desert climate (0.292) and the lowest weight is in the Khazari climate (0.183). The highest and lowest weights of aerated lagoon process is achieved in mountainous (0.269) and semi-desert (0.181) climates, respectively. Finally, the highest and lowest weights of trickling filter process is respectively achieved in Khazari (0.273) and mountainous (0.174) climates.

Keywords: analytical hierarchy process, optimal process selection, urban wastewater treatment.

Comparative Study about Adsorption Behavior of Two New Chelating Resins Containing Amine and Alizarin Groups with Rhodium (III) Ions in Environmental Samples

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Expanded Abstract

Introduction

Rhodium metal is known for its stability in corrosive environments, physical beauty, and its unique properties. Rhodium is now widely used for alloying platinum in thermocouples, crucibles, evaporating dishes, weighing boats windings for high-temperature furnaces. It has been applied as a coating material because of the hardness and luster of its surface. Rhodium is present at about 0.001 mg. L-1 in crust of the earth. Because of its commercial importance, a wide variety of reagents have been proposed for pre-concentration of Rhodium before spectrophotometric determination. The interest in ligand immobilized solid phases like silica gel, organic polymer or copolymers, cellulose and polyurethane foam. The solid phase extraction of metal ions present at micro/trace level in environmental samples, high purity materials, biological samples and other complex matrices, makes analytical techniques possible, such as flame atomic absorption spectrometry (FAAS) and inductive couple plasma Atomic Emission Spectroscopy (ICP-AES). Solid phase extraction is preferable over ion exchange and solvent extraction due to its advantages like selectivity. This is by controlling the pH, reusability, high pre-concentration factors, durability, versatility and metal loading capacity. Adsorption of metal ions is widely used in the removal of contaminants from wastewaters. Amberlite XAD resins are widely used for modification with chelating materials due to its proper physical and chemical properties such as porosity, high surface area, durability and purity. The aim of the present study were to use two new chelating resins prepared by coupling Amberlite XAD-2 with Diethylenetriamine (DETA) and Alizarin prepared by chemically bonding as an adsorbent of Rhodium

Materials and Methods

All the solutions were prepared in deionized water using analytical grade reagents acetic acid, sodium acetate, sodium hydrogen phosphate, sodium dihydrogen phosphate, rhodium chloride, tin (II) chloride, hydrochloric acid, sulfuric acid, nitric acid, sodium nitrite, sodium hydroxide, DETA, Alizarin red S. and iodide-starch paper. Amberlite XAD-2 resin (surface area 330 m2/g, pore diameter 9 nm and bead size 20-60 mesh) was obtained from Flucka (Germany). The stock solution (500 mg L-1) of Rh (III) were prepared by dissolving appropriate amounts of RhCl3.H2O, in deionized water. 10

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mL of 0.1 mol L-1 acetic acid - acetate buffer (pH 3-6.5), and 0.01 mol L-1 phosphate buffer (pH 6.5-9) were used to adjust the pH of the solutions, wherever suitable.

Amberlite XAD-2 beads (5 g) were treated with 10 mL of concentrated HNO3 and 25 mL of concentrated H2SO4 and the mixture was stirred at 60ºC for 1 h on an oil bath. Thereafter, the reaction mixture was poured into an ice water mixture. The nitrated resin was filtered, washed repeatedly with water until it is free from acid. It was treated with a reducing mixture of 40g of SnCl2, 45 mL of concentrated HCl and 50 mL of ethanol. The mixture was refluxed for 12h at 90ºC. The solid precipitate was filtered and washed with water and 2 mol.L-1 NaOH which released amino resin (R-NH2) from (RNH3)2 SnCl6 (R= resin matrix). The amino was first washed with 2 molL-1 HCl and finally with distilled water to remove the excess HCl. It was suspended in an ice-water mixture (350 mL) and treated with 1 mol.L-1 HCl and 1 molL-1 NaNO2 (added in small aliquots of 1 mL) until the reaction mixture showed a permanent dark blue color with starch-iodide paper. The diazotized resin was filtered, washed with ice-cold water and reacted with alizarin red S 0.03 mol in 30 mL 2 mol. L-1 HCl, respectively. The reaction mixture was stirred at 0-3ºC for 24 h. Thereafter, the resulting colored beads were filtered, washed with water and dried in air.

Five grams of Amberlite XAD-2 beads were acidified with 10 mL of concentrated HNO3 and 25 mL of concentrated H2SO4 and the resulting mixture was stirred at 60ºC for 1 h. After that, the reaction mixture was poured into an ice water mixture. The nitrated Amberlite resin was filtered and washed repeatedly with distillated water until it is free from acid. Next, it was treated with a reducing mixture of 40g of SnCl2, 45 mL of concentrated HCl and 50 mL of ethanol. The mixture was refluxed for 12 h at 90ºC. The solid precipitate was filtered and washed with water and 2 mol.L-1 NaOH which released amino resin (R-NH2) from (RNH3)2 SnCl6 (R= resin matrix). The amino resin was first washed with 2 mol L-1 HCl and finally with distilled water to remove the excess HCl. It was suspended in an ice-water mixture (350 mL) and treated with 1 mol.L-1 of HCl and 1 mol.L-1 of NaNO2 (added in small aliquots of 1 mL) until the reaction mixture showed a permanent dark blue color with starch-iodide paper. The diazotized resin was filtered, washed with ice-cold water and react with DETA, 0.03 mol in 30 mL1 mol. L-1 of HCl, respectively. The reaction mixture was stirred at -5ºC for 24 h afterward; the resulting colored beads were filtered, washed with water and air dried in room temperature.

Results and Discussion

The experimental FTIR spectrum of alizarin red S loaded on Amberlite XAD-2 is compared with that of free Amberlite XAD-2. There are two additional bands at 1638 and 3432 cm-1 which appear to originate due to modification of N=N and O-H, and the experimental FTIR spectrum of DETA, loaded Amberlite XAD-2 is compared with that of free Amberlite XAD-2. There are two additional bands at 1629 and 3418 cm-1 which appear to originate due to modification of N=N and O-H, respectively.

For XAD-2 DETA the optimum pH value and the sorption capacity have been found 7, and 13.4 mg.g-1, and for XAD-2-Alizarin 8.4, and 12.1 mg.g-1, respectively.

The kinetics of sorption was studied by batch method for Amberlite XAD-2–DETA, 0.05g resin was shaken with 50mL of solution containing 0.3 µg mL-1 of Rh(III) with different equilibration times (10, 30, 45, 90, 180, 300 min) under optimum conditions. Five milliliters of the solution was withdrawn at predetermined intervals for analysis (using recommended batch method). The concentration of Rhodium ion in the supernatant solution was determined by FAAS. The sorption is a function of time for Rh (III). The time taken for the sorption of 27.38 % of the metal ion for XAD-2–DETA was found to be 10.0 min, which indicates a very good approachability of Rh (III) towards chelating sites on resin.

Alizarin red S-Amberlite XAD-2 (0.1g) was shaken with 50 mL of solution containing 300 µg.mL-1 of Rh (III) for different times (10, 30, 45, 90, 180 and 300 min) under optimum pH. After taking out the sorbent, the concentration of Rhodium ions in the solution was determined with (FAAS) using recommended batch method. The sorption is a function of contact time for all the metal ions.

Less than 10 min of shaking was required for about 22.8% sorption. The profile of Rhodium uptaken on this sorbent reflects good accessibility of the chelating sites in the Alizarin red S-Amberlite XAD-2.

Kinetic adsorption data were analyzed by the adsorption time of Rh (III) on modified resin by four isotherm models Langmuir, Freundlich, Temkin, and Redlich-peterson.

The results showed that the obtained Langmuir type-2 isotherm was the best fit in linear equations (R2= 0.9995,RL =0.7720 ,qm =22.8908 mg g-1 ,Ka =0.0591 L mg-1) for XAD-2 DETA, and (R2= 0.9983, RL =0.717 ,qm =19.04mg g-1 ,Ka =0.079 L mg-1) for XAD-2-Alizarin. In order to evaluate the selectivity of the pre-concentration system, the effects of some metal ions (20 mg.L-1) on the sorption behavior of Rh ion (concentration 20 mg.L-1) was investigated.

Conclusion

Two new resins were synthesized by coupling of Amberlite XAD-2 with DETA and Alizarin red S. The synthesis of the resin is simple and economical. The resin has a good potential for enrichment of trace amount of Rh (III) from large sample volumes. The Rh (III) adsorption was due to immobilized ligand- metal ion interactions. The resins also present the advantage of high adsorption capacity, good reusability and high chemical stability. The sorption/desorption of metal ion takes place in moderate time, making the analytical procedure reasonably fast. Finally, the different isotherms were tested for their ability to correlate with the experimental results by comparing theoretical plots of each isotherm with the experimental data for the adsorption of rhodium ions on DETA -Amberlite XAD-2 and Alizarin red s at 293 K. The amount of rhodium adsorbed per unit mass of DETA-Amberlite XAD-2 and Alizarin red s, qe, is plotted against the concentration of rhodium remaining in the solution, Ce, and the good fit of the Freundlich and Langmuir isotherms were not the same even when the coefficient of determinations was high for both isotherms. Our results have demonstrated the applicability of the presented procedure for Rh (III) determination in real samples and environmental studies with high recovery.

Keywords: alizarin, Amberlite XAD-2, Diethylenetriamine, isotherm study, Rhodium, solid phase extraction.

Power Generation from Salinity Gradient Using Reverse Electro-Dialysis in Lab Scale

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Expanded Abstract

Introduction

Nowadays, energy, water and environmental issues are the intersection of all human's requisites. Supplying energy from a wide range of clean sources is a reliable response in order to obtain all of the requisites of mankind. Salinity gradient power is a clean energy source that is available everywhere and has the capacity of supplying a reasonable amount of energy suitable to be used in various applications. This source of energy has gained a global approval and many researchers are trying to expand and optimize its industrialization.

Many various methods has been studied and presented for power generation from salinity gradient and they are almost the reverse of dominant desalination systems such as Reverse-Osmosis (RO) and Electro-Dialysis (ED). In the Reverse Electro-Dialysis (RED) method, a concentrated and a diluted salt solution are brought into contact through an alternative series of anion exchange membranes (AEM) as well as cation exchange membranes (CEM). By diffusion of anions and cations through the AEM and CEM from concentrate to dilute, are created in electrolyte which is converted into electric current in the wire by redox reaction on the active anode and cathode surface.

Operational parameters in the RED system are salinity difference, temperature and flow-rate, which shown by TDS, C and Q. I. In this research, the Taguchi method was employed to achieve the best operational condition.

Material and Methods

The experiments were designed by Taguchi methods and used by an Orthogonal Array (OA) M16 for determination of the operational conditions.

Variance and S/N analysis were used to determine the effects of each parameter on the objective function (watt per square meter of membrane used).

The experiment was carried out by a lab scale set up that is consisted of 10 RED cells with 11 AEM and 10 CEM (type II Fujifilm manufacturing Europe B.V) with 100 cm^2 effective area. The current head was supplied by earth gravity with 2 tanks in 1 meter upper than RED stack.

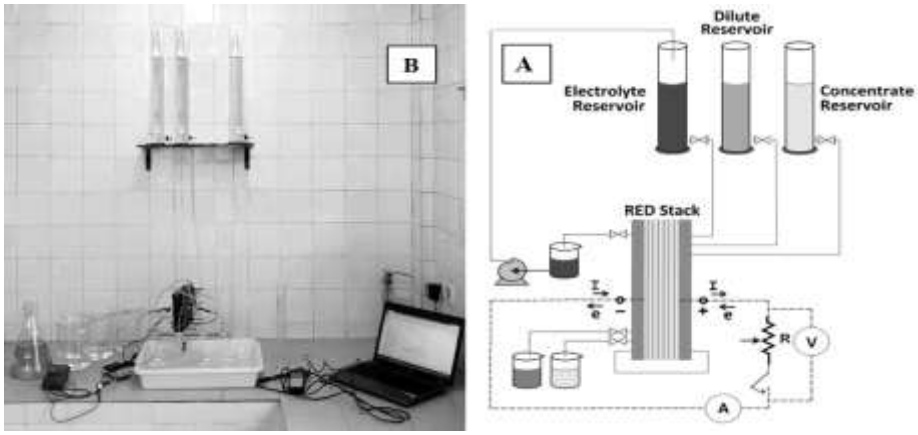

Fig. 1. Schematic diagram of RED system

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The pilot used in this study has been shown in Figure 1 schematically. 3 layer path flow tortuous spacers have been used and the thickness of the spacers were about 300 µm used for reduction of hydroelectric shortcut current effects.

The various solutions by different concentrations have been prepared in the laboratory. The stack has been formed from 10 cells. Each cell has obtained two compartments (dilute and concentrate) as well as the anionic and cationic membranes.

The electrodes were stainless steel with the thickness of 500 µm. The electrolyte solution is consisted of a 0.05 molar of $FeCl_3$ and $FeCl_2$ and 60 gr/L of NaCl, as the pH value was 2.

The voltage of the circuit was determined by Open Circuit Potential (OCP) method. The amounts of current and voltage values obtained in different temperatures and flow rates and salinity gradients (TDS) as operational conditions, have been used to calculate the output power which has been inserted into Taguchi method to be evaluated.

Results and Discussion

After determining the variables related to the structure, such as the distance between membranes during the early experiments to check the effects of factors and determine the optimum conditions of operating system in the Reverse Electro-Dialysis to generate electricity power, the experiments were consecutively done in 16 stages and each stage was repeated 3 times. Various factors considered in each stage were modified at different levels and the system operations to reach the sustainable condition. The amount of the rate of the current density and electrical potential difference was constant in 4 to 5 minutes after beginning the test.

Figure 2 illustrates the effect of temperature, flow rate and salinity gradient. In this graph, the horizontal axis indicates four levels considered for different amounts of each parameter and the vertical axis indicates S/N rate calculated from the experiments. According to Fig. 2 increase of the salinity gradient can increase the rate of power generation. Level 4 by 210 gr/lit salinity gradients had the highest power output.

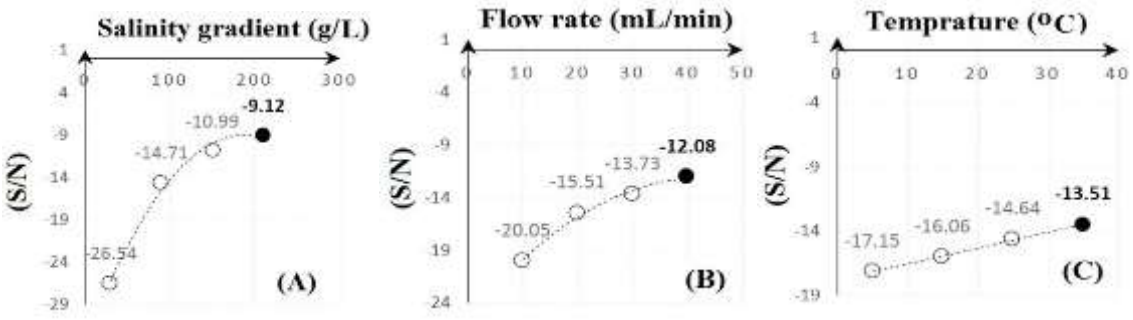

Fig. 2. The effect of temperature, flow rate and salinity gradient

After inserting the results of the tests into the QUALITECH-4 application, the ANOVA analysis of the tests results was carried out. The degree of freedom for each factor is the number of its surfaces minus one unit and the factor is the one of the quantities of which is available for different Orthogonal Arrays in the standard tables related to the method of Taguchi experiment. It can determine the rate of being effective or not for the considered factor in response to the system. According to the calculated amounts of the factor and its standard amounts in statistic references, all the selected factors are certainly 95 percent effective on generation efficiency of the electric power (The objective function in this research).

As specified from the above, concentration by 80.81 percent is the most effective factor in generating electric power in the Reverse $_{Electro}$-Dialysis (RED) method and temperature has the least effect by 3.29 percent on generating power in this process.

The results of experiments indicates that the maximum power output per square meter of the used membrane is resulted with 210 gr/L of concentration, flow rate equal to 40 mL/min and temperature equal to 25 degree centigrade.

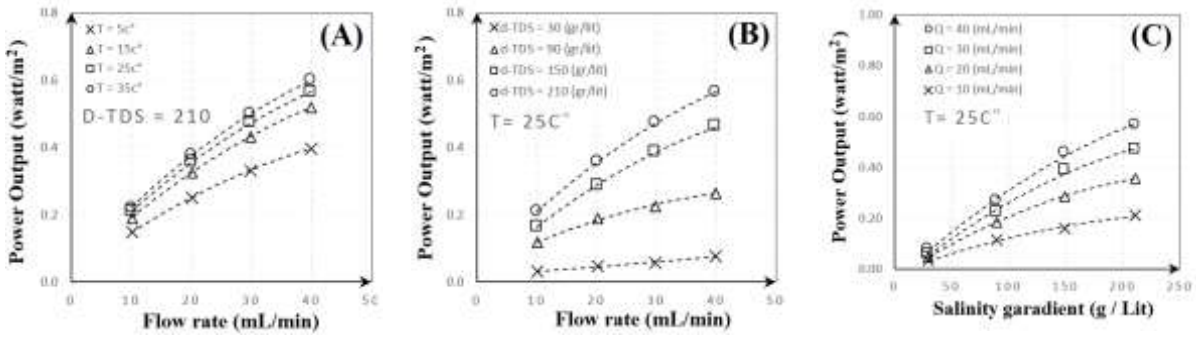

Fig. 3. Relation between flow rate, salinity gradient and power output

On the basis of the results obtained from/through the Taguchi method, the experiments were done under the optimum condition to determine the quality of parameter changes toward each other. Due to the least effect of temperature on the power of generating energy compared with other parameters, the optimum temperature was considered equal to 25 degree centigrade (temperature of the laboratory). By considering each of the parameters being constant under the optimum condition, changes of the two other parameters were determined according to the Figure 6 to 9 and the effect of each factor of the tests were analyzed by the help of the related curves. Figure 3 illustrates that by increasing flow rate, the power output will increase. Increasing the linear rate of flowed water on the membrane surface reduce the effect of the concentration polarization phenomena on the membrane surface that is a hindrance to energy generation. As observed above, by rising flow rate from 10 mL/min to 40mL/min, the power output also increases and the growth of intensity of power output is reduced by continuing this trend in flow rate.

Conclusion

Power generation from salinity gradient has been considered and evaluated currently. In this study the Reverse Electro-Dialysis method has been investigated as an applicable process and the best operational conditions were determined by lab scale pilot and Taguchi method. Our results showed that this process is a reliable method in order to generate power from salinity gradient and can be applicable in industrial dessalination plants.

Keywords: ion exchange membranes, power generation, reverse electro-dialysis method, salinity gradient.