

Future studies of water crisis in Iran based on processing scenario

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Abstract

According to studies by 2050 more than 15 percent of world people, most of them are in the Middle East and Africa will experience severe water crisis. Future water crisis is one of the most potential for international conflict and security challenges that have the potential to become a major international crisis. Iran as a country with abundant water stress and is located in the critical regional Middle East, faced with the worrying prospect, that If do not set the correct management and favorable domestic and international policies for the future, will be environmental crises, political, social, economic and even military- security inside and outside the political boundaries. Aspects and consequences of the crisis could challenge the country's independence and territorial integrity. Therefore, it is essential to recognize the consequences and how to manage them. The most accurate and the best way to know the future events, scripting, which in this study based on the main drivers water issue in Iran: 1) Population growth, 2) Growing demand for consumption and 3) Climate change, the drivers is extracted based on Delphi method and the Panel of Experts, four possible scenarios could be discussed. The four scenarios include: 1) Iran is unsafe; escalation of the crisis, 2) Defuse the crisis, 3) The postponement of the crisis in the short term, 4) The postponement of the crisis in the long term. By postulating each of these scenarios, can be a precise roadmap and strategy for correct management and reasonable facing a water crisis for coming years, prepared and placed on the agenda of organizations and institutions.

Keywords: future studies, Iran, panel of experts, processing scenario, water crisis.

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Evaluation of potential evapotranspiration and pan evaporative methods by lysimeter data in a semiarid climate (Case study: Qazvin Plain)

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Abstract

Iran was located in the arid belt and desert region of the world. This climatic situation was presented in several parts of Iran such as Qazvin. Evapotranspiration is one the most important parameter which was effect on agricultural development. There are different methods for estimating this item which selected by climatic conditions. This research concentrates to evaluate 28 empirical and combined methods in Qazvin plain. Lysimeter data was selected as a base data and daily results of 28 methods was evaluated with lysimeter. The results showed that Hargreaves-Samani as empirical method and temperature group with $r=0.87$, $RMSE=0.34$ mm/day and $MBE=-0.71$ mm/day is best method in Qazvin. Orang from pan evaporative method was more appropriated daily results with lysimeter data. To estimate evaporate from free water surface, Penman 1948 is the best method which has highest correlation coefficient (0.7) and lowest standard error (1.65 mm/day) and also mean absolute error (8.63E-6 mm/day). Amount of average evaporating from water surface with Penman method was calculated 10.18 mm/day.

Keywords: evaporative pan, hargreaves samani, lysimeter, potential evapotranspiration, Qazvin.

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Evaluating a new combined drought index based on remote sensing data (RCDI) in Central Iran

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Abstract

Monitoring and evolution of drought is the first step in any drought management system. In this study, evaluation of a new index a new method is provided to monitor the severity of drought with Remote Sensing Combined Drought Index (RCDI). The index is based on the fact that drought is a natural phenomenon caused by a combination of various factors such as a shortage in the amount of precipitation, less than the average long-term rainfall, temperature higher than normal and the properties of the soil moisture. The new index is a statistical index comparing the present hydrometeorological conditions with the long-term average characteristics in the same interest period within the year. Three data sources used in the RCDI index includes rainfall, temperature and vegetation data. In the present study, remote sensing data of TRMM and MODIS are used to provide the required data of RCDI index in central Iran for mapping the spatial distribution of drought over the period 2001-2004. Accuracy of the RCDI index based on satellite data carried out using the evaluation criteria of R and RMSE compared with soil moisture values based on monthly data of 50 synoptic stations in 95% confidence levels. The results of the evaluation criteria showed that drought severity index calculated by the RCDI index in accordance with soil moisture values had the significant correlation (0.61) and the lowest estimation error (1.98). Thus, a RCDI index could well use in drought early warning systems.

Keywords: Central Iran, combined drought index, drought monitoring, remote sensing, satellite data, soil moisture.

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Monitoring and assessment of water health quality in the Haraz River, Iran using macroinvertebrates indices

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Abstract

Some macroinvertebrate indices of stream health have been identified as most useful and efficacious. Management decisions can be made with greater awareness. The objectives of this study were to assess the biological water of the Hazar River using macroinvertebrates. The Haraz River is one of the best freshwater ecosystems in the Mazandaran province located in the north of Iran. To assess the macroinvertebrates diversity in the study area, Simpson index was used. This parameter is 0.25 of the area. These include the EPT index. The HBI is a index of stream organic. We identified 2 Class, 3 order, 16 families of macroinvertebrates. some sites of the case study were indicated to have a very bad condition. Especially, the downstream sites are affected by indiscriminating mining for construction-grade sand from alluvial reaches is among the most disastrous one. Diversity within the benthic macroinvertebrate community was described using the Simpson's diversity index. The Biotic Index was based on their tolerance to organic pollution , creating the Family Biotic Index (FBI). In this survey, biotic index of Haraz River was 5.72 which places in the rank of fairly substantial pollution likely this survey.

Keywords: bio-indicators, Haraz River, macrobenthos, water health quality.

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The investigation of bank stability and toe erosion because of surface flow using BSTEM model (Case study: Beshar River)

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Abstract

The Vital need for river management is understood and predict of bank erosion processes. Almost models will not be able to evaluate bank erosion, accurately. BSTEM model is the most usable model in many of river engineering projects in the world. Necessary data for this model are related to driving and resisting forces controlled by hydraulic and Geotechnical processes. These data include geometry, hydraulic and Geotechnical data that using of sampling, field measurements and laboratory test obtained. The results of this study showed that the regions with cover vegetation in comparison to the region of cover vegetation without significant differences in sustainability observed. Safety factor in the regions without cover vegetation is less than 1 that river in this section is unstable. Among the region of without cover vegetation only section 3 (event 4) have shown a safety factor less than 1. Compare the sections of viewpoint safety factors have shown that sections 5, 6, 8, 7, 3, 1, 4, 2 were unstable, respectively. Compare the sections showed that the events of 4, 2, 1 and 3 have the most impact on sections usability, respectively. Results of the sensitivity analysis model to input parameters indicated that safety factor has the most sensitive to height, water level and cohesion between particles with a variation coefficient 55%, 17% and 10%, respectively.

Keywords: bank erosion, Beshar River, instability, model, safety factor, toe erosion.

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Cropping pattern optimization by using of TOPSIS and genetic algorithm based on the capabilities of GIS

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Abstract

One of the core elements of water management and increase agricultural productivity is the efficient use of available resources. Due to increasing demand for agricultural products, increase the productivity of scarce resources is essential. Optimal utilization of these resources, in addition to meet the demand of the community as a major goal, can also increase operating income to be followed. One of the solutions for increasing productivity in the agricultural sector is reforming is the pattern of cultivation according to different parameters. In this study, using economic criteria, water requirements and crop season in the TOPSIS multi-criteria decision, efficient products were selected. Furthermore, by combining these results with the parameters of the water and common time development of products using a genetic algorithm, the optimal cultivation area allocated to each product specified. In addition, by using GIS spatial capabilities and parameters of different locations and combined with optimized data, map the optimal model has been developed crops. The results show that using the models used and the capabilities of GIS, suitable cropping pattern can be achieved, and, on average, raised by about 25% efficiency and the use of available resources.

Keywords: genetic algorithms, GIS, increasing productivity, optimization of cropping pattern, TOPSIS.

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Prediction of gully erosion susceptibility in Seimare region using certainty factor model and importance analysis of conditioning factors

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Abstract

Gully erosion constitutes a major problem in natural resources management and soil conservation, which causes severe land degradation in arid and semi-arid areas. Therefore, determination of gully prone area and identification of gully conditioning factors can help to managers and decision makers to reduce the hazard of gully erosion. The aim of this study is to predict the gully erosion susceptibility using certainty factor (CF) model and importance analysis of gully conditioning factors in the Seimare region, Lorestan province. At first, the raster dataset of gully erosion conditioning factors (e.g. altitude, slope degree, slope aspect, distance from river, topographic wetness index, stream power index, landuse, soil and lithology) was created using geographic information system (GIS). By means of field surveys, a total of 100 gully locations were identified and these locations were divided into two groups (1) training of the model (70% gullies), and (2) validation of the model (30% gullies). After calculation of CF and Z indices of certainty factor model and model calibration, the gully erosion susceptibility map was prepared using ArcGIS10.2. The validation of the gully susceptibility map was conducted based on the receiver operating characteristic (ROC) curve method, and validation dataset. The resulting gully susceptibility maps showed 85.6% accuracy. Therefore, it was established in this study that the CF model is promising of make accurate and reliable spatial prediction of gully susceptibility. Furthermore, the result of sensitivity analysis indicated that soil, lithology, and slope angle are most important factors in gully susceptibility prediction.

Keywords: conditional probability, probability of gully occurrence, Seimare region (Lorestan), sensitivity analysis, spatial prediction.

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Identify tele-connection patterns affecting on rainfall in Karoon basin

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Abstract

The Tele-connection patterns are the major constituents of climate at global and regional scale(s). The Karoon Basin is of a vital stance in providing natural water supply and hydroelectric; this basin is facing major fluctuations in rainfall regime. Identifying the effect of Tele-connection on great Karoon Basin rainfall regime is the subject of this study. To accomplish this objective the seasonal-annual rainfall volumes recorded at stations related to this basin are assessed for the period of (1956-2012) through 12 Tele-connection patterns. The method applied here is the data analysis through correlation statistical techniques and analysis of the main climatic components. In this basin, 49.7% of precipitation is of the winter followed by autumn with 34.9% and spring with 14.9%. The findings of the analysis indicate that the precipitation in autumn is influenced mostly by NINO4, NINO1+2, NINO3.4 and SOI patterns. The analysis of winter and spring precipitation reveals the influence of SCAN⁺ phase on both these seasons. The precipitations of the basin do have a harmonized change pattern with Tele-connection pattern by addressing the delay time. It is deduced that these indicators can contribute to moist and dry cycle's occurrence when the planning regarding this basin is of concern.

Keywords: ENSO, Karoon basin, rainfall regime, scandinavia index, tele-connection.

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The use of LAPSUS model to estimate the runoff and sedimentin the Kakhak paired catchment of Gonabad

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Abstract

In this research introduced the LAPSUS model as a runoff, erosion and sediment model in Iran. This model for the first time has operated in Iran at Kakhk paired catchment of Gonabad. LAPSUS model is a Landscape Evolution Model that can estimate the runoff, erosion and sediment at the four stages include: calculate the effective rainfall, runoff routing, calculate the capacity of sediment transport and calculate the rate of sediment transport. The input to the models include DEM, amount of rainfall, runoff coefficient, convergence factor, discharge and slope exponent, erodibility and sedimentation potential factors. The result showed that the LAPSUS model is able to show runoff, erosion and sediment as a raster maps for each rainfall event. The result showed LAPSUS model has a normalized RMSE of 3.5 percent for runoff and 2.6 percent for sediment. Also, coefficient of determination is 99% for runoff and 97% for erosion and sediment. On this basis, due to limited and available inputs, this model can be introduced as a runoff, erosion and sediment model in Iran.

Keywords: LAPSUS model, LEM model, routing, sediment transport capacity.

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Optimization of release from Gheshlagh reservoir based on hydrological uncertainty conditions

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Abstract

Dam reservoirs supplies water resources for drinking, agriculture, and industry almost in all parts of Iran. Lack of proper utilization rules and unbalanced demands versus available water has led to many problems regarding to ineffective use of the water resources. Precipitation and flow rate are stochastic phenomena. Therefore, multi-step processes related to the water use efficiency should be considered during the decision-making systems. The aim of this study was to optimize the maximum allowable release from Gheshlagh dam reservoir using linear and dynamic programming models in a one-year time scale. Therefore, Linear and dynamic programming models were applied in Gheshlagh dam reservoir, which supplies the drinking water of the Sanandaj city. Results indicated that the two-parametric log-Normal model appreciably describes monthly water stream flows entering to the reservoir. Thus, this model was applied to compute the stream flow rates with 95, 90, 80, 70, and 50 percent probabilities in each month. There was a good consistency between the drought periods estimated from precipitation data and stream flow rates and 51 months drought period was used in modeling procedure. The results of the maximum allowable release and storage optimization showed that the linear programming model is superior to dynamic modeling approach.

Keywords: dynamic programming (DP), linear programming (LP), optimum release, reservoir operation.

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The potential uptake of heavy metals by aquatic plants in Dez River

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Abstract

In order to evaluate the *Phragmites australis*, *Myriophyllum spicatum* and *Potamogeton perfoliatus* aquatic plant species as an indicator organism of heavy metals pollution in bio-monitoring studies of the aquatic ecosystems, the aim of this study was to determine the levels of heavy metals accumulation Zn, Cu, Pb and Cd in sediments, roots, stems and leaves of these plants in north and south of two stations of Dez River. 3 samples of surface sediment (to 10 cm depth) with 700 g weight of each station by plastic tools were collected and sampling was carried out of each different organ of plants. Results showed the highest and lowest of metals were measured in sediment Zn (270 ± 55.33 ppm) to (240.33 ± 50.22 ppm) and Cd (1.10 ± 0.09 to 1.60 ± 0.06 ppm), respectively. The concentrations of heavy metals in sediments and plants poses the same trends: Zn > Cu > Pb > Cd. The highest of Zn by *Ph. australis* in root (300.45 ± 60.22 ppm), *M. spicatum* in stem (104.43 ± 20.66 ppm) and *P. perfoliatus* in leaves (122.35 ± 21.44 ppm) were showed. According to results, three plants were showed potential for heavy metals and for each metal selectivity and could use for environmental monitoring.

Keywords: Dez River, heavy metals, *Myriophyllum spicatum*, *Phragmites australis*, *Potamogeton perfoliatus*.

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