Investigating the Trend of Water Level Changes in Allahabad Wetland Through the Use of Temporal Images

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Abstract

Wetlands are some of the most important ecosystems on Earth. They play a key role in alleviating floods and filtering polluted water and also provide habitats for many plants and animals. Wetlands also interact with climate change. Over the past 50 years, wetlands have been polluted and declined dramatically as land cover has changed in some regions. Remote sensing has been the most useful tool to acquire spatial and temporal information about wetlands. In this paper, digital processing of satellite images was used to investigate the trend of water level changes in this wetland. Therefore, ETM + and OLI sensor images related to 2017 and 2000 were obtained from the USGS database and processed by image classification (ML) method. Image processing accuracy of both periods based on kappa coefficient was more than 70%. The results of comparing the water body of the wetland in the two periods show a significant increase in water level in the cold season in the wetland and has a significant relationship with rainfall in the region. Due to the lack of ground information related to the condition of the wetland in the first period of the field study, the method used in the present study was able to monitor the changes in the wetland with relative appropriate accuracy.

Keywords: Allahabad Wetland, Yaghobad Lagoon, Multi-timed images, Supervised classification.

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Flood Zoning in Urban Areas Using Hydrological Model and Survey Data: Case Study of Bardsir City, Kerman Province

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Abstract

This research explores the role of hydrological modelling in geographical information system (GIS) and survey data as crowdsourcing (CS) data in flood risk management in the study area of Bardsir, Kerman Province, Iran. Conducting this research required spatial data including topography, land-use and hydrology. These were collected from relevant organizations. Also crowdsourced data were gathered through interview survey in the study area. Modeled and survey inundation maps of the study area were produced using HEC-RAS and crowdsourced data analysis indicating the Inundation area of 1.13 km^2 and 2.25 km^2, respectively. The results of comparison of these maps with the real data indicated 59.16 and 80.07 percentage accuracy. The combined inundation map of the HEC-RAS and CS showed an increase in accuracy result to 80.27 percentage indicating the effectiveness of crowdsourced data in flood risk management. Based on these results, researcher can collect crowd sourced data regarding previous flood occurrences in the study area to improve the hydrological modeling in regard to the design of flood plain extent and determining cross section of rivers. Combined results of hydrological modeling and crowdsourcing can assist decision makers and planers in managing flood risks.

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Supplying Environmental Water of Gavkhoni Wetland by Improving Agricultural Water Demand Management

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Abstract

Wetlands as bird habitats play an important and crucial role in the socio-environmental system. Water restriction which resulted from high water losses in agriculture dried up the wetlands in arid regions. Eco-environment water right could appropriately be improved by agricultural demand management in the region. The purpose of this study was to evaluate the efficiency of different scenarios for the management of agricultural water improvement including "modernization and upgrading agricultural water distribution systems", "improvement of irrigation systems performance in farms", "crop pattern optimization" and "reducing groundwater resource withdrawal". Furthermore, this paper attempts to assess the combination of these scenarios to save the eco-environment water right for the wetlands. For this purpose, Zayandehroud watershed, consisting of six irrigation networks and Gavkhuni wetland was selected as the case study. The WEAP software used to model an integrated water management. Additionally, the efficiency of the scenarios was evaluated and the reliability index for these scenarios was obtained. The results displayed that the most flexible scenario was the implementation of all scenarios with flexibility index of 87.3% followed by "modernization and upgrading agricultural water distribution systems", "crop pattern optimization" and "reducing groundwater resource withdrawal" with a flexibility index of 81.6%. The least flexibility index belonged to the two scenarios of "improvement of irrigation systems performance in farms", "crop pattern optimization" with a 2.2% and 2.6% value for the flexibility index. Therefore, the implementation of the combination of all management scenarios for agricultural water demand could be the most sustainable solution for the restoration of Gavkhuni wetland.

Keywords: Crop pattern optimization, Gavkhoni wetland restoration, modernization of water distribution systems, WEAP model.

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Investigation, Modeling and Analysis of Qualitative Parameters of Groundwater Resources in Kurdistan's Kamyaran Plain

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Abstract

Groundwater is an important part of the world's renewable water, accounting for about 60% of available renewable water resources. Due to the importance of this issue, this study was conducted to investigate the quality of groundwater resources in Kamyaran plain, Kurdistan. For this purpose and in the first step, 42 samples from the plain wells were withdrawn and analyzed using APHA method in a laboratory. Afterward, six key parameters were examined. These parameters are important parameters in drinking water and agricultural standards. Then, by examining the Root Mean Square Error (RMSE) of two well-known interpolation methods (Kriging and Inverse distance weighted (IDW)), the IDW method according to its lower RMSE was selected for zoning. The results showed that the electrical conductivity and total dissolved solids factors had many fluctuations in this plain and its range was identified for EC from 15000 µmhos/cm to 600 µmhos/cm and for TDS from 10200 mg/lit to 45 mg/lit. Using the drinking water quality standard, it was found that the concentration of the studied qualitative parameters in the groundwater resources of this plain, except for the pH parameter in some villages, is within the permissible range. Mainly the northern and southern parts of the plain have lower water quality. Therefore, with the identification of areas with poor quality in this study, priority areas for water quality improvement and areas which need to manage in prospective of groundwater resources withdrawal were identified.

Keywords: Water quality, Zoning, Groundwater, Kamyaran Plain.

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The Effect of Human Interventions on Bed and Right of Way of Faroub Roman River and Its Flood Characteristics

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Abstract

Since Iran is located in an arid and semi-arid region and because of flood damage in recent years, flood management studies are very important. The destructive effects and widespread human interventions in the river bed of the country have occurred in different ways. Therefore, hydraulic simulation of rivers is necessary to predict flood damage, flood control and other studies. In this study, a distance of 7 km from the Faroub Roman River in Neyshabur has been simulated. Modeling was performed for return periods of 2 to 100 years in two modes: with construction and no construction along the river using Arc GIS and Hec-RAS software. Then, effect of structures on the rate change of depth and width of flood was considered. The sensitivity of hydraulic parameters on discharge was also investigated. To study the changes in the riverbed, aerial photos of 1347 and 1398 were used and compared. The results showed the negative impact of structures on increasing the depth and area of floods due to human interventions in the river. Interventions have caused 16% increase in flood area and 30% increase in flood depth. By investigation of the area of flood plain, it was found that the amount of land area which is below the water is 85000 square meter. According to the results, the riverbed has been moved since 1347. The riverbed area has been reduced from 550 hectares to 330 hectares and the riverbed has decreased by 40%. Sensitivity analysis showed that the maximum error of the model and the observed water level was 6%, which can be understood with the desired accuracy of the model.

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Determining the Vulnerable Areas of Ajabshir Plain Aquifer Using Drastic Method Optimization by Genetic Algorithm and Fuzzy Logic

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Abstract

In recent decades, increasing of population and development of technology and, consequently, intense agricultural and industrial activities have exposed groundwater resources to a variety of pollutants. Ajabshir plain, located in the southwest of East Azarbaijan Province and southeast of Urmia Lake, is one of the areas that has faced groundwater contamination and needs more qualitative studies. In this study, first, the conventional drastic method was used to investigate the potential of nitrate contamination in Ajabshir plain, and then the optimization process was performed using the methods of genetic algorithm and fuzzy logic (Sugeno). The index values in the conventional drastic method were obtained from 87 to 145, as well as the drastic index values obtained by considering the weights of the genetic algorithm and optimization with fuzzy logic, from 47 to 74 and 0.01 to 0.6, respectively. According to the allergy classification, the ordinary drastic is located in low, low to medium, and medium to high ranges, in which areas from the north of the plain and the north of Ajabshir city had moderate to high vulnerability index. Also, the optimized variables with genetic algorithm and fuzzy logic are in the safe zone in terms of contamination potential due to lower index values than 79. The normal drastic correlation coefficient, genetic algorithm, and fuzzy logic method with nitrate concentration were 0.2,73, 0.57, and 0.796, respectively. Therefore, the results show the superiority of the fuzzy logic method over other methods.

Keywords: Ajabshir Plain Aquifer, groundwater vulnerability, DRASTIC, genetic algorithm, Fuzzy logic.

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Evaluation of Two Combined Hydrological Black Box Models for Flood Forecasting in the Halilrud River Basin

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Abstract

Forecasting river flow in flood conditions is an essential part of river engineering studies that, if accurately estimated, can greatly contribute to the effectiveness of management programs and reduce financial and human losses. Using appropriate models and increasing the accuracy of these models will lead to improvements in the accuracy of prediction results. One of the available solutions to increase the accuracy of existing and valid rainfall-run-off models is to build a combined model with the help of preferably intelligent methods link to these models. In the present study, the combination of WEAP 21 hydrological model with black box models based on ANN and GMDH methods is used to increase the accuracy of WEAP model and then the created model was used to simulate the flood of part of Halilrud river in Kerman province. Precipitation, flow, humidity, wind and temperature data were entered into the WEAP model for the existing record minus the last two years. After calibrating and validating the model, the last two years were forecasted. The results showed that the WEAP-ANN ($R^2 = 0.78$) model was able to estimate the run-off with higher accuracy compared to the WEAP-GMDH ($R^2 = 0.59$) and WEAP ($R^2 = 0.14$) models in the basin.

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Measurement and Evaluation of Water Pollution and Coastal Sediments in Estuaries of Bandar Abbas

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Abstract

One of the problems that threatens coastal ecology is the entry of urban wastewater into the sea by estuaries. Discharge of wastewater into the four estuaries of Bandar Abbas pollutes the coast of the Persian Gulf, which is a priority for the development of management strategies to reduce the risk of pollution. In order to realize this approach, the present study measured the physicochemical parameters of water and heavy metals in the sediments of the four estuaries of Bandar Abbas, including Sooro, Goursoozan, Shilat and Nakhle Nakhoda estuaries during four seasons in 2019 and evaluated by pollution indicators. The results showed that the concentrations of DO, BOD, COD, TSS, Cd, Zn, NO_3, PO_4, detergent and oils in the four estuaries of Bandar Abbas were higher than the environmental standard. The difference in temporal and spatial distribution of water quality pollutants was significant at the level of 95% and its maximum was in Goursoozan and in terms of time in summer, spring, autumn and winter, respectively. The average pattern of heavy metal concentration in the sediments was Zn> Cu> Pb> Cd which means concentrations were 103.20, 52.55, 19.95 and 0.611 mg/kg, respectively. The maximum metals were in Goursoozan and the evaluation of metal in sediments with I_{geo}, CF, mdc and PLI indices showed that Cd, Cu and Pb in four estuaries of Bandar Abbas, in the category of moderate to severe pollution. High concentrations of heavy metals indicated the impact of human activities, including the discharge of wastewater into the estuary.

Keywords: Dissolved oxygen, Heavy metals, wastewater of Urban, Goursoozan estuary, Pollution load index.

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Evaluation of Ecological Flow of Lorestan Herrud River Using Hydrological Methods

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Abstract

Given the global water crisis, the need for planning in water conservation is one of the most important development plans of any country. In order to preserve the existing ecosystems in catchments and also due to lack of water resources and inappropriate temporal and spatial distribution of rainfall in the country, it is necessary to consider the environmental needs of rivers. In the present study, the environmental needs of the Herrud River catchment area located in Lorestan Province in two hydrometric stations of Kakarza and Dehno during a long-term statistical period of 40 years was investigated using the following: hydrological methods of tenant, tesman, aquatic basin flow, flow continuity curve analysis, and change of the flow continuity curve using GEFC software and smokhtin. The analysis of the trend of discharge changes in Kakarza and Dehno basins was investigated using Monkendal graphic test and the results showed that it is not possible to imagine a trend for Herrud river in the location of Kakarza and Dehno hydrometric stations. Among the mentioned hydrological methods, the method of changing the flow continuity curve is proposed compared to other methods, considering ecological management classes and paying attention to the natural fluctuations of river flow and trying to maintain these fluctuations environmental flow. These are more efficient. The results showed that in order to maintain the environmental needs of the Herrud River, in class C (lowest acceptable ecological status) in Kakarza and Dehno stations, 49.47% and 56.34% of the average annual flow (5.63%, respectively) and 1.42 cubic meters per second) is required. It is important to note that the methods presented in the present study are not a definitive solution for environmental flow assessment, but the use of these methods in the absence of the necessary ecological information and for initial planning is useful for managers.

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Effect of Geometry on Classification of Flood Flow Source in Naplarood Forest Watershed of Mazandaran Province

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Abstract

Lack of studies in forest Watersheds due to the hydrometric stations absence always causes many problems for managers. The Naplarrood watershed, which has a permanent flow throughout the year and includes many villages downstream, can be the basis for the development of the region in the future with principled and scientific planning. This research tries to extract some of its important features by geometric analysis of Naplarrood Watershed. Therefore, in this study, 12 effective physiographic factors were used in the field of flood current origin. These factors include river channel bed slope, roundness coefficient, compaction coefficient, Horton coefficient, elongation coefficient, equivalent rectangle length, equivalent rectangle width, slope percentage, slope aspect, branch ratio, drainage density and time of concentration. Then, in order to determine the source of flood flow, all effective factors were rated and weighed based on the used data. Then, flood flow was prioritized using single parameter sensitivity analysis method, as the effective factors in the source. According to the results of sensitivity analysis, three factors of river slope bed, slope percentage and drainage density with weights of 7.42, 6.72 and 6.64 were identified as three important factors in the source of flood flow. Among the effective factors, three factors of drainage density, equivalent rectangle width and branching ratio had a higher optimal weight than the initial weight assigned to them, which shows the importance of these three factors in the origin of flood flow in forest basins.

Keywords: Geometry, Time of Concentration, Drainage density, Flood management, Physiographic factors.

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Determination of Agricultural Water Prices Based on Sustainable Development Criteria, Case Study of Qazvin Irrigation Network

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Abstract

Choosing the right price for agricultural water and investigating the effects of economic, social, and environmental interpretations are among the essential economic tools in the agricultural sector to manage water demand in the current situation in the country. For this purpose, the present study has estimated the price of agricultural water and investigate its intermediate impact based on economic, social, and environmental indicators in the Irrigation-Network of Qazvin. First, the agricultural economy's existing conditions in the network range and by the economic model of mathematical planning were simulated by GAMS software, simulated and possible factors of farmers to elect price scenarios and their interaction effects are studied. Finally, the degree of importance and ranking of the impact of economic, social, and environmental indicators by the TOPSIS process was used to achieve acceptable price and water labor in the irrigation network. The results showed that the maximum and minimum economic value of water in the irrigation network is related to rapeseed and alfalfa products, respectively, 3142 and 2177 IRR per cubic m. Also, the average economic value of water in this network was estimated at 2731 IRR per cubic meter. The results of water scenarios by the economic model showed that increasing irrigation water prices reduced the gross profit of crops in the irrigation network, as well as applying price scenarios, leads to increased unemployment in the study area. As a result, 2490 and 2731 were determined as two reasonable prices in the irrigation-network. Higher prices were selected as the best prices.

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Investigating the changes in the water body of Gorgan Bay and its relationship with precipitation and water level of the Caspian Sea by using remote sensing data

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Abstract

In the present study, long-term (1999 to 2019) and seasonal changes (2018) of the area of Gorgan Bay and their relationship with the changes in precipitation and water level of the Caspian Sea have been studied. The long-term water body was calculated by using the time series of Landsat8, Landsat5 and Sentinel-2 satellites imagery, and by employing the Modified Normalized Difference Water Index2 (MNDWI2). Data from Topix and Json satellites were used to study the changes of the Caspian Sea water level. Also, the TRMM satellite data was used to study the precipitation changes. The results showed that the water body of Gorgan Bay has decreased significantly during the study period and this trend continues. The long term changes in the water area of Gorgan Bay have a high correlation (0.92) with the amount of fluctuations in the water level of the Caspian Sea. It is worth mentioning that during this 20-year period, the changes in the water level of the Caspian Sea have been about 120 cm. But the correlation between water area and precipitation in the long period is low (0.1). This trend is quite the opposite in a short period of one year and since the changes in the water level of the Caspian Sea in a period of one year is very small (5 cm), so the water area of Gorgan Bay has a very low correlation (0.09) with it. But in the same period, there is a relatively moderate correlation between rainfall changes and the area of Gorgan Bay water body with a delay of one month.

Keywords: Gorgan Bay, Remote Sensing, Water Level, Water Body, MNDWI2 Index.

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Effects of Fluctuations of Persian Gulf Sea Surface Temperature and the El Nino-Southern Oscillation (ENSO) on precipitation variability in the South-Central parts of Iran

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Abstract

The present study tries to analyze the individual and the coupled effects of the sea surface temperature (SST) and the El Nino-Southern Oscillation (ENSO) on precipitation variability in the South-Central parts of Iran over the period of 1957-2019. The SST data comprise the monthly time series of this variable over eight grids located in various parts of the Red Sea (1 grid), Persian Gulf (1 grid), Oman Sea (2 grid) and the Arabian Sea (1 grid). In addition to these gridded data, the SST-precipitation relationships are also examined for differential values of these gridded datasets. Correlation coefficients are consistently found to be negative when monthly or seasonal SSTs are regressed with corresponding precipitation data in all considered stations. The strongest correlations are found when differential values of SST (The Red Sea minus eastern parts of the Persian Gulf) are regressed with precipitation data in Sirjan. Differential values have generally yielded stronger correlations than if the data of a single grid are used. Fluctuation of the SSTs data over the Red Sea, western parts of the Persian Gulf and eastern side of the Arabian Sea exhibited strongest relationships with rainfall variability over the study area. In contrast, the less significant associations are observed for the grids that are located over the Oman Sea. The SST-precipitation relationships are found to be negative during both the warm and cold phases of ENSO.

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Estimation of Event Based Run-off Coefficient Using Artificial Intelligence Models
(Case study: Kasilian watershed)

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Abstract
In this research, estimation of the Run-off Coefficient (RC) is carried out depending on land cover. Initially, RC modeling was performed using 54 hourly rainfall and corresponding run-off data during the period 1987–2010 in the Kasilian watershed. Artificial Neural Network (ANN), Adaptive Neuro-Fuzzy Inference System (ANFIS) and Support Vector Regression (SVR) models and effective factors including rainfall intensity, Φ index (the average loss), five-day previous rainfall and Normalized Difference Vegetation Index (NDVI) were used to estimate RC. The results showed that the ANN model was more efficient than the other two models and had Mean Bias Error (MBE), Coefficient of Determination (R^2), Nash–Sutcliffe Efficiency (NSE) and Normalized Root Mean Square Error (NRMSE) equal to 0.08, 0.85, 0.84 and 0.37, respectively for the training phase and 0.12, 0.76, 0.74 and 0.47 for the test phase. In general, since RC plays a major role in hydrological mechanisms and flooding. Thus, optimal estimation of RC can be helpful in better management of soil and water conservation and erosion and sediment management in this area.

Keywords: Artificial neural network, Normalized difference vegetation index, Run-off management, Soil and water conservation.

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Prediction of Combined Effect of Climate and Land Use Changes on Soil Erosion in Iran Using GloSEM Data

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Abstract

Soil erosion is a complex process with adverse environmental impacts. Today, on a global scale, by modeling the effects of natural and human factors on the severity of soil erosion, it is possible to determine the main drivers of ecosystems, for effective policy-making in optimal soil management. Therefore, in this study, to assess the severity of soil erosion in Iran watersheds, the validated data set of the Global Soil Erosion Modeling project (GloSEM database) were used. This project includes a baseline scenario (2015) and future forecasts (2070) of soil erosion with the effects of climate change in three scenarios RCP2.6, RCP4.5 and RCP8.5 on rainfall erosivity factor (R) and the effects of land use change in three combined scenarios SSP1-RCP2.6, RCP4.5 SSP2- and SSP5- RCP8.5 on vegetation (C) and soil protection (P) factors. The results showed that the vulnerability of central, southern, and eastern watersheds was higher due to climate change and land use change compared to other watersheds. In these areas, even without considering the effects of climate change, the trend of soil erosion changes in the baseline scenario (2015) with SSP2-RCP4.5 and SSP5-RCP8.5 scenarios has been increasing, but declining in humid or semi-humid areas in the north and the west. Considering the combined effects of land use and climate change, the trend of soil erosion changes between the baseline scenario (2015) with the scenarios of SSP1-RCP2.6 (with an average increase of 184%), SSP2-RCP4.5 (with an average increase of 243%) and SSP5- RCP8.5 (with an average increase of 341%) has been increasing in all watersheds except Aras watershed. The results of the study indicate the vulnerability of more than 10 times in the central watersheds of Iran due to climate and land use changes by 2070.

Keywords: Prediction of soil erosion, Land degradation, Climate models, Global model of soil erosion, Watershed management.

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Effect of Natural Flood Spreading of March 2019 on the Quantitative and Qualitative Characteristics of Groundwater in Floodplain at the End of Gorganroud Basin

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Abstract

In order to investigate the effect of flood in March 2019 on quantitative and qualitative changes of groundwater, the floodplain at the end of Gorganroud river basin, which was naturally exposed to floods, was selected. To investigate changes in groundwater quantity and quality, 17 and 11 observation wells with suitable distribution in the study area were selected, respectively. Then, quantitative (groundwater level) and qualitative data (11 physicochemical parameters) of wells were collected in two periods before and after the floods. First, groundwater level changes in two periods were evaluated by paired T-test and average groundwater level of the plain. Then, physicochemical characteristics changes in two periods were evaluated using paired T-test. Finally, hydrogeochemical changes were assessed using Gibbs, Durov and Piper diagrams, and the water quality for agricultural and drinking purposes were investigated using Wilcox and Schoeller diagrams. Paired T-test results showed that the groundwater level in 88.2% of the observation wells after the flood had a significant increase. This has increased the groundwater level as well as the unit hydrograph of the plain (about 2 meters) after the flood. The results of changes in groundwater quality parameters showed that the amount of EC, anions and cations (except NO_3) decreased in most of the observed wells after the flood. This has reduced the hardness of groundwater but has not had a significant effect on the type and hydro-geochemical faces of floodplain groundwater. The reason can be the hydrochemical similarity of infiltrated water and groundwater of the plain aquifer.

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Study of Salinity Spatial Variations
(Study Area: Hoz Soltan Watershed)

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Abstract

Soil salinity is one of the factors limiting plant growth and causing land degradation. The purpose of this study is to apply and provide access to soil salinity database which are inaccessible in arid and semi-arid regions using laboratory methods and GIS techniques. In this research, an attempt has been made to identify the soil salinity trend and its minerals by digging 8 profiles with an average depth of 1.5 meters and sampling water from 4 points on a transect from the Kenic line to the Playa in Hoz-e Sultan Qom. Soil water samples were taken from each soil profile at the end of the growing season in late Shahrivar and were analyzed in the laboratory. The results showed that the trend of salinity changes from Kenic line to Playa is such that chlorides, sulfates, carbonates and finally calcium carbonates are observed, respectively. This trend was significant in Hoz-e-Soltan region. In this study, soil PH range from 6.5 to 8.9, salinity starts from 1.5 ds / m / m2 near the Conic line and increases to 2.30 ds / m2 next to the salt pan. Also, in the study area, sodium (soda) soils, the percentage of exchangeable sodium is more than 15 and the ratio of sodium absorption in the saturated extract is more than 13.

Keywords: Soil salinity, Spatial changes, Kriging, Hoz Sultan.

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Uncertainty Evaluation of the Performance Indicators of a Reservoir System under Climate Change (Case Study: Namroud Dam)

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Abstract

Climate change is one of the major challenges for the management and planning of water resources. When evaluating the state of a reservoir system, consideration of uncertainties can present a more accurate picture. The present paper evaluated the uncertainty of performance indicators in the reservoir of Namroud Dam, located in the Hablehroud Basin, under climate change in the upcoming period (2021-2040). Accordingly, statistical downscaling for the upcoming period was performed using the output of the EC-EARTH general circulation model under RCP4.5 and RCP8.5 emission scenarios and the LARS-WG6 model. The basin run-off in the upcoming period was estimated using the IHACRES hydrological model. In addition, the changes in demand were calculated while taking the future inputs of the climate variables into account. The water resources system was modeled using the WEAP model. Finally, based on the changes in the river flow and using the Monte Carlo simulation, this study evaluated the performance uncertainty of the Namroud Dam reservoir under the current conditions and climate change. Moreover, it investigated potential adaptation strategies to reduce the demand (meeting 85% and 70% of the agricultural demand). The results showed the highest values of the stability index for the 30% reduction in agricultural demand under the RCP4.5 emission scenario. Under this scenario, the changes in agriculture in Firoozkooh and Garmsar decreased by 20.64% and 34.2%, respectively. However, the reduction in demand alone is not sufficient to improve the system's performance. Compared to other indicators, the changes in the stability index were more limited, and thus more reliable for assessing the system state. While uncertainties make it complicated to evaluate the effectiveness of climate change adaptation scenarios, they help increase the reliability of such strategies.

Keywords: Namroud Dam, Climate change, Uncertainty, WEAP, System performance indices.

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Application of Synthesis of Fe$_3$O$_4$-powder Activated Carbon Magnetic Nanoparticles in Removing Arsenic from Aqueous Media

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Abstract

Water resources contamination with arsenic resulting from industrial or agricultural activities causes many environmental problems. One of the mechanisms for arsenic removal from aqueous media is the surface adsorption process. In this study, walnut shell chemically activated by zinc chloride, sulfuric acid, potassium permanganate was used for optimization. Powdered activated carbon produced by iron oxide nanoparticles, and Fe$_3$O$_4$ magnetite were prepared by depositing iron on activated carbon to remove the toxic metal arsenic from aqueous media. The synthesis of PAC-AC/Fe$_3$O$_4$ was prepared by chemical co-precipitation method and the physical and structural properties of the adsorbent were analyzed by FESEM-EDX, TEM and FT-IR techniques. Then the effect of pH changes (2-10), contact time (15-240 minutes), amount of adsorbent (0.02-0.1 g), initial concentration of arsenic (2-12 mg/1) were examined and optimized; isotherm and reaction synthetics were also determined. The optimal conditions for arsenic removal contained magnetic adsorbent pH=2, and 0.02 g of adsorbent at a 6 mg/l concentration at medium temperature. Also, fit diagrams, Freundlich and quasi-quadratic models were determined as isothermal and kinetic optimal models, respectively. The Freundlich model (R^2 = 0.999) yielded the maximum absorption of 33.44 mg/g and second order equation of (R^2 = 1). The present study suggested that the synthesized adsorbent had a high potential for the removal of arsenic contaminants. Walnut shell can be used as a suitable adsorbent because of its waste in the country.

Keywords: Activated Carbon, Arsenic, Isotherm, Surface Adsorption, Walnut shell.

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Critique and Review of Desirable and Present Food Baskets of Iranian Society Using the Water and Food Nexus Approach

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Abstract

The community food basket, as a link between the agricultural sector and water resources, can be used as an indicator to assess the environmental sustainability of the community food supply. Therefore, in this study, the water and food nexus for the two desirable food baskets of the Ministry of Health (DMH) and the present food basket (PFB) of the Iranian society were investigated. The results revealed that in terms of the impact of food baskets on the environment, the DMH food basket has blue and gray water footprints equal to 736 m^3/person/year and 36.7 m^3/person/year, respectively. Among food groups, the food group of meat, eggs, legumes and nuts has the largest share in water footprints. Replacing the desired food basket (DMH) with the PFB will reduce 383 MCM/year of surface and groundwater resources withdrawal and 102 MCM/year of gray water footprint production. Survey of economic desirability of food baskets, revealed providing the DMH food basket costs approximately 7700000 Tomans/person annually, which is approximately 400 thousand Tomans less than the cost of providing the PFB for each person. Considering that a significant share of the cost and footprints of the DMH food basket belongs to the meat, eggs, legumes and nuts food group, replacing the products of this group with foods that have less water footprints, lower costs and sufficient nutrients is recommended. In general, the DMH food basket is introduced as a suitable economic and environmental alternative to the present food basket.

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