Abstract

Arid zone recharge is the subject of a long running unresolved debate and the desertified 'Badia' region within the Azraq basin of North Jordan is no exception. Independent methods of evaluation are needed to help constrain actual values for annual recharge. Such methods, whether direct or indirect, must always try to reflect recharge *mechanisms and processes* while acknowledging inevitable simplifying assumptions, so that reasonable confidence limits can be included.

Previous estimates of recharge for the basin vary from a mean of 34 million cubic metres per year (MCM/Yr) using a water balance approach to 16-36 MCM/Yr for a 'throughflow' approach, while negligible recharge is a possible scenario if a fossil recharge mound exists.

^{14}C data indicate that groundwater in the centre of the basin (near the former natural discharge point of Azraq springs) is 12,000-25,000 years old. Similar data for the most likely recharge area towards the Syrian Druz mountains in the north of the basin is absent or equivocal (Drury, 1993).

Rainfall generally occurs during low frequency, short duration, high intensity storms of small areal extent which cause high runoff events in the region's ephemeral wadis. Scattered mudfalts are seasonally flooded and field observations of such surface waters suggest that no deep infiltration takes place. Rainfall simulation tests are used to determine values for the 'initial abstraction', the amount of rain that must fall before runoff occurs.

These values are subsequently incorporated into a 'storm by storm' water budget model which uses records of daily rainfall from trans-national measuring stations. Results indicate that *modern direct recharge is a reality* with a mean annual recharge of 16.5±1.7 MCM/Yr for rainfall stations above 980m and 21±4 MCM/Yr for the Azraq and Safawi areas giving a total of 37±5 MCM/Yr for the northern part of the Azraq basin.

Recharge spikes on continuous chart recorder readings at observation boreholes beneath wadis are invariably found to match with rainfall events if a delay of 2-10 days is allowed. Such data is not quantifiable but indicates that *modern indirect recharge in the form of wadi runoff transmission losses is also a reality.*

Simple transient modelling using the most favourable parameters for persistance of fossil groundwater gradients suggest the fossil recharge mound theory of Lloyd and Farag (1980) is inappropriate to this, the upper unconfined aquifer complex of the Azraq basin.