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ORIGINAL PAPER

Studying the spatial distribution of maximum monthly rainfall in selected regions of Saudi Arabia using geographic information systems

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Abstract This paper presents the results of studying the spatial distribution of the maximum monthly rainfall within the Kingdom of Saudi Arabia (KSA) using geographic information systems (GIS). Isohyetal maps were constructed based on long historical rainfall depth data (1963–2013) of 255 rain gauges, after processing the data using different interpolation methods and their conversion to grid raster. Six interpolation methods were used: (a) kriging, (b) spline, (c) natural neighbor, (d) inverse distance weighting (IDW), (e) modified Shepard, and (f) triangulation with linear interpolation (TIN). Estimations of the rainfall at the rain gauges were compared to the observed measurements as controls and the method that resulted in minimum residuals and minimum standard deviation; in this case, the IDW was selected for the study. The percentage of residuals within ±2.0 mm were found to be 98 % for IDW, modified Shepard, and TIN, 97 % for natural neighbor, 90 % for spline, and 32 % for kriging. While identifying potential water harvesting sites depends on many factors, such as watershed area, topography, morphology, and rainfall, the results of this study can be used for the primary selection of water harvesting sites based on rainfall being the most important factor.

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Introduction

Rainwater harvesting is a technology used to collect, convey, and store rain water for later use by communities. It covers a wide spectrum of techniques that ranges from roof-based systems in houses to land-based or watershed systems, which include dams and reservoirs. Roof-based systems are applicable locally in cities and towns, where direct runoff from roofs of buildings is collected through gutters and pipes into in-house tanks for storage and use. Land-based rainwater harvesting, on the other hand, occurs when runoff from land surfaces (catchment areas or watersheds) is collected in furrow dikes, ponds, tanks, and reservoirs and is the focus of this paper. Gould and Nissen-Petersen (1999) categorized rainwater harvesting according to the type of catchment surface used and the scale of activity. Water harvested from rainfall and surface runoff, unlike groundwater, has the advantage that it usually has better quality and therefore is easier to use by humans and animals and for irrigation with inexpensive and simple treatment techniques. Rainwater harvesting and storage also relieves the pressure on sewers and environment by mitigating floods and soil erosion, in addition to replenishing groundwater.

Water harvesting can be defined as the process of concentrating rainfall as runoff from a larger catchment area to be used in a smaller target area. This process may occur naturally or artificially. The collected runoff water is either directly applied to an adjacent agricultural field (or plot) or stored in some type of on-farm storage facility for domestic use and as supplemental irrigation of crops. All rainfall harvesting systems have three components: a collection area, a conveyance system, and a storage area. The use of rainwater