# Simulation of Border Irrigation, Employing the Two Numerical Schemes

## MOHAMMAD ALI GHOLAMI SEFIDKOUHI[1], ALI KOULAIAN[2]*

1. Assistant Professor, Water Engineering Department, University of Sari Agricultural Sciences and Natural Resources
2. M.S. Graduated from of Irrigation and Drainage, University of Sari Agricultural Sciences and Natural Resources

## ABSTRACT

Saint-venant equations constitute some of the basic relations that play important roles in different hydraulic studies, including the ones in surface irrigation. Throughout the present study, full hydrodynamic model of the flow was solved using finite difference method and dispersive explicit Lax (HD-LAX) as well as MacCormack (HD-MAC) schemes. In order to evaluate these two schemes, output with six measured data series were compared under different conditions. The results revealed that within an irrigation border, the prediction accuracy in both schemes increased by increase in inflow. The simulation accuracy of both schemes decreased by increase in length, width and slope of the border. The findings indicate that HD-LAX scheme with respective 0.9452 and 0.8366 coefficients of determination within the advance and recession flow phases' simulation, and with -5.63 and 7.87 percent of the relative error are of more accuracy (in infiltrated water volume and runoff estimation) as compared with HD-MAC scheme.

**Keywords:** Numerical solution, Lax, MacCormack, Full Hydrodynamic

* Corresponding author: a.koulaian@yahoo.com

# Improving Crop Yield Estimation through SWAP Model Using Satellite Data

## ALIREZA BADIEHNESHIN[1], HAMIDEH NOORY[2]*, AND MAJID VAZIFEDOUST[3]

1. Master science of irrigation and drainage , Department of Irrigation and Reclamation Eng.,
College of  Agriculture and Natural Resources, University of Tehran
2. Assistance professor, Department of Irrigation and Reclamation Eng., College of  Agriculture
and Natural Resources, University of Tehran,
3. Assistance professor, Water Engineering Department, University of Guilan

## ABSTRACT

Updating the satellite data in crop growth models is a useful technique to estimate the crop yield on some large scale farms. Throughout the present study, the improvement of SWAP model simulation was investigated using this technique for crop yield estimation. The study was conducted during  2012 growing season at some three center- pivot farms, covered by fodder maize and sugar beet as the main crops in Qazvin Irrigation Network. SWAP model was run by two methods, namely through either non-updated or updated satellite Leaf Area Index (LAI) data. Results indicated that sugar beet and fodder maize yields estimated through updated SWAP model were improved by about 13.7 and 14.5 (%) in absolute percent error while they amounted to 3.321 and 1.621 (ton/ha) in RMSE. The obtained results indicated that the LAI assimilation technique (using satellite data) can greatly reduce errors related to model input parameters. It can reduce the uncertainty as well as estimate fairly accurately the crop yield in a large area and on any individual farm.

**Keywords:** Fodder maize, Leaf Area Index, Remote sensing, Sugar beet, *SWAP* model.

* Corresponding author: hnoory@ut.ac.ir

# Design of Groundwater Level Monitoring Network, Using the Model of Least Squares Support Vector Machine (LS-SVM)

**ELHAM REZAEI[1]\*, ABBAS KHASHEI- SIUKI[2], ALI SHAHIDI[3]**

1, Ms.C student of water resources management, University of Birjand.
2. Assistant Professor of Water Engineering Department., University of Birjand.
3. Assistant Professor of Water Engineering Department., University of Birjand.

## ABSTRACT

The present study presents a methodology for the design of long-term groundwater head monitoring networks to reduce spatial redundancy in which the additional wells if not sampled, the error related to groundwater level estimation would be negligible. This method is based on Support Vector Machine, and founded upon the statistical learning theory. Throughout the study, some 63 quantitative data, observation wells as well as meteorological parameters (precipitation and evaporation) of  Ramhormoz  plain (in a 7-year period) were employed to evaluate the performance of Least Squares Support Vector Machine model (LS-SVM) in the groundwater observation well network design concept. Different combinations of parameters affecting the ground water level were assessed using the model LS-SVM. The optimal combination of LSSVM model with RBF Kernel function carries such performance parameters as $R2=0.9992$, $MAE=0.3405$. Then, using Function Approximation Optimum, a number of 42 observation wells were pinpointed to apply the appropriate spatial monitoring in the plain of RAMHORMOZ.

\* Corresponding author: e.rezaei66@yahoo.com

# Use of Multi-Conditional Functions in the Field of Reservoir Management and under Climate Change

**PARISA-SADAT ASHOFTEH[1]\*, OMID BOZORG HADDAD[2]**

1. Ph.D. Candidate, Department of Irrigation & Reclamation, Faculty of Agricultural Engineering & Technology, College of Agriculture & Natural Resources, University of Tehran, Karaj, Tehran, Iran.
2. Associate Professor, Department of Irrigation & Reclamation, Faculty of Agricultural Engineering & Technology, College of Agriculture & Natural Resources, University of Tehran, Karaj, Tehran, Iran

## ABSTRACT

Mathematical multi-conditional functions are of many applications in the field of water resources management. Throughout the present Study, the Logical Genetic Programming (LGP) rule (along with an integration of these functions) is employed to derive reservoir hedging rule in the operating intervals of the baseline and climate change. The most appropriate values of release in the entire interval are extracted as based on the available water. The objective function is to minimize Long-term Shortage Ratio (*LSR*). The results obtained from the extraction of hedging rule in the supply of demand rationing rule by LGP are compared with the Traditional Genetic Programming (TGP) results for the baseline and climate change conditions using efficiency indices. The results show as based on the employed LGP approach and under conditions of climate change, relative to baseline indices, the reliability would decrease (34%), vulnerability increase (37%) and while resiliency being decreased (29%). Also, based on TGP and in the same situation the indices of reliability, vulnerability and resiliency would respectively, decrease (25%), increase (15%) and decrease (14%).

**Keywords:** Multi-Conditional Function, Operating Rule of Reservoir, Efficiency Indices, Climate Change

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\* Corresponding author: PAshofteh@ut.ac.ir

# Effect of Surface vs. Subsurface Drip Irrigation on Yield of Damask Rose under Different Irrigation Regimes

**ASMA MOGHBELI MEHNI DAREROODI[1], MASOOMEH DELBARI[2]\* AND NADER KOOHI[3]**

1. Graduate Ms.C. Student, Department of Water Engineering, Faculty of Water and Soil, University of Zabol
2. Associate Professor, Department of Water Engineering, Faculty of Water and Soil, University of Zabol
3. Scientific Staff, Technical and Engineering Section, Research Center for Agriculture and Natural Resources, Kerman Province

## ABSTRACT

The effect of two irrigation systems (surface vs. subsurface drip irrigation) on yield, irrigation water use efficiency and percentage of essential oil in *Rosa damascene* under three levels of irrigating water (100, 70 and 40 % of potential evapotranspiration) has been investigated. The experiment was performed as a split plots design based on randomized complete blocks of three replications at the Research Center of Agriculture and Natural Resources, Kerman Province (Joopar Research Station) during 2012 to 2013. Results indicated that the yield, irrigation water use efficiency and percentage of the rose's essential oil did not significantly differ for the two types of irrigation systems. The treatment 100% of potential evapotranspiration yielded the highest flower (2716.93 kg/ha). The highest irrigation water use efficiency (2.14 kg/(ha.m$^3$)) was found for the 40% potential evapotranspiration treatment. Moreover, the highest percentage of the flower's essential oil was recorded for the treatment of 70% potential evapotranspiration.

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\* Corresponding author: mas_delbari@yahoo.com

# An Experimental Investigation of Non-Darcy Flow in Granular Porous Materials

## MOHAMMAD BAGHER SALAHI[1], MOHAMMAD SEDGHI-ASL[2]*, MANSOOR PARVIZI[3]

1. MA student in Geotechnics, Yasouj University
2. Assistant professor, Faculty of Agriculture, Department of Soil Science, Yasouj University
3. Assistant professor, Faculty of Engineering, Department of Civil Engineering, Yasouj University

## ABSTRACT

Use of large grained gravel is increasing in hydraulic structures due to their specific features as regards filtration, canal covers, stilling basins, rockfill dams, etc. Flow behavior in high porosity media and as well in rockfill dams is very complex due to the existence of large pore size and consequently turbulence in the flow. Given the importance of flow within the rockfill materials, an investigation of the characteristics of this type of flow is indispensable. Considering the widespread use of large grained materials in civil projects, scrutinizing the flow properties in these materials and obtaining their hydraulic parameters is important as for non-Darcy flow studies. In order to study the flow behavior in grained materials, a constant-head permeameter was designed built. Experiments were carried out on three types of gravel grains with average diameters of 8.69, 13.08, and 16.62 mm. During the course of experiments, the outlet discharge, upstream and downstream heads as well as a measurement of the pressure drop (difference between water levels in upstream and downstream tanks), were recorded and their characteristics studied. The laboratory results indicate that the relationship between flow velocity and gradient is non-linear, following non-Darcy's law. The evaluation of results using goodness of fit criteria and their comparison with Kadlec and Knight (1996) and as well Ergun (1952) relations show that the Kadlec and Knight (1996) relation is of a higher reliability than latter. Variation of Reynolds number versus friction factor shows that the more the diameter of materials, the lower the abrasion factor and the higher the Reynolds number. The friction factor in higher Reynolds numbers decreases so that it is independent of the grain diameter and of Reynolds' number. The low pressure equations and relations obtained in this study can be used for calculation of water surface profile through dams and rock drains.

**Keywords**: constant head, flow characteristics, prmeameter device, large-grained materials.

* Corresponding author: M_sedghiasl@yahoo.com

# An Evaluation of M5 Model Tree vs. Artificial Neural Network for Estimating Mean Air Temperature as Based on Land Surface Temperature Data by MODIS-Terra Sensor

**SAEED EMAMIFAR[1], ALI RAHIMIKHOOB[2]\*, ALI AKBAR NOROOZI[3]**

1.   Former Graduate Student of Irrigation and Drainage Engineering Department, Aburaihan Campus, University of Tehran, Tehran, Iran

2.Associate Professor of Irrigation and Drainage Engineering Department, Aburaihan Campus, University of Tehran, Tehran, Iran

3. Assistant  Professor of Soil Conservation & Watershed Management Research Center, Tehran, Iran

## ABSTRACT

The use of satellite data in an estimation of air temperature (Ta) near the earth's surface has turned into an effective way for a large area of high spatial and temporal resolution. Throughout the present study, Artificial Neural Network (ANN) as well as M5 model tree were employed  to estimate Ta in Khuzestan Province (South West of Iran), using satellite remotely sensed land surface temperature (Ts) data acquired through the MODIS-Terra sensor. The input variables for the models consisted of the daytime and nighttime MODIS Ts as well as extraterrestrial solar radiation. A total of 365 images of MOD11A1 Ts product for the year 2007, covering the area under study were collected from the Land Processes Distributed Active Archive Center (LP DAAC). The results indicated that coefficient of determination ($R^2$) for both models exceeded 0.96. However, ANN model estimations of air temperature were more accurate than RMSE with the respective $R^2$ values of 1.7 and 0.97 $^{\circ}$C.

\* Corresponding author: akhob@ut.ac.ir

# Evaluation of the AquaCrop and CERES-Maize Models in Assessment of Soil Water Balance and Maize Yield

**GHAZALEH ZIAII[1], HOSSEIN BABAZADEH[2]\*, FARIBORZ ABBASI[3], FERIDON KAVEH[4]**

1. M.Sc. Graduated, Water Eng. Dept., Science and Research Branch, Islamic Azad University, Tehran, Iran
2. Assistant Professor, Water Eng. Dept., Science and Research Branch, Islamic Azad University, Tehran, Iran
3. Research Professor, Agricultural Engineering Research Institute, Karaz, Iran
4. Associated Professor, Water Eng. Dept., Science and Research Branch, Islamic Azad University, Tehran, Iran

## ABSTRACT

Importance of fresh water in agriculture along with the essential demand of the growing population for food, indicates an extreme necessity of the optimum use of water. To this end, plant growth simulation models have been introduced in agricultural sciences to reach maximum yields in varying climates. Variations in the of developed models cause difficulties for the unprofessional users. The AquaCrop model, which is developed by FAO is one of the plant growth simulation models which tries to improve the facility of the model by reducing the number of input data. Throughout the present study, the AquaCrop model was calibrated and validated for maize in Karaj region by due attention to soil water balance. Moreover, the results were compared with CERES-Maize as a specific maize growth simulation model. The results indicated an appropriate function of both models in predicting yield and as well in soil water balance parameters. The figures 85-94 constituted the index of agreement for the AquaCrop model in soil water simulation as compared with the figures within 58-64 for CERES-Maize model. RMSE figures in yield simulation for the AquaCrop model stood within 40-20%, although for CERES-Maize they varied from 20 to 80%. Finally, and as regards the accuracy of the AquaCrop model, it is a recommendable one to farmers, and to planners in Karaj region.

**Keywords:** AquaCrop; CERES-Maize; soil water balance; maize yield;

* Corresponding author: h_babazadeh@srbiau.ac.ir

# The Role of Qazvin Central Marsh Interceptor Drain in Controlling Shallow Groundwater Salinity

**ABBAS SOTOODEHNIA[1]\*, MOHADESE JAFARI[2], PEYMAN DANESHKAR ARASTEH[3]**

1.Assistant professor, Faculty of Engineering and Technology, Imam Khomeini International University,

2. M.Sc. graduate, Faculty of Engineering and Technology, Imam Khomeini International University.

3Assistant professor, Faculty of Engineering and Technology, Imam Khomeini International University.

## ABSTRACT

Qazvin salt marsh open interceptor drain has been designed and implemented to either prevent or reduce the risk of salinity expansion to its upstream fertile lands. This paper is intended to assess results of the data gathered from the monitoring system around the drain. To monitor the effect of the drain on water table level and on the shallow groundwater quality, 99 observation wells (in 9 sections perpendicular to the drain) were constructed. Water table levels were measured and samples taken on a monthly basis. Chemical analysis of the samples throughout the year showed chemical changes resulted from the existence of the drain. The drain performance was evaluated as positive since it resulted in a discharge of brine with a salinity of around 200 dS.m$^{-1}$ . The results showed that the construction of inceptor drain stopped movement of saline water towards fresh water aquifer to some extent by increasing the groundwater hydraulic gradient as due to a lowered water table of about one meter. The subsurface water salinity decreased to an extent of 13.6 percent throughout the first year. Obviously the decrease was not observed as even in all the observation wells. The performance of the drain was finally evaluated as positive during the first year of its operation.

**Keywords:** Salt discharge, Interceptor drain, Observation borehole, Monitoring

* Corresponding author: absotoodehniako@yahoo.com

# An Evaluation of Water Volume Controller Emitter as Compared with the Conventional Emitters in Micro Irrigation Systems

**SAEID ZAMANI [1], JAVAD BEHMANESH [2]\*, KAMRAN ZEINALZADE[3]**

1. Ph. D. student, Faculty of Agriculture, Urmai University
2. Associate Professor, Faculty of Agriculture, Urmai University
3. Assistant Professor, Faculty of Agriculture, Urmai University

## ABSTRACT

Increasing water distribution uniformity in micro irrigation systems has been an important subject in applied researches. Despite considerable progress in emitters' construction, some research reports refer to their incapability in water distribution uniformity. In order to achieve greater uniformity in micro irrigation, it is necessary to manufacture emitters with low variation in manufacturing coefficient vs. high water uniformity distribution. Throughout the present research the performance of new drippers, named Water Volume Controller (WVC) vs. four common emitters were assessed and compared. The results showed that the performance as well as all the uniformity parameters related to Water Volume Controller within all the applied pressures were desirable. The results finally indicated that the maximum emission uniformity in the Water Volume Controller drippers (at 1.5 bar applied pressure) was obtained to be 96% whereas for bubbler emitters in the best conditions, the mentioned parameter was recorded 38.3%.

\* Corresponding author: j.behmanesh@urmia.ac.ir

# Prediction of Specific Surface area and Cation Exchange Capacity Using Fractal Dimension of Soil Particle Size Distribution

**LEILA ESMAEELNEJAD[1], JAVAD SEYEDMOHAMMADI[2]\*, MAHMOOD SHABANPOUR[3], HASAN RAMEZANPOOR[4]**

1, Ph.D student of soil science, Tehran University.
2. Ph.D student of soil science, Tabriz University
3. Associate professor, Faculty of Agriculture, Guilan university
4. Associate Professor, Faculty of Agriculture, Guilan university

## ABSTRACT

Cation exchange capacity and specific surface area are among some of the important soil characteristics the direct measurement of which is laborious, costly and time consuming. Therefore, fractal dimension of particle size distribution has been widely studied in relation with many such dynamic and static processes as transmission of water and solutes, water holding capacity, heat storage and conductivity, etc., and as a useful parameter, it has been proposed for property estimation as related to soil texture. Throughout the present research, the relationship between fractal dimensions of particle size distributions ($D_m$) vs. specific surface and cation exchange capacity for 40 soil samples (32 samples for finding the empirical functions and 8 for testing of the derived functions), from Gilevan region, with textures ranging from sandy to clay and different parent materials were evaluated. The obtained results showed that the value of $D_m$ of the soil samples ranged from 2.45 to 2.99; the finer the soil texture, the larger the fractal dimension $D_m$. The $D_m$-specific surface area and $D_m$-cation exchange capacity relationships were described by power functions ($R^2$=0.87 and 0.80, (significant at probability level of 0.01)), respectively. Testing of $D_m$-clay content, $D_m$-specific surface area and $D_m$-cation exchange capacity relationships showed significant correlation (probability level of 0.01) for the measured vs. predicted data. The results indicated that $D_m$ can be used as an integrating index for estimating the specific surface area as well as cation exchange capacity of soils from particle-size distribution, useful in modelings and simulations.

* Corresponding author: seyedmohammadi.javad@gmail.com

# Evaluating Point and Parametric Spectral Transfer Functions for a Prediction of Soil Water Characteristics

**EBRAHIM BABAEIAN[1], MEHDI HOMAEE[2]\* AND ALI AKBAR NOROUZI[3]**

1. PhD Student, Department of Soil Science, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran
2. Professor, Department of Soil Science, Faculty of Agriculture, Tarbiat Modares University, Tehran, Iran
3. Assistant Professor, Soil Conservation and Watershed Management Research Institute (SCWMRI), Tehran, Iran

## ABSTRACT

Direct measurement of soil hydraulic properties is usually expensive and time consuming. Several attempets have been made to establish PedoTransfer Functions (PTFs), that use readily available soil data, to provide soil hydraulic properties. The objective of the present study was to evaluate point and parametric Spectral Transfer Functions (STFs) as well as PTFs to estimate van Genuchten (vG) and Brooks-Corey (BC) parameters needed for predicting soil water characteristics' curve. The derived STFs and PTFs were further evaluated with a number of available PTFs to find out if spectral variables can effectively improve the accuracy of soil water retention predictions. Consiquently, a number of 174 soil samples were collected and used to measure the spectral reflectance curves in visible, near-infrared and shortwave-infrared range, using a handheld spectroradiometer. Some physical soil properties and soil water contents at their specific matric potentials were recorded. Using a non-linear least square optimization method, the vG and BC parameters were then calculated. Stepwise multiple linear regression statistics was employed to derive point and parametric STFs and PTFs. The results indicated that the derived point and parametric STFs and PTFs are of higher accuracy (with mean RMSR of 0.029 $cm^3$ $cm^{-3}$) in predicting soil water retention than the published PTFs (with mean RMSR of 0.100 $cm^3$ $cm^{-3}$). Furtheremore, vG model was found to more accurately predict soil water content (mean RMSR of to 0.034 $cm^3$ $cm^{-3}$) than BC model (mean RMSR of 0.041 $cm^3$ $cm^{-3}$). The overall findings reveal that the derived STFs and PTFs provide almost similar results, but the STFs performance is somewhat more accurate at mid and high metric potentials.

**Keywords:** Soil spectral reflectance; Spectral transfer function; peotransfer functions

* Corresponding author: mhomaee@modares.ac.ir

# Application of Electro-osmosis to Accelerate the Removal of Water form Fine Soils

**MOHAMMAD NASEH[1], ALI RAEESI ESTABRAGH[2], MEHRDAD MOGHADAS[3]\***

1. Post graduate of water structures, Irrigation and Reclamation department, college of agricultural and natural resources, University of Tehran.
2. Assistant Prof, Irrigation and Reclamation department, college of agricultural and natural resources, University of Tehran.
3. Ph.D. candidate of water structures, Irrigation and Reclamation department, college of agricultural and natural resources, University of Tehran.

## ABSTRACT

Nowadays, application of Electro osmosis to remove water out of the soil is one of the most efficient methods of fine soil improvement. The electric field created by electrodes placed in the soil, cause water molecules move and get extracted from the porous media. In this research, an electro-osmosis system assembled as vertical drains was applied in a laboratory scale, for treatment and improvement of fine soil. For the purpose some saturated clay samples were prepared and placed in the designed physical model and tested. The results showed that using electro osmosis to withdraw water from the soil the quantity of water will be more and the extraction done more quickly. Also an increase in the difference of voltage between cathode and anode will increase the volume of water leaving the soil. Measurement of electrical conductivity (EC) and pH length wise in the soil showed that in electro osmotic process, pH will increase around the cathode and decrease at the anode. while EC being increased at either the cathode or anode. Also it was observed that the applied voltage to the soil sample decreases from anode to the cathode. Then it is concluded that the electro osmotic method can be a suitable alternative for soil settlement instead of surcharge being applied.

**Keywords:** electrical vertical drain, rapid consolidation, soil improvement

* Corresponding author: m.moghadas@ut.ac.ir

# Small Plot Soil Hydrologic Components as Affected by Application of Vinasse Organic Residue

**EHSAN SHARIFI MOGHADDAM[1], SEYED HAMID REZA SADEGHI [2]\*, ABDOLVAHED KHALEDI DARVISHAN[3]**

1. Former M.Sc Student of Watershed Management Engineering, College of Natural resources, Tarbiat Modares University, Noor, Mazandaran, Iran,
2. Professor (Corresponding Author), Department of Watershed Management Engineering, College of Natural resources, Tarbiat Modares University, Noor, Mazandaran
3. Assistant professor, Department of Watershed Management Engineering, College of Natural resources, Tarbiat Modares University, Noor, Mazandaran

## ABSTRACT

The present research was planned to assess the effect of application of two doses of 4.5 and 8 l m$^{-2}$ of environmentally friendly industrial organic waste of Vinasse on runoff commencement time, runoff coefficient and volume, soil loss and sediment concentration within small experimental plots of 20% slope under rainfall simulation with intensities of 50 and 90 mm h$^{-1}$ and 15 min duration on a sandy clay loam soil. The results indicated significant effects of the treatment on runoff commencement time and sediment concentration ($P<0.04$), runoff coefficient, runoff volume as well as soil loss ($P= 0.00$). Also the results revealed that the lower doses of vinasse application resulted in increasing runoff and soil loss for about 151 and 154% at 50 mmh$^{-1}$ and increasing the expressed variables for respectively about 64 and 200 % at 90 mmh$^{-1}$ in comparison with those recorded for control. The application of higher doses of vinasse increased runoff and soil loss rates for the respective 79 and 30% at 50 mmh$^{-1}$, and increased runoff and soil loss rates for 60 and 58% at 90 mmh$^{-1}$, respectively. In addition, the application of Vinasse increased runoff volume and soil loss in either one of the rainfall intensities. In this situation, 4.5 l m$^{-2}$ of vinasse in either of the rainfall intensities and 8 l m$^{-2}$ of vinasse in intensity of rainfall 90 mm h$^{-1}$ increased sediment concentration, but 8 l m$^{-2}$ of vinasse in the intensity of 50 mm h$^{-1}$ of rainfall reduced it, the effects of 8 l m$^{-2}$ treatment to reduce runoff, soil loss and sediment concentration were found out as more than those obtained for 4.5 l m$^{-2}$ treatment. These results show that the application of vinasse amendment does not always prevent soil loss; neither does it improve soil physical properties. Higher rates of application of vinasse, together with extending the persistency period before rainfall, are therefore suggested.

**Keywords:** Rainfall Simulation, Soil Conservation, Soil Erosion, Sediment Yield

* Corresponding author: sadeghi@modares.ac.ir

# Use of the Geomorphological Model, Based on the Stream Power, for Zoning Erosion and Sedimentation in Watersheds

**ALIREZA SHOKOOHI[1], SAHAR BEHESHTI[2]**
1. Associate Professor in water resources Engineering, Faculty of Engineering and Technology, Imam Khomeini International University, Qazvin, Iran
2. M.SC graduate student of Water Engineering Department, Imam Khomeini International University, Qazvin, Iran.

## ABSTRACT

Providing information for erosion and sediment yield simulation in watersheds is the major concern in employing the corresponding models. throughout this paper, a geomorphological model based upon  stream power theory is introduced. In this model, for simulating the potential erosion leading to sediment load in rivers, two parameters namely: slope and specific catchment area are employed. The model which uses just a Digital Elevation Model (DEM) to provide the required information is capable of zoning watersheds as based on the susceptibility of landscape to erosion. This advantage makes the model an efficient and affordable tool for initial planning in soil conservation projects regarding their importance in dam and river engineering studies. The MPSIAC model is employed to evaluate the results of the geomorphological model, while the recorded sediment data in the study river was used to calibrate MPSIAC. While the performance of the two models was close, regression relationship between the nine factors of MPSIAC model and geomorphological model showed that the factors of topography and surface erosion in MPSIAC constitute the most related parameters.