

Rainfall-Runoff Analysis and the Synthetic Unit Hydrograph for Wadi Fara'a Catchment

By
Basema Bashir-Takruri
(ABSTRACT)

Rainfall data are considered a major parameter in the analysis of the rainfall-runoff relation for surface water management. In the West Bank, rain gauges were installed in schools and other different locations during the Jordanian administration; no trained technicians were following up the measurement and recording at these stations; instead, teachers in these schools recorded measurements. Measurements were not always taken on daily basis since in many cases it was found that readings were taken on monthly or more bases. This has a direct effect on the quality of the available historical data; therefore, one of the major goals of this study was to check the quality of the available data. Different methods were used to accomplish this; time series plotting for daily, monthly and yearly time series in addition, spatial homogeneity tests were applied on the historical data. It was concluded that use of data on yearly bases were more reliable than daily or monthly records.

Analysis also included available rainfall intensity data that was used to construct the Intensity-Duration-Frequency (IDF) curves for the catchment; it relates intensity with rainfall duration and return period. The IDF curves are very important for hydrologic design projects including urban drainage design, where rainfall event or events are basic requirements for the design. Rainfall intensity is very limited in the West Bank and was available for Beit Dajan station and for three years only. The developed IDF curves were compared with curves available for similar catchments in the region including stations in Jordan and other catchments in the West Bank. Comparison of these curves showed that, taking into consideration limitations on availability of rainfall intensity data, the analysis give satisfactory results that favorable compare with available information. These results could be used for preliminary analysis in the catchment; on the other hand, approach for developing the curves for all surface catchments in the West Bank were presented; this is expected to support development of IDF curves needed for all catchments in the West Bank if data is available.

Peak discharge and the time to peak for large storm events are very important parameters for the appropriate design and management of hydraulic structures. This type of information is needed for a wide variety of design applications. Unfortunately, many streams around the world are un-gauged and do not have flow records. In addition, records are often not enough to predict extreme events when stream gauges exist. Synthetic Unit Hydrograph can be estimated for un-gauged drainage basins by means of relationships between parameters of a unit hydrograph model and the physical characteristics of the drainage basin. Synthetic unit hydrographs are frequently used to estimate hydrograph characteristics when observed data are not available. A number of synthetic unit hydrograph approaches are available, but the ones that found widespread use are those based on models of Snyder, Clark, Nash, and the U.S. Soil Conservation Services (SCS). Therefore, another major goal of this study was to develop a synthetic unit hydrograph for Fara'a Catchment, which is un-

gauged and considered one of the West Bank's most important catchments. Three methods were used for the development of the unit hydrograph, namely Snyder, SCS, and Clark methods. The latter two methods gave comparable results, but since Snyder method relies on estimation of parameters from other available hydrographs, results from this method were different from the first two (SCS and Clark). Taking into consideration the limitations on data availability, results of this study could be used as a first step in further research on the development of unit hydrographs for the other catchments in the West Bank where unfortunately, none of the wadis in the are gauged and flow records are not available. It is expected that if rainfall-runoff data is available for these catchments, the unit hydrograph method could give good results and a better assessment of the best method that suits our region.

Keywords: West Bank, Fara'a catchment, Rainfall, Rain Gauges, Intensity-Duration-Frequency curves, IDF Curves, Unit Hydrograph, Synthetic Unit Hydrograph, Peak Flow Rate, Time to Peak Flow Rate, Lag Time, Geographic Information System, Excess Rainfall, Rainfall / Runoff.