

Optimization of area–volume–elevation curve using GIS–SRTM method for rainwater harvesting in arid areas

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Abstract

The major limitation in planning water harvesting is the lack of knowledge in the estimation of surface area and storage volume at any depth of dam reservoir. The area–volume–elevation (AVE) curve of a reservoir plays a key role in estimating the most suitable depth, optimum surface area and highest capacity of reservoir storage. The existing methods to estimate the AVE curve are costly and time-consuming and require laborious work. This study attempts to develop a method to optimize the AVE curve for earth dams, using the digital elevation model generated by the Shuttle Radar Topography Mission (SRTM) data, and integrate it with the geographic information system (GIS), known as the GIS–SRTM. The proposed method was tested using field data in the Western Desert of Iraq, which is an arid environment. Three constructed small earth dams were selected for this study. The AVE curves were extracted for Horan 2 (H2), Al-gara 2 (G2) and Al-gara 4 (G4) earth dams. Comprehensive analyses have been carried out to evaluate the performance of the AVE curves using the proposed GIS–SRTM method and the field data. From the comparison, the proposed GIS–SRTM method was able to produce reliable AVE curves with a relative error less than 20%. Additionally, the proposed method was less time-consuming and the AVE curves can be visualized immediately. The proposed GIS–SRTM method is relatively supportive in analyzing spatial data to select the optimal site for rainwater harvesting and prevent excessive evaporation losses