



Identifying cost-effective locations of storage dams for rainfall harvesting and flash flood mitigation in arid and semi-arid regions

Amir S. Ibrahim^a, Islam S. Al Zayed^b, Fahmy S. Abdelhaleem^a, Mahmoud M. Afify^a,
Ashraf Ahmed^{c,*}, Ismail Abd-Elaty^{d,*}

^a Civil Engineering Department, Benha Faculty of Engineering, Benha University, Benha, Egypt

^b Technical Office, National Water Research Center, Cairo, Egypt

^c Department of Civil and Environmental Engineering, Brunel University London, Kingston Lane, Uxbridge, Sussex UB83PH, UK

^d Department of Water and Water Structures Engineering, Faculty of Engineering, Zagazig University, Zagazig 44519, Egypt

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ABSTRACT

Study region: Wadi Tayyibah is located in south Sinai, Egypt, in a region called Abou Zenima, and it is used to develop this study.

Study focus: Flash floods tremendously impact many facets of human life due to their destructive consequences and the costs associated with mitigating efforts. This study aims to evaluate the harvesting of Runoff by delineating the watersheds using the Hydrologic Engineering Center-1 (HEC-1) model and ArcGIS software in trying to benefit from it in different ways. All morphometric parameters of the basin were considered, and the risk degree of the different sub-basins was determined. The suitable locations of dams were identified using a Geographical Information System (GIS) using the basin's morphometric characteristics.

New hydrological insights for the region: The study proposed a total number of eight dams, including five dams that were recommended for sub-basin (1) and three dams in sub-basin (4), while sub-basins (2) and (3) are not suitable locations to build dams according to the contour map of Wadi Tayyibah. Results indicate that, based on the constructed flash flood hazard maps and the basin's detailed morphometric characteristics, the best locations of dams are Dam (3) in sub-basin (1) and Dam (7) in sub-basin (4), where the runoff volume reached 3.13 million cubic meters (Mm^3) and 5.56 Mm^3 for return period 100, respectively. This study is useful for decision-makers and designers for using morphometric parameters and flash flood hazard degree maps to select dam locations. Also, the cost-benefit analysis for using the morphometric parameters is required to be investigated.

Abbreviations: a.m.s.l, above mean sea level; DEM, Digital Elevation Model; DSSM, dam suitability stream model; Esri 2020, Environmental Systems Research Institute; FF, Flash Floods; GIS, Geographical Information System; GCS-WGS, Geographic Coordinate Systems - World Geodetic System; GPR, Ground Penetration Radar; HSG's, Hydrological Soil Groups; HEC-1, Hydrologic Engineering Center-1; MPDSM, Multi-Parametric Decision spatial Model; SCS-CN, Soil Conservation Service and Curve Number; SCS, Soil Conservation Service; STRM, Shuttle Radar Topography Mission; USGS, United States Geological Survey; UTM, Universal Transverse Mercator; WRRRI, Water Resources Research Institute; WMS, Watershed Modeling System.

* Corresponding authors.

E-mail addresses: Ashraf.ahmed@brunel.ac.uk (A. Ahmed), Eng_abdelaty2006@yahoo.com (I. Abd-Elaty).

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