Abstract

Jordan is facing a water crisis. Population growth is expected to continue at over 3.4% per annum while agricultural intensification is adding to national water burden. Renewable resources do not meet present water demands and alternative supplies are being sought e.g. desalination and recycling. Over-abstraction of ground water has resulted in significant falls in the groundwater table in the Azraq basin and domestic supply is only provided two to three days a week in Amman. The situation is exacerbated by possible changes in the seasonal pattern of rainfall. Jordan then requires more efficient use of its existing water supplies and this is particularly the case in the drier eastern region known as the Badia. One strategy that has been widely practiced in the past in the Middle East is water harvesting. This technique aims to make more effective use of precipitation through capturing and directing surface flows or harvesting rainfall directly. But this requires scientific assessment of water harvesting potential.

Assessing runoff potential in a hyper arid area is the main concern of this study. There are many factors affecting the runoff behaviour such as rainfall intensity, evaporation, infiltration, interception, rock size, drop size, kinetic energy of rainfall, wind, slope and crust. The number and complexity of intervening variables creates demanding experimental work in terms of time, effort and logistics. A portable drop former mobile rainfall simulator with 2 meters height was used. Detailed calibrations were carried out on the simulator board. Attention was paid to the issue of the spatial variability of rainfall, drop size and distribution. The work was carried out in three main sites, Hassan, Baqaweah and Sweaid in northeast part of Jordan called Badia. Two main rainfall intensities were used, a low intensity of 10 mm/hr and a high intensity of 65 mm/hr (medium intensities (35-40 mm/hr) were abandoned after the pilot study) to characterise rainfall conditions in the Badia. Four main surface treatments have been considered based upon the pilot study results, which are bare soil, 50% rock cover, crust removed and loose soil surfaces. The selection was based on the analysis of pilot simulation runs and land cover characteristics. For each plot two simulations took place, a dry and wet run (saturated surface).

720 rainfall simulations have been carried out over different sites with different ground cover conditions. Following multivariate analysis of the results it was evident that the main factor affecting runoff and infiltration rates is the rainfall intensity. Higher rainfall intensity means higher kinetic energy and faster crusting and shorter time to runoff. The surface cover does not have as significant an effect on runoff generation as rainfall intensity and surface cover can be discounted in this region for water harvesting assessment. This is an important finding. The condition of the surface, wet or dry, affects the runoff and infiltration rates as the time to runoff for wet surfaces is shorter than the dry surfaces.

The results of this research revealed that four main outcomes can be predicted from rainfall simulations; that is medium to high intensity rainfall generates 79 to 91% of precipitation as runoff; low intensity storms still generate 59 to 84% of the storm as local runoff. These values are very high and reveal the tremendous potential for water harvesting if the water can be collected locally. Losses through runoff are high such as

seepages and evaporation which increase with catchment size. Runoff needs to be collected within small scale catchments as practiced by Bedons by using the Mahafir technique. It is recommended that any new developments should be based upon the insights provided by this research to deepen the existing reservoirs of the old Mahafir to reduce evaporation loss amounts and to maximise water collection.