

THE IMPACT OF WATER DISTRIBUTION RULES ON  
FARM PRODUCTION AND INCOMES:  
A SIMULATION APPROACH

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by  
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I certify that the substance of this dissertation has not already been submitted for any degree and is not being currently submitted for any other degree.

I certify that any help received in preparing this dissertation, and all sources used, have been acknowledged in this dissertation.



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ABSTRACT

The purpose of this study was to test in terms of comparative efficiency, some alternative water distribution procedures that could be used in the agricultural environment of the Gwydir Valley, New South Wales. The prime interest was on the impact of the alternative water distribution procedures on farm production and income.

A simulation model developed by Anderson and Maass (1974, revised 1976) was used to examine effects of water supply restrictions and water delivery rules on farm production and income in the study area. Ten case study farms receiving irrigation water from the Gwydir and Namoi rivers were selected for the study. Technical aspects of water distribution in the area and stream flow data were obtained from the Water Resources Commission. Production data and details of water use at the farm level were obtained from the individual farmers. Irrigation water requirements for each crop were calculated using pan evaporation data and crop coefficient data for the area. Effective rainfall was calculated using the USDA, SCS (1967) method. Yield loss schedules were developed for each crop at each stage of crop development to express crop response to soil moisture stress and various water supply levels.

A total of 24 different water distribution procedures were tested and eleven procedures were selected for detailed analysis. The procedures were each simulated with 90 per cent, 75 per cent, 50 per cent, 25 per cent and 10 per cent of the water required to achieve full production of the crop hectares planted. The water supply was varied over 26 irrigation periods in a crop season.

The results showed that the distribution procedure used to distribute water in a shortage situation has a significant effect on net income from agriculture in the region. Examination of the comparative efficiency of the eleven procedures in term of net income per hectare, percentage loss in net income per hectare and net income per megalitre showed that the 'market' procedure for distributing water is the most efficient under all water supply situations. The next best procedure was the 'demand plan' procedure which approximates the volumetric allocation procedure currently used by the Water Resources Commission to allocate water in the Gwydir Valley. The difference in the net income per hectare between the 'market' and 'demand plan' procedures increased from \$26 per hectare at the 90 per cent supply situation to \$92 per hectare at the 10 per cent supply situation. For all distribution procedures losses in income were realised when water supply was 50 per cent or less of an adequate seasonal water requirement.

An examination of the tradeoffs between efficiency and equity for each of the procedures showed that although tradeoffs do exist it does not hold for all procedures. The ordinal ranking of the procedures which took into account both efficiency and equity criteria ranked the 'demand plan' procedure as the best procedure followed by the 'market' and 'Shares and demand' procedures.

Further work on this area will involve the incorporation of a soil-moisture-plant growth simulation model into the Anderson and Maass model and the simulation of the procedures over a number of production seasons. The results also call for a detailed study on the costs of developing a market for water by the Water Resources Commission in the Gwydir Valley.

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The usual caveat applies in relation to all those mentioned above.

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