WATER RESOURCES RESEARCH, VOL. 25, NO. 2, PAGES 333-334, FEBRUARY 1989

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Comment on "Stochastic Considerations in Optimal Design of a Microcatchment Layout of Runoff Water Harvesting" by Gideon Oron and Gerda Enthoven

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INTRODUCTION

The paper presents some items often overlooked in the design of a runoff water harvesting system. At the same time the authors have neglected several items which may be of equal importance in the success of a system.

RUNOFF EFFICIENCY VERSUS SIZE OF CATCHMENT AREA

In the introductory section it is stated, "It is commonly accepted that runoff efficiency, which is defined as the percentage of rainfall converted into runoff, is a decreasing function of the size of CA (catchment area) [*Oron and Enthoven*, 1987]." Later the authors note that "... the runoff efficiency is a decreasing function of the area size of the MC (micro catchment) ..." and indicate that the greater the overland flow distance, the less quantity of water that reaches the infiltrating area. This is illustrated by the authors' Figure 4. There is an unstated assumption in this approach. The runoff model presented is based upon the work of *Diskin* [1970], which assumes a linear relationship between annual rainfall and runoff. Therefore there is no change in precipitation quantities (either increase or decrease) with increasing catchment size; thus any change in runoff efficiency must be attributed to a change in water infiltration as the catchment area changes. As long as infiltration occurs, there will be an increased quantity of water lost from runoff due to the longer time the water is on the catchment surface. The longer the overland flow distance, the longer the time the water is subjected to potential loss to infiltration with a corresponding reduction in runoff quantity. Also, the rougher the catchment surface, the longer this water retention time.

This does not necessarily mean that the runoff decreases with increasing catchment area size. The statement is true only if the catchment areas have similar shapes and slopes; i.e., the overland flow distances and retention times are directly proportional to the catchment area sizes. It is possible to have equal area catchments but with different shapes which result in different lengths of overland flow and therefore different quantities of water collected. Similarily, it is possible to have the same size and shaped catchments but with different water collection points which would change the "average" overland flow distance (Figure 1). The authors' approach to evaluating the runoff efficiency/catchment size relationship requires a data set of runoff quantities versus size to statistically determine the coefficients α and β in (14). Without some extensive data collection experiments, this is a disadvantage in attempting to transfer the procedures and results to other locations with soil and precipitation characteristics different than the specific sites used in the model development. Without these data sets it is not possible to evaluate other shape and sized combinations. With catchment runoff efficiencies approaching 100% as might occur with various soil treatments, the effect of the overland flow distances and retention times on runoff efficiency becomes less important.

PRECIPITATION DISTRIBUTION

The authors, in their analysis, use annual rainfall quantities which are separated into individual storms based upon probability density functions. The parameters for the functions were derived from historical meterological data occurring in the Negev Desert. The authors note that in this area the precipitation occurred only as winter events with no precipitation during the summer [*Oron and Enthoven*, 1987]. The paper would have been much more comprehensive if the authors had included some precipitation data sets from other locations or at least performed a sensitivity analysis with different precipitation characteristic coefficients. This would allow for the estimation of the effects of natural precipitation variability.

There are also some unstated assumptions in the authors' model, namely, that all the collected water can be stored within the plant's root zone with no water loss from deep percolation. All soils do not have the same water holding capacity. It is possible that the catchment area will collect sufficient water but the soil can not retain the water until it is needed. This would be an important factor in areas where the precipitation occurs during the winter but the plants grow in the summer period.

COST OPTIMIZING

In cost optimization, the authors included only the cost of constructing a 1-m-long dike. This approach is only valid in flat areas where extensive land leveling or smoothing is not required. In many areas, the land will have sufficient slope such that some land smoothing would be required to install hexagonal-shaped catchment areas with the plant at the middle. Other items which are important and should have been included are (1) cost of the land and (2) labor costs for crop planting, maintenance, and harvesting. Even in regions with low land costs, individual catchment areas of 400–700 m^2/plant can encompass large tracts of land. Also, the life of the water harvesting system was estimated at 15 years. If the tree species used by the authors are planted as young saplings, there will be a period of 3–5 years before the trees reach full productivity and can effectively utilize the extra water provided by the water harvesting system. With many plant species the water requirements for plant establishment is different than the water requirements for sustained growth or production, particularly with water timing. Young plants may not

Paper number 88WR03924.

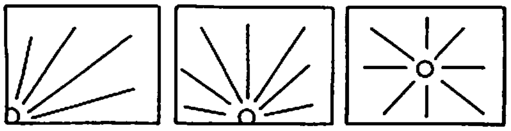

Fig. 1. Catchment areas with the same size and shape but with different overland flow distances.

have sufficient root systems to utilize water stored at a deeper depth reachable by mature plants. Any additional cost associated with plant establishment should have been included. These added costs, in actuality, could offset any potential profit. The authors' example was not cost effective for almonds. There is a question that if all costs had been realistically portrayed, the pistachios may not have been cost effective.

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(Received March 7, 1988;
accepted September 30, 1988.)