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Cadmium (II) removal from aqueous solutions using mineral wool waste

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Expanded Abstract

Introduction

Water pollution with heavy metals is a serious and spreading problem. Elevation in heavy metal concentration in environment has been caused health problems in human and other living organisms. Heavy metals are accumulated in the organisms' tissues following ingestion or feed and water absorption (Omid Sayar et al., 2015). Rapid growth of modern industry and human population are the main reasons of heavy accumulation in the environment that is a great global concern. Heavy metals' concentration is rapidly elevating in industrial wastewaters (Zhanga et al., 2015). In aquatic environments, cadmium is accumulated in riverine clams, shrimps, crab and fish. Hypertension, hepatic disorders, cerebrospinal damages and itai itai disease are of cadmium effects in human (Aksu et al., 2006).

Maximum allowable cadmium concentration in drinking water for a 70-kg person is 0.03 mg/l based on daily water consumption of 5.2 l (WHO, 2004). Therefore, heavy metals' removal or concentration suppression in wastewaters prior to iterrance to ground water or agriculture water is very important. Common methods for metal removal from wastewaters are chemical participation, chemical oxidation-reduction, ionic mobilization, electrochemical treatment, reverse osmosis and filtration (Ahluwalia et al., 2007).

Surface adsorption is a physiochemical process occurring at the intersection of two phases. It is an economic method for heavy metal removal with several advantages such as ease of use, high adsorption capacity, flexibility in designation and application (Talut et al., 2011). "Artificial mineral fibers" is a general term used to describe materials including mineral wool, slag wool, glass wool and refractory ceramic fiber (Luoto et al., 1998; Alvez et al., 2018).

Researches in this field show that producers attempt to produce products with high quality, low biological stability and less harmful effects in body (Kamstrup et al., 1998; Seraji et al., 2018). Mineral wool belongs to a family of mineral fiber thermal insulation (Luoto et al., 1998; Alvez et al., 2018). Metal oxides (MgO, TiO₂, Al₂O₃, B₂O₃, SiO₂) are presented in chemical structure of mineral wool. Mineral wool is extensively used in building construction and about 60% of total insulations in market are mineral wool (Papadopoulos, 2005). Thus, the aim of the present study was to investigate the feasibility of using mineral wool wastes for heavy metal removal from aqueous medium by surface adsorption.

Materials and Methods

In the present study, a wastewater was used for metal removal test. Four factors (pH, initial metal concentration, time and adsorbent concentration) were test for their effects on removal rate. Mineral wool wastes were prepared from Asia Mineral Wool Co. (industrial town of Najafabad, Isfahan, Iran). At first, some characteristics of mineral wool waste including pH, EC, pH_{ZPC}, chemical composition, structure and morphology were determined using XRD (Philips PW1800; for mineral woo; structure determination), XRF (Philips PW1480; for chemical composition determination) and scanning electron microscopy (Philips XL30; for morphological study and

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particle size determination) (Kumar & Rani, 2013). Different pH (3, 5, 7 and 9), initial cadmium concentrations (1, 5, 10, 20, 50 and 100 mg/L), contact time (5, 15, 30, 90 and 120 min) and adsorbent concentrations (1, 2, 5, 10 and 20 g/L) were tested. The fixed level for pH was 3, for adsorbent concentration was 1 g/L, for initial cadmium concentration was 1 mg/L and for contact time was 90 min. At all stages, the samples were mixed with shaker at 180 rpm for 90 min. Then, the solutions were filtered and cadmium concentration was determined in the supernatant using atomic absorption spectrophotometer (Perkin Elmer 3030) with three replications (Osasona *et al.*, 2011). Finally, cadmium removal percentage and adsorption isotherms were calculated for all stages of adsorption. Then, surface adsorption isotherms at different concentrations were graphed and Langmuir and Freundlich models were used for data fitting (Spark, 2003). The data were analyzed using the software Excel 2016 and SAS 9.4. Software Excel 2016 was used to draw the graph of the effects of pH, temperature, adsorbent concentration and time on adsorption percentage. Software SAS 9.4 was used to analyze the data of completely randomized block. Then adsorption isotherms for cadmium adsorption from the artificial solution were investigated using Langmuir and Freundlich models.

Results and Discussion

XRD analysis showed that the mineral wool was in amorph and non-crystalline form. XRF analysis showed that SiO₂, CaO, Al₂O₃, MgO, Fe₂O₃ and K₂O encompass about 95% of the chemical composition. Silicate was dominant compound, thus the mineral wool waste was chemically similar to other adsorbents such as zeolite and other silicate minerals. Erdem *et al.* (2004) investigated a natural zeolite potential to removed heavy metals and reported that the zeolite composed of SiO₂ (69.31%), Al₂O₃ (13.11%), CaO (2.07%), NaO (0.52%), MgO (1.13), Fe₂O₃ (1.31%) and K₂O (2.83%). The lowest adsorption percentage was observed after 5 min (19.03%), which was significantly different compared to the other times ($P < 0.05$).

The highest adsorption percentage was obtained after 30 min (95.11%); further increase in contact time had no significant effects on adsorption percentages. In this case, studies show that adsorption percentage increased along with time, because active sites at the adsorbent surface are more occupied by the adsorbed material. The highest adsorption rate occurs at the early contact time, which decreases along with time, because of decreased adsorption capacity.

Navish *et al.* (2018) studied the synthesis of iron oxide nanoparticle from wood meal ash to remove cadmium and reported that adsorption percentage increased by increase in contact time from 10 to 150 min, but it remained stable after 30 min. Osasona *et al.* (2018) studied the use of active carbon derived from oat for cadmium adsorption and found that the adsorption percentage reached the maximum level (99.24%) at the first 5 min and remained stable afterward. Among the different pH, the highest adsorption percentage was observed at pH 9 (83.5%; $P < 0.05$), while the lowest was obtained at pH 3 (60.5%; $P < 0.05$). pH affects metal speciation so that the metal can be as ionic or hydroxyl form; this affects adsorption efficiency.

Cadmium is found as Cd²⁺, Cd(OH)⁺, Cd(OH)₂, Cd(OH)₃⁻, Cd(OH)₄²⁻ at different pH in aqueous media (Geological Survey of Japan 2005; Chowdhury *et al.*, 2013). Moreover, pH affects functional groups and active sites on adsorbents' surface, thus markedly affects adsorption efficiency. Optimum pH for maximization of adsorption depends on the nature of the adsorbent. Navish *et al.* (2018) studied the synthesis of iron oxide nanoparticle from wood meal ash to remove cadmium and found that increase in the medium pH from 2 to 8 resulted in increase in adsorption of cadmium from 5 to 56%.

Osasona *et al.* (2018) studied the use of active carbon derived from oat for cadmium adsorption and found that elevation in the medium pH from 1.5 to 6 led to increase in cadmium removal from 75 to 99.75%. Nazar *et al.* (2015) investigated the efficacy of wood meal for cadmium removal from aqueous medium and reported that increase in the medium pH from 2 to 7 led to increase in cadmium removal; however, the removal rate were similar among pH 5, 6 and 7. The present results showed that the highest cadmium removal was obtained at cadmium concentration of 5 mg/L (75%; $P < 0.05$), thereafter the removal rate decreased with the lowest level at cadmium concentration of 20 mg/L (13%; $P < 0.05$).

Increase in cadmium ion concentration in the medium might led to rapid occupation and saturation of the adsorbent surface active sites preventing further cadmium adsorption. Moreover, increase in electrostatic repulsion power between charged metals on the adsorbent surface leads to decreased adsorption percentage (El-Ashtoukhy *et al.* 2008). Using natural phosphate for cadmium removal, Yaacoubi *et al.* (2014) found that increase in cadmium concentration up to 50 mg/L led to increased cadmium removal; however, further increase up to 350 mg/L had no marked effects on cadmium removal percentage. Nazar *et al.* (2015) investigated the efficacy of wood meal for cadmium removal from aqueous medium and reported that increase in cadmium concentration up to 500 ppm led to increased cadmium removal; however, further increase had no marked effects on cadmium removal percentage.

The mineral wool waste at the concentration of 20 g/L had the highest cadmium removal efficacy (57.5%; $P < 0.05$); whereas, the lowest efficacy was obtained the adsorbent concentration of 1 g/L (28%; $P < 0.05$). This is

due to increased available adsorption sites in the medium (Melamed et al., 2006; Santos et al., 2003). Using hydrate magnesium dioxide for lead removal, Meng et al. (2013) found that increased in the adsorbent concentration led to increased removal efficacy. Similarly, Navish et al. (2018) studied the synthesis of iron oxide nanoparticle from wood meal ash to remove cadmium and found that increase in the adsorbent concentration from 0.1/ to 2.4 g/L led to increase in adsorption from 4.3 to 85%.

Osasona et al. (2018) studied the use of active carbon derived from oat for cadmium adsorption and found that increase in the adsorbent concentration increased removal percentage up to complete removal. The results of adsorption was modeled with Langmuir and Freundlich isotherms to obtain the possibility for maximum adsorption. Both isotherms had high R^2 , but the value of Freundlich isotherm was higher than the Langmuir's. In Freundlich model, the coefficient "n" is index of adsorption rate, being 1.59 for cadmium adsorption with mineral wool waste. $n \geq 1$ indicates nonlinear adsorption on non-homogeneity surface (Borah, 2018). In this isotherm, increase in the adsorbed material concentration leads to early increase in adsorption followed by late decrease because of occupation of adsorption sites. The isotherm shows that the waste surface has low affinity to adsorb cadmium at low concentration, but increase in cadmium concentration leads to increased surface adsorption.

The coefficient " K_f " is index of adsorption power being 18.58 L/g in the present study. Navish et al. (2018) studied the synthesis of iron oxide nanoparticle from wood meal ash to remove cadmium and found that Freundlich model was better than both Langmuir and Temekin model due to higher R^2 (0.98). Osasona et al. (2018) studied the use of active carbon derived from oat for cadmium adsorption and found that Langmuir model was best fitted to the data ($R^2 = 0.92$) compared to Freundlich model. On the other hand, Nazar et al. (2015) investigated the efficacy of wood meal for cadmium removal from aqueous medium and reported that either Langmuir or Freundlich model were suitable with R^2 of 0.99 and 0.97, respectively.

Conclusion

This study investigated the adsorption of divalent cadmium using mineral wool waste at different parts. At the first step, effects of time (5, 15, 30, 90 and 120 min) were investigated and it was found that increase in contact time increased cadmium adsorption. At the second step, effects of pH (3, 5, 7 and 9) were studied and it was demonstrated that increase in pH resulted in increased adsorption. Then, the effects of initial cadmium concentration were assessed and it was demonstrated that increase in cadmium concentration led to increased adsorption due to much available ions for adsorption. At the fourth step, the role of different concentrations of the adsorbent was studied in cadmium removal. The results showed that increase in adsorbent concentration led to increase in adsorption maybe due to increased number of exchange sites and specific surface. Freundlich equation well described isotherms of divalent cadmium adsorption using mineral wool waste. Overall, it was found that mineral wool waste had high efficiency for cadmium removal from aqueous solution.

Keywords: aqueous solutions, cadmium (II), Freundlich and Langmuir isotherm, mineral wool waste.

Quality assessment of municipal effluent for agriculture using fuzzy inference system (Case study: Sahebgharanieh Wastewater Treatment Plant)

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Expanded Abstract

Introduction

There is an increasing global trend in using effluent as a non-conventional water resource for a wide range of applications. Effluent can be used in a number of applications, including makeup water in cooling towers and boilers, equipment cleaning, vehicle washing, agricultural irrigation, landscaping and lawn maintenance, urban reuse (air conditioning, toilet flushing, etc.), and fire protection. The scarcity of freshwater resources is a serious problem in arid and semi-arid regions, such as Iran. Effluent can have different advantages including being a constant, reliable water resource and reduces the amount of water extracted from the environment. Wastewater can be a vast resource if reclaimed properly to become effluent. The right on-site treatment system can transform treated wastewater into a reliable alternative water resource.

In a case of inappropriate treatment, wastewater is discharged untreated into rivers, lakes and oceans which is a global problem. Today, around 80% of all wastewater is discharged untreated into rivers, lakes and oceans. It poses health and environmental problems. Recovering water, energy, nutrients and other precious materials embedded in wastewater is an opportunity to cover water demand and contribute to improved water security. To handle increased water demand, effluent is offered to be used for agricultural irrigation. The use of effluent for agricultural irrigation is viewed as a positive means of recycling water due to the potential large volumes of water that can be reused.

The availability of nutrients such as N, P or K are necessity for plant growth. One of the advantages of using effluent for irrigation is supplying nutrients and reducing use of synthetic fertilizers. Effluent can provide the soils with micronutrients and organic matter. There are concerns, however, about the impact of the quality of the effluent, both on the crop itself and on the consumers of the crops. Quality issues of the effluent can cause problems in agriculture including nutrient concentrations, heavy metals, and the presence of contaminants such as human and animal pathogens, pharmaceuticals etc. There are international guidelines and national regulatory standards for quality control of effluent in agriculture. Department of environment in Iran issued the standard for effluent quality used in agricultural irrigation. EPA and WHO have also guidelines for the safe use of effluent. Using effluent for various applications including agriculture irrigation has been examined in many studies. These studies focus on comparing quality parameters of the effluent with the standards without concerning uncertainty in a framework for overall suitability of the effluent quality. This study aims to present a framework of effluent quality assessment for using in agriculture. We perform such an assessment by considering related uncertainty via Fuzzy Inference System and integrating it with Delphi method. The proposed framework can be used for wide range of applications in which effluent can be reused as a source of water.

Material and Methods

Tehran city involves seven operating wastewater treatment plants. Sahebgharanieh wastewater treatment plant is the oldest wastewater treatment plant in Iran being located in Pasdaran Street (North Tehran). Its executive

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operations started in 1960 which was designed with the capacity of 2000 people as the covered population. The material of collecting network with the length of 5.3 km is asbestos cement. Its average input flow is 25 m³/h and the network's diameters are 150 to 200 mm.

In the first step, the most effective quality parameters of municipal effluent were identified through questionnaires. The questionnaires were given to the expert panel to be answered. The members were drawn from the university professors and industry sector research organizations. After aggregation of expert's opinion, 28 parameters were identified to assess municipal quality for reusing in agricultural irrigation. Delphi method was used to select the most important parameters from the total of 28 identified parameters. The Delphi method is a structured communication technique or method, originally developed as a systematic, interactive for casting method which relies on a panel of experts. The experts were selected based on their educational level and work experience. The experts answered questionnaires in two or more rounds. Each member of the panels was sent a questionnaire with instructions to comment on each parameter by considering their importance in overall quality of the effluent for reusing in agricultural irrigation based on Likert scale (1= least important to 5=most important). In the second round, experts were asked to revise their earlier answers in light of the replies of other members of their panel. Finally, the process was stopped since there was low difference between scores of the first and second round. A predefined stop criterion and the mean scores of the final rounds determine the eight parameters (i.e. Fecal Coliform, pH, TDS, TSS, COD, BOD₅, NO₃).

In the second step, Mamdani fuzzy inference system was used to assess the overall quality of the effluent. The most commonly used fuzzy inference technique is Mamdani method. It is performed in four steps of: (1) fuzzification of the input variables, (2) rule evaluation, (3) aggregation of the rule outputs, (4) defuzzification. After fuzzification, 99 rules were used. After defuzzification, the results were compared with the results of crisp method.

Results

Based on fuzzy results, 39 samples were categorized as "excellent", 20 samples as "good", and 1 sample as "poor". According to crisp method, pH, BOD₅, COD, TSS, and NO₃ in the first sample were categorized as "low", Fecal Coliform and TDS were categorized as "medium" and "high" respectively. Based on fuzzy results, the sample was categorized as "excellent". The fifth sample was categorized as "poor" according to fuzzy results. In this sample pH and NO₃ were categorized as "low". BOD₅, COD, and fecal coliform were categorized as "medium" and Nematodes, TDS, TSS were categorized as "high". The ninth sample was categorized as "good". Fecal Coliform, nematodes, BOD₅, COD, pH, and NO₃ were categorized as "low". TSS and TDS were categorized as "medium" and "high", respectively. The last sample was categorized as "excellent" and all the parameters were "low". Fuzzy method results showed that samples No. 58, 59, and 60 were categorized as good and according to crisp method all the parameters except nematodes and TDS categorized as "high".

Discussion and Conclusion

Uncertainty as a result of data unavailability and incompleteness is a challenge in effluent quality assessment. In the present study, Mamdani fuzzy inference system was used to deal with uncertainty. Its ability to reflect the human thoughts and expertise in the assessment make it possible to deal with non-linear, uncertain, ambiguous and subjective information. In order to select the most important quality parameters considering agricultural irrigation, Delphi method was combined with Mamdani fuzzy inference system. Expert knowledge and standards were simultaneously used to determine membership functions. Eight parameters including Fecal Coliform, nematodes, pH, TDS, TSS, COD, BOD₅, and NO₃ were selected to assess the overall effluent quality for reusing in agricultural irrigation. The results showed the suitability of the selected eight parameters in effluent quality assessment. Reviewing other studies showed that they just make a comparison between calculated quality parameters and standards. But, the present study presented a framework for overall effluent quality assessment. The proposed framework was demonstrated via the case study of a Sahebgharaniieh wastewater treatment plant in Tehran. In order to indicate the model validity, the results of fuzzy model were compared with the results of crisp method. The comparison showed the same results. It can be concluded that Fuzzy model capability in considering thresholds in input and output values enables dealing with uncertainty. The proposed framework can be further used for other applications of effluent reuse such as industrial, aquaculture, environment, etc.

Keywords: agricultural uses, fuzzy inference system, municipal effluent, reuse.

Distribution modeling of hawthorn (*Crataegus azarolus* L.) in Chaharmahal & Bakhtiari Province using the maximum entropy method

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Extended Abstract

Introduction

Awareness of the distribution of plant species and their influencing factors have important roles in management, sustainable use and conservation. In particular, habitats and population of species due to increased human degradation, climate changes and pests and diseases are limited. However, because of the time and budget constraints available to study, there is not enough information available on the distribution of species. Therefore, species distribution modeling (SDM) techniques are an appropriate tool for overcoming these constraints. In these methods, prediction of species distribution from spatial distribution of environmental variables controlling this distribution is possible. Today, by using these powerful statistical methods and the GIS, these models are rapidly developing in the field of ecology.

Although a species distribution is influenced by factors such as its ecological niche, its movement ability and inter-species competition, species distribution models focus on environmental factors and ignore the effects of such ecological processes. So far, various methods and models for modeling the distribution of species have been introduced. Most of these methods depend on the presence and absence of species and habitat variables being related to the ecological niches. One of the strongest and well known models in the distribution of species is the maximum entropy (Maxent).

Many studies have been carried out using SDMs for animal species by maximum entropy in Iran, but there are fewer studies on plant species and in the case of hawthorn species (*Crataegus azarolus* L.), any habitat modeling has been done especially with this method as authors investigated. The aim of this study was to fill the gap of the above studies in order to identifying the ecological parameters affecting the spatial distribution of hawthorn species in order to prioritize and provide a map of conservation areas as well as to study the possibility of planting these species in similar areas with the actual site in Chaharmahal Bakhtiari and better management of existing habitats using maximum entropy analysis method.

Material and Methods

Chaharmahal & Bakhtiari province with an area of 16532 km² located in southwestern of Iran as parts of Zagros Mountain. The absolute maximum temperature is 47.5°C in Lordegan and the minimum absolute temperature of -34.5°C is recorded in Dezak station. The highest precipitation is belonging to the northern highlands with 1600 mm in a year. However, the minimum precipitation is recorded in northeastern parts of the province with an average annual rainfall of 250 to 300 mm. The average annual precipitation in the province is about 560 mm.

The criterion for the selection of species occurrence points was the presence of forest stands in which the species had a high density. The initial results from forest survey showed that a large part of the forest areas of the province has *Crataegus* genus in their composition. Finally, 37 species points were recorded using the Global Positioning System (GPS).

The environmental variables used for the model include 7 climatic variables, 3 topographic variables, and land use and soil variables (Table 1). The meteorological data of 9 synoptic stations with a period of 15 years (1995-

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1995) were collected and used. Topographic variables were extracted from digital elevation model (DEM) of the study area with a resolution of 30 m, as well as land use map and soil texture map in a scale of 150,000. Spatial resolution of all layers was changed to 30 m for use in the model and further analysis. After preparing the layers, Maxent 3.3.3e was used for modeling.

Results

The area under the curve (AUC) of the receiving operation factor (ROC) derived from the maximum entropy model was 0.95, indicating an excellent prediction of the model versus 0.05 in the sense of random prediction. According to the results, the most important variables that have the highest contribution in the model development are height, mean relative humidity and average annual rainfall. Jackknife test also showed that the most important variables that have the most contribution in predicting the model are the maximum annual temperature, height, mean annual temperature and mean relative humidity, respectively. Based on the species reaction curve, the highest probability of occurrence of the species is in areas with a height of 1000-2000 m above sea level and with increasing height, the probability of the presence of the species decreases. According to the response curve of the species to the maximum and the average annual temperature, the distribution of the species in regions where the air temperature is higher than 38°C is more likely. The most probable distribution of the species is in the temperature range of 10-15, which then, with increasing temperature, the probability of species occurrence has a descending trend and eventually proves. Also, the response curve of this species to average relative humidity, shows the best humidity range between 24 to 25%. The distribution rate decreases with increasing moisture content until 29.5%. It has another increasing trend. Overall, according to the final distribution map, the best predicted site for the presence of this species located in the east of study area, that is Ardal, Koohrang and Kayar towns.

Conclusion

The Maxent has proven to be very effective in predicting habitat quantification and distribution of species, since it relies only on species presence data and lacks many of the complications associated with the presence-absence analytical methods. The results obtained from the evaluation of the performance of the Maxent in current study through the AUC of about 0.95 indicate that the model has excellent predictive capability. The results of the current study showed that even with the small number of samples (occurrence points), the predictive function of the Maxent can compete with methods that have the highest predictive accuracy and provide acceptable results. In the process of modeling, it is important to know which variables and to what extent they have played a role in modeling. The results of species performance along the slope of environmental changes through the response curves are obtained. On the base of the analysis, in relation to the factors influencing the distribution of hawthorn species in this study, height, mean relative humidity and average annual sum of rainfall were the most important factors influencing the distribution of hawthorn species in Chaharmahal & Bakhtiari province. According to the response curve of hawthorn in relation to height, the most probable presence of species in areas with a height of 1000 to 2000 m is predicted, so that with the increasing of height the likelihood of presence of the species is reduced, which is consistent with the results of the research in the forests of Abdanan, Ilam Province. The response curve of hawthorn in relation to soil type also showed that the most probable presence of hawthorn is in the loam and silty soils. The highest presence of hawthorn species based on the response curve in the slope is about 0-2% and with increasing slope, the probability of prediction of species distribution decreases. Also, the results of hawthorn response curve to the land use indicated that the probability of species presence in areas with arable land, pasture and forest use is more than other uses. Finally, the results of this research provided important information about the range of tolerance of Hawthorn species to the influential environmental variables. This information is effective in making management decisions to prioritize conservation areas and to improve conservational measures, particularly in areas where vegetation is degrading, and increases the chance of success in planting and restoration projects.

Keywords: Chaharmahal & Bakhtiari, *Crataegus azarolus* L., Iran, maximum entropy, species distribution modeling.

Estimation of biological water rights of traditional orchards in Qazvin using remote sensing capabilities

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Expanded Abstract

Introduction

Traditional orchards are the gardens that are mostly outside the city. Typically, traditional orchards surrounding the city of Qazvin can be mentioned. The traditional Qazvin orchards, known for their 1400 years of existence, are one of the examples of optimal use of nature. The construction of traditional orchards around the city of Qazvin shows that the person considered the way of peaceful living with nature more than ever, and pursued sustainable development, albeit with a slow process (Akhavizadegan, 2002). The features of traditional orchards, mixed cultivation, customs and traditions related to the division of gardens, the division of water and property. Traditional orchards have been designed with a few goals. The first objective of the construction of this garden has been the direct and economical use of these gardens. The second cause has been the creation of green spaces around cities. This greenery encompassed the cities and made the cities appear as good-weather islands, even in arid and semi-arid regions (such as Isfahan, Shiraz and Qazvin). The third reason for the construction of traditional orchards was to control the upstream floods and to prevent flood damage to farms and lower villages.

The results of various research studies indicate that the use of remote sensing techniques due to capabilities such as wide and integrated vision, the variety of data forms, digitally data, providing timely and integrated data, wide and easy data availability, rapid access to remote locations and their high accuracy, can be used in large-scale planning in the water and environment study (Aynew, 2003; Timmermans et al., 2007; Sun et al., 2011; Giorgos et al., 2017). Sanaye Nejad et al. (2011) conducted a study to estimate actual evapotranspiration using satellite imagery in Mashhad study area. The results of the study indicate that the images of the mods and the SEBAL algorithm can accurately estimate the actual evapotranspiration on a daily basis in Mashhad sub basin .

Considering the historical importance of traditional orchards, providing and identifying its water needs, is one of the most important issues regarding the maintenance of gardens. However, due to the presence of traditional orchards on the outskirts of the city and the deviation of the outflow of flood during recent years, the debate has focused on the need to supply traditional alternative gardens to the traditional orchards. Hence, the first step in preserving and reviving these gardens is to estimate its water requirement. In this regard, due to the irregular cropping pattern of the mentioned gardens, estimating the need for traditional orchards using remote sensing facilities is considered .

Materials & Methods

The traditional orchards in Qazvin are great importance due to historical dates and habitat of drought resistant species, frostbite, pests and diseases. On the other hand, such as seasonal flood management in these gardens, the importance of preserving these gardens has been doubled. The traditional orchards of Qazvin have spread in three directions in the east, south and west of this city, which in the past few days (less than half a century) has an area of more than 3,000 hectares of productive gardens (Akhavizadegan, 2002). Providing water for gardens

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has been one of the most important issues for gardeners since the past. Water scarcity has been indicative of the central role of water in the sustainability of gardens since the past and has been mentioned in historical records.

The traditional orchards in Qazvin are irrigated from four rivers called Arenjak, Bazar, Zoyar, Dalichay and a flood river called Washteh in winter and spring. The waters of these rivers are mostly covered by melting of winter snow and spring rains from the northern mountains of Qazvin. The irrigation of traditional orchards mostly occurs twice a year; one in winter and one in spring. Due to the development of the city of Qazvin and the problems of exploitation and lack of attention to them, the area of traditional orchards around the city of Qazvin has declined in recent years. So that the area of productive garden plants has reached 3000 hectares in recent years and part of the gardens have been obsoleted. The traditional orchards have different cultivars of productive and non-productive plants. The cultivars in these gardens include grapevines (apple, pear), native plants (plums, cherries and apricots), pistachio trees, almonds, walnuts, hazelnuts and watermelons, grape caviar. Non-productive cultivars are mainly hippopotamus and marginal plants such as sepidar and nastaran.

Today, many studies have been carried out to extract spatially distributed spatial evapotranspiration using large-scale energy balance and remote sensing data. These techniques provide spatial information from the Earth's surface by measuring or emitting electromagnetic radiation. Measurement of thermal, infrared and visible remote sensing bands as input data for parameterizing the energy balance components in the calculation of evapotranspiration. This method includes the determination of surface variables such as surface temperature, albedo, vegetation index and exponential (Weligepolage, 2005).

In this research, ecological law is estimated in traditional orchards of Qazvin using remote sensing techniques and SEBAL algorithm, because SEBAL is an intermediate method that uses both empirical and physical parameters simultaneously (Terreza, 2006).

The components of the SEBAL algorithm are more empirical and require less grounding information. The model includes a number of computational steps for image processing, the final calculation of evapotranspiration and energy exchange between the earth and the atmosphere (Kinoti et al., 2010). In the SEBAL algorithm, by using solar radiation reflections recorded by satellite sensors and using aerodynamic relationships, the amount of energy remaining is calculated as the energy necessary for the occurrence of the evapotranspiration process, followed by the amount of evapotranspiration at the moment Satellite passes.

Landsat 8 satellite imagery is used in this research. Landsat satellite images are Path= 165 and Row= 35 are the main input data. The spatial resolution of the Landsat images is 30 m and the width of the cover strip is 185 km per image. The reason for the selection of the satellite images mentioned above was the high precision of the location and the availability of the images. The images were selected on days without clouds and dust. However, the important feature of the images used is that at the time of maximum water supply needs of the garden has been to provide water. Satellite imagery used to estimate the vegetation index of traditional orchards on dates 2013/06/19, 2013/7/21, 2014/7/21, 2014/7/24, 2015/06/25 and 2015/07/27 for the region studied. Since remote-sensing raw images always have errors in geometry (geometric errors) as well as values recorded for pixels (radiometric errors). Operations related to pre-processing, processing, performing corrections and calculations of image bands using ENVI software. To carry out the SEBAL algorithm, we need air humidity to obtain the temperature of the dew point and wind speed in the study area, which is also provided by Qazvin Synoptic Station.

Discussion of Results & Conclusions

The study of the level and density of vegetation index in traditional orchards around the city of Qazvin showed that despite the fact that the area of green and semi-green gardens (in terms of the threshold of vegetation density) has been greatly reduced. The spatial distribution map of the vegetation index in the traditional orchards area showed that vegetation density index variations are very variable in the study area. In other words, on the basis of the vegetation map of the southern region of Baghestan, it is in a juicy situation. In the western and eastern parts of Qazvin, about 800 hectares of traditional gardening, despite the maintenance of land use, have very poor vegetation, thinness and in some cases it does not have vegetation.

The results of this research and the researches have shown that remote sensing technologies can play an effective role in determining the maps of urban and suburban green spaces, vegetation density analysis, estimating the water requirement and providing an optimal model of water resources utilization. Make estimated initial water requirement using remote sensing capabilities in traditional orchards that have ancient trees, different vegetation densities, varieties of crops and orchards and irregular crop types are important and effective in managing water resources and comprehensive management of green spaces. The results of satellite data show that if the accuracy

of the images used is accurate when selecting the time, using the remote sensing data, factors such as classification and vegetation density and the amount of water requirement can be analyzed. Several studies have confirmed this (Jiang et al., 2010; James et al., 2009; Kundu et al., 2018; Grosso et al., 2018).

Keywords: remote sensing, SEBAL algorithm, vegetation index, water requirements.

The effect of general form and relative compactness of Tehran residential buildings on pollution resulted from heating in winter season

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Expanded Abstract

Introduction

Human's needs to energy and consumption of several fossil fuels lead to increased pollutants like CO₂. House buildings are high consuming subscribers and around one third of national energy is consumed by them. The Iranian architecture with several territorial areas in different seasons has invented and offered rational ways to provide welfare condition of human being. Since regress to the past building methods is not easy and certainly is not accountable for our present life condition, research on the field of designing according to territory by inactive method seems necessary. The main purpose and trend of in designing compatible to territory is the least use of mechanical systems and decrease energy consumption for heating, chilling and the most use of radiation energy. One of the ways of decreasing energy use in this climate condition is to increase absorption of radiation energy through the transparent level of the external cover in the south façade in the cold season. The windows provide the facility of receiving free solar energy and improve the condition of heat and visual welfare for the habitants of the building. Regarding the common technologies in country building industry, there is need to understand optimal ratio of window to the wall.

In this study considering the existing statistics about the residential units and rate of population, the necessity of identifying several types of residential common buildings and their relative aggregate have been considered and will be examined. Computer simulation and field survey have been the main trend of this study. The software of Design Builder calculates the energy consumption rate using the calculation motor Energy Plus.

Material and Methods

This research has been carried out based on library and field studies and from descriptive and semi-laboratory methods and the research instrument, the commercial software of radiant energy have been used to obtain the result. The case of study is Tehran residential common buildings that according to the descriptive design of 2012 is considered as 5 floor buildings. To calculate the types, field observations and air maps of Google earth have been used and by applying the theory of theoretical saturation and comparative adaptation, it has been developed. The residential width that is the problem of the present research includes the main application in Tehran. In field study of Master Plan of Tehran in 2012, of 997 residential application, the average aggregate with 403 number has allocated the most number to itself. Based on this modeling of the research with 5 floor aggregate has been considered.

Also, in this research to recognize compactness of building volume, relative aggregate index has been used. The studies carried out in the field of identifying lack of knowledge shows that the rate of RC is optimal and morphology based on it is a basic step in guiding general form especially guiding architecture design based on it. The most compactness of volumes according to Pasnler & Mahdavi is the geometric shape of sphere with RC equals to 1. As most of the buildings are orthogonal polyhedral, square shape has been the work base which

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relative aggregate of the established morphologies is calculated with the following formula. A study by Pessenlehner & Mahdavi about the geometry compactness and relative compactness has come to this conclusion that RC is the most influential concept on energy efficacy.

Modeling

As the maximum height of residential buildings in Tehran is usually up to 5 floors, the height is divided into 5 parts and in proportion to the common lots in Tehran, the length 6 parts and width 4 parts are also selected. Several states of the setting have been examined regarding to their types and RC in Table 1.

Table 1. Classification of RC and types of residential buildings in Tehran

Types	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 8	Type 9	Type 10
Relative compactness	Volume: 80m ³ Area: 112m ² Rc:0.96	Volume: 90m ³ Area: 136m ² Rc:0.86	Volume: 90m ³ Area: 166m ² Rc:0.70	Volume: 40m ³ Area: 76m ² Rc:0.90	Volume: 80m ³ Area: 152m ² Rc:0.71	Volume: 100m ³ Area: 180m ² Rc:0.70	Volume: 1290m ³ Area: 148m ² Rc:0.95	Volume: 90m ³ Area: 136m ² Rc:0.86	Volume: 100m ³ Area: 160m ² Rc:0.78	Volume: 100m ³ Area: 180m ² Rc:0.70
Typology										
Morphology										

In this article, in order to calculate heat load the software of design builder has been used by inputting climate data in each hour for every territory. In order to estimate the effect of architecture design and the elements used in the building on the demand rate to heating energy, an apartment building with 5 single unit floors in Tehran has been selected and the rate of needed heating energy has been calculated through modeling in software of design builder. In the examined samples, the elements and details of external and internal walls in connection to the used land and flat roof are provided in Table 2.

Table 2. The elements and details of the external and internal walls in connection to the used land and flat roof

Elements	Internal wall	Flat roof	Walls in connection to the land	External wall
Materials	Hemp, stucco walls filled with air	Roof built with concrete	Land elements + foundation concrete filling	Brick wall setting + one layer air + concrete wall+ internal stucco fine working

As it was said, most of energy loss occurs through external coverage in the buildings and in order to decrease the energy consumption, there could increase the rate of energy absorption through the surface of the transparent level of the external cover in the cold season so that the heating load decreases. To do this, the ratio of window to the wall introduced in 10 types in 3 different states of 10%, 25%, 40% has been modeled in software of design builder. In the following, the optimal states of heating load regarding the ratio of opening to the wall in different types will be calculated and analyzed. In the Figure 1, no.3 is shown as a sample on three dimensional modeling with the percent of openings 10%, 25%, 40% of the ratio to the wall and the rate of penetration of radiant energy as its heating load.

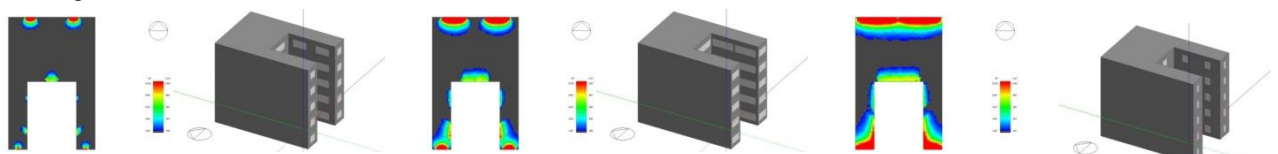


Figure 1. Three dimensional modeling of type 3 with the percent of openings 10%, 25%, 40% of the ratio to the wall and the rate of penetration of radiant energy as its heating load

Discussion and Result analysis

One of the influential factors in the building sector in increasing pollutant CO_2 is increasing energy consumption and as the most energy loss in the building occurs through external facades, the necessity of considering to this façade makes sense. As in climate condition of Tehran in cold months of the year, the rate of energy consumption in order to supply the temperature of heating welfare increases, so the necessity of considering heat load in these months increases. Modeling in 10 types and three states of window to wall ratio led to the analysis of 30 types and for heating load and CO_2 emission characters in the software of design builder, that were evaluated in 6 cold months in Tehran. Figure 2 shows the graph of 10 building types and the rate of heat load and Figure 3 shows the graph of 10 building types and the rate of CO_2 emission in 6 cold months of the year by the ratio of 10%, 25%, 40% window to the wall. In all the graphs, in the months January and February, the most heating load and CO_2 emission and in the months of November and April the least heating load and CO_2 emission are observed.

In the graph of heating load and CO_2 emission with $\text{WWR}=10, 25, 40$ the type of 4 has the least heating load and CO_2 emission in average of cold months in Tehran. The type of 7 with $\text{WWR}=10$ and the types of 6 and 10 with $\text{WWR}=25,40$ have the most heating load and CO_2 emission in average of cold months in Tehran.

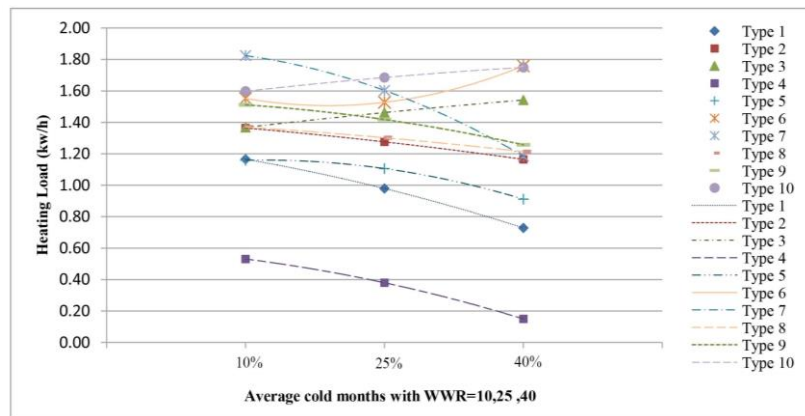


Figure 2. Ten building types and their heating load in average cold months with $\text{WWR}=10, 25, 40$

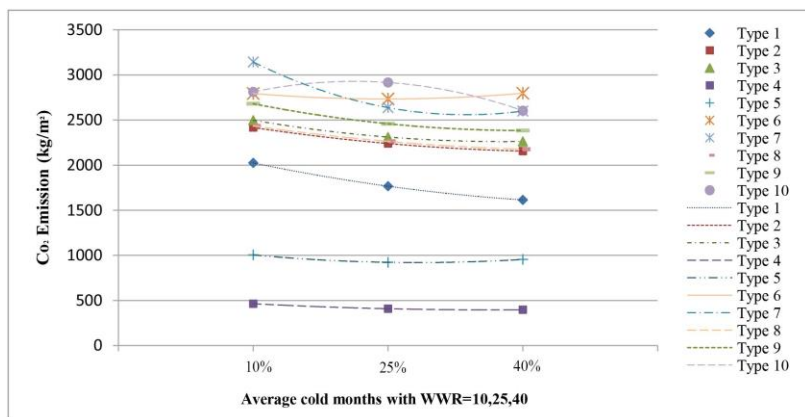


Figure 3. Ten building types and their CO_2 emission in average cold months with $\text{WWR}=10, 25, 40$

Conclusion

Regarding that the increase of heating load leads to increase of energy consumption and the increase of energy consumption leads to more pollution, the present study has been carried out on 10 fold types for Tehran residential buildings. The following results have been obtained:

1. By focusing on the graphs of heating load and CO_2 emission, altogether more heating load increase CO_2 emission increase more and more heating load decrease CO_2 emission decrease more.
2. As increasing window to wall ratio (from 10 to 40%), heating load and CO_2 emission decrease.
3. In general, as the relative compactness of building increases, its heating load and CO_2 emission decrease.

Finally, it was observed that though in general the rate of WWR 40%, the best result is obtained in the rate of heating load and as a result the rate of pollution caused from heating in cold season, but to reach to more exact result, it could consider the factors like orientation and self-shadowing in order to decrease heating load and as a result lowering the rate of pollution caused from heating in winter season.

Keywords: air pollution, relative compactness, typology, window to wall ratio, winter heating load.

Estimate the value of improving air quality in the Tehran City: Application choice experiment method

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Expanded Abstract

Introduction

Air is one of the most important parts of the environment that its pollution has destructive role in human life. Air pollution in Iran is one of the biggest environmental problems which faces different regions of the country, especially Tehran. Tehran is very crowded and very busy, which also exacerbates the air pollution of this great city. Studies show that air pollution in Tehran has various effects, including the presence of airborne diseases, increased mortality and reduced horizontal visibility. According to studies by Tehran's Environmental Protection Agency, 70% of deaths in Tehran are due to respiratory and cardiac problems, which are directly or indirectly related to Tehran's air pollution. According to the World Bank, illnesses caused by air pollution annually as much as 0.02% of gross domestic product damage to the Iran's economy. The condition of air pollution in Tehran is acute.

Effects of air pollution in the event of delay in implementing strategies to reduce this type of pollution may be worse. One of the most important strategies is necessary awareness and public participation in reducing air pollution. The community will have an understanding of the benefits of clean air that knows with pollution what benefits loses. Benefits when better understood that monetary amounts are determined. Therefore, estimating the economic value of different effects of air pollution and estimating the willingness to pay individuals to improve these characteristics is necessary. In recent years, the focus on ecosystem services valuation is rising. In Iran, estimating the economic value of natural resources and estimating the cost of pollution and environmental degradation in the development process and computing it in national accounts is obligatory. In national accounts only consideration is given to the costs and benefits exchanged in the market. In the cases there are not tradable on the market, it will lead to market failure. Environmental resource valuation is a tool that determines the value of non-tradable goods and services in the market. Studies show that so far no study on the value of air quality improvement in Tehran has been conducted using the choice experiment. Therefore, this study is the first study to estimate the value of improving the quality of air in the southwest of Tehran using a choice experiment method.

Materials and Methods

List of properties of that commodity is selected to determine the value of each goods in the choice experiment. Price variable are added to the feature set for simplify of proposed choice set for respondents. In choice experiment method, there are several main options in each selection set, fixed option that shows the status of the current scenario and other options that show scenarios for improving the current status of that product or service. In a choice experiment, respondents are given a series of options with different levels of features and they are asked to choose the preferred option. The choice experiment is based on the theory of Lancaster microeconomic economics and the random utility theory (RUT).

The conditional logit model is estimated using the maximum likelihood method according to Equation (1).

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$$\log L = \sum_{i=1}^N \sum_{j=1}^J y_{ij} \log [\text{Pr}_i(g|C_i)] \quad (1)$$

y_{ij} is an index variable that if the answer i chooses the option g is equal to one and otherwise equal to zero. In other words, the dependent variable in this model is multiplicative (one, zero and zero), unlike the simple Logit model, which is dual (zero and one). The results of the conditional logit model are reliable if the options in the choice sets are independent. Otherwise, the nested logit model is estimated. In nested logit model, assumption of homogeneity variance is observed within each of these subgroups and the assumption of Independence Irrelevant Alternatives (IIA) is preserved within each subgroup. However, variances between different subgroups will be different. After estimating the parameters, WTP is obtained according to Equation (2) for all properties of the choice set.

$$WTP = -\frac{b_c}{b_y} \quad (2)$$

In this equation, b_y is the coefficient of the price property or marginal utility of income and b_c is the coefficient of other characteristics within the choice sets. The model used in this study is expressed as Equation (3).

$$Y = ASC + \sum_{i=1}^6 \beta_i X_i + \sum_{k=1}^n \alpha_k PM_k + \sum \delta_m ASCM_i \quad (3)$$

In the above model β , α and δ is the coefficients of the alternatives characteristics (X), the coefficient of interaction effects of socio-economic characteristics with price and coefficient of interaction effects of socio-economic characteristics with Alternative Specified Constant (ASC) respectively. In the above model, Y is dependent variable that indicates the choice of the optimal option among the three possible options in each choice set.

Data and statistics were obtained by completing questionnaires from households in south west of Tehran with simple random sampling method. Each questionnaire includes the social, economic, health characteristics of the respondents and the choice sets (characteristics studied) and other sub-questions.

Findings and Discussion

The purpose of this study is to estimate the willingness to pay households to reduce each of the effects of air pollution in the southwest of Tehran including increased mortality, reduced horizontal visibility and increased washing costs. Choice experiment method was used to estimate the willingness to pay for each of effects of air pollution. The conditional logit model was estimated to examine the factors affecting the willingness to pay of households to reduce the air pollution. Results of Hausman McFaden's showed that the results of the conditional logit model are not reliable, so the nested logit model was estimated. Results of this model showed that the variables such as age, gender, number of children, educational level, income, awareness of air pollution in South West of Tehran and having a history of heart and respiratory disease are factors affecting the willingness to pay households. Results showed that average willingness to pay for improved levels of absolute and relative of mortality, respectively 102406 and 85359 Rials, for improved levels of absolute and relative of Horizontal viewing respectively 72202 and 24162 Rials, for absolute improved level of cleaning costs 35011 Rials. The average annual willingness to pay per household 319,140 Rials and value improve air quality in the South West of Tehran was obtained 118,705 billion Rials. About 64.8% of the households tended to pay for decreasing air pollution. 35.2% of people were not willing to pay for improving air quality due to reasons (government and polluters must pay, uncertainty of spend cost, low income). According to opinion households, the most common cause of air pollution in the southwest of Tehran is, respectively, timeworn and one-seat vehicles and factories in urban areas and traffic. Households suggested ways to reduce air pollution, including expanding subway lines, public transport and increasing the production of hybrid vehicles.

Keywords: air pollution, choice experiment, nested logit, Tehran, willingness to pay.

Assessing the level of citizens' satisfaction about urban environmental quality (Case study: Hamedan City)

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Expanded Abstract

Introduction

Climate change is a topical subject worldwide and there is evidence that this phenomenon is taking place. Climate change is expected to have serious economic and social impacts. Mounting evidence suggests that climate change will have both short- and long-term impacts on agriculture and the natural resources. Although there is some uncertainty as to the extent of the problem, and when exactly climate shifts will occur, it is anticipated that increases in temperature will lead to more heat stress for crops and make pests and diseases more prevalent. Literature noted agriculture is one of the sectors most affected by climate change and due to smallholder farmers heavy reliance on rainfed agriculture, climate change will increase vulnerability of the rural populations due to food and nutrition insecurity. Climate change is expected to affect agriculture in different ways and to a different extent in different parts of the world and in different agro-ecosystems. In particular, communities in most developing countries have been identified as being the most vulnerable to climate change because of multiple stressors and reduced adaptive capacity. Adaptation is one of the policy options for reducing the negative impact of climate change in agriculture sector. It is a key factor that will shape the future severity of climate change impacts on food production. A wide variety of adaptation options has been proposed as having the potential to reduce vulnerability of agricultural systems to risks related to climate change. In this regard, environmental information includes meteorological and hydrologic observations, analyses, and forecasts are valuable resources.

Meteorological information and forecast can be of value when used in decisions involving risks posed by adverse weather or climate. In fact, climate information is an important pre-requisite for informed decision-making in risk management and adaptation that would help prevent climate extremes from becoming disasters and threats to livelihoods of smallholder farmers.

Climate information and forecast have shown potential for improving adaptation of agriculture to climate shocks, but uncertainty remains about whether farmers would use such information in crop management decisions. Despite tremendous efforts to improve weather and climate predictions and to inform farmers about the use of such weather products, farmers' intension toward forecast use remain poor and farmer use of forecasts has not increased. Because little is known about the motivations underlying farmer decisions to use or not to use weather and climate forecasts, we designed and conducted a survey based on the combining social cognitive theory and Technology Acceptance Model to gather such information from farmers in Dehloran, Iran.

The Technology Acceptance Model (TAM) is a frequently used behavioral model for predicting and explaining information technology usage. A key purpose of Technology Acceptance Model is to provide a basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions. The Technology Acceptance Model identifies two most important factors namely perceived ease of use and perceived usefulness. To date, the Technology Acceptance Model has been used to address why users accept or reject information technology. This model is an adaptation of the theory of reasoned action proposed by Fishbein and Ajzen to explain and predict the behaviours of people in a specific situation. Social cognitive theory (SCT) also is a theoretical framework for analyzing human motivation. Social cognitive theory is a widely accepted, empirically validated model of individual behavior. The theory defines human behavior as a triadic, dynamic, and reciprocal interaction of personal factors, behavior, and the social systems. Social cognitive theory argues that a person's behavior is partially shaped and controlled by the influences of social network (i.e., social systems) and the person's

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cognition (e.g., expectations, beliefs). While social cognitive theory has many dimensions, Bandura advanced two major cognitive forces guiding people's behavior self-efficacy expectations and outcome expectations. In whole, the social cognitive theory consists of factors influencing behavior intention. Therefore, we used environment factors, perception of others' behavior, outcome expectancy and self-efficacy as variables of social cognitive theory in our integrated model. Hence, in our integrated model, two factors of perceived ease of use and perceived usefulness were considered as independent factors, perception of others' behavior, outcome expectancy, self-efficacy and environment factors as mediated and intention to use or not to use weather and climate forecasts as dependent factor. To our knowledge, no studies up to this date have been designed to investigate intention to use meteorological information in Iran. Therefore, the aim of this study is investigate intention to use meteorological information by Iran farmers.

Materials & Methods

In this paper, we address the questions of whether smallholder farmers in Dehloran would intend to use climate forecasts in making crop management decisions and whether such use would lead to benefits. A structural equation model was developed to explore relationships between factors affecting intention to use climate information and forecast. The study was designed as a cross-sectional survey. Target population of this study consisted of 3820 wheat growers. Using a multistage stratified random sampling method, 350 farmers were selected for this study. The sample size was determined using the Morgan table. Data were collected based on a questionnaire structured to assess the components of combining model. We use a self-report questionnaire to examine the proposed research model empirically. A self-report method refers to an approach in which observation data are provided by participants instead of raters or coders. The data were gathered based on a face-to-face survey of farmers. The respondents were assured about anonymity and confidentiality. They were also given the right to refuse participation and also to refuse to answer any question they deemed to be too sensitive or that they felt uncomfortable about. Those declining participation were replaced by other students. No payment was made to the respondents. Answering time for the questionnaire was about 15-20 min. The questions were scored on a 1–5 point scale (very low, low, moderate, high, very high) to reduce the statistical problem of extreme skewness. The survey was pre-tested and piloted on 30 farmers from outside the study area. Cronbach alpha reliability coefficients were calculated for the pilot study and used to refine the questions for the final questionnaire. All scales indicated good-to-excellent reliability, generally 0.76–0.89.

Results

Regarding demographic variables, the participants were aged between 22 to 85 and had a mean age of 44.59 years (SD= 14.24). The farmers' agricultural experience, how long they had been farming at the time of data collection, was distributed across a 1–60 year range, with an average length of farming experience of 18 years (S.D.= 13.65). In main analysis, structural equation modeling (SEM) was used to assess the causal relationships being hypothesized in the proposed model. The results of structural equation modeling obtained for the proposed conceptual model revealed that relative chi square $\chi^2/d.f.= 1.98$ ($P < 0.001$), GFI= 0.83, RMSEA= 0.053, NFI= 0.79, RFI= 0.78, and CFI = 0.88. Accordingly, the summary of the overall goodness-of-fit indices indicated good fit of the model and data. ($\chi^2/d.f.$ value was less than the recommended threshold value 5, RMSEA value was less than the recommended threshold value 0.08).

The finding indicates that Technological Acceptance Model factors (perceived ease of use and perceived usefulness) significantly positively affect three factors of the social cognitive theory (self-efficacy, outcome expectancy and perception of others' behaviour). Perceived ease of use has direct effect on self-efficacy ($\beta= 0.80$, $P < 0.001$) and outcome expectancy ($\beta= 0.27$, $P < 0.001$) and perceived usefulness also has direct effect on perception of others' behavior. Also, perceived ease of use has direct effect on perceived usefulness ($\beta= 0.74$, $P < 0.001$). In addition path relationships revealed that outcome expectancy ($\beta= 0.58$, $P < 0.001$) and self-efficacy ($\beta= 0.26$, $P < 0.001$) had a positive direct relationship with intention to use meteorological information. In fact, findings suggest that respondents' self-efficacy and outcome expectancy help predict whether an individual intends to use weather and climate information. Regarding indirect effect, perceived usefulness and perceived ease of use had a strong indirect effect on intention. The model accounted for 59% of variance in intention to use climate information and forecast. Also, the structural equation modeling revealed that the perceived usefulness ($P < 0.001$, $\beta= 0.72$) can explain 52% of the variation in perception of others' behavior. The finding showed that the perceived ease of use ($P < 0.001$, $\beta= 0.74$) accounted for 55% of the variation in perceived usefulness. Also, finding revealed that the perceived ease of use ($P < 0.001$, $\beta= 0.27$) can explain 62% of the variation in outcome expectancy ($P < 0.001$, $\beta= 0.27$) and 64% of the variation in self-efficacy ($P < 0.001$, $\beta= 0.80$). Also, our finding indicates that in suggestion model environment factors ($\beta= 0.01$, $P > 0.05$) and perception of others' behaviour ($\beta= 0.56$, $P > 0.05$) failed to make a significant and consistent contribution to the prediction of intention to use climate forecast and meteorological information.

Conclusion

Farmers have to varying degrees had to cope with and adapt to climate variability and change for centuries. To successfully transfer costly weather and climate products into meaningful information that farmers can use in their decisions, farmers must understand the products and have the intention and motivation to extract the relevant pieces of information and apply them to specific decision contexts. This study integrated two socio-psychological theories, namely social cognitive theory, with a widely used information system technology acceptance model to provide a comprehensive behavioral model of understanding elderly farmers intention toward using meteorological information. The framework was extended from the original technology acceptance model by considering the relationships among technological factors (perceived ease of use and perceived usefulness), and social cognitive factors (system self-efficacy, environment factors and perception of others' behavior, outcome expectancy), and behavioral intention to use the meteorological information and forecast. The aim of this study was two fold: (1) to understand which socio-psychology factors influence intention to use meteorological information, (2) to examine the use and efficacy of our integrated model in the information technologies.

The study leads to two major findings. First, results revealed that the self- efficacy and outcome expectancy are directly significant predictors of the intention to use climate meteorological. In other word, with increasing self-efficacy and outcome expectancy, farmers will have more intention to use meteorological information. Outcome expectancy was the most effective predictor of intention to use climate information. Perceived usefulness is indirect predictors of intention. Second, regarding the samples, the integrated model fitted considerably well. The proposed model has been proven to be valuable for evaluating and predicting the behavioral intention of climate information and forecast because it provides an integrative perspective that prompts researchers and practitioners to pay attention to the interdependence of these aspects. This study is a justification for using the constructs of this model in politics and decision making that encourages farmers to use meteorological information. The proposed integrative cognitive-technological model may serve as a theoretical basis for future research and can also offer empirical foresight to practitioners and researchers in the agricultural departments and rural communities.

Keywords: climate change, farmers, meteorological information, weather forecast.

Evaluation of groundwater vulnerability of Miandoab plain to nitrate using genetic algorithm

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Extended abstract

Introduction

Limitation of surface water resources and excessive water utilization from aquifers, as well as the pollutants intrusion through the agricultural, urban and industrial activities, cause irreparable damage to groundwater. Groundwater system doesn't respond quickly to contaminants and contaminants reaching time to the groundwater and its release into the aquifer is usually long. Remediation of contaminated groundwater and re-use often takes a lot of time and money and sometimes finding an alternative source of water is not possible. Therefore, the best and most effective solution is preventing the contamination entry to this valuable source. Determining the groundwater contamination level is one of the most important hydrogeological studies, which in this regard, is the identification of susceptible areas and aquifer vulnerability assessment. Determining groundwater contamination is one of the most important hydrogeological studies. In this regard, in identification of the contamination risk areas the aquifer vulnerability assessment has great importance. The Miandoab study area as a most important plain of the Urmia lake basin is one of the agricultural areas in Iran, especially in grape production. Therefore, because of overuse of various chemical and animal fertilizers, it can be a nitrate-contaminated plain. So, considering the importance of groundwater in the Miandoab region is also used for drinking, the vulnerability assessment of this plain. In the present study, the study of contaminant risk areas using DRASTIC vulnerability method has been investigated and the vulnerability map has been optimized using a genetic algorithm.

Materials and Methods

The Miandoab Plain with an area of approximately 1150 Km² is located in the south of Urmia Lake and is a part of the Alborz-Azərbayjan structural zone from the geological viewpoint. The average annual rainfall, based on the thirty years (1989-2018) data from Malekan and Miandoab synoptic stations is about 284 mm per year. This region, based on empirical Emberger method (1952) and using the statistics meteorology data, has a cold and semi-arid climate. Figure 1 shows the location of the study area.

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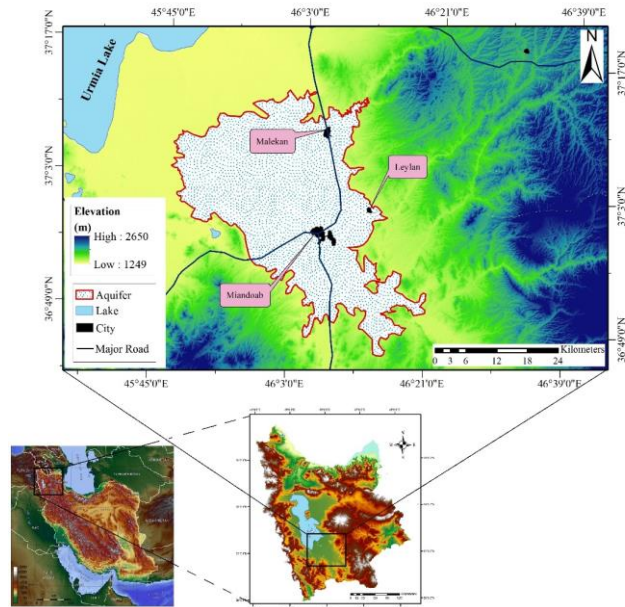


Fig. 1. Geographic location of the study area

The DRASTIC model has been used to mapping the groundwater vulnerability to pollution in many areas. Since this method is used in different places without any changes, it cannot consider the effects of pollution type and characteristics. Therefore, the method needs to be calibrated and corrected for specific aquifer and pollution. The DRASTIC model was improved with several methods such as the artificial neural network. In this study, the genetic algorithm is proposed for groundwater vulnerability.

Results and Discussion

The DRASTIC map was created by applying the weights for each parameter and integrating and overlaying the layers. According to the results of the DRASTIC model for plain, 15%, 10%, 17%, 33% and 25% of the plain, respectively located in areas with very low, moderate, high and very high vulnerability. In the genetic algorithm method, the optimal weights of the parameters were obtained by maximizing the objective function. Based on the genetic algorithm method, groundwater depth, hydraulic conductivity, and unsaturated medium have the most effect on the vulnerability of groundwater in the region, respectively. Figure 2 shows the vulnerability map of Miandoab plain based on DRASTIC and optimized DRASTIC. The optimized map using the genetic algorithm method shows that about 18%, 11%, 28%, 26 and 17% of the plains are located in very low, moderate, high and very vulnerable areas. According to the results of the model, the central parts of the Miandoab plain have been introduced as more vulnerable areas.

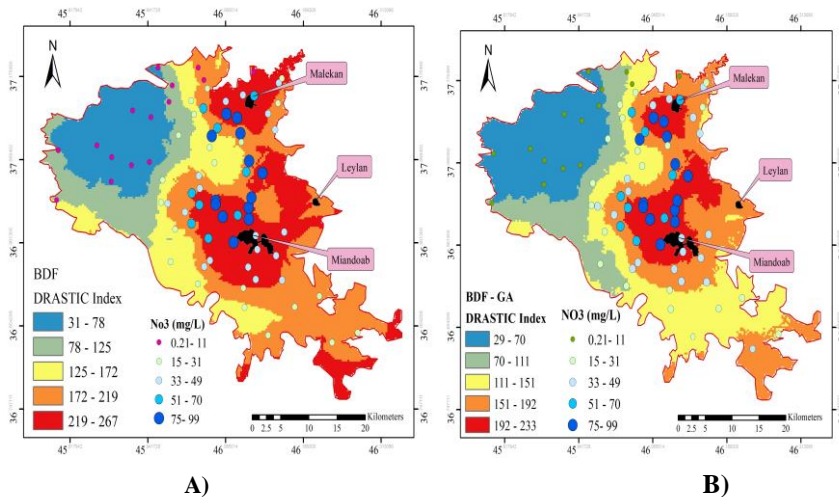


Fig. 2. Vulnerability map using: A) General DRASTIC, B) Optimized DRASTIC using genetic algorithm

Conclusion

In the present study, the study of contaminating risk areas using DRASTIC vulnerability method has been investigated and the vulnerability map has been optimized using a genetic algorithm. The optimized map using the genetic algorithm method shows that about 18%, 11%, 28%, 26% and 17% of the plains are located in very low, moderate, high and very vulnerable areas. According to the results of the model, the central parts of the Miandoab plain have been introduced as more vulnerable areas. Based on the results of correlation index (CI), optimized DRASTIC using genetic algorithm has the highest priority in identifying areas at high contaminate risk due to having the highest correlation coefficient (CI) with nitrate. In general, identifying the susceptible areas to contamination using appropriate methods, sources and contributing factors can be used for proper management and monitoring of groundwater.

Keywords: aquifer, contamination, DRASTIC, genetic algorithm, Miandoab plain.

Evaluation of diversity and functional group as one of the biodiversity indices in response to elevation gradients (Case study: Cheshme Sarkho rangelands, Ravar, Kerman)

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Extended abstract

Introduction

These days profitable development and the need to create new urban land uses to ask needs of urban residents has gradually declined and these located in the incorrect place. It causes, the distribution of green spaces in the city was often inappropriate and social injustice is created. The purpose of this paper is to evaluate the 15 regions of the Isfahan municipality in order to determine regions which have priority for the development of urban green space. Isfahan is one of the metropolises in Iran that has many environmental problems such as drought and water crisis, lack of proper urban land for developing of green space, air pollution, increasing population and vehicles, etc. So, a systematic planning in the field of optimum locating for green spaces is very necessary. This paper looking for answering this question: What is the priority of creating green spaces in 15 regions of Isfahan? So, at first 18 parameters which are effective in the construction of green spaces have been determined. Based on the data available of these parameters in the 15 regions, F'ANP model has been used in order to build composite index and evaluate regions.

Materials and Methods

The diversity of living organisms in natural ecosystems is reduced as a result of human intervention, climate change, and the effects of living and non-living interfering factors. In the past, to investigate the relationship between the functioning of ecological systems and the variety of classical varieties of diversity, this issue was criticized because it was unable to communicate well between diversity and function, and diversity and stability. For this reason, the researchers sought to use indicators that could solve the problem. They described the best way to solve the problem using plant traits and their involvement in diversity indices. Accordingly, they defined concepts such as groups and functional traits. This will have an adverse effect on the ecosystem's functioning and services. In the last decade, significant advances have been made in the use of spatial distribution of plant species in order to understand ecological mechanisms, preserve biodiversity and predict the dynamics of plant masses and the functioning of plant communities. The emergence of any plant is influenced by environmental factors and inter-species relationships that one or more environmental factors have a great influence on the establishment of a species if one can determine these factors and its behavior with the environmental variables of the species. In addition, it is possible to achieve predictive models of species distribution. However, quantitative studies have been done on functional traits at the community and location level. Considering that most of the research work carried out in the country concerned, the study of plant communities, richness and species diversity, so far, there has been little research on the establishment of functional species groups and diversity functional of plants. Such studies in the area of Ravar rangelands is necessary to know the effect of environmental factors such as elevation gradient on functional characteristics that causes the destruction of habitats, biomes and consequently the reduction of species diversity and function.

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Materials and Methods

Sarcho Fountain with an area of 5098 hectares located in the northeastern part of Ravar and north of Kerman province. Its minimum and maximum altitudes are 1880 and 3040 m above sea level. The average annual precipitation is 140 mm. Sampling in a gradient elevation was carried out from 1880 m to 2980 m above sea level. 12 altitude points were taken at a distance of 100 m for vector sampling. In each sampling point, 5 plots were positioned 10 m along the horizontal transect and information of all species within the plots was recorded. The plot size was 1 m² for herbaceous plants and 4 m² for bush plants and 25 m² for shrubs. In each plot, data such as species names, number of species, cover percentage, plant height were measured directly. The height of herbaceous and bush plants was measured using a crop rotation and shrubs using a meter. To illustrate the use of plant species in the community, two functional traits including plant height, vegetative form were directly measured and recorded in the plot, and four other traits including reproduction, longevity, the form of life and type Nitrogen fixation from the sources was collected. Then, the collected data were analyzed using FDiversity software, which was linked with R software (R Core Team., 2014), and the functional diversity and species diversity indices for each plot were calculated. In this study, eight functional variables were comprised of Quadratic entropy (Rao), Functional richness (FRic), Functional evenness (FEve), Functional divergence (FDiv), Functional dispersion (FDIs), Functional attribute diversity (FAD1) and the Modified Functional Diversity Index (MFAD). Also, the varieties of Shannon-Weiner, Simpson, richness and species evenness were also included. The effect of height on functional and species diversity was analyzed by ANOVA and the mean comparison tests in SPSS version 23 software. Nonlinear regressions were also used to study the relationship between variability and height indices infostat software. FDiversity software was used to determine the functional group along the gradient elevation. For this purpose, using functional traits and input method and Euclidean distance of dendrogram groups were extracted. Then height and frequency of species were compared between functional groups.

Results

The results showed that the only indicators of richness, functional evenness and species evenness at different heights did not differ significantly, but the remaining indices were meaningful. It can be said that the height of these indices has an effect. Most indicators of functional diversity show a curved pattern. In the middle elevation, the greatest amount of these indicators is seen. Convergent multidimensional index with $R^2= 0.078$ and FAD1 with $R^2= 0.88$ have the highest R^2 value. The dispersion index of the function and the divergence of function and the richness of function at all points of the altitude is interstitial and has not changed much. As the results show, there is no significant difference between the frequencies of the groups, but there is a significant difference between the heights of the species in different functional groups. According to Figure 4, the height of the species of the functional group was the highest, so that the group was placed in a separate group alone and the height of the species of the other groups was in the same group, with the difference of group 2 had to mean.

Discussion

In the low and high ranges, the rate of functional dispersion decreased, due to the decrease in the frequency of species, but in the middle elevations, with increasing frequency of species, this index also increased. The functional evenness index shows the uniformity of a vegetative feature in a sample or a community, which is conceptually similar to the Simpson Valley uniformity index but varies in terms of its function. Functional evenness shows how varieties are uniform in their impact on system performance. Therefore, in the present study, uniformity in vegetation characteristics is the same in all altitudes, although the variability and variation of the plants vary greatly, but the plants that were present in the area did not have significantly different characteristics and did not change dramatically. Therefore, the height of the effect, it has no meaning in functional attribute diversity (FAD1). The number of combinations of total plant characteristics of a sample or community is equal to or less than the number of species available. The FAD1 index, which is equivalent to species richness, has the lowest performance in elevations. This confirms that, in a situation where the richness of the function is reduced, additional use of food sources occurs and the function decreases. The FAD1 index is directly related to the number of species, in other words, increasing or decreasing the number of species. As a result, the MFAD was introduced to correct the above index. The FEve index showed a poor performance value because it is ecologically complex. This indicator may be further affected by other factors such as competition between plant species and land use. The uniformity of function changes from zero to non-uniformity to one for uniformity. Indicator value by relative frequency of species with uniformity is low. The results of the comparison of the height of six functional communities show that the height of the second community is greater than other communities because it includes shrubs and vegetative forms. All species in the region are multiplied by seed except for the *Iris Sisyrychium*, which is propagated through the underground gut located in a separate

functional community. The results of this research can be used in executive projects because functional characteristics of the ecosystem's intensity and direction are very well illustrated by environmental factors and in understanding ecological processes such as the formation of sequence and sustainability of communities. Also, functional plant features can be used as a management tool for assessing the effects of degradation on natural ecosystems.

Keywords: cheshme Sarkho rangelands, functional diversity, functional traits, plant height.

Urban streetscape quality in Tehran metropolis

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Extended abstract

Introduction

With the emergence of new concepts in massive urbanism and architecture of new millennium, such as quality of urban life, green urbanism, healthy and walkable cities, and with the competition of different cities around the world in order to enhance urban livability, one of the issues addressed in the meantime is improving urbanscape by organizing and identifying urban streetscape and providing vitality of urban streetscape. Necessity of incorporating this issue into Iranian Urbanism is due to the rise of modernity, modernization and modernism over the past decades as well as because of the lack of any comprehensive approach of improving historical streetscape felt more than ever before. Accordingly, this paper is aimed to first develop comprehensive streetscape indicators and present standard framework of streetscape assessing and measuring using "Meta-Analysis" research method based on explaining and analyzing of Iranian and international researchers' theories and domestic and international experiences. Next step in this research is measurement of urban streetscape quality in Tehran Metropolis with a focus on the subjective approach of citizens based on measurement of 60 streetscape indicators in target streets. Thus, in this paper, the comprehensive streetscape indicators has been developed and standard framework for assessing streetscape and measuring quality of urban streetscape in Tehran Metropolis has been presented. Selected approach for selection of measurable indicators is subjective approach. For this purpose, at first, basic definitions and concepts of streetscape have been reviewed and after that, theories of streetscape researchers have been discussed in two sections of Iranian and International theories. Then, in next section of this paper, the most important experience of urban streetscape in different cities has been reviewed, streetscape indicators from scientific and professional points of views are extracted and, finally, theoretical formulation and specific streetscape planning and design indicators are discussed. Then, based on relevant indicators, three streets have been tested using purposive sampling. Accordingly, streetscape quality from residents' point of view is evaluated based on average satisfaction with indicators in each of target street and, finally, last section of this paper discusses the measurement of streetscape indicators in three target streets and then final conclusion of this study is attempted.

Materials and Methods

Due to the mismatch between formation roots and western concepts, when it comes to the study of streets in Iranian urbanism, it is essential to consider Iranian researchers' ideas in this field in addition to world researchers' viewpoints on streetscape. Therefore, in this paper, we have tried to exploit theories of Iranian researchers worked in this field whom are mentioned in references and throughout research process in order to comply with Iranian culture and environment. Besides, western researchers are cited for extraction and documentation of common indicators existing in international research literature. It is worth noting here that in addition to the roadway surfaces, street scale and its functional realm are also meant within pedestrian space included in this urban space. Accordingly, street in this paper means urban space where cars move easily and, at the same time, appropriate space for movement and other civic activities by pedestrians is provided. In this way, first, once streetscape and basic concepts are brought up and theories and viewpoints of Iranian and international researchers and major domestic and international experiences on streetscape are considered, using "Meta-Analysis" research method, comprehensive streetscape indicators are developed and a standard framework is provided for streetscape evaluation. Following this, streetscape indicators in three streets are measured.

Weighing criteria of relevant indicators is arithmetic mean of relevant indicators considered by citizens which include 300 people according to Neiman sampling.

Discussion of Results

In this paper, in order to identify and document streetscape dimensions, criteria and indicators, first, definitions and concepts of urban streetscape are considered and then theories and thoughts on streetscape in 30 Iranian and international studies are refined, authors of which were selected considering citing frequency of their studies in related major scientific papers. In the following section, the most important domestic and international experiences on urban streetscape are discussed. The aim of this section is to find a theoretical framework to extract streetscape dimensions and indicators by reviewing experiences of major streets in the world. The difference between this section and last one is that it tries to extract streetscape indicators from scientific and professional experiences viewpoint in a sample of most important cities of the world. In order for this, 18 successful domestic and international experiences are reviewed and relevant studies are analyzed focusing on dimensions and indicators of streetscape. In the next section of the paper, general streetscape indicators are summed into 706. Following this, common indicators provided by Iranian and international researchers and also domestic and international experiences of streetscape were omitted and then, final indicators of streetscape in particular and in accordance with Iran conditions were extracted considering 4 following requirements: frequency of each indicator, selecting subjective indicators based on study's objectives (focused on subjective indicators), selecting measurable indicators (measurability through questionnaire), and urbanism and worldview conditions of Iran. Regarding this, 60 streetscape indicators in particular and according to Iran's conditions based on these requirements are extracted from general indicators and are provided as supermatrix of specific streetscape planning and design indicators in Table 1. This supermatrix has been formulated in two parts including: Iranian and international theories and domestic and international experiences. Iranian and international researchers and domestic and international experiences are placed in 48 columns and streetscape indicators are placed in 60 rows.

Conclusions

In this paper, comprehensive streetscape indicators were formulated and a standard framework was provided to evaluate streetscape and measure urban streetscape quality which has been a major urban planning and design priority during recent years. Besides, streetscape quality from citizen's point of view was evaluated based on average satisfaction with indicators. As research literature review in developed countries shows improving streetscape results in better environmental quality and desirability of streetscape and image of city and eventually urban competitiveness. Therefore, street planning and design guidelines in Iran focus on traffic and geometric conditions of streets. They considered objective indicators where less attention was paid to specific streetscape indicators from urbanism and subjective indicators point of view. On the other hand, in Iran, there is no comprehensive framework of streetscape to be taken as manifesto or guideline of action. In this regard, there is no criterion and indicator for evaluation of desirability or undesirability of streetscape as the most important component of urban form. This paper, first, formulated comprehensive streetscape indicators and then provided a standard framework for evaluation of streetscape. This step was carried out in two parts including refining the theories of important researchers on streetscape considering domestic and international opinions and refining the most important and successful international experiences. Eventually, 60 main measurable streetscape indicators were documented focusing on subjective approach and based on particular urbanism conditions in Iran and they were provided considering researchers and relevant indicators in the form of supermatrices of indicators and theories. In the following section of this research, first, a questionnaire was formulated based on indicators extracted from former step and then purposive sampling and determination of sample numbers were carried out, based on which three target streets were selected and in the next step, based on the questionnaire, data was collected in target streets, which was tested and refined according to research topic. Finally, each indicator in each street was studied and the existing situations of target streetscapes were compared. By reviewing general condition of target streets which include their social, physical and environmental conditions, it was found out that Naser Khosrow street with 2.7 scores, stands in top, Valiasr Street with 2.6 scores stands next and eventually, Enghelab Street with 2.2 scores is the last in rank. Social, physical and environmental condition of none of the streets was considered by local pedestrians and residents in average level of satisfaction.

Keywords: streetscape, subjective approach, indicator, measurement, Tehran metropolis.

Investigation of farmers' preferences to participation in payment for ecosystem services (PES) program of Ghazvin plain watershed

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Extended abstract

Introduction

From the beginning of 2000's, payments for environmental services (PES) have emerged as innovative instruments for environment conservation policy. Indeed, they allow translating non market values of ecosystems into financial incentives for local stakeholders who produce these services, thus increasing the acceptability of conservation policies. PES are voluntary agreements, under which direct beneficiaries of environmental services are willing to pay (incentive) the service suppliers, under the conditionality of effective service delivery. PES have been especially implemented for watershed protection to reduce erosion, regulate water flows, enhance groundwater recharge, mitigate floods and improve water quality.

The study of the world's environmental situation reflects that there is abundant evidence and many ecosystems have suffered from over-exploitation and mismanagement, to the point where their long-term viability, and thus their ability to provide services, is at risk. This is commonly explained by a lack of institutions, including markets, which could otherwise guide the supply and demand for ES. Externalities, a lack of well-defined property rights and limited information hamper efforts to optimize ES provision between those who benefit from an ES and those who affect its provision. PES programs are one potential solution to this problem. PES programs use conditional payments to encourage individuals and communities to undertake environmentally beneficial land management actions. They help internalize the benefits associated with enhancing or maintaining ES to ensure that land managers face incentives concordant with the interests of ES users. To improve the likelihood of achieving intended environmental benefits, PES programs should be designed to suit local circumstances, both in regard to the environmental problem at hand and the social context. An important part of adapting PES to a particular circumstance is taking into account the preferences of those targeted for participation. Therefore, it seems to be possible to implement it in many plains and ecosystems of the country and minimize the problems of resource mismanagement.

The increasing interest arisen by this type of instrument can be explained by the possibility to negotiate the contractual terms and the choice of conservation measures, the voluntary and free character of the subscription and the opportunity to adapt contractual terms and conservation measures to the local context (type of ecosystems and services providers). Moreover, in developing countries, PES may contribute to poverty reduction through the provision of additional income to vulnerable rural people.

Materials and Methods

The choice experiment approach chosen for this research, is based on stated preferences, and aims at understanding the determinants of individual choices. Individuals are placed in a hypothetical choice situation, as close as possible to reality where they are asked to compare several alternatives. Each alternative is described with attributes, with varying level or intensity, which are assumed to influence individual choices and, consequently, the utility associated with the attributes by individuals. Alternatives are selected and paired

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according to an experimental design and utility variations are assessed using an empirical model specified according to the random utility theory.

We use a choice experiment to quantify farmer preferences for PES program design. Choice experiments are often used to value environmental goods or services, but can also be used to value environmental programs represented as combinations of attributes. For instance, a PES program will combine a particular payment amount, a particular payment method and a particular set of land use requirements in order to create a functional program. Choice experiments can be used to quantify preferences for individual program attributes, as well as to quantify overall 'willingness to accept' (WTA) values: the amount of payment required to induce participation in the program. Valuably, choice experiments can test multiple, hypothetical versions of a program simultaneously. In a choice experiment, participants are asked to choose between competing hypothetical goods/ outcomes as described in a questionnaire. The hypothetical good/ outcome is a package of attributes, each of which can take on a number of levels being varied between scenarios. It is assumed that farmers face a loss of utility due to the changes in management practice required by a PES contract, and a gain of utility from the associated payment. A farmer is assumed to choose a contract if the net utility from that choice is greater than either no contract or any competing choices. Based on random utility theory, the probability of a farmer making a particular choice is assumed to increase as the utility of that choice increases. The willingness to accept (WTA) for a marginal change of a given attribute is measured by the ratio of two parameters statistically significant. WTA confidence interval is estimated using the "Delta" method proposed by Hole, 2007. When the parameter of the attribute or of the payment is not significant, WTA measure has no sense. The estimated model is a conditional logit which represents the observed indirect utility function.

Results

The first step in CE consists in choosing the attributes to describe the hypothetical PES, and in defining the number and value of attributes' levels. In our case study, the chosen attributes are related to, on one hand, different methods of serving ecosystems, and on the other hand, incentive measures aiming at encouraging farmers to join the PES program. Attributes were chosen as bellow:

- a) Changing the pattern of cultivation of cultivation, which have two levels as yes or no
- b) Improve irrigation methods, which have two levels as yes or no
- c) Cash payments to single farmers, which have five levels as 0, 5,000,000, 10,000,000, 15,000,000, 20,000,000 IRR
- d) Non-payment (agricultural land utilization by new methods of irrigation), which have two levels as yes or no
- e) Conditionality, which have three levels as low, moderate and high.

To conceive the choice sets it to be submitted to interviewees, all the possible combinations of the levels of all attributes have been generated. The choice sets selected for the experiment include two alternatives in addition to the status quo (opportunity to opt out). The selection of choice sets among all possible combinations was based on a reduced and D-Optimal approach of 16 alternatives, which have been distributed into two blocks, respecting orthogonality within and between blocks. Each respondent was faced with eight different choice sets.

In this study, survey was administrated to 144 household heads randomly selected among the 3 stratified of Qazvin plain. Farmers were questioned in face-to-face interviews. Surveys were undertaken in private and took an average of 42 min each. Enumerators were experienced research assistants, who were also local community members familiar with the culture and farming practices found in the study area. Interviews were requested with the 'head of household'. In addition to the eight choice sets, interviewees were also asked about their perception of the present state of the environment in the studied area, as well as their activities and their socio-economic and demographic characteristics.

The results of this study indicate that farmers are willing to participation for ecosystem services (PES) program. In this study, we assess farmers' preferences to three different levels of conditionality, two methods of payment and two methods of service delivery. Two methods of payment are as fixed annual cash payments to single farmers and non-payment (agricultural land utilization by new methods of irrigation) that are significant. So, these methods are affected on motivating farmers to participate. Two methods of service delivery are as changing the pattern of cultivation and improve irrigation methods that are significant but farmers prefer to change the pattern of cultivation. In addition, by increasing the constitutional level, the probability of participation decreases.

Keywords: choice experiment, conditional logit, payment for ecosystem services, Qazvin plain, willingness to accept.

The role of water resource management in controlling quantitative and qualitative water resource changes due to climate change in the catchment area of Zarivar wetland introduction

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Expanded Abstract

Introduction

Today, the climate change is one of the most important environmental and urban challenges. The negative effect of the climate change could be reduced through a proper management of water resources. The objectives of this research are to investigate the role of water resources management in controlling quantitative and qualitative changes of water resources due to climate change in the catchment area of Zarivar wetland. A watershed is a natural area created during a specified period of time and under a natural environmental situation which soil is saturated by surface and groundwater and includes biotic succession. This ecosystem contains the specific plants and animals adjusted to its climate conditions. The watershed's benefits include: groundwater feeding, flood water control, providing a suitable habitat for wildlife and plants and other environmental values, sand dune stabilization and preventing desertification. The research question is: "What is the impact of water resources management in maintaining and restoring the quality of water resources due to climate change in the catchment area of Zarivar wetland?"

The previous literature in this field indicates the negative impact of climate change on water resources throughout the world. It also shows an urgent need to proper and effective management of water resources to provide necessary adjustment with climate change and vulnerability reduction of such resources. There are related literatures on Zarivar Lake concerning the quantitative and qualitative change of water resources in Zarivar watershed basin indicating the lack of integrated water resource management in this region. Therefore, the quality of water resource management functioning should be assessed to discover the reason for increasing vulnerability of this basin. However there is a lack of research investigating the effectiveness rate of water resource management on restoring and maintaining the quality and quantity of water resources. Zarivar wetland with an area of 2000 acres is located in the city of Marivan, the western part of Kurdistan province. The water of Zarivar watershed is provided by spontaneous underground springs and several rivers. This wetland is internationally recognized as an important one because of its rich fauna and flora, rare species and immigrant birds. However, the excessive urban growth, human intervention and climate change are serious threats for the future of this wetland. It should be noted that because of having a dry and semi-arid climate, Iran is included in vulnerable countries in terms of climate change. So, it will be a great loss to such national and international environmental treasures, if environmental issues are ignored in urban planning. According to the related studies, there is a meaningful reduction in rainfall rate and relative humidity, increasing in the amount of dust, winds and temperature in watershed basin of Zarivar wetland. Hence, restoring and maintaining of the wetland is just possible through the management of its watershed basin. The conceptual model of the present research regarding the accomplished studies is represented in Figure 1.

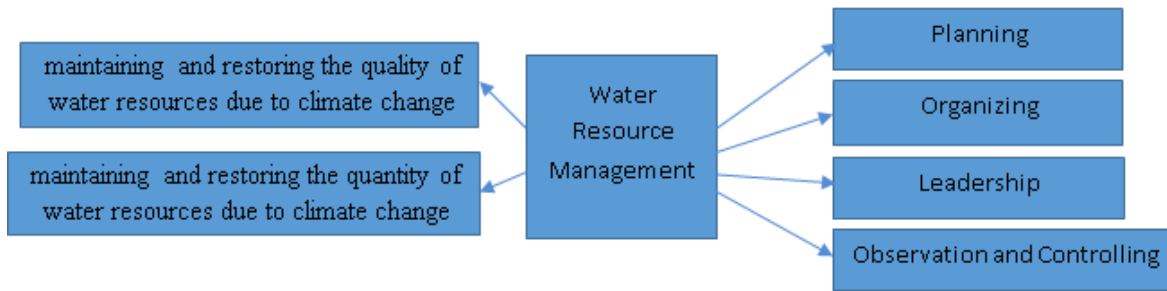


Figure 1. Conceptual model

Material and Method

The overall method applied in the present study is quantitative. The type of research on the basis of purpose is applied research and according to the nature of research is descriptive and correlational. Data collection in theoretical foundations section is carried out through library studies and by made questionnaire in field research section. Partial least squares method is utilized for data analysis of questionnaire and structural equation modeling by smart PLS software. The samples of this study are consisted of 56 specialists and experts in the field of natural resources an environment as well as managers in charge of water resource section in Marivan city. For the validity determination, the questionnaire was given to a group of expert critics and some issues were corrected by them and finally the sample size calculated 49 by applying Cochran formula.

Conclusions

At the first stage, by partial least squares structural equation modeling, a model of measuring was determined through reliability and validity analysis. At the second phase, the structural model assessment was carried out through path analysis and measuring coefficients between latent variables as well as the model fitting. Figure 2 indicates that the effectiveness rate of water resource management on restoring and maintaining the quality and quantity of water resources are 0.401 and 0.413, respectively. So, there are moderate relationships. Water resource management is also under the influence of 4 indexes including: planning (0.796), organizing (0.904), leadership (0.840), and observation and controlling (0.760). According to the results, all 4 indexes have high impact on water resource management.

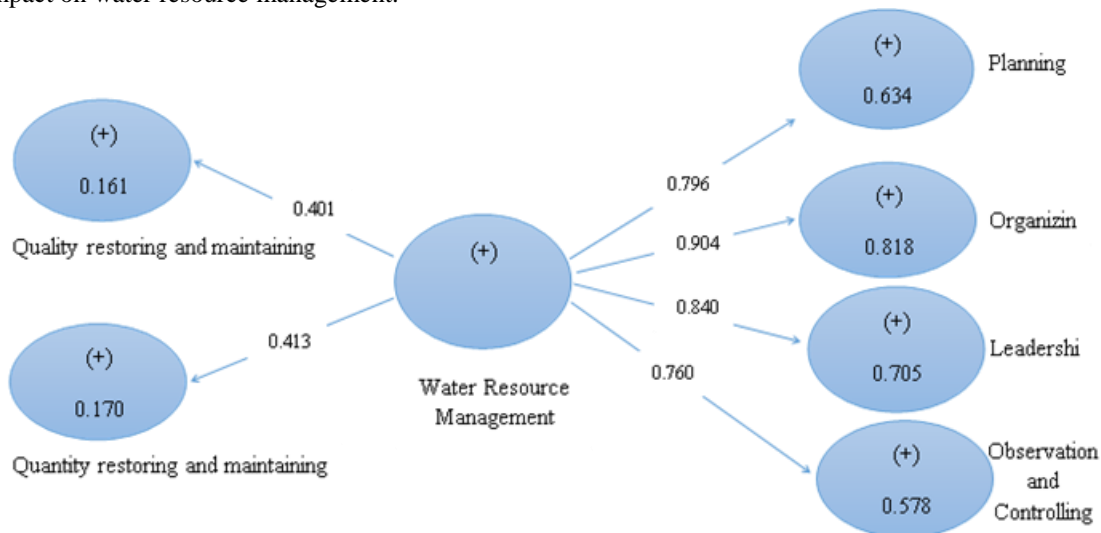


Figure 2. Path coefficients

Discussion of Results

According to the investigation, there is a meaningful reduction in rainfall rate and relative humidity and temperature increase in watershed basin of Zarivar wetland; so, it is gradually going towards climate change. The results analysis and interpretation of structural equation modeling represent the rate of effectiveness of water resource management on restoring and maintaining the quality and quantity of water resources of watershed basin of Zarivar alongside of climate change is 0.401 and 0.413, respectively. These numbers indicate the

negative moderate relationships showing the weak function of water resource management. Despite the inappropriate situation of water resource quality and quantity of watershed basin of Zarivar, water resource management could not be effective considerably on restoring and maintaining the quality and quantity of water resources alongside the climate change. So, there is an urgent need for a proper water resource management in this basin as Shamir et al. emphasized the importance of more efforts on water resource management role and duty when there is a climate change. Therefore, it is highly recommended for managing sector of the region to be correspondent with UNFCCC for improving the situation of water resource of Zarivar lake basin. It is also suggested that the formation of a coordinating council for Zarivar watershed basin would be a great help to join and coordinate different managing sections in charge of water resource of this region. In addition, accurate research and investigation is necessary to enhance the effectiveness of water resource management in this area. The constant investigation and measurement of water resource quality and quantity would be helpful as well. Another beneficial way is providing proper training programs for people to understand the importance of maintaining water resources and preventing them from being polluted and have a volunteer partnership in water resource management programs. Last but not the least, some policies should be made for confronting offenders concerning the water resource issues.

Keywords: