

## Qualitative evaluation of surface water resources of Hiv basin

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### Abstract

Water quality in each area, indicates the impact of geology, climate and anthropogenic pollutants. Monitoring of water quality in most cases result in complex data shows the perfect act of water resources, so they need appropriate method for analyzing. In this study hydro-chemical evaluation of Hiv basin which located in west of Hashtgerd have been done. To measure the concentration of main cations and anions, totally 12 samples from surface water resources at the year 1393 and 1394 were collected. By Wilcox diagram which shows the capability of water for agriculture, the class of the water set in C2S1 that is suitable for farming. According to scholler diagram, water consumption for drinking is acceptable and also in comparing to Iran standard and International standards, it is admissible. Piper diagram which use for hydro-chemical assessments, shows that the class of water set in CaSO<sub>4</sub> (anhydrite) and CaHCO<sub>3</sub> which are for evaporate rock and hard water, respectively.

**Keywords:** Hiv basin, scholler, water quality, water resources, wilcox.

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## Investigation of Malikan plain groundwater's pollution to arsenic

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### Abstract

The presence of Heavy metals anomalies in groundwater resource and their effect on human health through both drinking water and agricultural activities is a serious worldwide. Because of with the distribution of these elements in groundwater of Malikan plain, the information does not exist, this study were performed to evaluate heavy metals, especially arsenic in groundwater and to determining the most important factors on the arsenic anomalies of plains. Therefore, 27 samples were collected from groundwater resources in September 2014, and hydrochemical analysis were carried out in hydrogeology laboratory of Tabriz university as well as some heavy metals such as iron, aluminum, manganese, arsenic and chromium were analyzed by Atomic absorption- Graphite furnace method in Water quality control laboratory in East Azerbaijan Province. In this study the random forest (RF) algorithms, as a learning method based on ensemble of decision trees, are used for the first time in this context for evaluating of arsenics vulnerability. The RF technique has advantages over other methods due to having, high prediction accuracy, non-parametric nature, ability to learn nonlinear relationships, and ability to determine the important variables in the prediction. To model induction, five categories of explanatory variables, including aquifer characteristics, heavy metals, driving forces, remote sensing and physical-chemical variables, containing 24 variables, accompany with the response variable (arsenic) were entered into the model. Based on RF model predictions, transmissivity, nitrate, hydraulic conductivity and residential areas, were identified as the most effective parameters for having arsenic anomalies. The presence of high correlation between the amounts of nitrates and arsenic implicates the same origin for these ions. Based on the purposed model, 13% of the plain area is very low 53% low, 21% moderate, 11.5% high and 1.5% very high vulnerable to the arsenic contamination.

**Keywords:** arsenic, groundwater, Malikan plain, nitrate, random forest, transitivity.

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## Investigation of aluminum, iron, manganese, chromium and cadmium concentrations in groundwater of Oshnavieh plain

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### Abstract

One of the most important issues in groundwater is its contamination by heavy metals. Because of chemical stability and poor degradation of heavy metals and their ability to accumulate in living organism's bodies, they can become toxic. For this, 15 water samples were collected from the groundwater resources of the Oshnavieh Plain in September 2015, with evenly distributed, and then were analyzed by atomic absorption. Concentrations of aluminum, iron, manganese, cadmium and chromium and saturation indices for aluminum, iron and manganese were determined. The analysis results were compared with standard values of the World Health Organization using the Arc GIS software and PHREEQC software for calculating Saturation indices. The results showed that in 33.33 percent of the samples only aluminum concentration is higher than the World Health organization's maximum acceptable concentration and in the rest of samples concentrations of the metals are below the standard concentration. Except aluminum, contaminations of the other heavy metals are not in risk boundary. But, because of the shallow groundwater depth and intensive agricultural activities in the plain, certainly in the long term it will be followed by many environmental risks. So, it is necessary that the groundwater resources of the aquifer should be considered for monitoring industrial wastewater, agricultural pesticides and irrigational returned water flow.

**Keywords:** contamination, groundwater, heavy metals, Oshnavieh plain, saturation index.

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## Assessing climate change impacts on hydro-climatic parameters in the dam basin of Ekbatan, Hamedan

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### Abstract

Climate change is one of the most important factors that will affect different parts of human life on earth and will be adverse effects on environmental resources, economic, social and especially water resources, with changes in rainfall and timing of runoff amount. One of the strategies to mitigate the effects of climate change is to assess its effects on precipitation, temperature and runoff in each region. In this research, assessing uncertainty of climate change models; MPEH5, HadCM3 and IPCM4 for 2045-2065 period under two scenarios and effects on temperature, rainfall and runoff in the basin Ekbatan, Hamedan. So first determine efficiency LARS-WG model for downscaling of temperature and precipitation variables then assessing IHACRES hydrological model to simulate the runoff. Finally the monthly rainfall, temperature and runoff data were analyzed for the period 2065-2045 compared to base period 2010-1983. The results show that the annual mean temperature increase in 2065-2045 period under the scenario A2, 2.12 and B1, 1.12°C and annual rainfall decreases under the scenario A2, -6.1 and B1, -1.4 percent. In addition, runoff decreases under the A2 scenario -17.2% and B1, -4.19 percent. In view of the uncertainty of climate models under two scenarios A2 and B1 increase temperature and decreases rainfall in the basin and these changes will have negative effects on amount of runoff in the basin.

**Keyword:** climate change, IHACRES, LARS-WG, runoff, uncertainty.

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## Assessment and prediction of Qezelozan and Shahroud rivers discharge

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### Abstract

The aim of this study was the analysis of discharge variations of two rivers i.e. Qezelozan and Shahroud, regarding the sustainable rice production in Guilan province. To achieve this purpose four trend analysis tests including Sen, Mann-Kendall, linear regression and Spearman were used. In this study, river discharge data of 49 and 37 years for respectively Qezelozan and Shahroud Rivers were used. The results of all tests in quarterly and annual periods were similar. The results of all tests showed a significant decrease in river discharge of Qezelozan and Shahroud. Furthermore, for monthly periods the Man-Kendall and the Spearman tests were used that during the periods both tests showed similar results i.e. reducing discharge during the studied periods. In both rivers, the annual river discharge was reducing by 60% from the first year to the last year of the study period. In this study, the changes in both precipitation and temperature were also investigated; the results showed a significant reduction in the amount of rainfall and a significant increase in the temperature. The results of this research could be used in predicting future drought, irrigation planning and management of integrated water resources.

**Keywords:** Man-Kendall, regression, Sen, spearman.

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## Monitoring and prediction of drought in western Urmia lake basin rain gage stations by ANFIS model

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### Abstract

Drought as a climatic phenomenon affected many different environmental issues and generally is associated with the decreasing in average precipitation. Evaluation and monitoring of the drought is a fundamental step in proper programming of water resources management. Regarding the recent conditions water scarcity in the Urmia Lake basin, assessment of the drought index in this region is inevitable. This study was conducted to evaluation of the SPI index in western parts of the Urmia Lake basin. Rainfall data were collected from 11 rain gage stations in Tabriz and Maragheh plains. The standardized precipitation index in time scales of 9, 12, 24 months used for studying the drought features and adaptive neuro-fuzzy inference system model was applied for prediction of drought. The results indicated that the most serious (-4.07) drought was occurred in Bonab station at the 9 month time scale in October 1984. The longest drought periods were occurred in Heravi, Saiedabad, and Maragheh stations and the shortest drought periods were occurred in Zinjab, Tabriz, and Lighvan stations. The results of SPI prediction by ANFIS model indicated that the model desirably could predict the drought conditions in the study area. The highest value of the coefficient of the determination of ANFIS model was 0.829 for Maragheh station at 24 months' time scale and the lowest values of  $r^2$  was 0.480 for Saiedabad station at 9 months' time scale. Results also indicated that the capability of the ANFIS tend to be better at long time scales.

**Keywords:** ANFIS, drought, Maragheh plain, SPI index, Tabriz plain.

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## Gully erosion hazard zoning using of Dempster-Shafer model in the Gharnaveh watershed, Golestan province

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### Abstract

The goal of this research is Gully Erosion Hazard zoning by using Dempster-Shafer Theory for the Gharnaveh watershed (Golestan province). For this purpose, at first a gully erosion inventory map with the scale of 1:200000 (dependent variable) for the Gharnaveh watershed has been prepared using multiple field surveys and satellite pictures. From total gullies 70% of them have randomly selected for building gully erosion hazard zoning model while the residuals (30%) have used for validating the model. In the next stage, seven data layers contain slope percent, slope aspect, plan curvature, lithology, land use, distance from rivers and distance from roads have been selected as gully erosion conditioning factors (independent variables) and digitized in ArcGIS software. The amount of gully density in each factor class have calculated from combination of independent and dependent variables, and rating of classes have done based on Dempster-Shafer equations. Finally, the gully erosion hazard zoning map has drawn from summation of weighting maps. The results of model classification show that from total considered gully zones for model validating in the Gharnaveh watershed %68.06 are in the class of high and very high hazard. Also, the result of model validating with using the receiver operating characteristic (ROC) curves and areas under the curve (AUC) showed that Dempster-Shafer model is appropriate for gully erosion hazard zoning in the studied area with accuracy of %96.1 and standard deviation of 0.003.

**Keywords:** Dempster-Shafer, Gharnaveh watershed, gully erosion, hazard zoning.

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## Climate change impact on groundwater budget of ShahreKord plain in the future periods

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### Abstract

High greenhouse gas emissions lead to the global warming. Global warming and climate change resultant from it, has Significant effects on various systems, such as water resources, agriculture and environment. This study, climate change impact on budget aquifer, was investigated by applying two different scenarios of wells operations. For this purpose, the GMS software was applied to simulate fluctuations of groundwater table in Shahrekord Plain caused by the climate change from 2015 till 2029. The model was calibrated for the steady and unsteady states, both. Then the output of HadCM3-A2 model was used to simulate the temperature and rainfall in the same period of time. The output was downscaled for the region by LARSE-WG software. In order to access an efficient plan for the studied aquifer, two scenarios were considered including 10 and 20 percent of increase in the operation for mentioned period. According to the results, annual rainfall and temperature will both increase at the end of the period by the average of 12 percent and 0.4 Celsius, respectively. Also, due to the mentioned 10 and 20 percent of increase in the operation, the aquifer storage will be reduced 6.3 and 10.94 million cubic meters respectively.

**Keywords:** AOGCM, climate change, GMS, LARS-WG, Shahre Kord plain.

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## Hydrologic analysis and optimal release of the Qeshlaq dam reservoir, based on drought analysis of river basin

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### Abstract

Dam reservoirs supply potable, agricultural, and industrial water in most cities of Iran. Due to lack of proper operational rules or unbalanced demand versus water resources volume, (along operating time) correction in operational rules is required to fulfill current situations. Hence the goal of this study is to optimize the Qeshlaq Dam reservoir operation rules to maximize the water release for agricultural demand with considering maintaining reservoir capacity to allocate 100% of potable water demand. For this purpose a linear optimization program was developed in MATLAB. Herbst method was used to assess drought intensities and periods. Based on Herbst method, a critical period of 51 month (October 1987 – September 2012) was determined and an optimal release of 1.334 MCM was estimated for agricultural use. Based on downstream potential agricultural demand, this released water is supplied only 60% of the agricultural demands. So there will be shortage in supplying agricultural demands for months July (2.2 MCM), August (2.47 MCM) and September (2.29 MCM). The correlation coefficient of  $R^2 = 0.84$  was obtained between modelled and actual monthly reservoir storage. Results showed that the probability of the maximum long term storage of 162 MCM (equal to 0.75 of reservoir capacity) is 50%. Also statistical distribution analysis revealed that spillway discharge data are agreed with Gumbel distribution more accurately than other distributions. In general, the results of the optimization showed that linear programming can be used for optimal water resources allocation for agriculture and industry use.

**Keyword:** drought, herbst, linear programming (LP), optimization, remaining volume.

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## Change in irrigation methods under the framework of PES policy tool to restore Lake Urmia

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### Abstract

Among well-known managerial practices to protect scarce biological resources, Payment for Ecosystem Services is an efficient and effective policy tool to manage such resources and its application is attracting a growing interest in the world. This is why, in addition to clarifying the role of such a policy tool to encourage farmers to modify their irrigation system to reduce pressures on water resources of Siminehroud Basin, a technical and economic assessment of its feasibility, has been done in this study. According to the results of this study, the idea of “encouraging farmers to change current irrigation practices in their agricultural land” seems to be widely acceptable to them. About 91.45% of land owners have stated their willingness to adopt pressurized irrigation systems. Meanwhile, from technical and economic point of view, realization of such an idea has benefit-cost ratio of 3.98 and it will lead to a decrease in annual demand of 283 MCM water from Siminehroud water resources. Therefore, extension of the plan of change in irrigation practices in all sub-basins of Lake Urmia will be highly efficient and it can considerably increase water supply needed for restoration measures.

**Keywords:** benefit transfer, economic valuation, Urmia lake, water management.

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## Relations between physical characteristics of basins and low flow discharges with different return periods (Case study: Kashafroud basin)

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### Abstract

Regional analysis is one of the important methods for estimating the low flow in ungagged regions. Investigation of the relations between effective factors of hydrological drought is the most important strategy to contrast and reduction of drought losses. In this study to analyze of low flow, the daily discharge data from 20 gauging stations with 25 years period (1988-2012) in the Kashafroud basin have been used. Low flow series with durations of 7 and 15 days have been calculated and by using frequency analysis, Log Pearson type III distribution was recognized as the most appropriate distribution. Then, low flows with return periods of 2, 5, 10, 25, 50 and 100 years were calculated. After calculating the physical characteristics of basins effective parameters on low flow have been detected in two steps by factor analysis. Based on cluster analysis, studied basins divided to two homogenous regions and the low flow regional models were determined in each homogenous region by using the linear multivariate regression. Results showed the first and second factors indicated 66.1% and 24.2% of variance. Basin area, mean of slope and drainage density are the most effective physiographical parameters to estimation of low flow discharge and respectively in 100%, 79% and 79% of significant regression models are known as effective parameters in estimation of low flow in both A and B homogenous regions. In addition, with regards to high coefficient of determination and low standard error of relationships, models for homogeneous regions compared with the whole area models are more accurate.

**Keywords:** distribution function, eigenvalue, hydrological drought, regional analysis, time series.

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## Identifying potential rainwater harvesting sites in Sarab Seid Ali watershed of Alashtar using two GIS based methods of NRCS-CN and decision support system (DSS)

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### Abstract

Runoff Collect used for to minimize losses and strengthen water resources in watersheds. Countries like some areas of Iran are facing to water scarcity, faced with Unsuitable distribution of rainfall. By expanding the use of water sources, using the principles of runoff from rainfall can be effective to solve the problem of water shortage. In order to estimate the runoff in watersheds there are several experimental methods and mathematical models. One of these models is Curve Number Model (NRCS) that in this study is production base of runoff maps. The purpose of this research is Identifying potential rainwater harvesting sites (Artificial recharge of aquifers by percolation ponds and surface storage of runoff by Gradin and terracing) in Sarab Seid ali watershed of Alashtar by (NRCS - CN) method. this means that in the GIS software environment after mapping the runoff used of other six layers of information contain: Geology , Fault , Drainage density , Land use , Soil texture and slope and used of IF , WOA methods for weighting, rating and integrating existing 7 Layer and from the final maps of the two methods select maps with more accurate and with considering economic – Social issues Incorporation with 3 Map of distance from irrigated lands, drylands and residential areas in the form of a decision support system (DSS) and The final maps of suitable areas for artificial recharge and surface storage of rainwater became harvest.

**Keywords:** DSS, GIS, NRCS- CN, rainwater harvesting, Seid Ali watershed.

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