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Development and Application of the Qausi Distributed Water Balance Model (QDWB) in the Neishaboor-Rokh Watershed

S. Razavi[1]- K. Davary[2*]- B. Gahraman[3]- A. N. Ziaei[4]- A. Izady[5]- K. Eshaghian[6]- M. Shahedi[7]- F. Talebi[8]
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Introduction: During the last five decades there has been a sharp increase in water consumption owing to the population explosion, unprecedented rise in standard of living, and enormous economic development. Limitation of water resources in Iran motivates sustaining and preserving of these resources in order to supply future water needs. Fulfilling these objectives will not be possible unless accurate water balance of watersheds. An assessment of the available water resources is a pre-requisite to undertake an analysis of the stress on the water resources and to subsequently adopt appropriate management strategies to avoid adverse environmental effects and reconcile conflicts between users. Water balance models have been developed at various time scales (e.g. hourly, daily, monthly and yearly) and various spatial resolutions to varying degrees of complexity. Monthly water balance models were first developed in the 1940s by Thornthwaite (1948) and later revised by Thornthwaite and Mather (1955, 1957). These models have since been adopted, modified, and applied to wide spectrumof hydrological problems. Using GIS and computer models are useful tools for water balance calculating and results analyze. A spatial hydrology model is one which simulates the water flow and transport in a specified region of the earth using GIS data structures. The purpose of this study was to develop a computer model for rapid calculation of the water balance which is based on distributed meteorological data, and estimate uncertain factors of water balance on the basis of physical data. Try to minimize the complexity of the assumptions and also it is suitable for Basin water balance evaluation. Daily evapotranspiration and precipitation data were used to calculate daily changes of soil moisture balance, but the result is presented annually.

Materials and Methods: Model applied for Neishaboor- Rokh watershed. The total geographical area is 9,158 km2 that consists of 4,241 km^2 mountainous terrains and about 4,917 km^2 plain 9157 square kilometers. Neishaboor watershed is located between 35° 40′ N to 36° 39′N latitude and 58° 17′ E to 59° 30′E longitude with semi-arid to arid climate, in the northeast of Iran . Neishaboor watershed is located between Binalood and central Iran structural zones, and is separated into two distinct parts from a geological viewpoint. However, the model requires the distributed input data cells (500 per 500 mm) for the entire study area but model was called quasi distributed because to calculate runoff, has not been tracing flow from one cell to another and it uses the concept of effective runoff source area which it is assumed cells were integrated in these areas as Transmitter runoff to water ways. Model uses of the surface water budget equation, which is based on the difference between the input parameters (rainfall and irrigation) and outputs (evapotranspiration and surface runoff). Daily evapotranspiration calculated based on daily soil moisture changes from vegetation and bare soil. After calculating the runoff, precipitation surplus infiltrate to soil and after subtracting amount of evapotranspiration if soil moisture was higher than field capacity occurs deep percolation. In Irrigated land, if soil moisture is lower than a certain limit, the soil moisture deficit corrected with irrigation. .

Results and Discussion: The results of QDWB balance model were investigated for a **10 years period from 1998 to 2000** for Neishaboor –Rokh watershed. By examination the outputs of Hydro Climatology water balance those contain runoff, deep percolation and evaporation from precipitation, below results obtained: It is clear with increasing infiltration of rainfall reduces the amount of water needed for irrigation. By increasing infiltration, soil moisture content increase to field capacity, so the greater part of the soil deficient would be compensated from rainfall thus irrigation needs would be reduced .The results showed there was a good correlation between water balance parameters such as precipitation-runoff, precipitation-evapotranspiration, and precipitation- deep percolation and demonstrated that QDWB model was consistent with the basin hydrological process. Comparing SWAT evapotranspiration and QDWB results showed both models have a same trend over a 10 years period. Especially in years of high rainfall, amounts were closer to each other. In rainy years, a greater proportion of crop water requirement supply from precipitation and model presented the better results. The distributed pattern

1, 2, 3, 4, 7 and 8- M.Sc. Student, Professor, Professor, Assistant Professor and M.Sc. Students of Water Engineering Department Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran, Respectively
(*- Corresponding Author Email: K.Davary@ferdowsi.um.ac.ir)
5- Post-doctoral Researcher, Water Research Centre, Sultan Qaboos University, Muscat, Oman
6- MA of Khorasan Regional Water Company

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of runoff, infiltration, evapotranspiration and irrigation need showed that in mountainous and urban areas there was high runoff whereasin plain this parameter was little. Deep percolation rates in the plains were more than from mountains areas. In lowlands and irrigated lands evapotranspiration amounts was greater.

Conclusion: In this model the soil profile was divided into root zone and Evaporating layer. After estimating surface runoff and evapotranspiration, deep percolation was calculated and according to soil moisture deficit, amount of water needed for irrigation was determined. The results showed there is a good correlation between water balance parameters such as precipitation-runoff, precipitation-evapotranspiration, and precipitation- deep percolation and demonstrate that QDWB model is consistent with the basin hydrological process. The evapotranspiration results from a distributed model" SWAT" and QDWB model were in good agreement. It should be noted that the determination of the amounts to be used by tools such as remote sensing. The results of the model are consistent with physical models, such as SWAT at the basin scale.

Keywords: Quasidistributed, Neiyshabour- Rokh, Water balance, Watershed

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