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Estimating deep drainage and nitrate leaching from the root zone under sugarcane using APSIM-SWIM

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Abstract

The Burdekin Delta (BD) is located on the dry-tropical coastal strip in North Queensland, Australia. It is one of Australia's premier sugar producing districts with approximately 40,000 ha of land under sugarcane. Because the BD borders the Great Barrier Reef World Heritage Area (GBRWHA), industry, community, regulatory, and environmental organisations are interested in ascertaining the magnitude of deep drainage and nitrate leaching from the root zone and potential implications for the GBRWHA.

Direct measurement of deep drainage and nitrate leaching is difficult, and modelling is likely to play an ever-increasing role in guiding experimental work and decision-making. Here, we describe the collection of drainage and nitrate-leaching related data collected over two cropping seasons at a specific field site within the BD and its use in the calibration and application of a drainage and nitrate-leaching model created within the Agricultural Production Systems Simulator (APSIM) modelling framework with constituent crop-growth, soil–water, and nitrogen transformation modules (Sugar, APSIM-SWIM, Soiln2).

Model application indicated that the simulated amount of drainage and nitrate leached over a cropping season compared favourably to that derived from inferred drainage and observed soil–water nitrate concentrations. Subsequent investigation of fertilizer management options using the model

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identified the timing and amount of both irrigation and fertilizer application as key parameters over which management control might be exploited to minimise deep drainage and flux of nitrate to groundwater.

Keywords: Modelling; Deep drainage; Nitrate leaching; Groundwater; APSIM; SWIM

1. Introduction

The Burdekin Delta (BD) and Burdekin Haughton Water Supply Scheme (BHWSS) comprise Australia's largest sugar producing region with 80,000 ha under sugarcane (Fig. 1). Annual sugar cane yields from the combined BD and BHWSS are of the order of 9 Mt with an average yield of 117 t/ha giving 1.5 Mt of sugar. Some 80% of Australia's sugar production is exported highlighting the importance of this region as a foreign exchange earner.

The Great Barrier Reef World Heritage Area (GBRWHA) borders this region, and greater industry, community and political emphasis on the environmental sustainability of

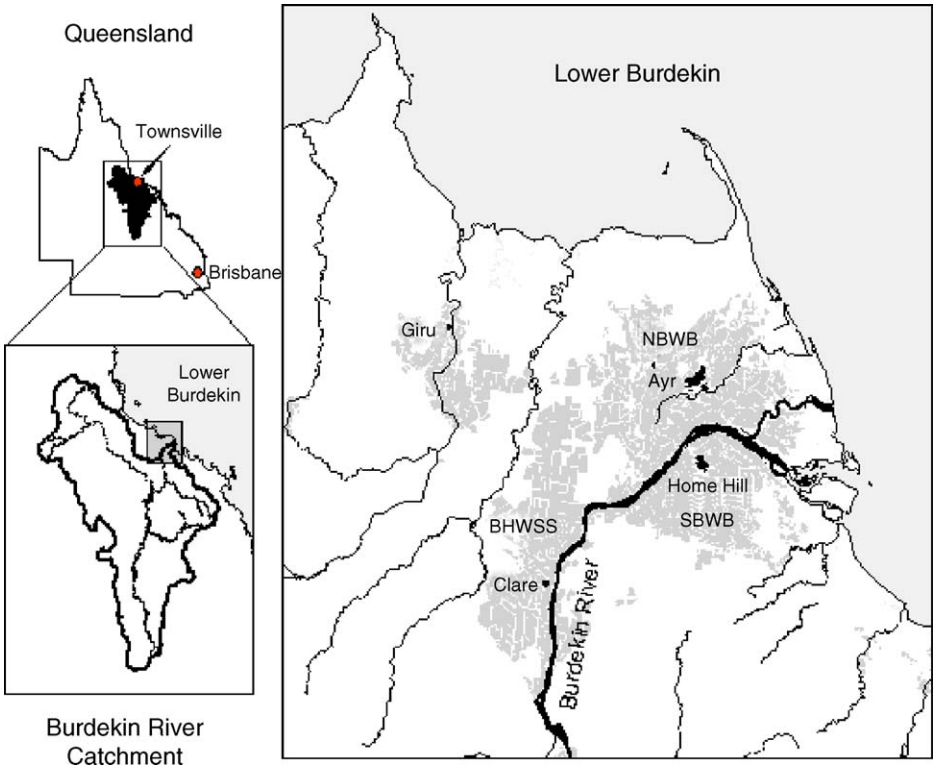

Fig. 1. Map of the state of Queensland, Australia, showing the location of the Burdekin Delta and Burdekin Haughton Water Supply Scheme, plus the Burdekin river catchment.