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Optimization of Land Allocation in Golestan Province to Planting Agricultural Crops using Compromise Mathematical Programming

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Expanded Abstract

1. Introduction

Rational planning and optimization of agriculture are essential because of water and land constraints, also the need to increase economic profit and to reduce the negative impacts of fertilizers and pesticides. To this end, decision-makers and planners need to acquire knowledge and information of the quantity, quality, type, and distribution and cultivation area of agricultural products. Therefore, for planning and management of local and regional agriculture, we need to know the distribution of agricultural crops and their planting pattern. Over the years, experts have researched the proper cultivation area for major crops. In this regard, optimization of land allocation in agricultural sector is very important. The agricultural economy will have sustainable growth if the cropping pattern is determined based on the environmental potential and climatic conditions of each region. It is necessary the environmental conditions, soil type, water resources, technology and other parameters considered to achieve the optimal cultivation pattern.

Due to the variety of ecological and climatic conditions of Golestan Province of Iran, a relatively fertile land, availability of resources including surface water, adequate rainfall in parts of the province and human resources, relatively ideal conditions exist in agricultural development of the region. However, the agricultural status of this region is now unfavorable because of the lack of attention to the factors affecting the agricultural income such as product type, economic efficiency, crop performance, cultivation costs, required water for cultivation and other factors. Therefore, it is essential that rational management and planning be implemented to mitigate these problems and to increase the economic efficiency of the agricultural sector in the province. Accordingly, the main objective of this study is to optimize land allocation of growing crops and garden products based on the initial scenario of Jihad Agricultural Organization, current status and the environmental scenario to achieve economic goals and to identify capacities of various agricultural activities in this region. To this end, we analyzed agricultural scenarios based on compromise mathematical programming using multi criteria analysis tool (MCAT).

2. Materials and Methods

The study area is Golestan Province in the north east of Iran located between $52° 51'$ and $56° 21'$ E and $36° 24'$ and $38° 7'$ N. The climate, latitude, topography, water resources, and the natural vegetation of the region is diverse. The total area of the agricultural land in the province is about 679678 hectares and the irrigated cultivation is practiced in about 377866 hectares.

The results of the land use planning of Golestan Province showed that about 316326 hectares of irrigated land have suitable ecological capacity to grow crops and garden products. Accordingly, in this study we carried out land planning to determine the optimal area for cultivation of irrigated crops and garden products according to the proposed scenario of Jihad Agricultural Organization of the province, the current status scenario and the environmental scenario. First, a comparison matrix was formed based on the 36 proposed products and 12 optimization factors of the agricultural land allocation. The matrix was completed based on experts' opinions

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and scientific information in relation to the crops and garden products. Also, the optimization criteria were weighted using Analytical Hierarchy Process (AHP) method using Expert Choice software. Due to differences in economic performance and strategic importance of the crops, we defined a prioritization factor for both positive and negative ideal values in each of the criteria. Next, data analysis was implemented based on the compromise mathematical programming using the MCAT software for land allocation of each product. The three scenarios including current (business as usual), organizational (the proposed Jihad agricultural organization) and the environmental option were assessed to performance of agricultural products.

3. Discussion and Results

The necessary data and information were collected and prepared using reports of the Jihad Agricultural Organization and the ongoing land use planning project of the Golestan Province (Salmanmahiny et al., 2013). After data analysis, weights assigned to the criteria (Table 1). In addition, the results of land allocation of each agricultural crop are shown in the Table 2. In the end, the performance of all products was assessed on the basis of the criteria (Table 3).

The results showed that water consumption with a weight of 0.261 is the most important criterion among the considered criteria because of its important role in agriculture. Also, the results illustrated that the production of clover, barley, wheat and canola in 12.37, 6.91, 6.81 and 6.08 percent of the total area of the irrigated land have priority for cultivation, whereas according to scenario of Jihad Agriculture Organization, most of the province's irrigated land should be allocated to wheat, soybeans and cotton. In comparison, the environmental scenario indicated that water consumption, the need for machinery, fertilizer and chemical pesticides can be decreased, whereas, the employment, benefit to cost ratio, quantity of dry matter, share in household basket and performance ratio of agricultural products can be increased at the same time.

Table 1. Obtained weights of the evaluation criteria based on AHP method

Criterion	Unit	Weight	Criterion	Unit	Weight
Water consumption	m^3/ha	0.261	Benefit of cost ratio	….	0.045
Chemical pesticides	Kg	0.193	Quantity of dry matter	gr	0.033
Nitrogen fertilizer	Kg	0.137	Share in household basket	….	0.023
Performance ratio of products	….	0.107	Employment	MJ/ha	0.023
Phosphorus fertilizer	Kg	0.076	The need of machinery	MJ/ha	0.022
Water footprint	m^3	0.059	Policy support coefficient	….	0.021
Inconsistency ratio:		0.07			

Table 2. Designated areas of cultivation of irrigated crops based on the three scenarios

Product	Area					
	Current S.		Organizational S.		Environmental S.	
	ha	%	ha	%	ha	%
Wheat	152095	40.25	100000	31.61	21536	6.81
Barley	10992	2.91	10000	3.16	21843	6.91
Rice	50992	13.49	12000	3.79	4275	1.35
Corn	661	0.17	2000	0.63	5075	1.60
Lentil and pea	28	0.01	50	0.02	3599	1.14
Kidney bean varieties	808	0.21	800	0.25	4050	1.28
Chickpea and others	69	0.02	50	0.02	504	0.16
Sunflower	7467	1.98	7000	2.21	12014	3.80
Soya	49514	13.10	65000	20.55	6972	2.20
Cotton	9753	2.58	40000	12.65	5352	1.69
Tobacco	2257	0.60	4000	1.26	6875	2.17
Sesame	117	0.03	50	0.02	6286	1.99
Peanut	595	0.16	3000	0.95	11232	3.55
Canola	9799	2.59	5000	1.58	19094	6.04
Vegetables	23493	6.22	1800	0.57	7209	2.28
Bean	6814	1.80	3600	1.14	8952	2.83
Onion	472	0.12	800	0.25	4238	1.34
Strawberry	429	0.11	400	0.13	4008	1.27
Potato	6474	1.71	6000	1.9	9553	3.0
Tomato	9260	2.45	3500	1.1	7560	2.4

Other vegetables (sweet corn, etc.)	7287	1.93	3120	1.0	5752	1.8
Watermelon	2163	0.57	500	0.2	5341	1.7
Melon	918	0.24	850	0.3	5958	1.9
Cucumber	2455	0.65	2000	0.6	10224	3.2
Forage maize	7813	2.07	8000	2.5	5840	1.8
Alfalfa	2039	0.54	2000	0.6	5647	1.8
Clover	1311	0.35	2000	0.6	39122	12.4
Sorghum and millet	504	0.13	1800	0.6	14959	4.7
Seed trees	214	0.06	446	0.1	2229	0.7
Stone trees	3930	1.04	5950	1.9	12112	3.8
Olive	5162	1.37	2238	0.7	5298	1.7
Citrus trees	754	0.20	5518	1.7	5226	1.7
Decorative and medicinal flowers and plants	69	0.02	111	0.0	4205	1.3
Nuts (walnut, hazelnut and pistachio)	300	0.08	615	0.2	5088	1.6
Other garden products	828	0.22	1628	0.5	13372	4.2
Development of gardens in sloping land	30	0.01	14500	4.58	5725	1.81

Table 3. Comparison of the products' performance in the three scenarios

Criterion	Unit	Scenario		
		Environmental	Organizational	Current
Water consumption	m^3/ha	2162	2325	2793
Employment	MJ/ha	374	233	267
Benefit of cost ratio	….	0.22	0.16	0.20
Quantity of dry matter	gr	0.10	0.09	0.12
The need of machinery	MJ/ha	731	743	943
Nitrogen fertilizer	Kg	61.2	52.5	61.7
Phosphorous fertilizer	Kg	25.4	26	29.1
Chemical pesticides	Kg	1.12	1.39	1.53
Policy support coefficient	....	0.29	0.33	0.41
Water footprint	m^3	670	929	813
Share in household basket	....	898	1249	1888
Performance ratio of products	….	0.40	0.30	0.35

*The numbers are in million.

4. Conclusion

The results of this study clarified that the profitability and economic efficiency in the agricultural condition of Golestan Province can be increased by implementation of the environmental scenario. Moreover, this study shows that officials, managers, experts and farmers of the province can learn to reach an informed decision when optimizing the cultivation of each product using the results of the employed decision supports system. Certainly, it would be useful to improve the agricultural condition of this region through considering the local conditions.

Keywords: crop products, mathematical programming, MCAT, optimization.

Integrated Environmental Assessment (IEA) of Groundwater Depletion in Ardebil Plain for Management Solutions

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Expanded Abstract

1. Introduction

Management and decision-making issues related to water resources, especially groundwater, which is an important source of fresh water, is the main decisions of a country. According to population growth and increasing demand as well as lack of water, proper management of these resources will be needed. So, integrated environmental assessment is one of the best and most effective tools in determining the economic, social and environmental problems.

In reviewing previous studies, most research is done on the effects of groundwater depletion or Environmental Impact Assessment (EIA) before and after construction of a project or plan and there is less comprehensive view in social and economic dimensions of the environment. In this study, overview and integrated research on the causes and effects framework of groundwater depletion is used and Integrated Environmental assessment (IEA) as a main methods in water resource management, survey all present and future threats. So, IEA can be used in environmental planning and management towards sustainable development.

mDSS software has been used in the field of surface waters at the international level but this application isn't used in IEA for GW depletion.

The study area is Ardabil plain, in Ardabil province in the northwest part of Iran. Ardabil plain area is about 853 km^2, and groundwater using has been raised during the past half century because of increasing population and agriculture development. Now, the plain decline is close to 10 m.

2. Materials and Methods

This study prepared by library documents, interviews and a questionnaire filling out by academics and experts. Integrated assessment should be provided in the form of a conceptual model called DPSIR to link between the data collected. The DPSIR framework aims in analyzing the cause-effect relationship between interacting components of complex social, economic and environmental systems and in organizing the information flow between its parts. Driving forces (D) represent major social and economic developments in societies and the corresponding changes in lifestyles, overall levels of consumption and production patterns. As an effect of driving forces, the pressures (P) are developed. The pressures represent processes affecting the resources (land, water) by producing instance substances (emissions), physical and biological agents which consequently cause changes to the state of water resources (S). Depending on the changes of state, positive or negative consequences of society may occur. These consequences are identified and evaluated to describe impacts (I) by means of evaluation indices. In a generic decisional context, the perception of the existence of relevant impacts in the catchment area induces decision-makers to develop responses (R) which prevent, compensate, or mitigate the negative outcomes of state changes. Responses may be targeted to address the driving forces, the pressures or the state itself: either the driving forces may be re-organized (prevention, changing behavior, etc.), pressure mechanisms may be altered (e.g. the introduction of new production systems), or the state of the environment may be restored or adapted to reduce its sensitivity to pressures.

Software of mDSS (MULti-sectoral, INtegrated and Operational Decision Support System) is a useful application to support decision-making on issues related to water resources management and solving complex problems arising from it. The software mDSS also integrates environmental modeling techniques, social and economic in GIS with multi-criteria decision-making techniques (MCDMs).

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3. Results

Among the various indicators, according to expert's opinion, population growth and agricultural development are the most important factors (driving force) in groundwater declining. Land use and water consumption were considered as pressures. Depletion of groundwater that is the subject of this study is state and loss of water quality, the amount of surface water as well as increased vulnerability to drought (dry gardens and agricultural lands) are considered as the effects of this research respectively.

Climate Change. To evaluate the changes in climate, the temperature and precipitation data obtained from synoptic stations of Ardabil and evaporation data obtained from hydrological stations. The results of homogeneous data series, according to Mann-Kendall test, show the trend of rising temperature and evaporation, so could be one of the factors in groundwater declining.

Population Growth. To assess the impact of population growth on groundwater resources, Ardabil population data were collected from 1355/1976 to 1390/2011. The results show increasing demand of groundwater in agriculture, industry and drinking.

Agricultural Development. More than 88% of water consumption in agriculture is supplied by numerous wells drilled in the plain area. By studying agriculture in three parts (the area under cultivation, production and type of products), we found that from 662,063 ha of land, 434,541 ha are rain-fed land and 227,522 ha are irrigated, but much crop growth is in irrigation products. Product types were examined in this study, too. Potato cultivation in the Ardebil plain that is the first place in Iran (about 14 percent), takes place with irrigation method, which can cause overuse of groundwater.

Land Use. In this study, Landsat images between June 1987 and 2014 were analyzed. Results classified by Maximum Likelihood method, reveals that made lands (29%) and pastures (21/5%) increased, while agricultural land and water have been reduced. One reason for the loss of agricultural land and surface water, is declining groundwater.

Groundwater Consumption. According to the latest inventory of existing wells, 0.8% of wells are industrial, 8% drinking and 91.2% agricultural consumption.

State. Ardabil plain area is about 850 ha that has 3667 deep and semi-deep wells. In this study, we selected wells data in 1987 compared with the same data in 2014. By Kriging interpolation, we found that the depletion of GW in the South is much more increased, up to 83 m.

Changing Water Quality. In this study, water conductivity indicator (EC) was used over a period of 12 years. The average annual EC's increasing from 834 μmho/cm (in 2000) to 1170 μmho/cm (in 2010).

Reducing the amount of Surface Water. In this study, data from Gilandeh, Kuzetapraghi and Gharehsou stations, over a period of 1978- 2010, shows reducing these river's discharging is clearly visible.

Responds. Based on the questionnaires, the best strategy is to improve the agriculture. Four important strategies defined by a hypothetical scenario. These scenarios include:

1. Part Participation (P.P) in watershed management under the supervision of co-operative plain and cooperation of non-governmental organization
2. Changing in G.W Cultivation Pattern (C.G.W)
3. Trying to create New Systems (N.S) and change traditional irrigation systems
4. Changing the Cost of Price (C.C.P) especially in the agricultural sector in order to reduce excessive consumption and increase savings.
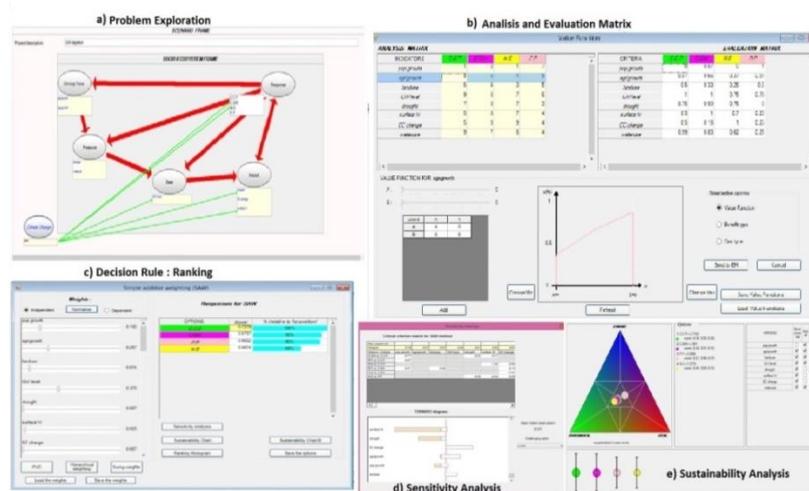

Fig. 1. Collection of screens representing a typical sequence of mDSS implementation steps

4. Discussion and Conclusions

The results obtained from testing the Decision Support System 'mDSS' software. In this typical application, the first step is to identify the socio-economic and environmental characteristics are described according to the DPSIR conceptual framework in Conceptual Phase. Then we describe the alternative options, with selecting the decisional criteria like Simple Additive Weighting method (SAW), one of the Multi-Criteria Decision Making (MCDM). This modeling is stored in the Analysis Matrix (AM). The AM is structured with indicators in the columns and options in the rows. The AM matrix is placed in Design Phase in mDSS software. The evaluation, normalization and weighting of options are done on Evaluation Matrix (EM) in *"Choice Phase"*. In this study, weighting is done on a priority basis by Swing Weighting. In this way GW depletion ranked first, (No. 1) agricultural water consumption ranked second (No. 2), population growth ranked third, and so on, GW consumption, surface water, land use changes, changes in water quality and drought. It should be noted that final assessment that means prioritizing of responds or options is also done by using Simple Additive Weighting method (SAW). Changing Cost of Price (C.C.P), the actual costs of groundwater, especially in the agricultural sector in Ardabil Plain, with score 2.7 by this application, was identified as the best option in this research. Then this option compared with other options and the stability and histogram rankings were obtained (all matrix tables and mDSS phases are presented in Fig. 1).

The Integrated Assessment of GW, by examining how to create a problem, provide solutions and management options within the Cause & Effect framework to help decision makers to solve the complexity and difficulty of GW management to take a major step forward in sustainable development and this is easily done by using mDSS software.

Assessment of medical waste in Tehran province hospitals

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Expended Abstract

1. Introduction

Medical waste contains highly toxic metals, toxic chemicals, pathogenic viruses and bacteria, which can lead to pathological dysfunction of the human body. The hazards of exposure to hospital waste can range from gastro-enteric, respiratory, and skin infections to more deadly diseases such as Hepatitis B & C, and HIV/AIDS. Additionally, medical waste contains potentially harmful micro-organisms, which can infect public health and may present a high risk to human and environment. Hospital waste management is an important and necessary component of environmental health protection. Poor management practices of healthcare waste can present significant inconveniences and health risk to the inhabitant. Healthcare waste management includes all activities involved in waste generation, segregation, transportation, storage, treatment and final disposal of all types of waste generated in the healthcare facilities, stages of which require special attention. The main objective of this research is the study of the medical waste management in hospitals of Tehran province.

2. Materials and Methods

This is a cross-sectional study based on questionnaire, interview, observation and meetings performed in Tehran province hospitals in 2015. This study was conducted to determine the amount of hospital waste that was produced the condition of segregation of waste, type of storage containers used, temporary storage area, collection procedures, transport and treatment of waste, and disposal of hospital waste at these hospitals. In each hospital, after interviewing hospital directors, waste management employees and other personnel as well as observing the process of collection and disposal of waste. For assessment of treatment technologies, standard tests including TST strip test and spore tests were used.

3. Discussion and Conclusions

It is important to determine the weight and composition of the waste stream in order to improve proper waste management strategies. The quantity of medical waste depends upon several factors such as the size of healthcare facility, the segregation program of medical wastes, the medical activities, type of services provided, economic, social and cultural status of patient and the general condition of the area where the hospital is situated. Hospital waste is produced from various activities in hospitals such as administrative departments, housekeeping, food preparation, laboratories, surgical operating and so on. According to the results of the present study (Fig. 1), total active beds in 165 surveyed hospitals were 26444, which produced 91.22 ton/d of medical wastes, and per bed production of wastes was 3.44 kg/d. Of all wastes in hospitals, 38.35% were infected wastes (1.31 kg/day/bed), 57.85% were non- infected wastes (1.99 kg/day/bed) and 3.75% were pharmaceutical and chemical wastes (0.13 kg/day/bed). The treatment efficiency of 81.29% of hospitals was accepted (TST and Spore test results were negative).

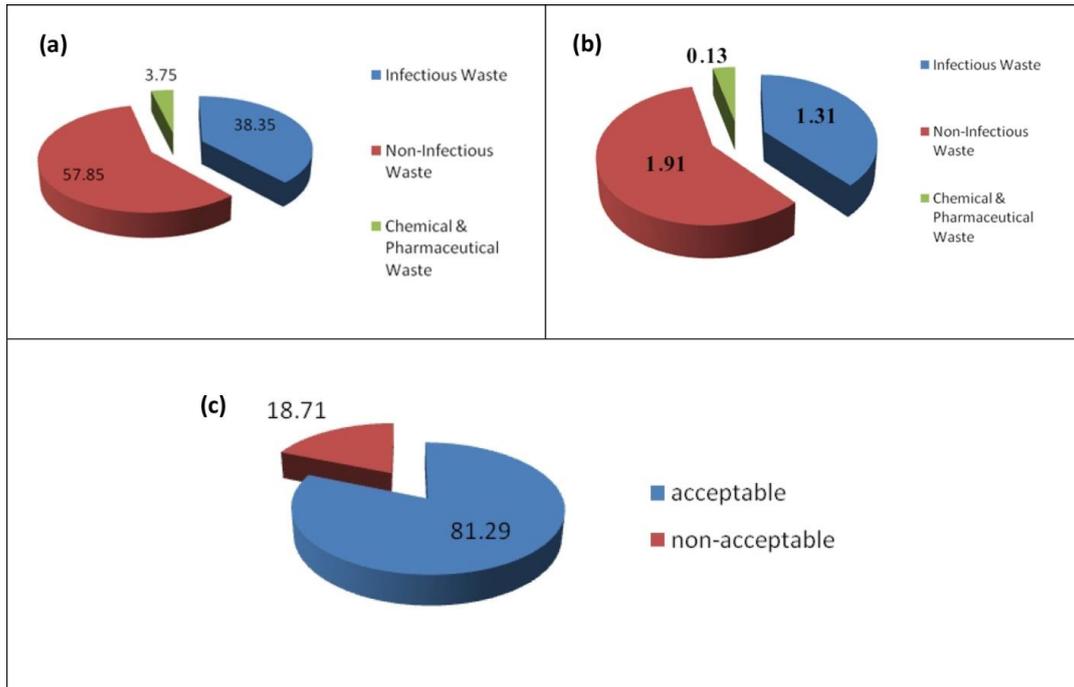* Corresponding Author: Email: akbarpour.fatemeh@ut.ac.ir

Fig. 1. a) Percentage of medical waste, b) Waste generation rate per bed
(Kg/day) c) TST test results of treatment systems

Fig. 2. a) Percentage of infectious wastes treatment systems, b) Percentage of medical wastes segregation
c) Percentage of managed chemical & pharmaceutical wastes

Results indicated (Fig. 2) that all of the hospitals surveyed (42.27%) segregated and packed various medical wastes in color-coded plastic bags. After segregating and collecting the medical wastes, the staff should transport them to the temporary storage location. Several methods are applied for the treatment of medical wastes such as autoclave, hydroclave, microwave, chemical disinfection, dry heat disinfection and disinfection with super heated steam. Waste treatment leads to a decrease in volume, weight, and risk of infectivity and organic compounds of the waste. The generator of waste is responsible of ensuring proper disposal and treatment of the medical wastes and also the prevention of pollution and infection within and near the hospital. This study revealed that 93.93% hospitals in Tehran province are doing treatment on their infectious wastes. They use

proper (controlled with special tests) autoclaving method for the treatment of their wastes. After all of the above process, hospitals deliver their generated wastes to municipality. Municipality transports hospital wastes into the Kahrizak landfill. Most pharmaceutical & chemical wastes (79.80% hospitals) are collected in white bags and, therefore, follow to Qazvin & Markazi provinces disposal sites of hazardous wastes.

Insufficient segregation, classification of waste was noted at all surveyed hospitals. For the most part, some of the general waste was mixed with infectious waste, which was collected, transported and disposed of in a similar manner as infectious waste. Environmental measures were not available. To implement better medical waste management, there should exist bins with different colors and appropriate yellow bags for infectious solid waste, black suits bins or bags for household like solid waste, white plastic bags or bins for pharmaceutical and chemical waste and safety box for sharp infectious waste. It seems necessary high rate of infectious waste shows the need of establishing executive rules and standards of medical waste management. The effect of number of inpatients and outpatients treated in the hospitals on healthcare waste generation rate varied from hospital to hospital. It was observed that as the number of inpatients and outpatients increase, the hospital waste generation rate will also increase. A number of gaps exist regarding proper hospital waste management in the Tehran province. Therefore, there is an urgent need of raising awareness among healthcare workers and supporting staff on healthcare waste management issues (segregation, storage, collection, transport, treatment and disposal) and their relevance in addressing public health and environmental risks. This study focused on the determination of hospital waste generation rate, composition and assessment of its management system using mixed study designs. Both quantitative and qualitative data collection techniques were implemented to collect data on hospital waste generation and its management systems.

Medical managers should update their knowledge and further educating their staff; implying careful and constant monitoring of waste management. This study may create awareness regarding the magnitude of the problem of waste management in hospitals of Tehran province and may stimulate interests of systematic control efforts of hospital waste disposal. Hospital waste management cannot succeed without documented plans, certain equipment, defined staff trainings, and periodic evaluations.
Considering the quality and quantity of the generated hospital wastes especially infectious wastes and their unfavorable effects on the peoples' health and environment, it is necessary to compile a distinct policy of the management of hospital wastes.

Keywords: hospital, management, medical waste, segregation, Tehran province.

Life Cycle Assessment towards Optimization of Water Use in an Industrial Cattle Farming Complex by Focusing on Virtual Water Approach (Case study: Foka Complex)

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Expanded Abstract

1. Introduction

Isfahan province covers an area of 107045 km^2 and a population of about four million with an average annual rainfall of 120 mm. In the event of successive droughts over the past six years, the water resources were affected both from the viewpoint of quantity and quality. Due to successive droughts in the province and the uncontrolled consumption of water table, water resources has got into a dangerous situation and must be economized in different domains. The issue of virtual water trade is great and has particular importance in sustainable development planning of the future of many countries located in arid and semi-arid areas to save and maintain parts of water needed of domestic production of goods. The consideration that the consumption of meat and dairy products has an extraordinary effect on the dearth of water globally has been widely published and proclaimed. The consumption of animal products in large quantities has an extra effect on fresh water resources. About one third out of the world′s total agricultural water footprint is related to animal products while their water- footprint is extremely higher than that of farm products with an equal nutritional value.

Poor food efficiency in the process of production of livestock products is largely responsible for the relatively high water footprint and virtual water content. Life cycle assessment may help save water, return water to cycle and reduce energy costs. According to the statistics provided by the statistical center of Iran in 2013, the number of active cattle farming complexes in the province is around 180. If the consumption of livestock per capita is considered 100-150 liters daily for drinking and services (different in summer and winter), around 2086 cubic meters will suffice only for drinking needs in this part.

2. Materials and Methods

This study was conducted with two main objectives: To determine the amount of virtual water content of one Kg of beef (calf) and also to optimize water use in the life cycle of a livestock breeding. So, in this boundary, cycle input is a farm for producing animal feed and cycle output is the slaughter- house.

The method used in this study was presented by Chapagain and Hoekstra (2003) that determines the virtual water content and also estimates the grey virtual water used by Hoekstra et al. (2011). Also, the amount of water needed to irrigate the product is obtained in order to calculate the amount of water needed for the production of any agricultural product (animal feed).

This is affected by the amount of evaporation from the soil surface. Blue virtual water, including water resources (surface and subsoil), is along with the supply chain of a product. Blue water used in this research includes water used in irrigating crops, drinking and washing services. Green virtual water content refers to the use of green water resources. Water used in dry farming (products for animal feed) is located in this category. However Rain-fed crops are not included in this study. As a result, blue-green water is sent together. Gray virtual water content refers to the volume of pollution and is defined as the volume of freshwater used to absorb pollutants to reach normal levels and current standards required for water quality. To calculate the virtual water derived from animal products such as "pure meat", it is necessary to acquire virtual water in living animals and then distribution of water in the products. Every living animal (cattle) has three components of virtual water. Virtual water content of an animal at the end of his life is the total volume of its virtual water content. This amount includes the amount needed for food, service, and drink. As mentioned above, for calculating the virtual

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water content of livestock and livestock products, having a virtual water content of the plant (used in animal feed) is needed (Hoekstra & Hung, 2002). To calculate the amount of water needed to produce each product, the amount of water needed to irrigate the product should be considered. Furthermore, the evaporation and transpiration from the earth's surface, soil and plant should also be included. As a result, information such as crop water needs throughout the growth period, evaporation and transpiration rate, annual performance product and product returns are required. Virtual water of crops (cubic meters per ton) is obtained by dividing the total amount of water needed to produce the entire product. Penman-Muntit equation is usually used to calculate the reference plant evapotranspiration. In the original Penman-Muntit equation water requirement of the plant is determined in one step by plant resistance coefficient, reflection coefficients and air resistance. Due to the lack of FAO data, regarding the constants in this equation, it has been calibrated to estimate the reference plant evapotranspiration. In this method, water requirement is calculated by using the coefficients occur in two stages. In this study NETWAT software is also used.

3. Results

The amount of feed consumed by cattle depends on many factors like weather conditions in the region, season, race, diets and also whether the cattle is raised for meat production or not. Animal feed and diet composition are different although the same nutritional value as follows. Weight gain in beef cattle by nutrition is related to race. The amount of feed for cattle is calculated according to data from the case study. In this cycle, the virtual water content will be studied including blue-green water used for farm irrigation and gray water from the fertilizers and pesticides used on the farm. In this respect, the required information includes: area under crops fodder, expertise, the crop water requirements (used for animal feed) and the content of plants virtual water. After the assignment of feed intake of animal by each cattle breeding, feed virtual water content is achieved and then by using formulas, we calculate the virtual water content of the drink as well as the service. Value of virtual water in cubic meters per ton of bone and boneless meat from the original product (living cattle) can be obtained. Information and data relating to the calculation of value fraction are taken from the Foka's slaughterhouse. The cow virtual water content when slaughtering is 11055 cubic meters per ton. Virtual water content of meat with bone is 19485 cubic meters per ton and the virtual water content of boneless meat is 22,800 cubic meters per ton.

4. Conclusions

It is clear that animal products need a lot of water. As a result, different methods of water management in animal product chains should be proposed, evaluated and implemented. What can be a good happening in Iran and also at the global level is to apply changes in diet and to consume meat products as economically as possible. This can play a big role in saving water content of the food at the national and international level. Minimum and maximum values of water recovery on farms (within Isfahan Province) have been measured to be 17.6% and 59.1%, respectively. Therefore increased efficiency in the agricultural sector is an effective step to reduce water consumption. Alternatively, it is also possible to reduce water consumption by changing agricultural products. Using organic matters and agricultural biotechnology can help to increase agricultural productivity and thus reduce the virtual water content. Storage and transport of water process will have their own virtual water content. Due to different water requirements of plant performance in different regions, the virtual water contents in different provinces are not the same. Accordingly, the required feed may be supplied from provinces where lowest amounts of water are consumed to yield crops.

Assessing the Livability of Cities based on F'ANP Method
(Case study: 15 Areas of Urmia City)

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Expanded Abstract

1. Introduction

According to available statistics, nearly half of the world population is living in cities and there is expectance of increasing in the coming decades. In general, this may be due to the efforts of people to satisfy their needs and the existence of suitable facilities of urban life in the cities. With the development and expansion of cities in developed and growing countries, studies of life quality has become important tools to plan and manage the sustainable and livable cities. Studies show that on the one hand importance and necessity of addressing to livable cities in related with new tasks of planning in response to the needs of post-industrial society that desperately in search of facilities and quality of life, and on the other hand the livability in order to threats are facing today's urban life also has double importance .Urban areas are the main centers of economic, social and political growth in every country that have proved itself as the most attractive places to build wealth, work, creativity and innovation. But these areas face with important challenges in the field of areas of physical and environmental destruction, social deprivation, insecurity, unemployment, lack of housing and traffic. These problems reduce the quality of life and livability. The city as the context of human life has a fundamental role in creation of satisfaction and really lifestyle and determinative the quality of his life. The population increases in migration from surrounding cities and villages and integration of rural areas in city. Some problems such as lack of facilities and services, disproportionate distribution of population with the capacity of areas, access or lack of access to service land uses, green spaces and leisure times have been founded in lack of different alternatives of transport and etc. It has reduced the quality of life and livability in some urban areas.
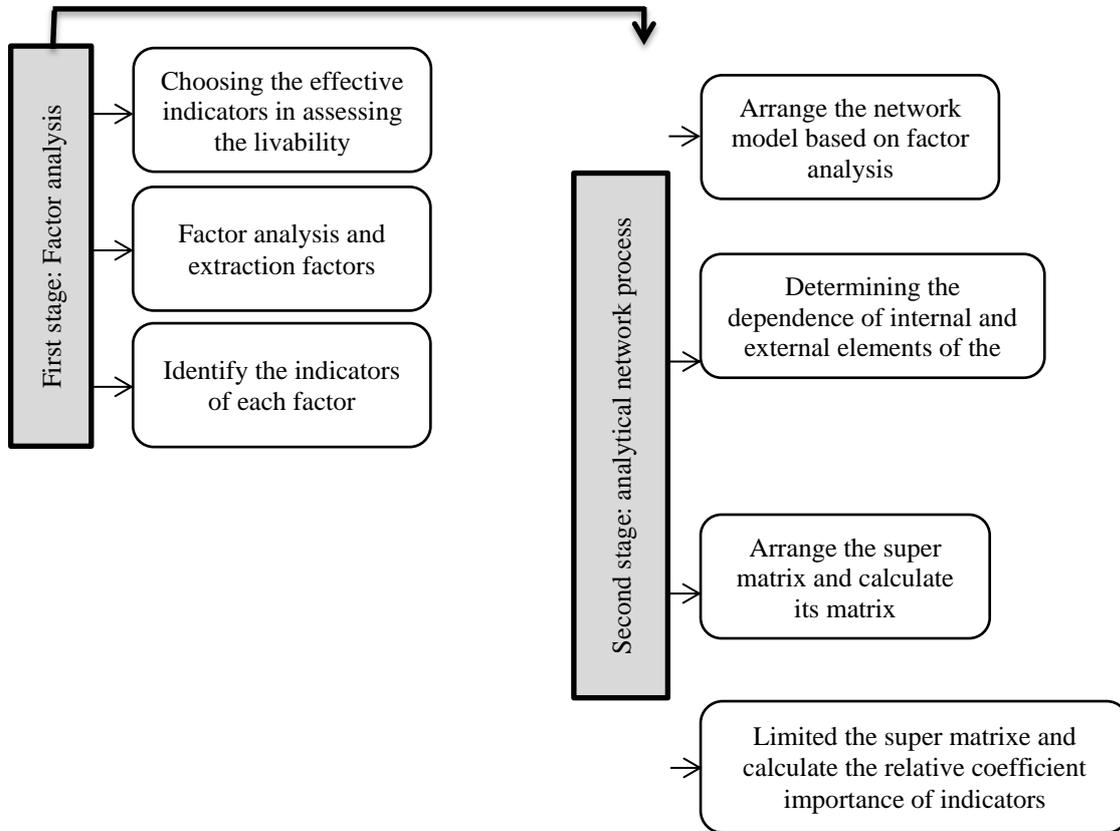
According to the above, the aim of this study is to assess the livability in the areas of Urmia on the basis of affecting factors in determining the livability. To achieve this goal first through different factors, number of 14 indicators based on the existence of information of Urmia city are chosen so that in the process of implementing the F'ANP model number of 9 indicators with respect to the acceptability of Meyer and Bartlet test and Kaiser for measure the livability in urban areas is calculated.

2. Materials and Methods

This research, according to its purpose, is the kind of applied research and according to method of work has descriptive- analytical nature. Collection of information has conducted through library and field studies. In this paper, after studying related references, 14 indicators affecting on the livability of urban areas have chosen and its values have been calculated in SPSS software. After the calculation of the 14 indicators and achieve the required accuracy (KMO> 0.5 and Bartlett's Test <0.05) in the F'ANP, 5 indicators include the share of commercial land use, religious, green space and gardens, river existence and affordable housing from the research process has been deleted. In the first stage of implementation of the two-stage F'ANP model for the implementation of the factor analysis model number of factors, percentage of change and the load factor of 9 indicators including the share of educational land use, health, law-office, cultural-arts, strength of building, facilities and infrastructure, sports, sewerage coverage and access to public transport have been calculated. In the second stage of F'ANP model that includes ANP model, after the formation of the super matrix (Network model) and calculating the matrix elements in Excel and MATLAB software, the relative importance of the indicators has been derived and finally to achieve the output of research these coefficients have been multiplied in 15 areas and its results have been shown in the map in GIS software.

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First stage: Factor analysis

Choosing the effective
indicators in assessing
the livability

Factor analysis and
extraction factors

Identify the indicators
of each factor

Second stage: analytical network process

Arrange the network
model based on factor
analysis

Determining the
dependence of internal and
external elements of the

Arrange the super
matrix and calculate
its matrix

Limited the super matrixe and
calculate the relative coefficient
importance of indicators

3. Discussion of Results

The model used in this study is F'ANP that it has been presented for the first time in 2013 by Esfandiar Zebardast to manufacturing composite indicators. The F'ANP model process includes two-stage, which its first stage is Factor Analysis. Accordingly, in order to assess the livability in 15 areas of Urmia, first according to existence of information, number of 14 indicators include the share of commercial land use, religious, green space and gardens, river existence, affordable housing, educational land use, health, law- office, cultural-arts, strength of building, facilities and infrastructure, sports, sewerage coverage and access to public transport has been selected and their amounts have been calculated in SPSS software.

In the first stage of implementation of F'ANP model in order to calculate the Factor Analysis of indicators in SPSS software, 5 indicators were removed from 14 primary indicators so that appropriateness of Factor Analysis of the indicators comes (KMO=0.52 and Test=0.04 Bartlett's). To determine the number of factors that have to be extracted in the analysis for the sets of datas, Kaiser Criterion was used. According to this criterion, the only factors with eigenvalues of 1 or more are accepted as possible reference of changes in data and the Factor has the highest priority that has the most eigenvalues. When the Factor Analysis was done by Varimax rotation, clear structure of factors with 4 indicators were done that totally explain about 85.2% of the total variation. In the second stage, the network analyze process is being used. According to obtained results of Factor Analysis, network model for determination the livability has been formed. In this diagram first cluster is the goal of research. The second cluster is the livability dimensions and the third cluster includes the subset of each dimensions. Forming the indicators of each dimensions are related to each other. After building the network model, the super matrix has been composed and the individual matrix of it will be built.

$$\begin{array}{ccc} \text{Goal} & \text{main criterion} & \text{subsets} \end{array}$$

$$\begin{array}{c} \text{Goal} \\ \text{Main criterion} \\ \text{Subsets} \end{array} \begin{pmatrix} 0 & 0 & 0 \\ W_{21} & 0 & 0 \\ W_{33} & W_{32} & 0 \end{pmatrix}$$

In this matrix $[W_{21}]$ vector shows the relative of the research goal and 4 dimensions of livability. So, to calculate the $[W_{21}]$ vector like the conventional process in ANP, the binary comparison between the four dimensions in order to achieve the goal of research should be done. Namely in the construction of binary comparison of $[A_{21}]$ matrix, instead of using the Sati's Quantitative 9 scale, the percentage of changes that each factor explains, is used. For calculating the importance of 4 factors, first the geometric mean of the $[A_{21}]$ matrix of row elements earns and then normalize them so that $[W_{21}]$ vector is obtained. The elements of $[W_{32}]$ matrix shows the relationship between factors and indicators. In F'ANP model variable loads are considered as well as their importance in binary comparison of $[W_{21}]$ matrix binary. Since it was shown, instead of the formation of a binary comparison matrix importance coefficient can be obtained directly from the relevant vector normalization, so the weight of elements vector related to the first factor (X_1) is achieved through normalizing the load factor of indicators. The elements of $[W_{33}]$ matrix, show the interdependence between the constituent indicators of each factors. To obtain the importance coefficient of constituent indicators of the prime factor (X_1), the correlation coefficients matrix between these indicators has been obtained and are normalize them. The importance coefficient of constituent indicators of other factors is calculated similarly. Thus, the $[W_{33}]$ matrix is calculated. After calculating the elements of basic matrix, we replace them in the basic super matrix to obtain issue super matrix. Super matrix is weighted (sum of columns is equal to 1), then bring it to the limit until obtain the relative importance coefficient of indicators. Important coefficient of indicators is recoverable from goal column in limited super matrix[1]; the vector is normalized to obtain the relative importance of the indicators. In the next stage any of indicators explain a subject matter, after determination and action the relative importance weight for each of them are combined together that in this article the arithmetic procedure is used. After the relative importance coefficient of livability indicators were obtained, by calculating the SLI_i composite indicators of livability have been achieved in the 15 areas of Urmia city.

4. Conclusions

The results of applying the F'ANP model to assess the livability in the 15 areas of Urmia show that 158 hectares of land areas of Urmia city contains 9% in the too low livability zone, 696 hectares contains 38% in the low livability zone, 457 hectares contains 25% in the average livability zone, 250 hectares contains 13% in the high livability zone and 281 hectares contains 15% in the too high livability zone has been located.

Keywords: F'ANP, livability, sustainability, Urmia.

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1. Weighted super matrix has been reached to limit via MATLAB software in the exponentiation of 12.

The Role of Spillover Phenomena in Transition of Responsible Environmental Behavior from Home to Public Sphere

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Extended abstract

1. Introduction

Spillover of pro-environmental behaviors between places represents a stream of research gained broad attention in recent years, given both the interest bearing for scholars and the relevant implications. It is for policy makers and marketing campaigners. This study builds on the assumption that a positive spillover of pro-environmental behaviors in one domain increases the uptake of other green behaviors in different and not correlated domains. One of the determinant factors of forming behavior in the field of environment is "place". Individuals' place preferences have special results and could be studied by environment researchers. Emotional effects of places such as home, neighborhood and city develop symbolic relationship between individuals and place and it influences in attitude and social behavior. Attachment to home and the sense of belonging to home creates impetus to renew home environment and forms the effective behaviors in it, such as consumption, buying and using household and personal staffs. Furthermore, it is assumed that environmental attitudes and behaviors formed in the home, no longer confined and finally spillover to other aspects of citizen's life.

Realm of the study is Tabriz. The extent of Tabriz, population density, mass consumption, mass production of garbage, various and unstable lifestyles of citizens, besides existence of natural, structural and cultural limitations in making of sustainable lifestyle and environmental responsible behavior have made this city to appropriate case of environmental studies.

This article surveys the linear relationship between attachment to home, responsible environmental behavior in home and responsible environmental behavior in public sphere. The basic question of this paper is:

- Is it possible to overflow a responsible environmental behavior of the private sphere (home) to the public domain? If yes, to what extent is the role of place attachment?

2. Materials and Methods

About theoretical framework in this paper, we used Low and Altman approach dealing with place attachment. They believe that attachment to a special place such as home or city increase probability of engaging individuals with responsible environmental behavior in those places. Furthermore, supporting theory of the creative idea of this research is cognitive dissonance theory from psychology. New idea of us is possibility of spillover of responsible behavior from a favorite place of individuals (like home) to other places in routine life. Finally, with respect to theoretical framework, our hypothesis as follows:

- Attachment to home increases responsible environmental behavior in home.
- Dependence to home increases responsible environmental behavior in home.
- Forming identity on the basis of home increases responsible environmental behavior in home.
- Repeat of responsible environmental behavior in home causes behavior spillover to other areas of individual's life.

This paper is extensive study and in terms of time is sectional one. Also, type of this research is an applied one and method of study is survey. We have used questionnaire as a technique of gathering data. Statistical society is 15 to 75 years old citizens of Tabriz and the sample size is 442 that were selected by cluster sampling. In questionnaire used in this research several scales have been applied for measuring all of the dependent and independent variables. Stern scale (2000) and Milfont and Dukitt scale (2010) were applied in this questionnaire for measurement of responsible environmental behavior in public sphere and responsible environmental behavior in home. Place attachment is a new, complicated and multidimensional concept in social science especially used in urban sociology and urban planning. But few studies have attempted to define it operationally. So, we created a new scale for it with

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combining and summarizing four scales and then assessed validity and reliability of them. Two dimensions of place attachment is place dependence and place identity and each of them have two indicators. Validity of questionnaire was checked with confirmatory factor analysis and reliability of that was checked with Cronbach's alpha. For analyzing data, we have used SPSS software. Also, we applied structural equation modeling (SEM) with LISREL software to explore real multivariate relationships because of existence of errors and covariance between indices. Furthermore, goodness of fit statistics was calculated with this software.

3. Discussion and Conclusions

Findings show that attachment of citizens to their home is 5.05(85%). Average score of responsible environmental behavior in home and public sphere respectively are 77% and 73%. Also, the result of SEM shows that direct relationship between attachment to home, responsible environmental behavior in home and then responsible environmental behavior in public sphere being assumed in theoretical section are confirmed. Goodness of fit indices in this paper is CFI, AGFI, GFI, RMSEA and Chi-square. These factors show appropriate results about research structural model. So, the model presented in findings section has a hopeful fitness with our data.

Over the past few decades, the spillover hypothesis gained broad attention being object of a large literature and an increasing number of empirical investigations. Yet it is still far from clear why or how spillover effects occur and whether they are due primarily to contextual factors or individual motivations. Studies have focused on a wide set of possible drivers, ranging from environmental values to social norms, from behaviors´ similarities to their ease and costs, and so on. This research add place attachment concept in studying relationships among behaviors in different contexts. Attachment to home effects on repeating of behaviors and maybe creates habits that impact individuals' attitudes and behaviors. That is, such individuals could be expected to be more flexible and prone to change their behavioral intentions. On the other hand, individuals for whom recycling is already a habitudinal activity in their home might experience only minor and incremental increases in their intention to recycle in other areas.

This study proposes that human behavior- attitude, values and norm- are a function of the environment they are in. This includes home environment, where people do spend more than half of their active living time interacting and being influenced by it. We cannot categorize a person according to his geographical where about having one personality (active attitude, values and norms) at home, and later switch on to another personality while somewhere else. Having dual and conflicting personalities is always a cause for an uneasy feeling within a person. The natural need to avoid this uneasy feeling is spillover of responsible environment behavior. This phenomenon is rooted within well-established social-psychological theories, where people are expected to have a strong desire to be consistent in their attitudes, beliefs, words, and behaviors in several areas in their life. But, these results have limitations; findings show that some behaviors spillover easier than the other and this is related to how much time or money require to behaviors.

The low-cost hypothesis suggests that environmental concern (triggered in our case by spillover effects) has stronger effects in situations and under conditions connected to low costs and little inconvenience of individual actors. For example, in the domain of energy consumption inexpensive and easy to perform actions such as switching off lights are easier to be spillover to other areas of life.

According to the so -called Campbell paradigm, broad goals such as the protection of the environment can be pursued by means of a wide range of interrelated behaviors, with different degrees of financial, physical and psychological costs. Individuals motivated to attain a specific goal tend to implement easy behaviors towards that goal first, compared to more costly and inconvenient behaviors connected to the same goal.

lso, my interpretation of the results adopts a dynamic perspective, considering positive spillover a process building over time, trespassing the static boundaries of a snapshot on individual intentions and behaviors. Since most everyday behaviors tend to be pretty stable over time, one should not expect radical changes to develop over the short time. However, it is possible that this foot-in-the-door approach might eventually push people to adopt even more relevant behavioral changes, consistently with the broad goal of preserving the environment.

This study suggests that people will be even more willing to behave in a pro-environmental manner only if it is motivated by self-interest. However, repeated studies have shown that human choice for a pro-environmental behavior is more strongly influenced by positive universalism values over other selfish reasons and their decision is a practical way to express their ethical values and concern for the common good. Based on our own studies, we also conclude that sustainable behaviors at home- such as responsible water usage, 3–R (recycle, reuse and reduce), waste segregation, buying energy efficient products, cutting down electricity use, carpooling to office, wasting less food etc.- are behaviors driven by a person's knowledge, experience, and concern to the environment wellbeing. More importantly, our study also shows that the opportunities to develop these drivers for pro-environmental behavior exist at home itself.

Justifying the proposition that environmental behavior is contagious and a behavioral norm that originated from one domain could spread to another domain, could give policy makers a cost-effective and socially acceptable

alternative in addressing the deteriorating environmental situation. Considering the dire environmental situation that we are facing, and thus enormous challenge that lay ahead, any suggestion, however trivial it seems, must seriously be taken into consideration. Even though many might tend to agree with the assumptions put forward by proponents of the rational choice theory that assumes people will choose to behave in a way that would only ensure their immediate personal benefits over something they see as too idealistic.

Effect of Crude Oil Consume on CO$_2$ Emissions in OPEC Member Countries with an Emphasis on Environmental Protection: A Generalized Method of Moment Approach

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Extended abstract

1. Introduction

In recent decades, use of fossil fuels is one of the most important factors creating air pollution. Air pollution has different harmful effects and sometimes irreversible or devastating in humans, animals and plants life. Air pollution threatens the survival and health of organisms, including humans. Carbon dioxide emissions lead to increased heart disease, breathing disease, decreased vision, warming, acidification and etc. After the industrial revolution with growth and development, air pollution was increased. In seventies, very attention was to environmental problem especially industrial pollution. In some countries, new technologies help controlling urban pollution. Green Belt is an effective tool for reducing air pollution. Contradictions in economic growth and pollution by expand production. Experience of many developed countries suggests that, if properly trodden path of economic growth, then there is not only a contradiction but growth will improve the environmental situation. The environment is one of the most important issues of this century. Fossil-fuel is main inputs of mostly produces and use of these fuels causing damage to the environment. When countries achieve higher economic growth, environmental pollution with economic activity is a controversial topic. Industrial development led to greater use of fossil fuels. According to many ecologists, in the coming decades because of global greenhouse gas emissions, the planet will face severe environmental crises.

Ruttan (1993) raised three wave associated with resources and the environment. The first wave emerged in the late 1940's and early 1950's, that size of connection between economic development and resources available was important. The second wave in late 1960's and early 1970's is about the scarcity of natural resources and the pollution of the growth cycle which leads to the limitation of the growth. In this decade processing capacity of the ecosystem pollution from production and consumption of goods and increase in consumer demand because of increased growth and per capita income was important. With release of limits of growth in 1972 by the Rome Club, Ruttan in 1980 raised the third wave about changes and quality of global environmental, human health and food production for the next generation. The theory of growth restriction, for some reason was discussed. Resources had been estimated more than and the progress of technology and access to resources improved.

2. Materials and Methods

Crude oil consumption data extracted from Energy Information Administration (EIA) site and carbon dioxide emissions data, trade data and GDP data has been taken from the World Bank. Shahbaz and others' (2014) and Al-mulali and others' (2014) models have been used to analyze the effects of crude oil consumption on carbon dioxide emissions in OPEC member countries according to the following equation.

$$LCO_{it} = \beta_{0i} + \beta_{1i} LCO_{it-1} + \beta_{2i} LOIL_{it} + \beta_{3i} LTRAD_{it} + \beta_{4i} LGDP_{it} + U_{it}$$

In the above equation, LOIL represents the log of crude oil in million liters, LTRADE is logarithm of trade openness and GDP is real gross domestic production in 2005 base year. Because of its dynamics, lags in the independent variables and persistence of pollution from one period to the next, estimation is based on generalized method of moments (GMM). Because of its dynamics, each of the other models, had a failure that results in generalized method of moments can be reduced. After determining the methods, parameters using Stata12 estimated.

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Sargan test that stipulated by Arellano and Bond (1991), Arellano and belief (1995) and Blundell and Bond (1998) used for adapted of GMM estimator and analysis no serial correlation error terms assumption and tools. In this test, by determine pre-determined restrictions, validity of instruments exam. There is no evidence of serial correlation and provides a valid tool, failure to reject the null hypothesis. GMM estimator is consistent if second-order serial correlation in the error terms of first-order differential equation does not exist. Due to use of GMM estimator includes:

    a) Existence endogenous regresses in model. Endogenous regresses are variable that is correlated with the error term.

    b) The correlation between the fixed effects such as geographic and demographic factors with explanatory variables.

    c) Existence of short period and a lot of cross section. Heteroskedasticity is one of the most important reasons that using GMM model.

3. Discussion of Results and Conclusions

In recent years, greenhouse gases emissions that cause air pollution and change in global climate is in international attention. The results showed a significant positive relationship between the consumption of crude oil, GDP and trade with emissions of carbon dioxide. Lag logarithm of carbon emissions variable by a significant and positive impact on carbon emissions log shows that the last period with an increase in carbon emissions increased carbon emissions for the next period. Lag of LCO variables in the model use according to Rein and others (2014) and Manaji and others (2009). Carbon dioxide gas that released in a period is not fully absorbed and some affects remains in the environment for storage and influence. According to the results, a positive coefficient of the logarithm of GDP representing that increasing levels of pollution increased GDP per capita. In other words economic growth is associated with the occurrence and CO_2 emissions. Trade has been a positive effect on carbon emissions.

According to various studies, the effect of trade on pollution is ambiguous. According to Ang (2009) and Halicioglu (2008), the positive effect of openness on carbon dioxide emissions was approved. On the other hand, Jalil and Mahmoud (2009) showed a negative relationship between these two variables.

Pollution from trade can be effective in two ways:

1. through increased international shipping

2. with goods transfer of exporting country to importing country and increasing production in exporting countries followed the possibility of increasing pollution in these countries.

On the other hand, trade by access to newer technology can reduce the pollution. According to previous studies, in this study, real GDP has a significant positive impact on the carbon emissions. Some researchers such as Kolstand (1993) believe that economic growth requires greater use of resources and fossil fuels that in turn leads to environmental degradation. By increasing the production of goods and services, consumption of inputs such as crude oil increase. Crude oil is one of the important production factors. Use of fossil fuels to achiev the goals of economic growth and low environmental pollution will increase energy efficiency. Only parts of energy lead to economic production and the rest of it into environment polluting. Pollution is result of economic growth in these countries. In recent decades, greenhouse gases, especially carbon dioxide emissions, cause global damage such as global warming and climate change. Increased consumption of crude oil and increased GDP leads to carbon dioxide emissions. Positivity of LCO variable lag indicates that carbon emissions depend on prior periods and there is dynamics of the carbon emissions in estimation. In this study LCO_{t-1} coefficient obtained 0.67 which is very close to the 0.6 in research Manaji and others. With the increase in crude oil consumption, GDP and trade open, carbon dioxide emissions will increase. Economic growth of crude oil consumption and foreign trade caused environmental pollution and carbon dioxide emissions. So, the impact of energy consumption on CO_2 emissions was greater than the other explanatory variables.

As a member of OPEC countries produce crude oil, due to higher economic growth and industrial production and on the other hand crude oil leads to more carbon emissions. Energy consumption and pollution are parts of the production system and the national economy. However, considering the relationship between CO_2 emissions and economic growth is important to achieve appropriate solutions.

According to the study results recommended that:

1. Determining the amount of permissible emissions

2. Installation of cleaner pollution equipment in the area

3. Taxes on pollution emissions in OPEC countries

4. Use of new technologies

5. Improving research and development in clean technologies and environmentally friendly alternative

6. Managing crude oil consumption proportional to efficiency

7. Using of clean energy and renewable energy use in production

9. Adoption international environmental law in the OPEC countries

10. Investment in the production of goods with low emissions in OPEC member countries

11. Plants can absorb and metabolize the pollution, so more attention is need for reducing air pollution. For this planting trees and extension the green spaces is recommended to reduce pollution.

GDP has a significant positive effect on carbon emissions, so government can be monitored to control of energy consumption. Elasticity of crude oil consumption is estimated to be 0.06 on carbon emissions and elasticity of carbon dioxide lag, trade open and economic growth extracted 0.67, 0.11and 0.22, respectively. In this study, the effects of carbon dioxide emissions in the previous period as a variable that remains in the environment were more than other variables in the model.

Content Analysis and Comparison of Urban Environment Challenges in Iran and the World during the Recent Fifteen Years (1380-1394h/ 2000-2014s)

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Expanded Abstract

1. Introduction

Environment is a pervasive platform for all the living creatures, which is exposed to multiple challenges, especially with the increasing rate of urbanization. Levels and dimensions of these threats have been increased. Scientific activities in a publishing form such as reports and articles are an accepted procedure between various scientific fields. Documents, reports and articles are suitable tools to measure and analyze environmental concerns and challenges among different nations. These various challenges are depending on urban living experience, culture and citizenship reactions in the different countries and nations. In the meantime, the attention to the situation of environmental challenge is very important, according to the circumstances of any environment. Today, these challenges are global in scope, and the hypothesis such as urban environmental transition has been introduced for the formation and persistence of environmental challenges. Continued international sessions and global reports from different aspects are symptoms of these notifications. However, scientists have a crucial role to enhance technical knowledge about this field. Peer review and academic articles are one of the main tools of them, which have a high reliability. Periodical review and content analysis of scientific data sets can clarify the strengths and weaknesses of scientific research about the urban environment. Orientation focuses on the environmental challenges are also given in this way.

2. Materials & Methods

This study examines the current situation in Iran and the world's environmental challenges over the last fifteen years from the beginning of 1380 until the end of 1394h and the beginning of 2000 until the end of 2014s. At first, it reviews comparative environmental literature in Iran and the world. For the evaluation of Iran's environmental challenges and global scale, 2,627 environmental articles from a total of 9,791 articles have been studied between 24 scientific journals in Persian and English language. Eleven international journals were chosen as basic journal, which have been introduced at MIT University in website platform as a name of Environmental Strategies for Cities to meet the challenges of the urban environment. Among these journals, five journals were selected as a leading English-language international journals besides of 19 Persian environment journals. The method of this study was based on quantitative content analysis technique with an inferential approach. Content analysis is a technique commonly used in environmental research and allow researchers to have a more understanding process of gathering the information. In this study, the unit of data collection was environmental articles, and the unit of analysis was environmental challenges. Analytical approach has been selected to remove descriptive aspects of the analysis. Then, according to topic-oriented approach papers, all papers have been studied and the key topics of each of them were categorized, by American Planning standards guideline in the environmental sector.

3. Discussion and Results

Findings of the study indicated twenty-one environmental head topics. Due to the number of their significant environmental articles, environmental issues had various scopes of research. The first six environmental head challenges in the Iranian journal were the "health, sanitation, solid waste", "management and planning environment", "pollution and environmental health", "water", "lakes, rivers and river valleys" and " forests and

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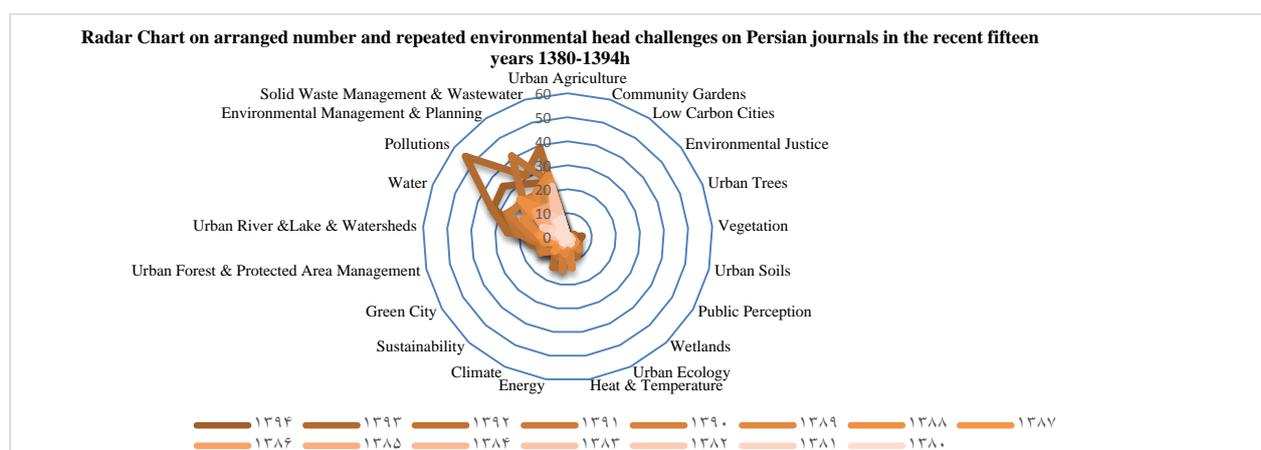
protected areas". In contrast, the first six head challenges of international articles were "climate", "management, environmental planning", "Sustainability", "Health, wastewater, solid waste", "urban ecology" and "pollution and environmental health". In Persian articles, head topic's environment of "water" was the most frequently subject and head challenges of sustainable development; energy and wetlands have been less emphasized. By comparative approach and quantitative viewpoint, in spite of slowly increasing number of local papers, there is a significant capacity in this field. On the other hand, from qualitative dimension, in the international articles, attention to both green and brown agendas, environmental challenges could be observed, whilst in local papers; concentration was on the brown challenges of the urban environment. The primary priority of green agendas in international journals and brown agendas in domestic journals reflects the gap and differences in the quality of environmental researches between Iran and world scale. Most percentages of environmental issues on initial six head challenges revealed weaknesses in both environmental articles of nations. Table 1 and 2 and Figures 1 and 2 also show some main brief of analysis.

Table 1. Main head topic of urban environment issues in selected Persian journals
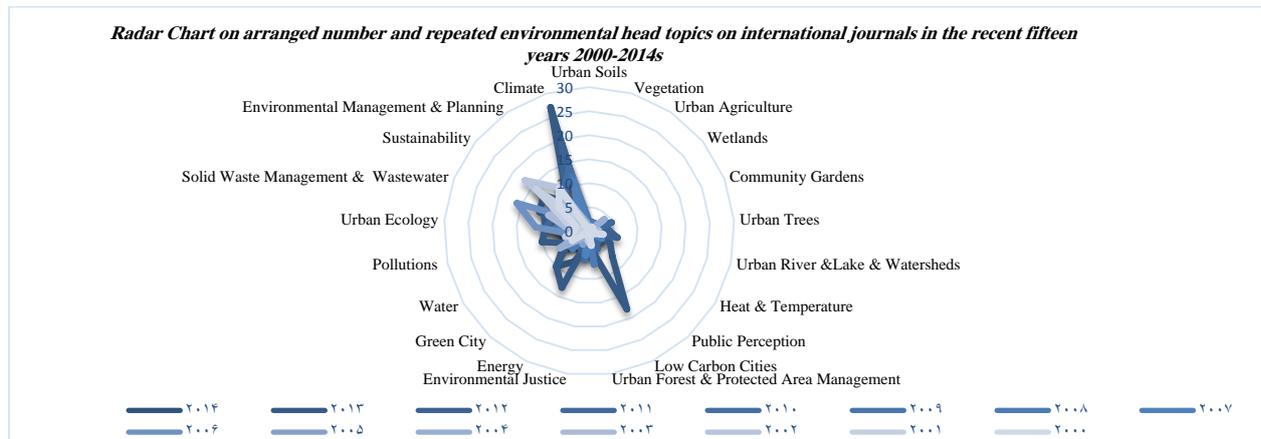
Journals	Name of head challenges	Rate	Average of article
Persian	Health, Wastewater, Solid Waste	1	18
	Management and Planning Environment	2	17
	Pollution and Environmental Health	3	17
	Water	4	15
	Lakes, Rivers and River Valleys	5	10
	Forests and Protected Areas	6	6

Table 2. Main head topic of urban environment issues in selecting international journals

Journals	Name of head challenges	Rate	Average of article
International	Climate	1	8
	Management and Planning Environment	2	8
	Sustainability	3	7
	Health, Wastewater, Solid Waste	4	6
	Urban Ecology	5	5
	Pollution and Environmental Health	6	4

Fig. 1. Radar chart of arranging number and repeated environmental challenges in Persian journals

Fig. 2. Radar chart of arranging number and repeated environmental challenges in Latin journal

4. Conclusions

Nowadays, the environment has become a serious issue due to growing environmental concerns and changing old human thoughts. Evaluation of scientific papers about environmental challenges indicates a clear image of the current situation and determines future suited strategies. In general, the literature on environmental challenges inside and outside the country, according to first priority on common head challenges like "sanitation and wastewater treatment", "management and environmental planning" and "environmental pollution and health" show the importance of the brown agendas in both sets. On the other hand, despite the attention to both brown and green agendas in the pattern of global, problems were focused just on brown challenges at the local level. In other words, there were no articles on the research field of "environmental justice" or "low carbon cities" topics regardless of its origin and also numbers of researches around sustainability are few. Moreover, there are some shortages for studying some brown challenges like energy and wetland's challenges in our native research. However, changing this current situation requires a shift thinking of the number and scope of the environmental research and revising of environmental studies around the country.

Keywords: content analysis, scientific researches, urban environmental challenges.

Modeling Areas Exposed to Oil Pollution in the Coastal City of Bandar Abbas Using ELECTRE-I and AHP models

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Expanded Abstract

Introduction
Persian Gulf coasts are considered if the beach oil-gas, fisheries, trading and Residential. During the Persian Gulf coast of the role of communication and sea transportation due to the national and international trade, legal and illegal, from oil and gas activities and fishing and the coastal fisheries is an economical three principal approaches. Coasts are the most important areas of the world that is inhabited by humans and uses its resources, strongly. Sensitive areas of coastal are regions that have sensitive source or dependent on the sea coast. This sensitivity by biodiversity, species richness, species at risk, vulnerable and rare, vital social being on the verge of ecological tolerance, sensitivity to pollutants, healing, environmental damage and problems caused by clean up the environment and environmental pollutants. Because more than 30 percent of the country's borders, formed coastal boundaries, detect sensitive sea areas of the coast of Iran are the great importance. Therefore, the first step to control and clean up quickly and accurately at the time of sudden oil pollution, determination of the degree of sensitive coastal areas is to manage the crisis and to minimize damage. This step is necessary to be done carefully and use appropriate tools and techniques. By using spatial multi-criteria decision-making methods and Geographic Information System, the role and importance of various criteria and also multiple scenarios and also multiple scenarios are considered to be sensitive coastal areas of oil pollution. This can be important role in making correct decisions by managers and planners. According to the economic importance of coastal areas of southern Iran and the Persian Gulf coast ecosystem conservation, this research is planned. In this regard ELECTRE-I and AHP models have been used.

2. Materials and Methods
The study area includes the part of the coast that dry side of the border based on the highest facing the sea on land and water is determined based on the watermark line. It is the part of the land adjacent sea in the stormy conditions placed under the direct influence of the sea water. So, contains the unstable and seating sand dunes and vegetation of the land is one of the signs. This study also considered the potential and actual activities in adjacent areas. So, land use in the onshore coastal border villages was considered.

Electre- I model was introduced in the late 1980s and is considered one of the best multi-criteria decision making techniques. This model is based on non-ratings relations. It is not to rank all factors leading, may be less than the value of options that the decision is also removed. All stages of the implementation of this method are based on a set of coordinated and uncoordinated series. To run this model in forms picture and spatial mode, MATLAB software was used. In the AHP, the comparison between the criteria was used in pairs and weight of each criteria and sub-criteria for the ratio as output. In this method, creating hierarchy of decision-making compared the relationship between each level will be discussed in the form of a matrix. This model was implemented in software ArcGIS 10.1.

2.1. Effective criteria in determining sensitivity of coastal areas to oil pollution

In the present study, to assess the current situation in the region, and in the views of experts in the management of coastal areas as well as the review of the studies, the criteria has been studied in three general groups: the criteria being categorized in three categories of criteria related to beach physics (landforms, kind of sediments, slope, liquefaction and earthquake), biological criteria (protected areas and ecological potential) and human criteria (ports and docks, industrial units, aquaculture, settlements and ...). The importance and the sensitivity of each of the criteria and sub-criteria to the oil pollution were used in five degrees (from very low to very high sensitivity).

2.2. Weighting the criteria

The purpose of weighting is to be stated the importance of each criteria relative to other criteria. In this study, the weights according to average experts of specialists were determined by Delphi method. In this regard, the questionnaire was designed and completed by several people. Then mean of their argumentation entered in expert choice software and final weight was obtained after the pair-wise comparison of criteria with AHP method. The pair-wise comparison matrix is calculated for each criteria. The matrix pair-wise comparison is formed between the main criteria. Biological criteria weighed 0.369 has greatest weight and human resources criteria and beach physics with the weight of 0.335 and 0.297, respectively were the next priorities.

3. Conclusions

In this part of the implementation of the AHP and ELECTRE-I in determining the locations susceptible to oil pollution in the coastal city of Bandar Abbas was explained.

3.1. AHP model

In this method, a hierarchy of decision-making compared the relationship between each level will be discussed in the form of a matrix. It dine from high to low levels. Next, the relative weights of the different layers are multiplied together. Then, this layers overlay as base weighted overlay algorithm in the GIS. So, places are detected with different sensitivity (low to high sensitivity). The map of sensitivity class of the implementation of AHP model in the coasts of Bandar Abbas County was drawn. More sensitive areas are shown on the map by a darker color.

3.2. ELECTRE-I model

If a problem multi-criteria exists n criteria and m options, in order to choose the best option using ELECTRE-I, the following steps should be done:

Step 1. Normalization: At this stage, the decision matrix becomes a Scale without matrix.

Step 2. Scale weighted matrix: At this step, raster map of normal weight matrix of each layer multiplied in the layer.

Step 3. Identified sets of coordinated and uncoordinated (pros and cons)

Step 4. Calculation of coordinate matrix

Step 5. Calculation of uncoordinated matrix

Step 6. Determine the effective coordination matrix

Step 7. Determine effective inconsistent matrix.

As it is seen in regions located in 5 classes of sensitivity (very low, low, medium, high, very high): Class 1, areas with very low sensitivity and class 5 areas with very high sensitivity. In this map coastal areas with red color show the coastal areas with very high sensitivity.

4. Discussion and Results

In this research, in addition to identification of the factors affecting production, distribution and accumulation of oil pollution, the criteria are categorize in three categories of criteria related to beach physics, biological criteria and human criteria. Biological criteria weighed 0.369 has greatest weight and human resources criteria and beach physics with the weight of 0.335 and 0.297 respectively, were the next priorities.

In both models, the highest areas coastal city of Bandar Abbas shows medium sensitivity (sensitivity class 3).

The results of class sensitivity between the values of classification model ELECTRE-I suggest that respectively, the highest rate of approximately 76 km^2 of coastal city hypersensitive average, 32 km^2 of high sensitivity and approximately 12 km^2 sensitive too are high.

The results of the sensitivity classes were classified in the amounts of AHP model showed that respectively about 160 km^2 of the coast city has an average sensitivity, 113 km^2 of high sensitivity and low sensitivity are approximately 71 km^2.

The results of numerical indicators show areas around the Shahid Rajai port , the Shahid Bahonar port and parts of the coastal port city of Bandar Abbas have a very high sensitivity to oil pollution. In addition, the east parts of coastal area of Bandar Abbas that are mostly mangrove protected areas have moderate to high sensitivity.

Keywords: AHP, ELECTRE-I, oil pollution, sensitivity of coasts, spstial multi criteria decision making.

Artificial Neural Network Based Model to Estimate Dust Storm PM10 Contents using MODIS Satellite Images

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Extended abstract

1. Introduction

Concentrations of suspended particles are one of the main indicators of air quality. Suspended particles are formed of a combination of liquid and solid particles with aerodynamic diameter less than 10 micrometers, or less than 2.5 micrometers. A major source of these particles in nature is sea salt, dust, volcanic ashes or sources which is created by human activities such as fossil fuels, dirt's produced by industry and transportation activities. In another category for mechanical particles, they are sorted into categories such as dust or a chemical compound (such as SO_2 and NOx).

AOD (Aerosol Optical depth) is one of the parameters that help us to estimate air quality using satellite imagery. AOD can be defined as reduction of the amount of sunlight absorbed by the aerosol particles. Passive imaging is capable of providing measurement data for the AOD.

AOD products can be obtained from satellite sensors such as TOMS, SEAWIFS, OMI, POLDER, MERIS, and MODIS. Algorithms such as deep blue and dark object are developed in order to extract AOD from satellite data.

In most of studies which is done by Kaufman the importance of MODIS data in such studies is emphasized. This is because of MODIS's daily coverage and its fine spatial resolution. Kaufman introduces NDDI (Normal Difference Dust Index) which uses MODIS band 3 and 7 to detect dust storm.

In 2014 Green used PM10 and PM2.5 data to create a model. This model used AOD of MODIS and GEOS and AERONET data. The final R2 value was about 0.523 and showed that this correlation is maximum in autumn and the minimum value is in winter.

2. Materials and Methods

In this study two sets of data is used. The first one is PM concentrations which is acquired of ground stations. These data is used to build model and then in order to validate them. The second data set is MODIS AOD data which are used to combine with other data to build the model. This data and metrological data is combined together in an ANN model to estimate PM concentration.

AOD which is derived from MODIS satellite is produced with a spatial resolution of 10×10 km at Nadir and 20×40 km in the corners of the image. This product is produced using the dark target algorithm and is called MODIS MOD04. MODIS products for aerosols are freely available. These data is acquired for each day which PM concentration is higher than a standard threshold. Using ENVI and its free extension MCTK, these data is extracted as geotiff and then the value above each ground station is expected.

Climatic factors affecting the PM are characterized in two general categories: factors influencing on particles directly (such as speed and direction of air flow, Earth's surface temperature and precipitation) and the factors influencing on PM indirectly (such as temperature, humidity weather, clouds form and barometric pressure).

Data which are used in this model includes the relative humidity (RH), wind speed (SWD), wind direction (SWD), the average temperature (T), and the Earth's surface pressure (SP) which have been collected from local meteorological stations. These data are in hourly average scale and for each day these data are extracted.

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Finally, a set of data for each day is prepared. These data include AOD, temperature, humidity, pressure, wind speed, wind direction as input data and PM10 concentrations in ground stations as output data.

3. Study area

Ahvaz, the center of Khuzestan province, is one of the major cities in Iran. Its geographical location is in 31° 20' north latitude and 48° 40' east longitude, in the plain of Khuzestan. This city is 18 m above sea level. There are large industrial plants, offices and industrial facilities, the South Oil Company and National Iranian Drilling Company in Ahvaz. Because of these facilities Ahvaz has turned into one of the most important industrial centers in Iran and this has caused many immigrants to the Ahwaz. It is one of the cities where most dust storms happen. The origin of most of these dust storms is Iraq and Syria, and some recent storms have domestic source.

4. Discussion and Results

The model of the PM10 content in dust storms are primarily based on data from meteorological stations and MODIS MOD04 products. Wind speed and direction, relative humidity, and the PM is collected by ground stations in according to the time specified and selected satellite overpass.

At the first step days with dust storms are specified. These days are specified using the reports about dust storms and also visibility of the ground stations in study area.

Because MODIS AOD values are calculated in different bands, in the first stage a correlation must be calculated between AOD values which are extracted from MODIS different bands and values of PM associated from ground stations. Modis AOD data is available in seven different bands. In order to select the best band at first, a correlation analyze is applied on data. This correlation is applied to find the relation between AOD data in each band and PM10 concentration (Table 1):

Table 1. Correlation between AOD data in each band and PM10 concentration

	Corr.		Corr.		Corr.
Band 7 AOD	-0.159	Band 4 AOD	0.308	Band 1 AOD	0.408
		Band 5 AOD	0.398	Band 3 AOD	**0.493**

As Table 1 shows, the correlation between AOD MODIS band 3 and PM10 is 0.493 which is the highest value and this bond is used for model.

4.1. Modelling

After determining the best band of MODIS AOD with the highest absolute correlation with PM10 levels, in order to increase the precision of the PM10 prediction in the final model, the climate parameters were used in the modeling process. As mentioned in section 1, these data were included of wind speed and direction, temperature, pressure and humidity.

To model these input data and estimate a PM10 concentration, an ANN modeling is used. Two models of RBF and MLP are applied in these data.

4.1.1. Neural network model

In this study, two Multilayer Perceptron Neural Network (MLP) and Radial Basis Function (RBF) models are used to predict. The results are compared with each other. In the current model, in order to estimate the values of PM10, five input layer and an output layer exist. As the input layer parameters including temperature, relative humidity, wind direction, wind speed and the amount of AOD and output is the corresponding neural network model of PM10 per station at the time of imaging.

4.1.2. Validation

In order to validate the model used in this paper, the two indicators of RMSE and MAE are used. The validation process is applied in 20% of data which are held out of model and are not used to create model. This is because of increasing the accuracy of validation.

5. Conclusions

After the implementation of artificial neural network models on input data, results of the model are shown in Table 1.

Table 1. The result of models and their statistics

	Mean	Median	Mod	Standard deviation	R	R square
model MLP	382.91	156	296.073	296.073	0.85	0.7225
model RBF	369.25	609	173.373	173.373	0.361	0.130125
Ground station data	368.25	261	120	316.348		

The MLP model is more accurate than another model in prediction of the sample data values for PM10. Of course, this model is less accurate PM10 levels above the ground which has high values of PM10. This is because of less accuracy in ground stations.

This study focuses on possibility of using MODIS data to study air pollution. One of the main factors to study air pollution is spatial and temporal resolution, so MODIS data because of their temporal and spatial resolution, is a good choice for this purpose. In the most of previous studies AOD of MODIS band 0.555 nanometer is used to predict PM10. But, because the correlation among PM10 and MODIS AOD in band 3 was highest, this band is used in this study.

The main reason in modeling PM10 concentration in dust storms is because of their high value of concentrations in dust storms and therefore can cause a higher correlation than normal days.

Keywords: ANN, AOD, MLP, MODIS, PM10.

The efficacy of applying Fered-Fenton advanced oxidation process for removal of organic loading (COD) from saline tannery wastewater

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Expanded Abstract

1. Introduction

Access to clean water and sanitation on the one hand and water use in agriculture and industry on the other hand to meet diverse needs of human societies in the coming decades is still a challenging issue. There is a growing concern about the presence of non-biodegradable materials and organic contaminants in water supplies as important limiting factors of the exploitation of water resources. In large numbers of developing countries, leather industry is one of the most active sections. Most of the produced leathers are hides of cattle and sheep changing from degradable material to non-degradable ones by experiencing physical and chemical processes. Leather industries produce large amounts of saline wastewater due to their plenty use of water in each section of the tanning process. Saline wastewaters are kinds of wastewater such as the tannery, petroleum refinery and oil extraction that contain more than 10 gram per liter mineral salts. The saline tannery wastewater also contains the high concentration of organic materials and various chemical compounds like lime, sodium sulfite, sulfate ammonium, sodium chloride, disinfections, vegetable tannins, salts of chromium and chloride. In recent years, different applications of advanced oxidation processes (AOPs) are applied to remove organic loading (COD) from wastewater. Advanced oxidation processes produce Hydroxyl radicals that among them $HO^\bullet$ is the most powerful one after Fluoride in oxidization of organic compounds. This radical is also favorable because of its high efficiency in oxidation beside non-selective reactivity that makes it able to take the electron from all organic compounds. Fenton as one of the (AOPs) has a broad-spectrum in contamination elimination. Fenton has the simplicity of the technology, with low operation expenses and can be applied at the low temperature and atmospheric pressure. Fenton reagents are Fe^{2+} and H_2O_2. The consumption rate of Fe^{2+} is higher than its regeneration. To solve this problem electrochemical advanced oxidation processes (EAOPs) are introduced. (EAOPs) are based on the combination of Fenton reagents and electrochemical process. Compared to the conventional Fenton process, the electro-Fenton process has the benefit of allowing better control of the process, more efficacy in less hydraulic retention time, less excess sludge and avoiding the storing and transport of the H_2O_2. The Electro-Fenton process has two different types. In the first one so-called Fered-Fenton, Fenton reagents are added to the reactor from outside and inert electrodes regenerate ferrous ions while in the second type, only hydrogen peroxide is added from outside and Fe^{2+} is provided from sacrificial cast iron anodes. The main purpose of this study was effective investigation on Fered-Fenton advanced oxidation process for removal of organic loading (COD) from saline tannery wastewater under optimized conditions including the effect of initial pH, $[Fe^{2+}]/[H_2O_2]$, H_2O_2 concentration, current and hydraulic retention time in the presence of high concentration of Cl^- ions.

2. Materials and Methods

Pilot studies and investigations were carried out in laboratory scale. Saline tannery wastewater samples were taken from the wastewater treatment plant of Varamin, Iran. The examined Fered-Fenton reactor depicted on Figure 1 consists of four graphite electrodes, two anodes and two cathodes, due to chemical inert and decomposable characteristic of graphite. The electrodes dimensions were 140mm*60mm*1mm, and the distance between them was 1.5 cm. The reactor volume that is made of Plexiglas was 1 L, equipped with an electrical mixer and digital power to adjust amperage. Chemicals including ferrous sulfate, hydrogen peroxide, and

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concentrated sulfuric acid (Merk Chemical Co. Inc., Germany) and filter paper #42 (Whatman Co. Inc., United Kingdom) were analytical grade and used without further purification. The pH values of wastewater samples were adjusted using sulfuric acid and soda before ferrous sulfate and hydrogen peroxide were added to the system. At first, ferrous sulfate was added and mixed vigorously, then hydrogen peroxide was injected into the reactor. After connecting electrodes to the power supply and putting them in the reactor, amperage and voltage were set. All tests were done according to the standard methods (APHA) and each part of experiments was repeated three times.

Fig. 1. Schematic and the picture of the Fered-Fenton reactor

3. Discussion and Results

pH is one of the most impressive factors in Fenton reactions. Adjustment of pH is necessary for precipitation of iron, hydrogen peroxide decomposition, complex and recalcitrant iron compounds and overall efficacy of the process. Based on the own results at the laboratory scale (Fered-Fenton reactor) observed the maximum efficiency of COD removal at pH between 2.5 and 3.5. Oxidation efficiency essentially reduces at pH values lower than 3 because of resulting stable complexes from Fe^{2+} and H_2O_2 that leads to deactivation of Fe^{2+} as a catalyst. While pH value increases from 3 to 5, the process efficiency declines continuously. At higher pH values than 5, Iron species begin to precipitate as ferric hydroxides and cause a reduction in efficiency of the process. During the process continuous detection of pH in order to keep optimized pH value constant is really essential. Generally, water hydrolysis and formation of Carboxylic acids make the pH decay in the system. Since high concentrations of Cl^- ions available in tannery wastewater, Hypochlorous acids (HClO) and Hydrochloric acid (HCl) are formed that they would also drop the pH. Hence, lack of continuous detection of pH results in the inadequacy of Fered-Fenton process for COD removal from saline tannery wastewater at pH optimized. In the Fenton and Electro-Fenton processes, the mass ratio of ferrous iron and hydrogen peroxide is very crucial in terms of overall cost and efficacy of the process in COD removal. Excess or shortage of any of these two reagents would make the process insufficient either by scavenging of hydroxyl radicals or by stopping the process. In the absence of Fe^{2+} efficiency of the process is limited to only 14% that is because a few number of iron ions were available as the catalyst to generate enough $OH^\bullet$. Besides, water electrolysis could not provide so many hydroxyl radicals to oxidize organic compound more effectively. The maximum efficiency of the system was achieved by $[Fe^{2+}]/[H_2O_2]=0.6$. More addition of Fe^{2+} causes both $OH^\bullet$ scavenging and more iron sludge. Hydrogen peroxide is the main source of hydroxyl radicals in Fenton related processes. An inadequate dosage of H_2O_2 does not generate enough hydroxyl radicals to achieve complete mineralization. Although an increase in the amount of H_2O_2 raises the efficacy of the process, the overdose of it let the side reactions initiate i.e. all of the generated $OH^\bullet$ would not be utilized to oxidize organic matters. New radical species generated from side reactions are not as strong as $OH^\bullet$ so they reduce the efficacy of the process. Furthermore, COD is defined as the amount of a specified oxidant that reacts with the sample under controlled conditions. Therefore, the determination of Fenton reagent's dosages should be made on the basis of initial COD for an efficient treatment. By increasing the initial COD, the required dosage of H_2O_2 would raise and consequently expand the amount of Fe^{2+}. By considering the fact that samples are real saline tannery wastewater, all of the samples do not show the same initial COD and oscillate in a range of 900 to 1500 mg/lit. Further increase in the ratio of $[H_2O_2]/[COD_i]$ would lead to the adverse effect of scavenging reactions and finally to the ineffectiveness of the process. Therefore, the $[H_2O_2]/[COD_i]=2$ would be considered as the optimum ratio. When no current was applied to the reactor, Fenton process was predominant. With the increase in current, the electro-regeneration of Fe^{2+} from Fe^{3+} would be improved. At the current equal to 0.8 Ampere, the maximum COD removal occurred. Higher current has an inhibiting effect on redox of Fe^{3+} and also would decrease the efficiency of the process due to the decomposition of hydrogen peroxide to oxygen and water. The hydraulic retention time (HRT) is an essential

parameter in operation. Although the shorter hydraulic retention time ameliorates the operation, it corresponds to the higher treatment capacity. In the first 2 hours of the process, the highest COD removal (61%) was obtained due to high concentrations of the degradable organic matter and later it gradually slowed down. However, increase in the hydraulic retention time would raise the chance of oxidation of organic matters. Energy consumption must be considered for long HRTs. Hence, in order to make a balance between COD removal, treatment capacity and energy consumption 120 minutes is the optimized HRT for Fered-Fenton process. Chlorine gas generated at anode due to high concentrations of Cl^- ions formed hypochlorous acids (HClO) and hydrochloric acid (HCl) which could disinfect and diminish the disgusting odor of wastewater. Although the generated acids could oxidize organic matter, their oxidation power could not be compared with $OH^\bullet$ oxidation power. Halide ions like Cl^- ions in saline tannery wastewater act as the significant scavengers of $OH^\bullet$ but forming reactive halogen species (RHS). However, AOP treatment of saline wastewaters anticipated to be inefficient, RHS are also capable of oxidizing contaminants but react more selectively with electron-rich compounds. Besides, their oxidation power is also less than $OH^\bullet$ oxidation power. Moreover, it is predicted that poor-electron or electrophilic compounds like Formaldehyde and Azo-dyes that are common in tannery wastewater do not react with RHS and finally reduce the efficacy of the process. Hence, relatively low COD removal from saline tannery wastewater by employing Fered-Fenton process in comparison with other wastewaters those are not saline with employing Fenton process which is less effective than Fered-Fenton could be explained. Furthermore, Chlorine was removed (40%) under optimum conditions of COD removal by Fered-Fenton process that could be continued as long as the current was applied to the system. (Fig. 2).
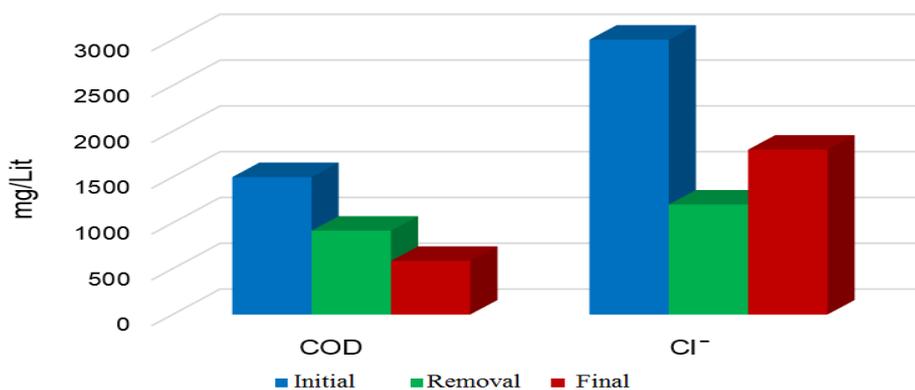

Fig. 2. COD and Chloride removal by applying Fered-Fenton method

4. Conclusion

In the present study, efficacy of Fered-Fenton as one of the advanced oxidation process for removal of organic loading (COD) and Chloride from saline tannery wastewater was investigated. Under optimized conditions for Fered-Fenton process including pH=3, $[Fe^{2+}]/[H_2O_2]=0.6$, H_2O_2 concentration 2260 mg/Lit, 0.8 Ampere for current and 120 minutes of hydraulic retention time COD and Chlorine removal were 61% and 40%, respectively. According to achieved results and observations, it could be concluded that, although considerable amounts of chloride as a key factor of salinity in tannery wastewater was eliminated, high concentrations of Cl^- ions in the tannery wastewater was restricting the effectiveness of COD removal by Fered-Fenton process.

Keywords: Chloride removal, COD removal, Fered-Fenton process, saline tannery wastewater treatment.

Comaring the Capability of Photocatalyst Nano Zinc Oxide Process by Two Slurry and Immobilized Methods in Dye Acid Orange 7 Removal

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Extended Abstract

1. Introduction

Daily, million liters of color wastewater are produced in different industries and cause environmental problems. The textile industry significantly affects the environment, producing high volume of wastewater from water and chemicals used in processes including sizing, washing, bleaching, dyeing, printing, and finishing. The wastewater contains salts, acid, or alkali, washing solvents, other chemicals, intermediates and residue dyes. In the presence of toxic colored substances in water light, the penetration of the waters lower layers fails and consequently the photosynthesis of water plants and the level of dissolved oxygen decreases. The result is the death of aquatic life. Dyes are stable compounds that are not easily biodegradable; especially Azo dyes which are considered to be carcinogens that pollute the surface and groundwater.

Generally, the physical, chemical and biological methods or a combination of them have been used for treating textile wastewater. These can be mentioned as membrane filtration, and ultrasonic waves, electrocoagulation, adsorption, Fenton, photo-Fenton, ion exchange, electrolysis, coagulation, conventional, and advanced oxidation and photo-catalytic process.

In recent years, the ability of advanced oxidation processes in treating various hazardous wastes has brought this technology to the forefront of research. Among advanced oxidation processes, application of heterogeneous photo-catalysis by using semiconductors has been proved to be real interest as an efficient tool for degrading both aquatic and atmospheric organic contaminants. Semiconductors are photo-reactive metal oxides to contaminants eradication that refer to photo-catalysts. These methods mineralize and converse pollutants into CO_2, H_2O and inorganic ions, by the action of hydroxyl radical, which acts as a nonselective and strong oxidant of organics.

Because of the excellent properties and wide applications of nanomaterials, in recent years researchers start to focus on the nano-zinc oxide granule size lies in the 1-100 nms. Because of having nanophase structure and char acteristics, it gets the surface effect and bulk effect and gains some special capabilities (on magnetism, light, electric and sensitivity etc.) and many new usages.

Photocatalytic reactors of water and wastewater treatment can be classified to slurry and immobilized systems. In the slurry reactors, the nano particles are freely dispersed in the water phase and consequently the photo-catalyst is fully integrated in the liquid mobile phase. Whereas the immobilized catalyst reactor designs features a catalyst anchored to a fixed support and dispersed on the stationary phase.

The mail aim of this study was to compare removal efficiency of acid orange 7, one of the high consumed textile dyes, in slurry and immobilized methods by using photocatalyst UV/ZnO process.

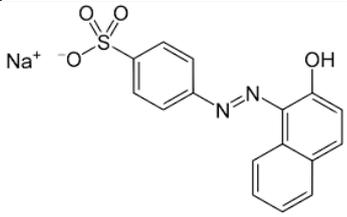### 2. Materials and Methods

In this study, after determination of the maximum absorption wavelength of acid orange 7 (Table 1), the initial experiments were done to determine the main role of photocatalyst process (Fig. 1). Then the effect of different amounts of dye concentration and catalyst, pH, irradiation power and energy consumption were investigated and optimized in both slurry and immobilized systems by changing one parameter and keeping the others constant.

The Water Sealer Method (WSM) was used to immobilize the nano ZnO powder on concrete surface (Fig.2). The process was begun by complete mixing of 100 mL of selected concrete sealer (colorless liquid) with
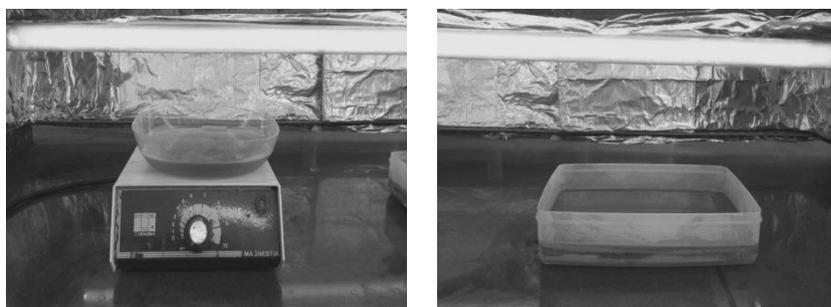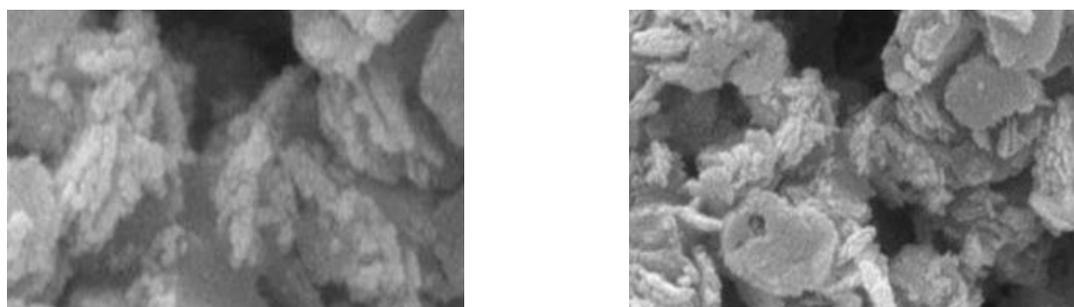
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measured amounts of ZnO. To the cured concrete surface of one reactor, 10 mL of 10% (by mass) ZnO sealer solution was prepared and put into ultrasonic cleaner (Fungilab UE-6SFD) for 5 min to ensure the complete separation of nano particles. Then, the solution was applied and allowed to be cured for at least 3 d.

Table 1. Characteristic of acid orange 7

Structure	
Formula	$C_{16}H_{11}N_2NaO_4S$
Molar mass	350.3243
λ_{max}	487 nm
Solution pH	3

Fig. 1. Slurry and immobilized photo-catalyst reactors

Fig. 2. SEM results of concrete surface after immobilization

According to the Beer Lambert law, by measuring the absorbance of samples at the maximum absorption wavelength of the dye (487 nm) in a spectrophotometer, dye concentration and removal rate (Eq. 1) were calculated, where CR was color removal efficiency (%), C_0 represented initial dye concentration, and C indicated instant dye concentration. In order to eliminate flocks errors, samples were filtered and centrifuged prior to placing them in the spectrophotometer.

$$CR = (C_0 - C)/C_0 \quad (1)$$

The main equipment used in this study include a Kern PLS 360-3 digital scale with 0.001 accuracy and Metrohm 691 pH meter. The amount of dye in solution was measured by using a Hach DR-4000 spectrophotometer at a wavelength of maximum absorption of acid orange 7 (485 nm) and the calibration curve of dye concentrations, respectively. All experiments were performed according to the method of analysis of water and wastewater and repeated at least 3 times.

3. Discussion and Results

In summary, acid orange 7 could be successfully degraded and mineralized by nanophotocatalysis in both slurry and immobilized ZnO nanoparticle photocatalytic reactors.

The experiments in optimum conditions in both slurry and immobilized methods were shown that in pH of 7

(Fig. 3), catalyst concentration of 80 gr/m^2 (10.32 gr/L) and 32 Watt UVc lamps, over 95% and 35% of 50 ppm dye (Fig. 4) was removed in slurry and immobilized methods, respectively. The amount of COD removal was higher in the slurry method (Table 2).
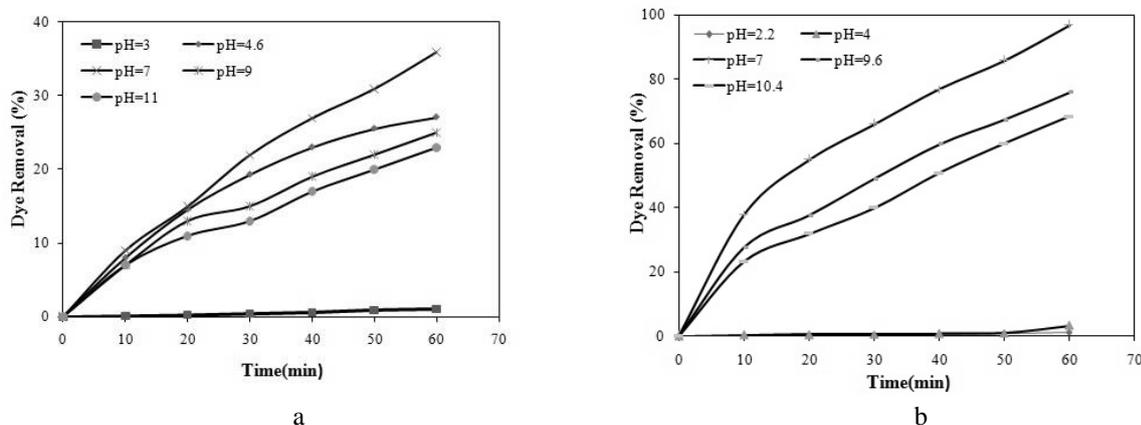

a   b

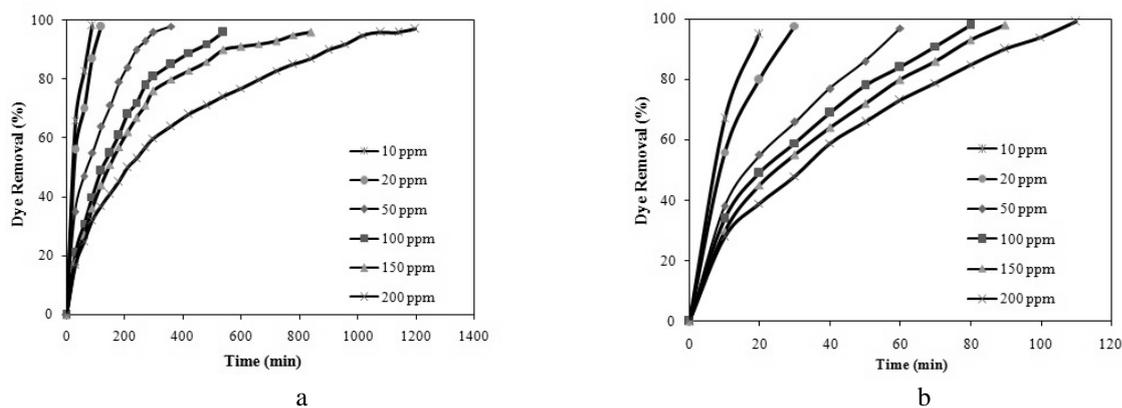**Fig. 3. Effect of pH a) Immobilized system, b) Slurry system**

a   b

Fig. 4. Effect of concentration a) Immobilized system, b) Slurry system

Table 2. Comparison of optimum conditions in the studied systems

Parameter	Slurry system	Immobilized system
Catalyst concetration	10.32 gr/L	80 gr/m^2
Dye concentration (ppm)	50	50
pH	7	7
Power (Watt)	32	32
Time	56	375
COD removal after 60 minutes	6	4
COD removal after 375 minutes	45	35

Keywords: COD, immobilized, photocatalytic, slurry.