Incorporating hydrologic reliability in rural rainwater harvesting and run-of-river supply

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Many households in rural areas obtain water from rainwater harvesting (RWH) and/or run-of-river (ROR) flow but many of the methods used to assess the yield of RWH and/or ROR supply unrealistically aggregate data into monthly or annual time steps and do not incorporate measures of reliability. Most approaches do not assess the improvement in supply that would be obtained from integrated utilization of the two sources. This paper demonstrates a realistic incorporation of reliability and integration in RWH and ROR hydrologic analysis via daily simulation of household supply and frequency analysis of the annual levels (number of days) of supply. The analysis is based on representative household conditions of a rural community in a low-rainfall area of South Africa. The results reveal the expected reduction in supply level with increase in assurance thereby revealing the need to incorporate reliability in the hydrologic design of RWH and ROR systems. For specified levels of reliability and roof size, the optimal levels of RWH tank size are obtained. At an assurance level of 1 in 25 years, integrated utilization achieves 9 months for a roof area of 100m² and a tank volume of 20m³ while individual supply from either ROR or RWH achieves a maximum of only 4½ months of supply per year. Design and operational integration of the water resources typically available in rural areas could therefore substantially improve supply.