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Evaluation of SCS curve number and rational equation methods for the determination of surface runoff using GIS and remote sensing - A case of South Saudi Arabia

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Water resources are not only important for the wellbeing of every life but necessary for economic development. In Saudi Arabia, water resources are scarce and water continues to be the most expensive commodity in this region. In view of this, the adoption of ways, strategies, plans and methods to quantify the limited resources and harness it for both economic development such as building irrigation facilities become a urgent necessity. In this paper, an evaluation of two methods for the estimation of surface runoff was conducted using storm data collected for a period of 30 years. These methods include the popular SCS curve number and the rainfall runoff rational method . These methods were implemented in the two study areas in Aseer region in the South of Saudi Arabia by using the GIS and remote sensing application to set the soil and land cover GIS layers as a main input for WMS (Water Modeling System) software to calculate the CN number values. On another hand, the digital elevation model (DEM) extracted from ASTER satellite images was used as an input for WMS software to delineate the watershed and calculate its properties. The results indicated that for first study area Wadi - Qutayna of watershed area of 2.69 km^2, the volume of surface runoff from Wadi Qutayna watershed calculated using curve number was 133981.5 m^3/year, while the volume of runoff of the same watershed calculated using the rational formula was 92350 m3/year. In the other case, the results from Wadi Ihlali of a watershed area of 33 km^2 shows the volume of surface runoff from Wadi Qutayna watershed calculated using the curve number was 2930000 m^3/year while the volume of runoff of the same watershed calculated using the rational formula was 2913300 m^3/year. Though the results show a discrepancy between the two methods in the small catchment of Wadi Qutayna, while the two methods shows the comparable results in the big catchment of Wadi Ihlali, this because of the watershed heterogeneity of Wadi Ihlali which has a big catchment area and different land cover and soil classes which leads to lower values of CN number and volume runoff value. In another case the watershed homogeneity of Wadi Qutayna which has a small catchment area with homogeneous land cover and soil classes which leads to high values of CN number and volume runoff values. This explains why the two methods are not comparable in this case. Therefore, it is highly recommended not to use the SCS curve number for the small catchment area because it is giving a high values However, it is highly recommended to use it for the big catchment area because it is giving the reasonable values. The paper anticipates a contribution to the knowledge base of the potential of water resources in the region and measures for harnessing these limited resources in the region for irrigation and other economic purposes.

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