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Thermal Comfort Evaluation in Urban Open Space
(Case Study: Chamran Street in Kermanshah)

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Expanded Abstract

Introduction

In Iran, there has not been much research and study on the effects of macro-scale climatic factors (especially in the cold climate and cold season); only a few studies on the mental senses of people in urban open spaces have been used in this climate. Therefore, in this paper, we try to investigate the factors affecting cold weather in the cold season in urban streets by examining the thermal comfort index (PMV) and introducing ways to balance the comfort with physical intervention.

Methodology

This study is carried out for typical winter conditions in Chamran Street in Kermanshah (34.19 N and 47.7 E), Iran. The climate of this city is cold and mountainous. In this article, February 11 was considered as one of the coldest days of the year (one of the most critical days of the year) to study.

The case study has width of 40 m with East-West orientation. The height of buildings is between 3 m and 39 m. The ground floor use of this street is mainly commercial and the major materials used in the facade of the buildings are stone and brick, on the floor of the mosaic and concrete; the middle street reflection are also stones. The shadow projection and the Calendar of Climate Needs for Kermanshah City show that there is a need of radiation in the coldest days of the year (from mid-October to March). Therefore, providing sunlight is very necessary. In April, you will need both radiation and shadows. In the months of May to September, shade is needed. Therefore, urban spaces should be designed in a way that meets the needs of people in all seasons.

Several tools were used to collect climatic parameters. In this study, we used an anemometer to measure the wind, and to measure the temperature humidity, humidity and spherical temperature from a multi-function data logger (Table 1). In order to measure physical parameters, the instruments were placed at a height of 1.5 m above the ground plane on a stack in the areas under study. The study area was selected according to the variation in the enclosure of several points to investigate and measure the climate parameters. All points were monitored at 5-minute intervals on February 11. Multi-function data logger measurements with 30 second intervals were automatically recorded from 9-17. Other measurements were done manually due to lack of data logger. This interval is chosen because the greatest number of people in the urban space occur at this interval. In this research, the model of the standard Ashrae 55 is used. This climate model is used to calculate and simulate climate variables in urban space with regular grids accuracy of 0.5 m to 10 m.

Discussion

Observations show that PMV has changed tremendous in comparison to the existent situation, and comfort zone has changed over the course of time, but T_{mrt} has not changed much. In the intervention, this article did not change much in the mean radiant temperature, but the thermal comfort index has changed considerably. As a result of decreasing a building with two feedback 3-meters and 4- meters in height, the PMV at 9 o'clock from a relatively cold zone to cold zone has reached to comfortable zone at 10-12 o'clock. Between 13 and 15, the most change is observed, with the PMV zone changing from very cold to cool and relatively cold.

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Therefore, based on the studies, conducted on the base of studies carried out, in the temperature at 45° to 56°, the street of Chamran is in the comfort zone. Therefore, the design of the spaces should be such as to obtain the highest amount of solar radiation, in order to improve the comfort of the spaces. Therefore, suggested in the future development plan of the city, it should be proposed in the South Front building, to feedback for buildings above 24 m because the best way to improve the comfort of Chamran Street in winter is having a 30-32° shadow angle, which PMV will have the best of situation.

Conclusions

Recent studies have shown the closure of urban canyons effects on the microclimate at the street level. In this study, Thermal Comfort in an Urban Street Cold Region Calculated wae used by physics parameters and evaluation personal variables. This study also had the goal to Calculated Thermal Comfort in an Urban Street Cold Region by software to be able to evaluate outdoor thermal perception. One of the output data of ENVI-met is the Predicted Mean Vote (PMV), a thermal comfort index based on a 7-point scale ranging from -3 to +3. This study has been examined techniques in responding sufficiently to the urban geometry characteristics, such as H/W ratio and SVF. So, by analyzing field survey and existent and proposed simulationm the following results were obtained:

1. To determine the effect of solar radiation on the amount of thermal comfort, the relationship between SVF and PMV is investigated in different locations where are analyzed. In the study area, sections have more opening (higher SVFs), more potential for solar access in winter, and this improves the comfort of people.

2. Based on the simulation carried out on the model, the desired intervention is affected by many changes in the climate and the thermal comfort of the outdoor space. The mean radiant temperature under the influence of some components is significant changes, including the vegetation added to the site designed to reduce the radiant temperature, which reduces the comfort of people during cold weather. So, reducing the height of high-rise buildings on the street can have an impact on improving the comfort of the street.

Keywords: ENVI-MET, Kermanshah, thermal comfort, outdoor space.

Estimation of the Economic Value of Non-Market Forest-Recreational Services of Perdanan in Piranshahr City, West Azerbaijan Province

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Expanded Abstract

Introduction

Evaluation is the first step in designating the importance of environmental districts and emphasizing their economic aspect. In this research, the economic value of Perdanan forest in Piranshahr city is estimated through two current methods of Contingent Valuation Method and Individual Travel Cost Method. The most significant functions of it are in the fields of aesthetic, entertainment, climate adjustment, wildlife habitat, protection of plant species, and flowage control, The goal of this evaluation is designating the importance of the protective and recreational functions of Perdanan forest and measuring the Revealed and Expressed Willingness to pay of the individuals and their effective factors in order to secure the functions of this jungle. Contingent valuation Method (CVM) is always facing with the probability that the individual pays less than his willed amount, due to the conjecture that proclaiming a specific payment might cause the actuality of payment, and as a result, a lower expected value might be estimated. Individual Travel Cost Method (ITCM) concentrates on the recreational use and neglects the protective and other functions; however, it has the advantage of using the real prices over CVM. In this method, no longer does the individual proclaim his Willingness to Pay (WTP), yet by utilizing a set of technics, his WTP is depicted by calculating the replacing prices. Consequently, employing and comparing both of the noted methods would result in more comprehensive outcomes and also reveal the differences of human behaviors in different markets.

Materials & Discussion

The data is gathered by distributing and completing 400 surveys throughout Piranshahr city and Perdanan districts during 1397/2018 spring and summer, which is an appropriate time for tourism. After further scrutiny, 24 surveys were omitted due to the outliers, therefore, the data analysis has been done with 376 surveys. With the resultant information, Logit Model, for reaching WTP function, and Zero-Truncated Negative Binomial Model (ZTNB), for reaching the Travel Demand function, has been estimated to obtain the economic value of Perdanan and the yearly value of the forest has been designated in different scenarios.

The resultant outcome of Logit Model shows that the variables of gender, marital status, household size, monthly income, and the yearly amount of visits to Perdanan are not statistically significant, yet the symbol of estimated coefficients shows that females, married people, those with larger households, with higher monthly income, and those who yearly travel more recurrently to Perdanan have had more WTP to secure the functions of Perdanan. Also, the most important explanatory variable in the model, meaning the bid variable has become significant and per 1000 Tomans of increasing the bid price, the probability of average acceptance lowers approximately 1.6%. The variables of education level, NGO membership, and locality are also significant with 99% certainty; so that it is expectable that with the increase of one unit of education level and change of status from non-NGO member to NGO member, the average probability of acceptance increases 8.1% and 31% and for each unit of change of status from non-local to local, the average probability of acceptance decreases 23%. Therefore, the most effective factors on the payment by individuals to secure functions of Perdanan are NGO membership, locality, education lever, and the suggested fee. Moreover, WTP per person per year in order to secure the functions of Perdanan is estimated around 68000 Tomans and the total yearly economic value of Perdanan under different scenarios is estimated in a range between 1.4 billion to 21.27 billion Tomans.

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The results of ZTNB model are also implying that the variables of household size, marital status, and gender are not statistically significant but the symbol of estimated coefficients of these variables suggests that people with larger household, married status, and male gender have had more recurrent travels to Perdanan. Nevertheless, the most important factor discussed in ITCM, i.e. the variable of travel costs, is statistically significant on the level of 99% certainty and per 1000 Tomans increase in the travel costs. The average probability of visiting Perdanan will decrease approximately 0.37%. Furthermore, the variables of locality, monthly income, and age are significant with a certainty of more than 99% and with one unit of change of status from non-local to local, the probability of the individual visit to Perdanan increases approximately 5.2% and with the increase of one unit in the individual age and 1000 Tomans monthly income, the probability of visiting Perdanan respectively decreases by 0.3% and increases 0.0074%. The most important factors in individual demand from Perdanan recreational site are, then, locality, travel costs, age, and individual monthly income. Using the estimated coefficients, individual consumer surplus per visit is estimated at about 53000 Tomans and total consumer surplus in different scenarios is estimated in the range from 4 billion to 60.47 billion Tomans. The resultant outcomes of both methods proved Perdanan forest peculiarly important for residents of Piranshahr and other visitors. Therefore, the authorities and the relevant organizations can utilize these outcomes in financing and efficient decision-making and possibly prioritize securing Perdanan. Moreover, according to the tourism potential of the aforementioned forest, they can help the local population increase their income by installing recreational and welfare facilities.

Results

Various outcomes result from this research can stand as a base of suggestions in efficient management and utilization of Perdanan forest, including:

1. The results of economic value estimation of Perdanan forest implies high value and importance of this forest. In year, this forest produces use value and non-use value caused by aesthetic, entertainment, climate adjustment, wildlife habitat, protection of plant species, and flowage control to an amount between 5.4 billion and 81.74 billion Tomans.

2. Each year many visits to Perdanan forest take place with average 3.64 visits per person per year that in light of individual consumer surplus of around 53000 Tomans per visit, each year each person pays approximately 0.19 million Tomans to travel to Perdanan, so he evaluates this forest according to this number.

3. Individual expressed WTP per visit is estimated about 18000 Tomans, which if multiplied in average car passengers (4 passengers) equals to 72000 Tomans per car, meaning that the passengers of each car that enters Perdanan site have sum WTP of 72000 Tomans.

4. If the amount of expressed WTP per year per person, i.e. 68000 Tomans, multiplies in the household size, WTP of each household to secure the functions of Perdanan functions will be about 340 thousand Tomans.

5. Investing activities should be devised together with securing the functions and the services of Perdanan and the development of its recreational aspect should not have negative effects on its other aspects. It is possible under the supervision of relevant organizations to prevent, with appropriate planning, visits more than Perdanan's capacities.

Keywords: conditional valuation, consumer surplus, foresters, travel cost, willingness to pay.

Assessment and Prioritization of Protected Areas Management Strategies in Hamadan Province

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Extended Abstract

Introduction

In this study, the protected area of Hamadan province was investigated and a four-stage decision-making method was used. In the defined model, SWOT analysis is used as the basis for environmental status analysis. Scenarios are analyzed by experts using the ANP method as one of a set of multi-criteria decision-making methods. The purpose of this study is to develop a systematic approach and identify, analyze and rank the proposed scenarios to enhance the potential of the protected area with an emphasis on its role as a key factor in the development of the western region of the country. Protected areas in regional development have been evaluated positively and based on multiple criteria (Mohammadi Deh Cheshme, 2014), Conflicts between key stakeholders that influence the development of protected areas and the management of those areas are a major obstacle to the development of areas in many countries (Coria & Calfucura, 2012). In order to achieve stakeholder collaboration and management of protected areas, a partnership is needed based on the achievement of shared goals (Ghorbani et al., 2015). The use of multi-criteria decision-making models clearly illustrates many of the indicators and risks of activities in protected areas. Risk ranking helps experts adopt policies and strategies to reduce risks (Malekhosseini, 2014). Risk factors include the destruction of protected areas. Identifying and assessing risks is an appropriate factor to deal with the crises ahead.

The environment as an important part of people's lives has attracted the attention of many experts and policymakers. In many countries, laws are in place to reduce activities that lead to pollution and environmental degradation and activities that cause irreparable environmental damage are forbidden (Qavam Abadi, 2013). In the meantime, attention to protected areas and wildlife sanctuaries seems necessary (Majnoonian, 1987).

Materials & Methods

Hamadan province is located in the west of Iran with an area of more than 19,000 km^2 (Fig. 1). Hamadan protected areas are a significant part of the western part of the country, well known for its natural diversity and historical values.
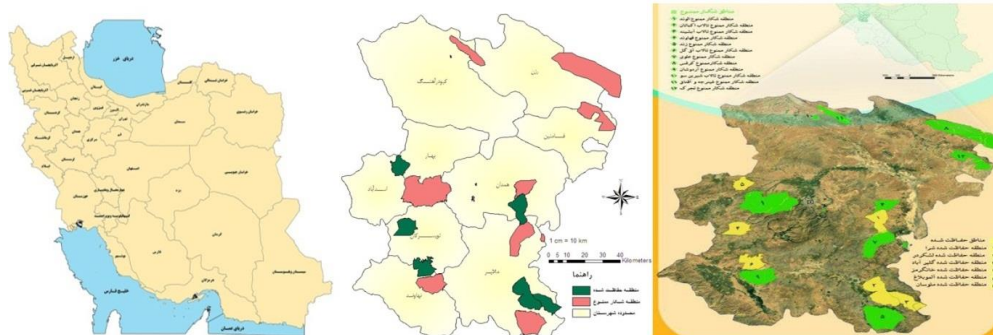

Fig. 1. Hamadan protected areas (Source: Hamadan Environmental Protection Agency)

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Management issues in protected areas need to be up taking into account community needs and economic and environmental principles and ensuring the utilization of all regional development capacity (Bulatović & Marković, 2015), through rational resource utilization, efficient allocation of revenues and assets and improved tourism.

Plan and develop the conditions of a region without considering all the internal and external stakeholders protected area is very difficult management and required to multi-disciplinary research on a wide range of issues. This set of factors depends on the development and implementation of clear and effective management strategies (Montasseri & Ashrafzadeh, 2016).

SWOT analysis is a tool for generating and ranking strategies in combination with multiple MCDMs, being significantly enhanced and significantly more applicable. In other words, combining strategy-based approaches such as SWOT with methods used to rank and analyze decisions enables the expert opinions to be shared with the public as well (Kheirkhah et al., 2014; Soltani-Zoghi & Sayyad Chamani, 2020). An integrated global model can be used to rank the proposed scenarios in realizing business prospects based on the integration of strategic goals and SWOT factors, using ANP for multipurpose decision making (Reihanian et al., 2012).

The ANP method is one of the multifunctional decision-making techniques widely used by experts in various fields, with the ANP as the best solution to define a network decision model to achieve predetermined goals in multiple models. The criterion is known (Hamidi et al., 2014). The environment, as an important part of people's lives, has attracted the attention of many experts and policymakers. In many countries, laws are in place to reduce activities that lead to pollution and environmental degradation and activities that cause irreparable environmental damage are forbidden (Qavam Abadi, 2013). In the meantime, attention to protected areas and wildlife sanctuaries seems necessary (Majnoonian, 1987). Also, the advantage of the ANP method over other methods is the ability to measure the relationships between clusters of network structure and the elements within them by adding potential interactions, interdependencies, and decision-system feedback (Sevkli et al., 2012). Protected area management often requires a multidisciplinary approach to the decision-making process. The decision-making process based on the combination of SWOT (strength, weakness, opportunity, and threat) analysis and network analysis (ANP) methods has been presented as a very useful tool in numerous surveys (Back et al., 2015). The main purpose of this study is to develop a strategic decision model that can be used to evaluate alternative scenarios against SWOT factors and strategic goals. The structure of the proposed approach comprises a network with the following clusters: 1. Outlook, 2. Strategic Goals, 3. SWOT Agents, 4. Suggested Scenarios (Soltani-Zoghi & Sayyad Chamani, 2020).

In order to generate priorities in the (proposed) scenarios, the multi-criteria analytical network decision-making process approach has been used in the study of protected areas. This study provides a model with the possibility of selecting the proposed scenario for achieving a defined perspective based on the interaction between the strategic goals and the SWOT sub-factors. Realizing the proposed approach, it is done through four steps: 1. identifying elements, 2. interacting criteria in the model, 3. comparing alternatives and sub-factors, 4. extensive analysis of ANP results.

Discussion of Results & Conclusions

Also to SWOT analysis, participants were asked to develop and analyze seven strategic objectives under consideration:
1. Conservation of biodiversity and cultural heritage;
2. Increase the level of employment and people's lives;
3. Reforming the social outlook on tourism and the economics of protected areas;
4. Development of small and medium enterprises;
5. Sustainable use of natural resources;
6. Promoting tourism and increasing the number of tourists;
7. Improving cooperation between the private and public sectors.

Based on the results of the study, four proposed conservation strategies being practically feasible were identified as proposed strategies.

The strategies examined are current status, sustainable development, industrial-economic development, and green protection. Reducing the tensions and disparities caused by the interaction between the tourism industry, visitors, the environment and society helps to preserve natural values in protected areas. The primary precondition appropriates rules and oversight of the planning and management of protected areas (Grošelj et al., 2015). Also, an important part of this strategy is in the form of educational activities on nature and cultural heritage aimed at raising awareness of all institutions in the region. The final ranking of the alternative scenarios in the last step of the proposed model was determined by a general analysis of the results of the previous step using the ANP method. The results are presented in Table 1. According to Table 1, it can be deduced that the

current situation is the last option backed by experts. The experts do not see the current situation as favorable and believe that the conditions should continue to change and improve strategies.

Table 1. Alternative ranking priority options

	Priority	Ranking
Current status	0.141	4
Sustainable development	0.332	1
Green conservation	0.239	3
Development of industrial-economic structure	0.288	2

Overall the analysis shows a feasible and reasonable alternative to protected areas management to replace the "Sustainable Development" option with the one currently in place to have a positive impact on regional development focusing on tourism. Green conservation is the second alternative that emphasizes environmental protection but does not focus on the economic development of the region.

The intensity of environmental protection is very important. Development of industrial-economic structure affects short-term economic growth, but it does not emphasize environmental protection whereas protecting natural areas needs to meet the needs of the next generation. Existing status is rated as the last option in the list of available scenarios and this indicates the existing inefficient status because the weaknesses on which the model is based exist in the same conditions and have been very traumatic.

SWOT analysis presents the strategic goals of sustainable development to tourism as the only possible and rational strategy for managing protected areas of Hamadan province.

Based on the results, the proposed landscape to protecte areas represents an appropriate decision-making tool and provides a viable framework for sustainable development of the region among other protected areas.

According to the results, to make the most of the concept of sustainable development, there is a need of fundamental reform in various sectors. In the education section, it is recommended to add curricula to the concept of protected areas and wildlife shelters. In the legal sector, the laws move towards stricter laws on harvesting, infestation and hunting and construction.

In the organizational sector, the environmental organization needs to review and receive a higher financial budget to counteract the activity of other organs. Environmental tourism tours have received more financial support to attract more people to the area and become familiar with the area. By sending environmental advocacy groups to inform residents and stakeholders of the area of their mutual rights and the environment and how to deal with the environment properly.

Modeling the Risk Possibility of Trees with Artificial Neural Network and Logistic Regression Application in Urben Green Space

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Expanded Abstract

Introduction

Urban green space plays an important role in city functioning and its lacking can lead to city life disruption. Urban green space trees include a wide range of environmental, aesthetic, social, physiological and economic benefits. Tree falling due to various factors, especially storms and high-speed winds, can cause severe economic damage, even endangers public health and safety, which is very important due to their widespread presence, especially in the urban areas. It is attracted by municipal green space and urban crisis management to identify and quantify the severity of the hazardous trees and only can provide risk management and suitable preventive measures.

Hazardous trees refers to absolutely dried or drying trees, dead components or highly unstable living trees that may be come from structural damage or other factors. These trees pose to a high risk of threatening citizen lives or their property in the urban environment. Normally, healthy trees are more resistant to applied forces and damaged while defective trees are more prone to fracture and eradication in the crown, trunk and root. Hazardous trees management inspects tree risks in the natural and synthetic green space by modeling the behavior and measuring tree conditions in the urban green space.

There are several ways to correlate the quantitative and qualitative variables (defects) of trees with their probability of tree hazardous, including artificial neural networks and multivariate regression that have less constraints and assumptions than statistical methods for modeling process. The purpose of logistic regression is describing the relationships between quantitative and qualitative variables as a set of independent variables and risk intensity as a dependent variable. This model maximizes the probability of an event will occur and does not necessarily have a linear relationship between the independent and dependent variables. The neural network model is able to detect the relationship between a set of inputs and output data to predict the output corresponding to arbitrary inputs regardless of the parameters.

Recently, studies have been performed on the risk possibility of the trees. Elm tree (*Ulmuscarpinifolia var. Umbelifera*) belongs to the family Ulmaceae. This genus has various species that are distributed in most parts of the world, especially in Asia, Europe and North America. These trees have relatively dense distribution in the natural forests of Iran, especially the northern and southern slopes of Alborz. They are also used in the most urban green spaces due to their beautiful appearance and wide shade as an ornamental and shaded tree. According to available information, in our country, despite the great extent of the urban green space and its importance and the need to be aware of street tree dangers that pose to a high risk to the life-threatening safety of citizens or their property, on the other hand, there has been limited applied research to predict the risk possibility of the fallen trees. Therefore, this study aimed to determine the most important independent quantitative and qualitative variables affecting the probability of falling trees and developing multilayer perceptron neural network models and logistic regression to predict the probability of falling of elm hazardous trees and also to compare these two models in predicting the probability of falling in a tree in Shariati, Shahrekord.

Material and Methods

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The study area is located in Chaharmahal anf Bakhtiari province, Shahrekord, between 49 degrees and 22 minutes to 50 degrees and 49 minutes and latitude 32 degrees and 20 minutes to 33 degrees and 31 minutes, respectively. The study area was a part of Shariati Boulevard between Basij Square and the intersection of North Ferdowsi Street with a length of 584.13 m. In order to compare the ability of neural network model with logistic regression to predict the risk possibility of elm trees, the study was performed on 129 elm trees in Shariati St. Boulevard. For this purpose, the variables including tree diameter, tree height, dry branches and woods, cracks, structural and physical weakness (vertical deviation), root and wound and root problems as independent. Quantitative and qualitative variables were classified and the risk classification of elm trees were measured as dependent variables. A complete survey method used to measure and record the quantitative and qualitative variables of elm trees on both sides of the street.

First, Normalization of the data was performed and then Principal Component Analysis was used to select the main variables.

If KMO (Kaiser-Meyer-Olkin) index is less than 0.5, the data is not suitable for principal factor analysis and if the value is between 0.5 and 0.69, it should be used with higher caution. Also, this method used for binary logistic regression models that is a step-by-step method bring included in the model. By choosing this method, it is possible to isolate significant independent variables related to the probability of elm falling trees (dependent variable). In this study, 70%, 15% and 15% of the total data were allocated to multi-layer perceptron network training, validation and testing, respectively. Qualitative and quantitative variables are considered as input variables and dependent variable of risk intensity class in each tree as output. In order to predict neural network model for prediction of the risk of hazardous elm tree two hazard severity classes were used based on weighting method. According to general approximation theorem, a neural network with a hidden layer and a sufficient number of neurons per layer can approximate any arbitrary continuous function. This study aimed to train neural network from Multilayer Perceptron network of artificial neural networks. Neural network training was used with learning rate reduction 10 (BDLRF). The activity functions in the hidden layers for all networks were considered as sigmoid function and in the output layer linear transfer function. Accordingly, multilayer perceptron network with 5 neurons in input layer, one hidden layer with 20 neurons and one neuron in output layer were used to modeling the risk possibility of elm trees. Surface area under ROC curve and Kappa curve were used to evaluate model prediction accuracy.

Results and Discussion

Results showed that three criteria for branches, root and trunk problems were 87%, 79% and 77%, respectively, and criteria for contact with power lines had the least rate (29%) in the risk of elm trees. Regarding the analysis of principal components tree height, tree diameter, dried branches, structural status or physical weakness (vertical deviation), root problems and advanced decay are the most important variables affecting logistic regression and neural network models. Logistic regression results indicated that with 65.9% confidence including five independent variables of tree height, tree diameter, branch and dried branches, structural weakness or physical weakness, advanced decay are predictor variables in probability of tree falling in the present study. The results of the NIMBUS tests to exam the model's explanatory power and efficiency show that the fit of the model is acceptable at the error level of less than 0.01. Independent variables used have moderate explanatory power regarding variance and variations dependent on the probability of falling trees. In fact, these variables were able to explain between 0.33 to 0.456% of tree fall variations. Hosmer-Lamshow fitting statistics showed that the fit of the prediction of the dependent variable changes at the level of less than 0.01 is not significant and the model was not appropriate and did not have the required fit, which means that independent variables cannot predict the dependent variable changes.

In logistic regression model, the independent variables of status and structural or physical weakness (vertical deviation) and advanced decay introduced in the regression analysis are able to predict dependent variables (healthy trees and hazardous trees) and their predictive ability at 0.01 is significant. On the other hand, tree diameter has the highest probability of falling tree. In this model, the area under the curve (AUC) in the ROC curve for elm trees is 0.855. The results show that logistic regression model is able to predict the probability of falling trees. Kappa coefficient was 0.492 and 0.01, which is significant for elm trees. In neural network model, a network with five inputs, twenty neurons in the hidden layer, and one output, gave the best results for predicting the probability of falling trees. Correlation coefficient (R) between experimental data and neural network model for training, validation, evaluation and finally all data were 0.827, 0.768, 0.614 and 0.783, respectively. Mean error squares (MSEs) for training, testing and evaluation were calculated 0.055, 0.136 and 0.226, respectively. In this model, the area under the ROC curve for elm trees is 0.953. The results show that the model is capable of predicting the probability of falling trees. Also, the kappa coefficient was 0.775 and at 0.01 error level significant for Elm trees.

Conclusion

Diagnostic criteria for hazardous trees showed that three criteria of dried branches, root problems and trunk cracks had the highest rate in the risk possibility of elm trees. Using the principal component analysis reduced the number of input variables to the models. It also eliminated the correlation between the input variables to the model and easier interpretation of the models. According to this analysis, the variables of tree height, tree diameter, twigs and branches, structural or physical weakness (vertical deviation), root problems and advanced rot were identified as the most important variables. Therefore, two criteria for woods and shoots and root problems in both analyzes are selected the most important variables.

The correlation coefficients, Rock and Kappa index in the ANN model are higher than the logistic regression model and close to 1, which shows the high capability of the neural network model with the LevenbergMarcoat training algorithm than the logistic regression model. Using neural network model without performing complex nonlinear equations, lead to dynamics of system, and thus, the model outputs can be predicted. By choosing the right type of learning technique, the appropriate number of hidden layers and neurons, as well as the type and number of input variables and their appropriate calibration, the ANN is a very efficient tool to predict the probability of falling trees. Results of the present study suggested that the artificial neural network model is an appropriate way to predict the risk possibility of trees and is a tool for researchers, urban green space managers and relevant experts to know the risk of falling trees as well as to take preventive and control measures to reduce the risk of falling trees.

Keywords: danger diagnostic criteria, Kappa index, principal components analysis, receiver operating characteristic.

Application of Ecosystem Services in Life Cycle Assessment Using TES_LCA
Case Study: Faraz Firoozkooh Cement Factory

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Expanded Abstract

Introduction

During the last decades, Iran's economic development has been pursued, while insufficient attention was paid to environmental necessities. This has led to irreparable environmental damage.

Currently the Life Cycle Assessment (LCA) is among the most prevalent methods of designing and evaluating sustainable systems. This method favors options with less environmental impact. However, it doesn't measure the available ecological carrying capacity for controlling these effects. This can lead to a choice in services and goods which affects endangered ecosystems adversely. Therefore, absolute sustainability metrics, require defining ecological service roles and ecological carrying capacities. Current endeavors for utilizing ecosystem services in sustainable decision making include connection of Ecosystem Services (ES) and LCAs which divide the global scope into smaller scopes, thus utilizing the ecological carrying capacity data for indicating certain factors.

Ecosystem services include services, conditions and processes which through them, natural ecosystems and species enable the continuance and sustainability of human life. Ecosystem services are the services human beings receive from ecosystems which include logistical, regulatory and cultural services that directly affect people. Also, support services which are required for maintenance of other services are included in this category. Over the past three decades, ecosystem services have found prevalence in policymaking and academic circles. The constant approach towards land evaluation has led to interest in adapting this interdisciplinary concept. Human societies receive basic and essential products and benefits from natural ecosystems. The fact that these services enable the progress of civilization was neglected until recent times. These services are provided through complex natural cycles which involve solar power in different sequential and spatial cycles. Currently, there is an increasing interest in comprehending ecosystem services, as a step towards sustainable utilization of natural resources.

Methods and Materials

Initially, the general aspects and research background were performed through library research and collecting documents and published scientific papers through scientific websites specializing in the field. Thus, the various relevant aspects and concepts were examined thoroughly as well. This study undergoes through an applied approach. The study area is observed and evaluated through a life cycle assessment at the site of the Firoozkuh cement plant. The TES-LCA model is applied for evaluating LCA. Therefore, this study identifies ecosystems and ecosystem services and their roles in LCA and evaluation of absolute sustainability and environmental sustainability. The study tries to offer policy-planners and investors assistance in order to better direct their plans, too. Sima-Pro software is used in this study.

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LCA has enabled a broader assessment of environmental impacts beyond the narrow scope of traditional engineering practices. Environmental sustainability requires provision of ecosystem goods and services to support human activities. The conventional LCA does not consider the role of nature in the process. This study provides a method for Techno-Ecological Synergy in LCA which is called TES_LCA.

TEC_LCA method

Human activities are dependent on ecosystem goods and services. However, intensive human activity has led to negative effects on the ecosystem which reduce environmental sustainability. There are certain methods for sustainable environmental decision making, which all require that the services demanded from the ecosystem shouldn't exceed the ecological capacity. The ecological efficiency must increase while the environmental impacts on nature reduces. If the ecosystem's capacity is ignored while it offers services, the demand of services may exceed its capacity and lead to the break-up of the ecosystem.

To tackle these problems, methods are required which measure the absolute ecosystem sustainability by considering supply and demand. TES_LCA is one of the methods devised by Bakshi et al. (2015). TES_LCA offers ecosystem services required by technological systems through selecting spatial scopes. The TES_LCA is developed from the conventional LCA by modifying it. This includes the role of the ecosystem and ecosystem services and also the interdependency between technological systems and environments. This method identifies opportunities to enhance a lifecycle by decreasing its impacts and saving and preserving ecosystems and includes four steps:
1. Goal and scope definition
2. Inventory analysis
3. Impact assessment
4. Analysis and Interpretation

Discussion and Results

The current research, applied ecosystem services to assess the life cycle of Faraz Firoozkuh Cement production plant located in Firoozkuh through the TES_LCA method. However, this must be performed in several scopes and software. Many researchers and environmentalists in Iran and abroad have performed numerous studies but this research is unique in aspects of case study and software.

Conclusion

- Clinker is the main substance in cement production which impacts the environment most of all. Second to clinker, cement factory construction itself, has the most negative environmental impacts such as a decrease in minerals, fuels and emissions, renewables and water contamination.
- Scenario No.1 indicates that cancerous and non-cancerous human poisoning are paramount to other environmental issues. Next comes freshwater contamination and global warming.
- During the power generation stage, ozone layer depletion and acidification are significant environmental hazards
- Scenario 2, in a similar manner to scenario 1, indicates that cancerous and non-cancerous human poisoning are principal to other environmental issues. Next comes freshwater contamination and global warming again.
- The normalization of assessments in Scenario 3, also shows that cancerous and non-cancerous human poisoning are paramount to other environmental issues. Next comes freshwater contamination and global warming as well.
- Eventually Scenario 3 indicates that ecosystem services have a positive effect on environmental impacts such as global warming, dust production, air pollutive particles, oxidation, acidification and fresh water eutrophication and mineralization.
- Finally, Scenario 4 also shows that ecosystem services have a positive effect on environmental impacts such as global warming, dust production, air pollutive particles, oxidation, acidification and fresh water eutrophication and mineralization.
- Faraz Firoozkuh Cement production plant which produces Pozzolan cement has less severe environmental impacts than a Portland cement production plant.

An Integrated Framework Model for the Analysis of Sustainability in the Agriculture Water System (Case Study: Jiroft plain- Kerman)

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Expended Abstract

Introduction

Groundwater depletion is one of the main factors that determine the sustainability management of the groundwater. Recently, it has become a significant debated topic, particularly for food production in agricultural ecosystem of arid regions.

Numerous groundwater scholars have tried to estimate the results and causes and of groundwater decline, and have shown that groundwater is being used at rates exceeding the natural rates of recharge, globally. Both climate change and excessive extraction, for irrigation, were responsible for groundwater level decline. In this study, groundwater depletion and its dynamic factors including agricultural activity and metrological drought indexes were investigated in the Jiroft plain- south of Kerman.

Material and Methods

The present study with an integrated approach investigated the groundwater level's change using statistical methods. In other to determine the role of agriculture activity on the groundwater level, the performance of the selected crop was determined. The main criteria for the selected crop were the highest area under cultivation. Selected crops were including wheat, barley, corn, watermelon, cucumber, potato, and onion. In the next virtual water of selected crops, based on blue and green water, were calculated. On the other side, to determine the role of drought the parameter in reducing groundwater level 6 meteorological indicators of SPI, RAI, DI, ZSI, CZI and, MCZI were examined in a ten-year period by using RDIT software.

Results

The results of this study show one-meter depletion in groundwater levels each year (Fig. 1). The results of virtual water offer the production and export of agricultural products with low economic value.

Drought indicators are the most widespread years of severe drought related to the years 1990, 2000, 2010 and 2020 (Fig. 2). In other years, there is a moderate but frequent drought due to the dry nature and low rainfall in the region, and in rare cases, it has faced a situation other than drought.

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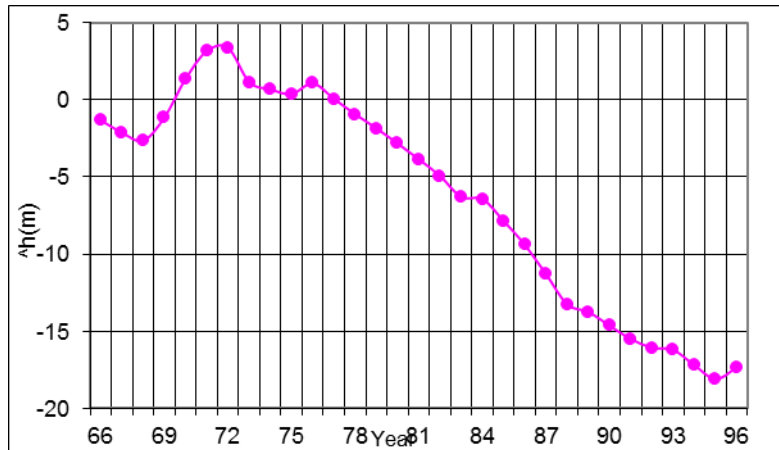
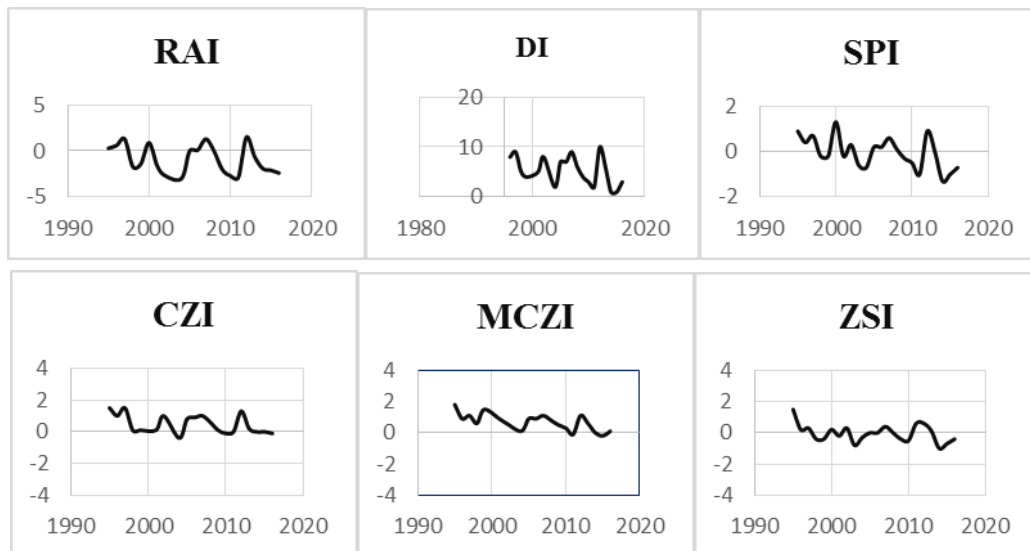Fig. 1. Trend of groundwater level in the Jiroft plain

Fig. 2. Status of the study area in terms of meteorological drought indicators

The results showed that among the selected crops with the highest level of cultivation in the study area, wheat, and barley with 2621 and 2079 (m^3/kg) had the highest amount of virtual water consumption. It is also worth mentioning that products such as watermelon need an average of 314 (M^3/kg) of green and blue virtual water. These results mentioned the trend of agricultural activity moved to low-value crops with the high water demand that has the largest share of exports.

Conclusion

This study revealed that human activities have strong influence on the groundwater decline, while the effect of metrological drought was insignificant. Results from driving force analysis indicated that agriculture activity was the primary factor and temperature and precipitation could be used as positive criteria for groundwater recharge. Therefore, the problem of groundwater in the agricultural ecosystems is serious and needs to be highly valued. Modern management of farms with crops by less water and produce more could also be effective for water-saving. Also, it is crucial to raise the awareness of farmers regarding water-saving.

Keywords: groundwater level, metrological drought, Jiroft plain, virtual water.

The Fundamental Characteristics of the Rural Landscape through Application of Grounded Theory (Case Study: Historic Village of Furg)

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Expanded Abstract

Introduction

Over a long period, rural landscape has been established by the relationship between nature and humans. Landscapes are recognized as a part of the natural, historical, cultural, and scientific heritage. The rural landscape patterns are particular contexts because of having cultural characteristics. Humans have survived by gathering wood and grass for fertilizer, fuel, fishing in the rivers, creating agricultural fields, burning woodlands and construction materials. They expanded the agricultural fields by managing water and rural forests serve as the sink of resources used by humans for daily life and agriculture.

Nowadays, people do not need organic fertilizer and housing materials as before. As local residents in rural areas tend to use modern technology, preservation of cultural values and natural attractions should not be underestimated, so many criteria must be considered in order to achieve sustainability.

The rural landscapes are particular due to cultural characteristics. The definition of landscape can be identified as an area where is the result of nature and human interaction. The rural landscapes are particular due to cultural characteristics. As local residents in rural areas tend to use modern technology, preservation of cultural values and natural attractions should not be underestimated.

In rural contexts, primary activities such as agriculture and forestry are no longer the only ones that influence landscape structures. Some rural areas have potential value due to outstanding nature and unique landscape; While soil fertility and the capacity to produce goods were the basis of landscape appreciation in the past, it is now aesthetic, environmental, and heritage qualities which make landscapes appreciable.

Human manipulations of the nature which are basically due to socio-economic development have been on the rise in the world since the industrial revolution. These have affected the rural ecosystem entity, by decreasing biodiversity, destroying amenities, and so on. While local residents in rural areas tend to use modern technology and development, preservation of traditions and cultural values, use of local materials and methods of building and conserving the natural attraction points should be highly emphasized.

Materials & Methods

This research was done by describing the process of developing a methodology to investigate the fundamental characteristics of the rural landscape in historic village "Furg". It is vital to study those areas where have undergone the least changes in order to refrain further unnecessarily changes and retain sustainability in both cultural and constructional sectors.

Furg is a village in Darmian Rural District, in the central district of Darmian county, south Khorasan province, Iran. Furg Castle is located on the north side of the village at an altitude of 1840 m on the edge of the heights of Darmian Valley leading to Asadiyeh plain. It has a good strategic situation, because it has a commanding view of the entire village, farms and roads around its eastern region.

The researcher documented the process and illustrated an individual's search for the method that would suit the research problem. Some qualitative researchers believe that in-depth qualitative research is especially well suited for revealing higher-level concepts and theories that are not unique to a particular participant or setting.

The "grounded theory" and "participant observation" are the qualitative methods that particularly suited to the areas of rural social research. Grounded theory is an analytic method to construct theories from inductive qualitative data. Data collection and analysis inform each other in an iterative process as researchers developing their idea. It has been done with Memo-writing and theoretical sampling; Memo writing to elaborate categories,

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specify their properties, define relationships between categories and identify gaps. The new features enhance the brief sections headed by clear section headings.

Discussion & Results

This research reviews the backgrounds and meanings of fundamental of landscape characteristics in Furg.

The rural landscapes have become a space with different functions from those of past. There are many criteria which must be considered in order to achieve sustainability; such as specific cultural backgrounds, which have influenced on the settlement patterns of regions and countries. The main driving force in landscape change is the human impact on rural landscapes. The changes in agricultural systems and socio-economic environments in rural landscapes, have led to changes in rural ecosystems.

As a result, human activities in the areas create special features in rural landscape. The research analyzed the rural landscape and finally indicates the main characteristics that shape the unique landscape of Furg village; and shows that the landscape is seen here as symbols of these backgrounds.

The nature and the special manner of lives have reduced the possibility of cultural interference; as a result it keeps their old customs and traditions. Thus, unlike other countrys' rural areas, they did not replace the building materials.

The results show that Furg's rural landscape is based on characteristic features including "homogeneity of village texture with context", "rise of architectural pattern by land and climate form", "lack of diversity of agricultural perspective", "overcome beliefs and opinions on the development of the rural landscape" and "security-based development perspective and their influence on rural landscape".

Conclusions

Each part of the landscape has its distinctive character, which offers a unique sense of place. Current condition of a landscape can be a reliable indicator of future trends and areas in need of further attention. The economy of rural areas has always been strongly dependent on natural resources exploitation.

In recent years, the lifestyles of most people in rural areas have changed due to modern technology. Recent technological advancements in exploitation, loss of rural livelihood, and increased social demand for the amenity aspects of these resources have dramatically changed rural landscape and visual quality. The cultural change has affected the form and appearance of villages. Many villagers have left to bigger towns and cities. The main issue is that changes are growing very rapidly.

Furg has maintained its original architecture, traditional customs and the language. They have barely changed due to the isolated location of the village. This study calls for further research to establish stronger links between sustainable landscape theories and rural sustainability. Despite the limitations, we believe this framework is a useful approach to rural landscape sustainability.

Capacitive Deionization and Disinfection of Water Using Graphene Oxide-Dendrimer-Ag Electrodes

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Extended abstract

Introduction

With population growth, industrial development, and increased pollution of freshwater sources, access to adequate and safe water and become a crisis in some countries. Most of currently in use water disinfectants are not fully effective in destroying pathogenic microorganisms in drinking water, or they may produce side products that are harmful to human health. Also, some of these disinfectants are toxic.

Today, finding special methods with high efficiency, appropriate cost, and impact on the wide range of pathogenic bacteria, have been highlighted because of resistant microbial contamination of conventional treatments, as well as other disadvantages of existing disinfection methods. At present, nanoscale with a multi-purpose antibacterial potential has created hopes of solving the problem of drug-resistant bacteria.

Silver is one of the most effective antibiotics known in human history and can destroy more than 650 different bacteria in few minutes, and have been used in antimicrobial applications since the 19th century. Despite the good antibacterial property of silver, silver nanoparticles due to its surface properties and photocatalytic properties can facilitate oxidative damage to nearby cells, and also have remarkable bio-toxic activity due to the sustained release of Ag+. A solution to prevent the release of silver nanoparticles and silver ions into the water was found to utilize the antimicrobial properties of nano silver.

A new method of antimicrobial agents is to place an antimicrobial agent on the surface of carriers, such as graphene oxide, activated carbon and composite formation. Graphene oxide, has been a good selection for composite materials. GO contains two-dimensional materials composed of carbon atoms in a crystal honeycomb grid. GO, and composites of GO using chemical and physical mechanisms have been reported to have antibacterial properties.

Also, researchers have shown that due to the synergistic effect of silver nanoparticles and graphene oxide, the combination of these two substances has a better antibacterial effect.

Despite the antimicrobial properties of GO-Ag nanocomposite, due to the nanoscale thickness of these materials, GO-Ag nanocomposite is stable in water, and it is not possible to remove it from drinking water with conventional methods. Therefore, for the use of GO-Ag nanocomposites to disinfect drinking water, a method should be used to stabilize these substances and prevent them from releasing and suspending in water.

Capacitive deionization (CDI) technology is a method for removing ions from brackish water with active carbon electrodes. The overall efficiency of CDI system depends on the surface properties of the electrode, such as the specific surface area, the distribution and porosity size, the absorption characteristics and the main chemical groups at the electrode surface. The good results of a capacitive deionization system in water desalination have the potential to use this system for the removal of organic matter, microbial agents, and other water

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contaminants. The capacitive deionization process is a continuous flow process, which is performed by ion absorption and ion desorption alternating cycle, to remove ions from water and regeneration stage, respectively which is applied to a direct voltage.

Due to the low energy consumption (2 V), good regeneration ability, and Non-use of chemicals at different stages of desalination, the CDI system has been considered. The CDI technology with enhanced and improved electrodes can be a good solution of disinfecting and desalination water.

In this research, a new coating of graphene oxide dendrimer silver on the activated carbon electrodes was introduced for high desalination and disinfection capacity of water by a capacitive deionization-disinfection system.

Materials and Methods

Graphene oxide (GO), Activated carbon (AC), hydrochloric acid (HCL), Sodium hydroxide (NaOH), Epichlorohydrin (C_3H_5ClO), Sodium borohydride ($NaBH_4$), Sodium Sulfide (Na_2S), sodium acetate (CH_3COONa), silver nitrate ($AgNO_3$) were supplied from Merck Co, Germany.

Method
- Dendrimer grafting on the graphene oxide (GO-D)
- Preparation of silver nanoparticle
- Nanocomposite CDID Electrode Fabrication
- Measurements and characterizations

FTIR, TGA, FE-SEM/EDS
- Initial solution preparation

NaCl solutions with different TDS (1000 to 20000 mg/ L)

Initial MPN of coliform (1000, 5000, 10000 and 100000 MPN)

Results and Discussion

Effect of initial TDS and contact time

Nacl solution at concentrations of 1000, 1500, 5000 and 20,000 mg/l was tested for a 5 to 90 minutes' contact time to determine the deionization ability of the water. To compare the salt solution and the actual sample of water, Caspian Sea water was tested with a TDS of 20000 mg/l. Experimental results show that the system has high capability of deionizing water.

Also, to determine the simultaneous deionization and disinfection capability, NaCl solution with concentrations of 500, 1000, 1500 mg/l and 5000 mg/l was tested with 10000 MPN of initial coliform and 15 to 60 minutes' contact time to determine the impact of TDS on coliform removal. Experimental results showed that the system had ability of removing 80% of water salinity simultaneously with water disinfection.

Effect of initial coliform

One of the parameters in the evaluation of the disinfection activity has been initial coliform. For this purpose, various coliforms (500, 1000, 10000 and 100000 MPN) were tested in NaCl solution 500 mg/l, 30 and 60 minutes' contact time. Killing rate of coliform in the initial 500 and 1000 MPN was 99.9% at 30 minutes. This retention time was similar to the time required for disinfection in the conventional chlorination system in water treatment plant but without the use of chemicals for disinfection and remaining by product in disinfected water. It also had the ability to remove 99.9% of 10000 MPN in 60 minutes.

Conclusion

GO-D-AG is a new nanocomposite, synthesized from graphene oxide with a new generation of dendrimers, with silver nanoparticles on branches, to make new electrodes for CDID system. A thin layer of GO-D-Ag nanocomposite will be located on the surface of carbon electrodes.

Due to the covalent bonding between dendrimer and graphene oxide and the strong complexation between sulfur and silver nanoparticles in the branches, this system is a safe solution for the use of silver nanoparticles in water disinfection.

The amount of nanoparticles used in the electrodes had a great effect on the disinfection property of the capacitive deionization system. Contact time was also an effective factor in reducing coliform from water. Experiments were evaluated for 15 to 120 minutes on contaminated water with coliform content of 1000 to 100000 MPN. This electrode had a disinfection effect of at least 99.9% (4 Log Reduction of coliform) and 90% (5 Log Reduction of coliform) with 60-minute contact time and completely removed 100000 MPN of coliform in

120-minute contact time. Experiments have shown that these electrodes were capable of disinfecting water at salinity levels up to 5000 mg/l, whereas in the previous research, only disinfection at 200 mg/l was performed by CDI system. Disinfection by this CDID system with the new generation of the electrode can be an excellent alternative to traditional disinfection processes because it had low energy consumption (2 V uses for disinfection), quick and useful regeneration, and disinfection without any byproduct.

Keywords: CDI, dendrimer, disinfection, silver nanoparticle.

Experimental Study on the Transport and Distribution of Carbon Monoxide in Indoor Spaces

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Extended abstract

Introduction

Increases in the world population and changes in the pattern of urban life together with the countless sources of air pollutants in semi-closed spaces have changed the air space of our cities into a hostile environment. Therefore, the problem of air pollution is not only limited to the outdoor environment but also became a real problem in indoor spaces. In modern cities, people spend 70-90 percent of their time in indoor spaces and their activities are limited more to these environments. Carbon monoxide is one of the most dangerous gaseous pollutants in the buildings with both residential and industrial operations that are frequently reported to cause diseases and death.

Carbon Monoxide (CO) is a colorless, odorless, and tasteless flammable gas that is slightly positively buoyant compare to air. Carbon monoxide is produced from the partial oxidation or burning of fossil fuel (coals, oil, and natural gas) or any other carbon-containing compounds. CO can build up indoor spaces and poison people and whoever (animals and plants) breathe it. Poisoning due to Carbon monoxide is a common type of fatal air poisoning reported around the world. The most common symptoms of CO poisoning are headache, dizziness, weakness, upset stomach, vomiting, chest pain, and confusion. Many researchers such as Sykes and Walker (2016) and Levy (2015) have investigated the health effects and the risk of CO poisoning on resident safety and peace. Various concentration of CO is found in fumes produced by burning fuel in workshop buildings and Industrial Units. It is ranged from 2-5 percent (20,000-50,000 ppm) and can cause long-term health problems to workers who breathe it. Various health organizations have established the Carbon Monoxide (CO) concentration limits. ASHRAE sets outdoor maximum levels at 35 ppm (1 hour averaging) and 9 ppm (8 hour averaging), while the World Health Organization limits CO concentrations based on exposure time ranging from 90 ppm (15-minute exposure) to 10 ppm (8-hour exposure). The ASHRAE indoor's maximum concentration limits for CO in industrial units is 50 ppm (8 hour averaging), which is usually hard to meet in place works and workshops. Harmful health effects of carbon monoxide make it essential to be able to predict the behavior of flow in indoor spaces for the successful implementation of any mitigation measures. Natural or forced ventilation is the simplest way to reach acceptable indoor air quality standards. Numerical and experimental models are common tools to predict the behavior of airflow in indoor and outdoor spaces. Experimental works also by providing a benchmark for the calibration of the numerical works and by developing the empirical equations for the prediction of flow patterns are commonly used to define airflow in indoor spaces. Modeling of airflow through the simulations of flow in the water tank has rarely been investigated. Chen et al. (2010) used a water tank and LIF technique to simulate contaminant distribution inside an airliner cabin using a one-tenth scale water model. The same approach has been followed in the current study. A small scale model of a workshop has made to simulated airflow distribution and transport. To correctly represent the flow, a small-scale model should be designed based on similarity analysis, in which the relevant dimensionless flow parameters are identical between small- and full-scale. The similarity of the forces is reached by the equality of Froude or Grashof and Prandtl numbers.

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Materials and Methods

For the flow of carbon monoxide, regarding the density difference between CO plume and air the forces of inertia and buoyancy (density difference) are dominated. Due to the high turbulence of the flow, the viscous force is negligible compared to the two aforementioned forces. Therefore, the Froude number that consists of the important properties of the flow can be considered to set the similarities. On the other hand, regarding low velocities compare to the speed of sound (Mach number <1) the compressibility of flow can be ignored. So, the density difference and inertial forces are the only important forces and flow can be assumed incompressible carefully.

In this study, a simple regime of CO plume from a point source in a workshop building has been investigated. The building is a 3 mm perspex box that is 30 cm long, 30 cm wide and 35 cm tall with the sloping roof at both sides. The flow of contamination is a CO plume on the floor with a diameter of 1 cm. The discharge speed is 10 cm/s and the CO concentration is 20,000 ppm, so the Froude number is 1.44 and the Reynolds number is equal to 1124. A roof window, 1 cm wide and 10 cm long, is considered for the outflow.

The experimental works are performed at the Environmental Fluid Mechanic Laboratory of Babol Noshirvani University of Technology, Iran, using the Three-Dimensional Laser-Induced Fluorescence (3DLIF) system that especially developed for this purpose. The scaled experimental test facility placed upside-down fully submerged in the water tank. Conducting the experiment in a water tank besides index-matching is simpler to quantify flow mixing and dilution using the illumination of fluorescent.

Discussion of Results

In this study, the behavior of a plume of carbon monoxide in the indoor space of a stationary environment was investigated where no wind or forced ventilation implemented. CO is less dense than the ambient air and the flow moves upward due to its initial buoyancy. The flow reaches the steady-state condition after some seconds from the beginning. The concentration of contamination decreases due to flow entrainment and mixing while plume moves upward. The dimensions of buildings and outflow roof window determine the time requires to reach steady-state and it was 50 seconds for this experiment. So, the experiment was recorded after this time when it became time-independent. This time would be exactly equal for the same size building in either water or air. However, the time is proportional to $\frac{T_P}{T_M} = \sqrt{\frac{L_P}{L_M}}$ between model and prototype. For the flow speed also the same relation i.e. $\frac{V_P}{V_M} = \sqrt{\frac{L_P}{L_M}}$, is established.

The mixing and dilution of the contamination are proportional to flow speed and its initial buoyancy. Due to the dominant forces, the flow goes upward to eventually reaching to the ceiling, then moves outward from the roof widow up to reach the steady-state condition. In the uniform steady flow of CO smoke, a stratification forms in the building in which the concentration gradually decreases from the floor (20,000 ppm) up to the ceiling (2,600).

As a result of this study, self-similarity was observed for the profile of concentration and plotted at different locations from the source ($\frac{y}{d.Fr}$). The 2D configuration of flow, changes in flow width and centerline concentration are also plotted.

Conclusions

In this study, utilizing the LIF system, the spatial and temporal changes of CO concentration from a plume of contamination in a workshop have been investigated. Concentration variation along the centerline is plotted along with the changes in flow width and pollutant distribution in the building. For the aforementioned dimension with a point source at the floor and a roof window at the ceiling, it observed that the flow reaches the steady-state condition after about 50 seconds in which as stable stratification forms in the building. The CO concentration gradually increases from zero to maximum from the floor up to the ceiling. The pattern of changes depends to flow initial fluxes and the roof window's dimensions. The effect of walls on entrainment restriction and the ceiling on flow re-entrainment were observed and plotted as the self-similar profiles. The concentration of CO found in the range of danger at the height of human respiration in this building. It shows that natural ventilation can not decrease the high concentration of CO in this plume. Forced or mechanical ventilation is required.

Measurement of Kinetic, Isotherm and Thermodynamic Parameters of Cadmium Adsorption by Mesoporous Iron Oxide Nanoparticles Synthesized via Co-Precipitation Method

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Extended abstract

Introduction

Today, what has attracted more than each other category of human thoughts is the problem of environmental pollution by heavy metals, which affect the health of humans and humans due to their lack of absorption and the effects of physiologic effects at low concentrations. Cadmium is a two-capacity metal, soft, malleable, flexible, and whitewash, which was discovered in Germany in 1817 by Friedrich von Steiner. This metal has a large Ionic radius (pm 95) and electronegativity (1.7 degree pauling). Cadmium has been identified as a carcinogen due to severe toxic effects on human organs. As long-term use usually results in lung cancer, osteomalacia, hypertension, congenital defects, mutagenesis, iron deficiency, calcium, protein, and vitamin D. The sources of cadmium inputs to aqueous solutions include wastewaters from chemical fertilizers, pesticides, mines, melting, building batteries, pigments, stabilizers, and alloys, plating, sewage sludge, plastics and synthetic rubber. The exposure to and uptake of Cd was mainly from food ingestion and contaminated water.

Also, lower concentrations of cadmium can be found in vegetables, cereals, and starchy roots (Rajai et al., 2012). The daily intake of this substance is 10-35 μg/l. Smoking is another source of cadmium exposur (Organization, 2011). According to Standard 1053 of Iran, the maximum allowable cadmium concentration in drinking water, based on the average daily consumption of drinking water equal to 2.5 l, for a human with 70 kg is 0.005 mg/l. According to the World Health Organization's 1996 standard, cadmium concentrations in drinking water were limited to 0.003 mg/l (Organization, 2011; ISIRI, 2013). Nowadays, there are several removal processes for heavy metals from wastewater such as chemical deposition, membrane processes, ion exchange, coagulation, flocculation and absorption. However, absorption method is one of the most effective and efficient methods. In fact, it can be argued that in many cases protective shells not only prevent the oxidation of iron, but can also be used for more function (Wu et al., 2008). Magnetic oxide nanoparticles are most often used in aqueous solutions due to their many advantages such as high surface to volume ratio, very small size, high reactivity, and better absorption of toxins and heavy metals. But one of the main challenges of pure iron oxide nanoparticles is their high chemical activity, which makes it easy to oxidize against air (especially magnetite) or in acidic aqueous media. This will result in the loss of magnetism and the dispersion of iron oxide nanoparticles. Therefore, in order to prevent this occurrence, providing the appropriate coverage level and developing some effective protection strategies to maintain the stability of magnetic iron oxides is very necessary. Protective shields (especially silica), in addition to stabilizing iron oxide nanoparticles, have the benefits of preventing the accumulation of iron nanoparticles, increasing the compatibility of magnetic nanoparticles with solid matrices in

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the environment, creating graphene and bonding more nanoparticles with organic ligands, reducing the release rate of the oxygen molecule to the magnetic nuclei and to stabilize the crystalline structure of nanoparticles at high temperatures (Mdoe, 2017). Several studies have been done to remove pollutants from aqueous solutions by magnetic iron oxide nanoparticles. For example, in a study by Karimi et.al, nanoparticle synthesis of nanoparticle nanoparticles with a silica content of 130-30 nm in size has been used to remove organic humic acids from aqueous solutions. Therefore, the aim of this study was to adsorption cadmium from aqueous solutions by synthesis of mesoporous iron oxide nanoparticles based on co-precipitation method.

Materials and Methods

A two-step method was used to prepare magnetic nanoparticles coated with silica. In this study, cadmium adsorption was performed on adsorbent $Fe_3O_4@SiO_2$ iron oxide mesopes in a closed reactor within 100 ml echinoderms. In the first step, the iron oxide nanoparticles were synthesized via a simple co-precipitation and then, in the second step, the tetraethyl ortho-silicate was used to coating it. For this purpose, 22 g of $Fe_2Cl_3.6H_2O$ and 8 g of $FeCL_2.4H_2O$ were mixed to 400 mL of deionized water and the resulting mixture was stirred for 1 h in the presence of nitrogen gas at 80°C. Then, 15 mL NH_4OH (25% w/w) was added drop wise to reach pH 9. The produced nanoparticles were collected from the solution using an external magnetic field (1.2 Tesla) and washed several times with ethanol and deionized water and then, dried in an oven at 60°C for 24 hours. In the second step, a tetraethyl ethoxylan (TEOS) material was used to mixter of Fe_3O_4. Therefore, the nanoparticle was synthesized in the previous stage with 15 ml of TEOS, 6 ml of ammonia (25%), 80 ml of ethanol (65%) and some of the deionized water injected into the reactor. At the same time, a little amount of ammonia used, because it reduces the size of the nanoparticles and increases the number of free groups of silanol (Si-OH) on the nanoparticle surface and activates them. Finally, the supernatant was isolated by magnet and washed five times with distilled water and ethanol and then, dried in an oven at 60°C for 24 h. X-ray diffraction (XRD), infrared spectrometer (FT-IR), transient electron microscopy (TEM) and scanning electron microscope (SEM) were used to study absorbent properties.

Discussion of the Results

The calculation of the adsorbent isoelectric point (pH_{ZPC}) is an essential part of the adsorption process. The isoelectric point is called the pH where the adsorbent has a neutral load. At this point, due to the low electrostatic interactions between adsorbent and the amount of absorption of pollutants is reduced. However, at pH $<pH_{ZPC}$, adsorption load is negatively charged due to the presence of H^+ ions and at pH$>$ pHzpc the adsorption load is negatively affected by the presence of active hydroxide ions (OH). The pH_{ZPC} of $Fe_3O_4@SiO_2$ nanoparticles is calculated to be about 3.26. Therefore, according to the above, it can be stated that the adsorbent has a negative charge in pH$>$3.26. The maximum removal percentage and its adsorption capacity were 72.86% and 33 mg/g at pH 5, respectively. In this regard, pH 5 was used to continue the experiments. The cadmium adsorption was investigated at interval of 10–60 min. The results indicated that cadmium adsorption increased with increasing contact time. In the present study, iron oxide magnetite nanoparticles coated with silica as adsorbent in the cadmium adsorption process were used. Then, the effect of important pH and contact time factors on the removal of cadmium from aqueous solutions and kinetic, isotherm and thermodynamic models were investigated. According to studies, It was found that the adsorption reaction rate increased by the adsorbent at initial times. The main reason is the availability of more active cadmium sites on the adsorbent surface, which over time will increase the amount of cadmium removal from the solution. The values of Langmuir and Freundlich isotherms parameters of the cadmium adsorption process by $Fe_3O_4@SiO_2$ are shown in Table 2. The results showed that regression coefficients of Langmuir and Freundlich isotherm models were determined to be 0.984 and 0.957, respectively. The values obtained from the kinetic parameters of the first-order, second-order kinetics model are shown in Table 3. This suggests that the adsorption of cadmium on the adsorbent surface is more consistent with and consistent of Langmuir isotherm model. In order to analyze the results of the cadmium uptake process at the synthesized absorbent level, first-order and pseudo-second order kinetics models were used. According to Table 3, the regression coefficient in a pseudo-second-order kinetic model is higher than that of the pseudo-first kinetics ($R^2 = 0.991$). In addition, in this study, by increasing the solution temperature from 25 to 45 degrees Celsius, the percentage of cadmium removal increased 72.3 to 78.12 percent. Increasing the absorption of pollutants at high temperatures can be due to the combined desire of adsorption sites for metal ions. In this way, the increase in temperature leads to an increase in kinetic energy and an increase in the number of collisions between the adsorbent and the absorbent and decreases the viscosity of the soluble, thus facilitating the addition of absorbed ions to absorption positions (Zhang et al., 2013). Based on experimental results and regression coefficient, cadmium adsorption on $Fe_3O_4@SiO_2$ nanoparticles has been followed by a pseudo second-order

kinetic and Langmuir isotherm. Finally, the thermodynamic studies showed that the adsorption process is of endothermic and spontaneous nature. Various researchers have reported similar results. For example, the results of thermodynamic studies in Zang et al., titled titration of ion by magnetic nanoparticles, showed that ΔS^0 and ΔH^0 were 73.23 and 18.5 µol/mol, respectively.

Conclusion

Morphology analysis showed that $Fe_3O_4@SiO_2$ nanoparticles had a size of 15 nm, approximately. The results of adsorption kinetics indicate that cadmium adsorption on adsorbent follows a quadratic kinetic model. The obtained optimal conditions for the cadmium adsorption were included, pH 5 and reaction time 30 min. Based on experimental results and regression coefficient, cadmium adsorption on $Fe_3O_4@SiO_2$ nanoparticles has been followed by a pseudo second-order kinetic and Langmuir isotherm. Examining isothermic models suggests that this process follows the Langmuir isotherm model, which indicates homogeneity and the single-layer absorption process. Due to high surface-to-volume ratio and mesoporous size of the silica-coated magnetic nanoparticles, removal of cadmium from aqueous solution was well done, and thus it can be used as an efficient adsorbent for the removal of heavy metals from aqueous solution.

Keywords: adsorption, cadmium, isotherm, kinetic, thermodynamic.

Management Practices on Agricultural Non-Point Source Pollution (Aslanduz to Parsabad Spatial Range, 1993 to 2007)

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Extended abstract

Introduction

Recently, to control the adverse effects of agricultural management practices on surface water quality, it is essential to identify factors that affect the pollution of agricultural non-point source pollution. Therefore, the management of agricultural non-point resources pollution and prevention of non-point pollution transmission is one of the important ways to reduce surface water pollution, especially rivers. In addition to the importance of environmental biology, the Aras River plays an important role in the lives of nearby people. Therefore, the comprehensive modeling of surface water system is a good approach to identify and determin the amount of nutrient reduction caused by the application of management scenarios and it can be a useful tool to prioritize the design to improve the quality conditions and meet water quality standards in the water body. Therefore, any management strategy before implementation should be simulated in the form of simulated management scenarios and their efficiency. The main purpose of this study is simulation and evaluation of factors affecting on agricultural non-point pollution and the impact of land use management practices, such as land use management and chemical fertilizer consumption management under different scenarios, on reducing the load and improving the impact of non-point pollution and improving water quality on this river 60 km range using MIKE11 numerical model and evaluating their impact on reducing nutrient load.

Materials and Methods

Aras river, the largest river of northern Iran was selected as a case study in this study. The maximum flow in the studied area is 1100 m^3/s at Aras dam and 2,600 m^3/s at Moghan Dam site. However, the mentioned values may reach 32 and 180 m^3/s respectively in dry season respectively. In recent years, with the increase of adjacent agricultural land and low flow rates, the load of agricultural pollutant resources has been known as one of the main factors of Aras river pollution. MIKE11 model, a one-dimensional tool with strong hydrodynamic to manage and evaluate the performance of river systems, beals, irrigation canals and … the Danish hydraulic Institute (DHI) is developed and used to identify the factors affecting the agricultural non-point source pollution and management of simulation scenarios to reduce river pollution during the study area of hydrodynamic module (HD) with advection-dispersion (AD). The main data for hydrodynamic simulations and river quality include topographical maps, irregular triangle network (TIN), land use maps, hydrometer and qualitative studies of the study area from the regional water administration and agricultural jihad in Ardabil province. For hydrodynamic calibration of water level data and also on the research goals and data quality monitoring data, concerning the availability of water quality data, nitrate and phosphate were selected as water quality indices for calibration. The calibration station was used in the Parsabad station from May 2007 to May 2008. In this study, Manning's roughness coefficient was used to resist the bed roughness. To investigate the quality of water and to estimate the quality and load estimation of nitrate and phosphate pollution of the river, qualitative parameters were calculated monthly at the river section and a drain stream. Based on the processes governing, the nitrate and phosphates and the results of sensitivity analysis in the river, the parameter of the applied fertilizer conversion factor is estimated as a calibration coefficient using the mass equilibrium method of solution in the river. The results showed that the coefficient with Manning's modulus of 0.35 is better compared with other coefficients. The calibration results

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of the dispersion coefficient were determined based on the comparison of nitrate concentration and phosphate with the measured value at the Parsabad station. Based on the Fisher's relation ($D_x = m^2/s$) in case a= 66.2 and b= 0.52 with RMSE of 0.81 mg/l and 0.08 mg/l, for nitrate and phosphate, respectively. In general, the average runoff the region was 10.2% and 3.7% of nitrate fertilizer and input phosphate. According to the results of the validation, the model performance with Manning roughness coefficient n and runoff coefficients are approved by water levels of nitrate and phosphate from June to December 2008. In this study, by land use observations and fertilizer use, the factors affecting the sources of pollution in agricultural land were determined. Agricultural and fertilizer fields were carried out as factors affecting the sources of agricultural pollution in the form of four scenarios in 1993 (scenario 1), 1997 (scenario 3), 2003 (scenario 3) and 2007 (scenario 4).

Results and Discussion

Simulation results show that nitrate and phosphate loads in the Aras river output increased from 730.4 kg/s and 58.6 kg /s in 1993 to 814.3 kg/s and 61.1 kg/s in 2007. Also, due to the increase in the amount of fertilizer, there has been a significant increase in agricultural pollution in the region. So, from 1993 to 1997 (existing conditions) levels of nitrogen and phosphorus fertilizer in 320 kg/ha and 81 kg/ha in 1993 in 500 kg/ha and 120 kg/ha reached in 2007. Due to the above results, land use and fertilizer have a significant impact on the load of agricultural pollution; therefore, in the next step, it will be carried out to implement the measures of land use management and fertilizer. According to Aras River, agricultural water supplier three ranges (Aslanduz, cultivation, industry and Parsabad), the area land use was divided into three domains. In the scenario of land use management, when agricultural planting is reduced, nitrate and phosphate loads have been greatly reduced in the Aras river output. In the first scenario, nitrogen and phosphorus charges were estimated at land use 540.72 kg/s and 50.83kg/s respectively. Also, nitrate and phosphate loads were decreased by 34% and 16.8% in comparison to the existing conditions, so it could be concluded that the reduction of non-point pollution due to low-level reduction of agricultural land. Four scenarios were simulated to implement fertilizer management efforts. In scenarios 1 and 2 non-point pollution loads are reduced compared to the conditions available due to the decrease in the amount of fertilizer. However, in scenario 3 and 4, with increasing loading, the load contamination of agricultural non-point pollution was significantly increased. In the scenario 4, given that the amount of fertilizers increased to 1.5 times. The nitrate and phosphate loads were also increased to 18.02 and 8.51 times as compared to the existing ones. Therefore, due to the results, the increase in the amount of fertilizer leads to more nutrient loss.

Conclusion

This study was conducted under different scenarios to investigate the effect of management strategies to reduce river water pollution in the Aslanduz to Parsabad. First, the factors influencing the pollution of agricultural pollution in the study area were then determined the effectiveness of management measures to control agricultural pollution with MIKE11 model. Management practices were carried out in the form of land management scenarios and fertilizer. Managerial practices were carried out in the form of land management scenarios and fertilizer. Different amounts of nitrate and phosphate were directly proportional to the use of land use and land use. Simulation results show that the effect of different scenarios of fertilizer and land is similar in reducing the nutrient load of the same river. To reduce the cultivation area under cultivation, pollution charges have been reduced and the maximum contamination of non-point pollution with 34% in nitrate has been reduced. Also, with an increase of 1.5 times the amount of fertilizer compared to the present situation, the nitrate increased by 18.02% with the highest change.

Keywords: agricultural management practices, agriculture non-point source pollution (ANSP), Aras River.

Optimization of Reverse Osmosis Water Desalination Supply Chain with Economic and Environmental Approach
(Case Study: Water Desalination Supply Chain in Hormozgan Province)

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Extended abstract

Introduction

The importance of examining the economic and environmental impacts of water purification using desalination technology and the supply of desalinated water according to the supply chain allows the decision maker to examine the system as a whole. For example, any delay in the distribution of water from storage tanks to consumers could disrupt the desalination process and affect overall performance of the water desalination supply chain. The activities of the desalination water supply chain include the acquisition of feed water and chemicals needed for desalination processes, the desalination process system, the storage of produced water and the distribution of fresh water to end users. Environmental impacts of reverse osmosis desalination can be broadly classified into three categories: energy consumption, intakes and outfalls. Desalination outfalls results in known environmental impacts in seagrass habitats and phytoplankton communities, invertebrates and fish in areas surrounding outfalls. In this study, the environmental impacts of energy consumption resulting in CO_2 emissions and the cost of dilution pre-discharge effluents that reduce the environmental impacts of salinity and chemicals are investigated. Most of the models mentioned in the literature have focused on optimizing the economic dimension of water supply systems. However, in the mathematical model, they have neglected to detail the environmental aspects. This research has expanded the economic model presented by Al-Nory et al., 2014, For the water supply chain in a way that considers environmental detail in addition to being able to minimize total investment and operational costs. According to library studies and searches so far in Iran, no research has been conducted to optimize reverse osmosis water supply chain with economic and environmental approach and this is the first research of its kind.

Matherials & Methods

The research method was based on Saunders research onion model. This research in terms of orientation is developmental at design stage and is applied at test stage in organizations and industries. The data collection method is a study of documents, articles and semi-structured interviews for the purpose of conducting research. To conduct a case study, the supply chain of water desalination plants in five cities of Hormozgan province including Abu Musa, Bandar Abbas, Dargahan Qeshm, Sirik and Hormoz Island was selected.

A supply chain network is assumed to be a graph G= (V, E) where V is the set of vertices containing relation (1).

$$V = N^s \cup N^a \cup N^d \qquad (1)$$

where N^d represents the set of demand locations, N^a the set of aggregator locations, and N^s the set of desalination plant locations.

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The objective function specified in relation (2) minimizes the total cost of investment and operation of both the plant and the water pipeline in supply chain. It also minimizes environmental impacts.

$$minTC = \sum_{l \in N^s} c_l^T + c_l^{enviT} + \sum_{i \in E} c_i^N \qquad (2)$$

Total water cost (TWC) is often cited in the literature of the desalination industry as a common comparison between projects. Table 1 compares the total cost of the objective functions and their components per cubic meter of fresh water.

Table 1. Comparison of total cost of objective functions and their components per cubic meter of fresh water

Objective functions with its components	Cost of one cubic meter of fresh water in US dollars (US $ / m^3)
TWC1	Plant- Total Investment, Operation, and Environmental Costs (Salinity Reduction + CO_2)
TWC2	Plant- Total Cost of Investment, Operation and Environment (Salinity Reduction)
TWC3	Plant- Total investment and Operation costs, no environmental costs
TWC4	Water pipeline- Total investment and Operation costs
TWC5	Plant plus Water pipeline- Total Investment, Operation and Environmental Costs (Salinity Reduction + CO_2)
TWC6	Plant Plus Water pipeline- Total Investment, Operation, and Environmental Costs (Salinity Reduction)
TWC7	Plant Plus Water pipeline- Total Investment and Operation Costs, No Environmental Costs
TWC8	Environment- Costs (CO_2 + Salinity Reduction)
TWC9	Environment- Costs (CO_2)
TWC10	Environment- Costs (Salinity Reduction)

Discussion of Results

The mathematical model was coded in MATLAB software and solved using the opti- intlinprog solver from the OPTI TOOL BOX software suite. By modifying the parameters, the model sensitivity analysis and validated. Also, the model for water supply chain of existing water desalination towns of Abu Musa, Bandar Abbas, Dargahan Qeshm, Sirik and Hormuz is solved based on input data for 20 year time horizon presented in Table 2.

Table 2. Comparison of total cost of objective functions and their components in terms of cubic meters of fresh water

Objective functions with its components	Unit	Abu Musa	Bandar Abbas	Dargahan Qeshm	Sirik	Hormuz
TWC_1	US$/m^3	0.6250	0.4875	0.6028	0.6122	0.6346
TWC_2	US$/m^3	0.5366	0.3991	0.5144	0.5238	0.5461
TWC_3	US$/m^3	0.4872	0.3640	0.4683	0.4759	0.4951
TWC_4	US$/m^3	0.1458	0.0458	0.0806	0.0698	0.1849
TWC_5	US$/m^3	0.7708	0.5333	0.0806	0.6820	0.8195
TWC_6	US$/m^3	0.6824	0.4449	0.5950	0.5936	0.7311
TWC_7	US$/m^3	0.6330	0.4098	0.5489	0.5457	0.6800
TWC_8	US$/m^3	0.1378	0.1235	0.1345	0.1363	0.1395
TWC_9	US$/m^3	0.0885	0.0885	0.0885	0.0885	0.0885
TWC_{10}	US$/m^3	0.0494	0.0351	0.0461	0.0479	0.0510

(Reference: Authors)

Conclusions

This research considers the optimization model of strategic and operational decisions with respect to the planning time horizon. The most important strategic and operational decisions modeled that are include optimizing the net present value of the costs of investing and operating the desalination plants, the environment, and water pipelines. Environmental costs include costs of CO_2 emissions and brine diluting to reduce the environmental impacts of brine salinity and chemicals over the planning time horizon.

The results show that the cost of freshwater is lower than the cost of research literature, mainly due to the low cost of subsidized energy in Iran. Regarding the objective function to reduce the environmental impacts of the brine salinity, the results show that the environmental objective is opposite to the cost objective. The higher the cost, the greater reduce the environmental impact, and the lower the cost, the greater the environmental impact. As the cost of brine disposal increases, freshwater production becomes more expensive. The Bandar Abbas desalination plant with a nominal capacity of 100,000 cubic meters per day generates 100,053,800 kg of greenhouse gas CO_2 annually. Reducing energy consumption reduces the amount of greenhouse gas CO_2. Recycling energy can partially reduce energy consumption to reduce CO_2 emissions. But, the main solution is to use renewable energy instead of fossil fuels.

This research has some suggestions for future research including:

1. Complete water resources optimization model of Bandar Abbas City including groundwater and surface water (dams and desalination water) to meet water needs and understand the real value of freshwater in a sustainable integrated water resources planning model

2. Consider the small components of investment, operating and environmental costs of the water desalination plant and other parts of the supply chain in a mathematical model to optimize and analyze them.