OPTIMISATION OF IRRIGATION WATER RELEASES IN THE WET SEASON USING PROBABLE RAINFALL

Master of Science Thesis in Hydraulic Engineering

by

W. B. M. Thoradeniya

Examination Committee

Prof. dr M. J. Hall

Ir H. J. L. van Oorschot

Ir E. R. Dahmen

INTERNATIONAL INSTITUTE FOR INFRASTRUCTURAL,
HYDRAULIC AND ENVIRONMENTAL ENGINEERING
DELFT, THENETHERLANDS
Thesis HH 225,

April 1995

Abstract

Irrigation water has become scarce. The availability is decreasing due to the ever increasing demand for fresh water and the competition between the different uses of it. This scarcity persuades us to introduce improved management in irrigation schemes to get the optimum use of the available water. Sound scheduling of irrigation gifts is an important part of system management.

Irrigation water releases are based upon two major factors: the crop water requirement; and the availability of water, from reservoir storage or run-of-the-river, and from rainfall. Crop growth stage and soil conditions can be translated into the evapotranspiration need, and seepage and percolation rates. The expected rainfall can be based on the seasonality of rainfall.

The study concentrates on rice growing with emphasis on rotational water supply, even though the methodology could be adapted to other crops as well. Rice is grown mainly in tropical climates. The rainfall in the tropics shows a distinct seasonality. When rules for scheduling are developed, these are mostly based on dry season crops. Yet, saving water in the rainy season, by implementing strategies to use less irrigation water, increases the water availability for the dry season crop. The rules used to decide upon the irrigation gifts should incorporate the expected rainfall for the next irrigation interval.

This study aimed at developing new rules and comparing them with existing rules for the supplementary irrigation of wet season rice crops. The formulated rules are used to simulate daily water balances of a unit field, which are then transformed into relative yields through the use of yield reduction functions for excess water and water stresses.

Three equations to estimate evapotranspiration are discussed and compared. It was found that the latest method advocated by FAO is not yet fully developed and should not be used in its present form without suitable corrections of the crop coefficients.

The expected rainfall computed by using the traditional method of 80% probability of exceedence was compared with rainfalls at other probability levels. Transition probabilities of weekly rainfalls were used as well to estimate the expected rainfall of the following irrigation interval.

The formulated rules were also applied to three other rainfall records. The results of this application confirmed that a significant water saving -up to 60%, when compared with the usual practice- can be achieved by using a constant lower level of exceedence throughout the crop period, by having different lower levels of exceedence in different crop phases, or by using the transition probabilities of rainfall from week to week.

From the point of view of water savings the two latter methods were found to be the better ones even though they have the disadvantage of requiring a more complex operation of the system.