



Review

Benefits, challenges and opportunities of integrated crop-livestock systems and their potential application in the high rainfall zone of southern Australia: A review



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ABSTRACT

Integrated crop-livestock systems (ICL) have played an important role in human civilisation and have dominated the broadacre agricultural production system in the wheat-sheep zone of Australia. Over the past couple of decades, an increase in grain prices and decline in wool prices have led to the expansion of cropping into the high rainfall zone (HRZ) in southern Australia. While there has been a great deal of research into integrated crop-livestock systems for the medium to low rainfall environments in the wheat-sheep zone, there is much less information and many challenges confronting farmers to effectively integrate crops into the grazing systems in the high rainfall zone due to climatic and environmental differences and the complexity of the systems in Australia. This paper reviews the benefits of integrated crop-livestock systems and the challenges in implementing and managing these systems based on current Australian and international knowledge. The concept, types and terminology of integrated crop-livestock systems are discussed to provide greater clarity. Plant species, particularly annual and perennial legumes, are reviewed to find species with potential for use in integrated crop-livestock systems. Major gaps and opportunities for further research and development are identified, and recommendations proposed for developing effective integrated crop-livestock systems for the HRZ. These include: 1) Targeted R&D on ICL systems in the HRZ of southern Australia assisted with information from and outside Australia; 2) Biophysical and bio-economic modelling using current knowledge from the HRZ and other environments to guide future research; 3) Studies on N fixation, transfer and losses to develop strategies to balance N cycling and reduce N losses; 4) Development of compatible species/cultivars for ICL systems in the HRZ; 5) Management of waterlogging through ICL in the HRZ; 6) Effective stubble management to minimise the negative impact on crops and pastures; 7) Integrated research on grain yield reduction in crop-pasture intercropping, a potentially major type of ICL systems in the HRZ; and 8) Effective control of weeds, pests and diseases in ICL systems for the HRZ.

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1. Introduction

Integration of livestock production on grasslands, with cereal and other crops on associated arable land, formed the basis for the agricultural revolution that helped shape western civilization during the 16th century in Europe (Franzluiebers et al., 2014a).

This practice diversifies enterprises, builds up soil fertility through improved nutrient cycling between the grazing and cropping systems, restores soil structure, and improves both crop and livestock productivity with little increase in inputs (Bell et al., 2014). In Australia, crop-livestock systems have dominated broadacre agriculture, and are primarily located in the wheat-

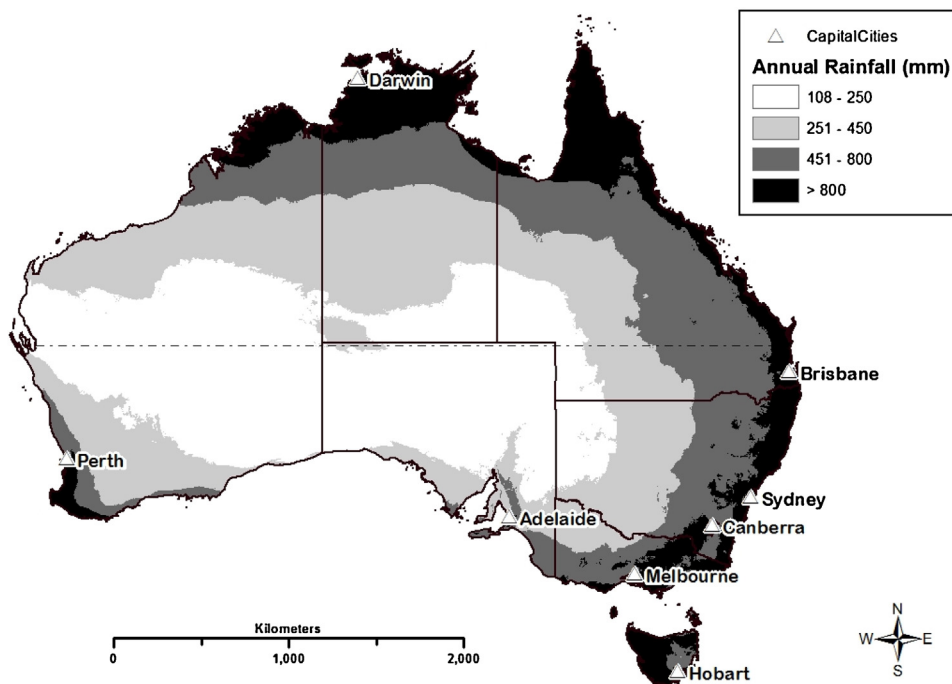


Fig. 1. Banded annual rainfall distribution in Australia [dotted line from west to east shows the approximate northern extent of southern Australia where the high rainfall (>600 mm annual rainfall) and wheat-sheep (300 and 600 mm annual rainfall) zones for integrated crop-livestock systems are located].

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