

Evaluation and Analysis of Groundwater Vulnerability Using Empirical Orthogonal Functions and Cluster Analysis

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ABSTRACT

DRASTIC is known as the most prototype models of groundwater vulnerability assessment. The DRASTIC constitutes from seven schematic parameters consisting: Depth to groundwater, Recharge to aquifer, Aquifer geology, and surface Soil texture, Impact of vadoze zone and hydraulic Conductivity. In this study the models parameters were extracted by the main schematic maps of model. Instead using the linear combinations of parameters by the proposed weights of model, a principal component analysis (PCA) also known as empirical orthogonal function, was taken into account for assessing a more reasonable and accurate value for aquifer vulnerability. The advantage of this approach is accurate derivation of model weights and consideration of the maximum model parameters variances affecting groundwater system vulnerability. In the current study the models parameters evaluated for Qorveh-Dehgolan aquifer and the groundwater vulnerability of this site assessed using PCA. Eventually the first component (PC_1) scores clustered using different Clustering Analysis (CA) and the best method delineated by Dunn cluster validation technique. PCA Results showed a large value of variance justification by PC_1 equal to 72.5 percent. Also Dunn validation technique delineated the Single method as the best clustering manner.

Keywords: Groundwater, Vulnerability, PCA, CA, Qorveh-Dehgolan

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Reducing of Water Seepage from Ab-Bandan by using Nonoclay, Cement and Lime

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ABSTRACT

The efficiency of Ab-Bandans is reduced with water leakage from them, so one solution is adding different materials to the soil of Ab-Bandans. In this study, different percentages nanoclay, 10% cement and 5% lime was used to reduce hydraulic conductivity of the soil of Ab-Bandans. The hydraulic conductivity reduced from 1.58×10^{-4} to 2.88×10^{-5} with the addition of %0.5 nanoclay. Measurement of piezometric pressure showed that nonlocal, cement and lime decreasing the phreatic surface on banks. Composition of the soil with nanoclay, cement and lime, respectively, decreased 58%, 51% and 28% losses that nanoclay further reduces leakage. Statistically significant differences between water seepage losses of natural soil with other materials exist at 95%. So the use of different materials such as nanoclay, cement and lime, respectively their impact on reducing of seepage, recommended for control the leakage of Ab-Bandan that lime was more economical in the case study.

Keywords: Experimental Model, Hydraulic Conductivity, Leakage, Nonomaterials.

Influence of Partial Root-zone Drying Management with a Combination of Sea Water on Water Productivity and Yield of Sunflower

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ABSTRACT

Application of saline water sources combined with reducing water consumption during crops growing seasons will have an important role in adjustment with water crisis. In this regard, applying a suitable water management aimed at sustaining crops under osmotic stress and water deficit can cause food security. Thus, in this research, the influence of partial root zone drying with a combination of sea water on quantitative properties and water productivity of sunflower was investigated in Agricultural Sciences and Natural Resources University of Sari. Treatments were arranged on factorial based on randomized complete block design with three replications. Six treatments included full irrigation with fresh water (FI), full irrigation with saline water (SI), full irrigation with periodic use of saline water and fresh water (FSI), partial root zone drying irrigation with fresh water (PRD₁), partial root zone drying irrigation with saline water (PRD₂) and partial root zone drying irrigation with periodic use of saline water and fresh water (PRD₃). The results showed that significant difference was not found between the treatments of PRD₁, PRD₃ and FSI compared with FI in yield, harvest index and water productivity. The highest yield with the value of 4706 (kg/ha) in the control treatment and the maximum values of harvest index (%50.63) and water productivity (1.12 kg m³ ha⁻¹) in PRD₁ treatment was found. SI and PRD₂ treatments had the lowest level of yield with values of 3983 and 3636 (kg/ha), respectively. It could be concluded that in addition to 25 % water saving under applying a suitable irrigation management in PRD₃ treatment, it is possible to supply a part of crop water demand with saline water during treatment period which results in higher fresh water saving for sunflower cultivation.

Keywords: partial root zone drying, water use management, alternative use of saline and fresh water, randomized complete block design

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Distribution Pattern Optimization of Watershed Check Dams to 25, 50 and 75 Percent of Flood Control (Case study: A sub Catchment of Kashaf Rood)

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ABSTRACT

Statistics show the damage caused by floods has increased in recent decades. One of the solutions for flood damages control is the construction of check dams. Because these check dams by saving some of flood volume, reduces a part of flood volume and the height of the flood peak in downstream. This study has been performed with the aim of spatial optimization of this check dams. For this purpose, masonry check dams in one of the sub catchment of Kashaf Rood were located. Then by calculating the flood volume and the volume of dam reservoirs, number and location of check dams to achieve different objectives were optimized. Since the study area is a mountainous sub basin, the best condition for flood control was considered when check dams with priority one and two are proposed and goals that require dams to be more than that, is not recommended. Accordingly, the selection of check dams with the priority one and two in study area can control 50 percent of flood with return period of 50 and 100 years and 75 percent of flood with return period of 50 years.

Keywords: Masonry check dams, control volume, Kashaf Rood catchment, flood control, locating

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Effect of Land Use Changes on Physical Fractionation Properties of Organic Matter, Clay Dispersion and Aggregate Stability in Some Khuzestan Soils Province

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ABSTRACT

This research was conducted to study the effect of land use change on some physical fractionation component of organic matter and some of its quality factors. Therefore, two uncultivated and cultivated (such as rotational cropping and sugarcane) were selected in Khuzestan province. Disturbed and undisturbed soils were sampled from 0-30 and 30-60 cm depths. Total N, OC, dispersible clay (DC), aggregate stability and organic matter differentiation were comprised as factorial in Randomized blocks. The results showed that total carbon content was increased from 3.57 g kg⁻¹ for uncultivated to 10.5 and 10.65% for sugarcane and rotation cropping system, respectively. Maximum aggregate stability was belonging to sugarcane and minimum was for uncultivated land use. Due to land use changes, dispersible clay content was reduced from 44 in uncultivated land to 33 and 38% under sugarcane and rotation cropping system, respectively. Organic carbon content and total N was increased with land use change from uncultivated to cultivate but sand component was more sensitive to the land use change as comparison to other component and reacted rapidly. Also, organic carbon and nitrogen was more reach in sand particle of organic matter in surface layer. While, the change of land use increased clay fraction of organic matter at first level, this was for sand fraction in second level and third level was belong to silt. This is related to aromatic structure and resistance of this fractionation of organic matter. It was concluded that for soils do not have good quality, best management practices (BMP) and increase organic matter can improve the soil quality and aggregate stability due to make good situation for cultivation.

Keywords: aggregate stability, dispersible clay, land use, organic matter, physical fractionation

Vertical Simulation of Soil Salinity Using Markov Chain in Ardakan Pistachio Gardens

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ABSTRACT

In this research, a first order Markov chain model was applied to simulate soil salinity in nine standard depths and 10 classes in the cultivated pistachio areas of Ardakan city. Transition probability matrix, kernel and uniform distribution were used to simulate 500000 soil profiles. Results indicate kernel function could reproduce soil salinity values with statistical criteria (i.e. mean, standard deviation, skewness and kurtosis) more closely to the observed data when compared to data simulated by uniform function. Moreover, simulation processes from down-up is more accurate than that of up-down method. Overall, Markov simulation technique is able to consider the relationship between different classes.

Keywords: Kernel function, transition probability matrix, uniform distribution

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Investigating Interbasin Virtual Water in Sefidroud Basin

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ABSTRACT

Virtual water trade is investigated in industrial, agricultural, social sectors for national and global scales. In this study, interbasin virtual water was evaluated in irrigation sector for the Sefidroud basin to use in the allocation of water resources. In this regard, through investigating eight cropping pattern (S1- S8) in the riverbank of Qezelozan River (provinces of East Azarbaijan, Zanzan) during the years 2001-2025 were evaluated SWAT model. Data of Meteorological, hydrological river and crop yield for the years 2014- 2025, were produced using Minitab 17.0 software through ARIMA time series model. The results showed that cultivating dry- irrigated wheat (S6) is more appropriate in the East Azarbayjan and Zanzan province because of average of virtual water of wheat and rice is 2.73- 3.24 and 3.28- 4.06 (m³/kg) ,respectively. Also, excess water exchange for S6 from East Azarbayjan and Zanzan provinces to Gilan province resulted in to reduce virtual water of rice Guilan province.

Keyword: Guilan province, Rice, Sefidroud basin, SWAT model, Wheat.

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Evaluation of the SALTMED Model under Different Managements of Drip Irrigation with Saline Water

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ABSTRACT

Irrigation with saline water needs to the different managements to reduce the harmful effects of salinity on plants, soil and the environment. Simulation models are the useful tool to irrigation management in conditions of soil and water salinity because, they can predict crop yield and soil conditions considering to different climate, plant and management practices. In this study, the SALTMED model was evaluated under different conditions of irrigation management with saline water for corn. Irrigation was done with tape irrigation system in the strategies mixing, one-alternate and half-alternate of fresh water and saline water at four levels of salinity. The SALTMED model was calibrated based on half of the treatments and validated with the other half. The model calibration was done on soil moisture, yield and biomass. The average of normalize root mean square error (NRMSE) for simulation of yield and biomass calculated 3.21 and 2.35 percentage respectively, that indicating high accuracy for model. The mean of NRMSE in simulation of soil moisture for different managements calculated 6.52 percentages. As well as the SALTMED model simulated distribution of soil salinity in alternative strategies with less accuracy (NRMSE=15.71) than mixing management (NRMSE=9.57).

Keywords: Simulation, Yield, Soil Moisture

Evaluation of Copula Performance in Groundwater Quality Zoning (Case Study: Kerman and Ravar regions)

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ABSTRACT

This study presents a new method for interpolation by use of copula for groundwater quality zoning. In this regard, the data of the concentration of bicarbonate in 87 piezometric wells on the plains of Kerman and Ravar in September 2013 were examined. For this purpose, four Archimedean copula including Clayton, Frank, Gumbel and Joe have been used. Then, the obtained results were compared to the results obtained from conventional zoning methods to evaluate the performance of copulas. Analysis of the results with respect to the root mean square error criterion in the zoning was obtained about 1.84 and 1.95 mg/L based on median and mean respectively, by use of copula which had a better performance compared to kriging method with an error of 2.21 meq/l, kriging method within Box-Cox transformation and error of 2.14 meq/l, kriging with Logarithmic transformation of 1.98 meq/l and inverse distance weighting method with an error of 2.83 meq/l.

Keywords: Archimedean copula, Kriging interpolation, Bicarbonate modeling, Spatial prediction, Geostatistics

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Calibration and Validation of AquaCrop Model for Barley in Pakdasht Region - Iran

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ABSTRACT

Crop Simulation models are used for water management in farms and are widely used for optimization of water use efficiency. AquaCrop model is based on yield response to water that developed by FAO. The objective of this study was calibration of two parameters, including growing degree days from sowing to maturity (GDD) and water productivity normalized (WP) for barely in Pakdasht region, Iran. The experiments were done in 2014-2015 and the treatments were three crop calendars, including early, normal and late planting. Using calibration data and try and error method, GDD and BWP were calculated 1260 degree and 14.8 gram/m², respectively. The results showed that calibrated model provided close agreement with the reference values, with a coefficient determination of 0.99 and root mean square error of 0.59 ton ha⁻¹.

Keywords: Crop calendar, Crop yield, growing degree days, Water productivity normalized

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Investigation of Root Clogging for Different Inline Dripper under Subsurface Drip Irrigation of Grass

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ABSTRACT

The objective of this study was to evaluate emitters clogging by root of grass for four types of inline emitters under subsurface drip irrigation system. The experimental treatments consisted of four discharge emitters include 3.5, 4, 2.2 and 2 liters per hour (respectively T3, T2, T1 and T4). The four treatments were arranged in a randomized complete block design with three replications for two years. The soil texture of site was silty clay loam. Uniformity indexes at the beginning and end of the experiment consists of emitter flow variation (q_{var}), coefficient of variation (CV), coefficient of uniformity (CU), emission uniformity (EU), Range and statistical uniformity (Us) were measured. The EU value was 96, 87, 94, and 94% for new emitter in the beginning of the experiment and was 79, 19, 45, and 85% in the terminated of the experiment for T1, T2, T3, and T4 treatments, respectively. Our results showed that emitter clogging by root were 4% for T1 and T4 treatments, 24% for T2 and 36% for T3 treatments. Based on the findings emitters that were installed in the pipe (flat integral drip line) was more efficient than the cylindrical tube emitters clogging rooted.

Keywords: Clogging emitters, drip line, local irrigation, uniformity index

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Simulation of the Snow Depth Using Single Layer Snow Model (SLSM) at Saghez Station

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ABSTRACT

The aim of this study is the calibration and validation of the physical-empirical SLSM model for simulation of the snow depth in the Saghez synoptic station. For this purpose, essential daily meteorological data of the model for the time period of 1992-2014 were prepared from the Iranian Meteorological Organization and by applying the Generalized Likelihood Uncertainty Estimation (GLUE) method, that performed by considering 15 parameters and performing 15000 simulations and using both Coefficient of Determination and Nash-Sutcliffe Efficiency indices for evaluating the accuracy of the model, Calibration and validation of the model were performed for the 1992-2009 and 2010-2014 time periods, respectively. Calibration process of the model was led to extracting 108 behavioral simulations and for performing validation of the model, the median of the 108 behavioral simulations was considered as the final output of the model and compared with the measured snow depth data. The results of the model validation showed that in most of the cases, the calibrated SLSM model has an acceptable efficiency to following the fluctuations of the measured snow depth data but it partly underestimates high values of the snow depth.

Keywords: SLSM Model, GLUE method, Snow Depth, Saghez Station

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Experimental Investigation of the Effect of Height and Crest Slope of Bendway Weirs on Flow Pattern in a 90 Degree Bend

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ABSTRACT

Bend way weirs are an important tool in multi-purpose erosion control and are implemented to control erosion, restore streams, and improve habitat. These structures create a hydraulic effect that reduces erosion on the outer bank of a bend by reducing flow velocities near the outer bank and reduce the concentration of currents on the outer bank creating better current alignment through the bend. In this research the effect of bend way weirs on flow pattern in a 90 degree mild bend has been investigated experimentally. Experimental tests were conducted in a curved flume with relative radius of 3.3 ($R/b=3.3$) and with 24 m length and 0.92 m width at three flow discharges (55, 66 and 77 l/s). Series of bend way weirs (7 weirs) were constructed at the outer bank side of the bend at three weir height ratios (0.3, 0.5 and 0.7 of water depth), three crest slopes (0%, 5% and 10%), while inclination angle (60°) and distance between weirs (equal to 3 times of weir length) were kept fixed. Velocity measurements around weirs were performed in two levels, near the bed and close to the water surface. The research results showed that the velocity magnitude decreased in the outer bank by more than 70% and increased in the inner bank side by more than 50%, after bend way weirs installation. Weirs with height of $0.5y$ and with crest slope of 5% were more effective in deceleration of velocity at the outer bank side. On the other hand, weirs with height of $0.7y$ and also weirs with flat crest slope were more efficient in velocity magnitude increment at the inner bank side, especially in the head of the bend. Generally, the present research results revealed that the bend way weirs with crest slope of 5% and with height of $0.5y$ are the most suitable design options in such bends.

Keywords: Bendway weirs, 90 degree bend, flow pattern, crest slope, outer bank

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Assessment of AquaCrop Model for Simulating Forage Maize Yield along the Furrow

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ABSTRACT

The growth and development of crop models such as AquaCrop model is the most important tools for decision-making and predicting crop yields. The aim of this research was to assess AquaCrop model for simulating spatial variability of forage maize yield along the furrow. Four treatments for calibration and validation of the model were investigated based on the percentage of supplied crop water requirement at the end of furrow (100, 75, 50 and 25 percent of full irrigation at the end of furrow). Full irrigation and deficit irrigation treatments were considered for model calibration and validation, respectively. The full irrigation treatment had the lowest coefficient of variation for observed forage maize biomass and crop yield (9.0 and 12.1%, respectively) and simulated forage maize biomass and crop yield (6.5 and 6.8% respectively). Indicators of RMSE and NRMSE for simulation of maize biomass were 1.6 ton/ha and 10.1% in the calibration stage and 1.5 ton/ha and 11.9 % in the validation stage, respectively. The results of this study indicated that the AquaCrop model can be applied for simulation of forage maize biomass along the furrow.

Keywords: deficit irrigation, furrow irrigation, simulation, uniformity

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Regression Model for Predicting the Compressive and Tensile Strength of Reinforced Soil and Soil-cement

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ABSTRACT

In this research the effect of randomly reinforced soil and soil cement with different percent of cement and fiber and different length of fiber was investigated. Samples were prepared according to the maximum dry unit weight and optimum water content due to the corresponding compaction curves. Compressive and tensile strength were conducted on samples for different curing times. Regression equations were proposed based on the experimental data for prediction of the compressive and tensile strength of reinforced soil and soil cement. Comparison between the model predictions and the experimental results showed that the proposed model can predict the mechanical behavior of reinforced soil and soil cement satisfactory.

Keywords: Soil reinforcement, soil-cement-fiber, compressive strength, Tensile strength, regression model, Sensitivity analysis.

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Use of Arbuscular Mycorrhizal Fungi for More Effective Bioremediation of Contaminated Soil Using Both Corn and Sunflower

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ABSTRACT

One of the methods to clean up contaminated soil is growing a hyper accumulator plant which is named phytoremediation. Some of hyper accumulator plants are proper host for mycorrhizal fungi. In this relationship, fungus, consume a part of organic carbon from the plant and by developing its mycelium network help plant to uptake more mineral nutrients from the soil. By doing a greenhouse research tried to determine the mycorrhizal efficiency to increase plant ability in mineral nutrient and heavy metal uptake from a contaminated soil with a high level of Cr, Ni and Cd. In this exam two hyper accumulator plants, sunflower and corn and also 4 species of mycorrhizal fungi, including, *Glomus mosseae*, *Glomus intraradices*, *Glomus etunicatum* and *Glomus sp* and one treatment without fungi as blank, with 5 replications per treatment were used. Results showed that mycorrhizal inoculation in two plants, sunflower and corn by increasing mycorrhizal colonization enhanced aerial part growth of plant and also macro and micro nutrient uptake. T4 treatment, including *G.mosseae* and *G.intraradices* in corn growth had the highest capacity for Cd, Ni and Cr uptake from the soil, so that it increased the uptake of these three elements in corn stalks react, 1.57, 3.79 and 4.18 micrograms per pot. In sunflower this treatment was able to increase Cd and Ni uptake, react 0.21 and 0.23 micrograms per pot. Finally if we want to use these two plants for phytoremediation, the use of these two fungi will be proposed.

Keywords: Phytoremediation, Mycorrhizal symbiosis, Corn, Sunflower and Heavy metals.

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Evaluation and Comparing of Redistribution of Moisture in Drip Irrigation by Pulsed Flow and Continuous Flow

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ABSTRACT

Pulse irrigation is consisted of an irrigation phase and a resting or non-operative irrigation phase. Water intermittent use causes that advance front with less volume water over continuous irrigation is completed, which it effect on the pattern of soil moisture. Another important subject in trickle irrigation is water distribution in non- operative irrigation that called redistribution. Amount of Redistribution is notable so it should have been considered in designing. The main objective of this present study is to evaluate pulsed and continuous redistribution of water in drip irrigation. For this purpose, both pulse and continuous surface drip irrigation by specified discharge (2.4 and 8 L/hr.) on three soil textures was tested in a physical model. The results showed that the vertical moisture redistribution in clay for less discharge (2.4 L/hr) is considerable and reached to 23 percent. The conclusion in continues showed horizontal redistribution in sandy for less discharge is 7 percent more than clay and this is 5 percent for pulse. Also for continues the vertical redistribution value in clay with q1 is about 6 percent and for pulse is about 4 percent more than clay.

Keywords: horizontal front advance, resting phase, vertical front advance, wetting pattern, pulse irrigation

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Evaluation of Zeolite and Soil Moisture Impact on Increase of Phosphate Fertilizer, Soil Extractable Potassium Uptake and Agronomic Traits of Corn

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ABSTRACT

Due to the limited availability of Phosphorus in soil especially calcareous soils, it is important to investigate strategies to increase ability of Phosphorus uptake by plant. Evaluating the effect of Zeolite (Clinoptilolite), irrigation levels and preferential flows, simultaneously and independently, on increasing Phosphorus uptake by corn was objective of this study. Potted study was done in completely randomize design with 3 replications. Factors include existence and non-existence of Zeolite, existence and non-existence of artificial thin plastic pieces as macro pores for facilitation of preferential flows and two levels of moisture allowable deficiency (40 and 50 percent). Also the effect of treatments on uptake of soil extractable Potassium by plant was investigated in this study. Plant Phosphorus concentration on treatments with and without Zeolite was measured 1593.3 and 1545.2 milligram per kilogram respectively. Also this amount on treatments of MAD40, MAD50, with and without artificially created macro pores was 1557.3, 1581.2, 1561.8 and 1576.6 mg/kg respectively. Results have demonstrated that treatments had not significant effects on increase of phosphorus uptake. Also the factors had not significant effect on increase of soil extractable Potassium uptake by plant. Among agronomic traits, weight of Bilal (Corn Crop) was increased in existence of Zeolite but others have not influenced significantly ($P < 0.05$).

Keywords: Phosphorus, Macro Pores, Moisture Allowable Deficiency, Calcareous Soil

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Long term Evaluation of Temporal and Spatial Changes in Soil Salinity (Garmsar Irrigation and Drainage Network)

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ABSTRACT

Salinity lowers plant water uptake and therefore crop cover. Control this phenomenon requires appropriate management and constant monitoring of the spatial as well as temporal salinity variations from time to time. In this study the spatial and temporal changes in salinity of Irrigation and Drainage Network soils in Garmsar, Iran, were investigated from 1986 to 2013. To Follow the purpose, employing satellite images and on the ground data, temporal changes of field area ratio were studied in three salinity levels of low, medium and high at the end of fall and spring planting seasons during the mentioned years through five satellite indexes. Finally the trend of changes was determined applying Mann-Kendal Test. Also Through a determination the trend of changes, the value of each salinity index's pixel (through Mann-Kendall Test) as well as zoning changes the salinities were extracted. Results indicate that (with a probability of 95%), at the end of fall planting period the trends of ratio of fields with low, medium and high soil salinity are decreasing, increasing and increasing, respectively. At the end of spring planting season, trends are similar to fall planting period for fields with low and high salinity levels and while medium levels indicating no significant trend. Also zone classification of soil salinity shows that north, south and west regions of Garmsar plain are at the risk of increasing salinity during the time while the north-east and central regions that are equipped with secondary irrigation network present a decreasing trend in soil salinity. During the considered years, of the total 16 thousand ha area, fields with low soil salinity decrease around 6.5 thousand ha while the area of fields with medium and high salinity increase for around 4 vs. 2 thousand ha, respectively, within the studied region.

Keywords: Salinity, Soil, Satellite images, Satellite indexes, Mann-Kendal Test, zoning, Garmsar.

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Forecasting of the Alavian Dam Inflow water Using Optimized Adaptive Neuro-Fuzzy Inference System (OANFIS)

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ABSTRACT

In this study, Optimized Adaptive Neuro-Fuzzy Inference System (OANFIS) was employed on a set of daily, weekly, 10-days and monthly data of inflow water into the Alavian Dam to predict the real-time inflow of the reservoir. Sequential and exhaustive search algorithms were used to determine the numbers and time steps of the model inputs and also reducing the prediction's errors. In sequential search stage, several inputs series in daily, weekly, 10 days and monthly scales were developed as inputs and those were compared with outflows in time t as expressed by $V(t)$. Also in exhaustive search phase, combinations of 2 from 10 and 3 from 10 which was included 45 and 120 models of time scale of $V(t-1)$ to $V(t-10)$ as inputs were developed and compared with outputs in time t as V_t . Statistical techniques including goodness of fit was used to evaluate the developed models performance. In sequential algorithm with daily scale, in the first step the input of $V(t-1)$ with $RSME=0.211$ MCM, in the second step the input combination of $V(t-1)$ to $V(t-8)$ with $RSME=0.187$ MCM and also in the third step $V(t-1)$, $V(t-3)$ and $V(t-4)$ with $RSME=1.525$ MCM were selected. Also in weekly scale, in the first step the input of $V(t-1)$ with $RSME=0.175$ MCM, in the second step the input combination of $V(t-1)$ to $V(t-8)$ with $RSME=0.192$ MCM and also in the third step $V(t-1)$, $V(t-3)$ and $V(t-4)$ with $RSME=0.391$ MCM were selected. In all of the optimized models of the studied time steps, the inputs of the $V(t-1)$ was recognized as an effective factor and models outputs were sensitive to this variable at this time step which had the least time difference with output.

Keywords: Forecasting, OANFIS, Sequential, Exhaustive Search Algorithms .