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“Resilience of agricultural systems against crises”

Using Systems Modelling to Assess Production Efficiency in Contrasting Agricultural Systems

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Abstract

The prospects for increasing global agricultural productivity can be assessed by comparing current performance of farm enterprises relative to their potential productivity as well as the riskiness of current and proposed intensification options. The concept of eco-efficiency, the production of food and fibre products relative to the ecological resources used as inputs, is used in this paper to diagnosis of state of agricultural production in contrasting agricultural systems in Australia (rainfed wheat systems), China (irrigated wheat-maize double crop systems) and Zimbabwe (rainfed maize systems). Surveyed crop yields in these three countries were compared against simulated yields at farmer-specified levels of inputs and risk.

In this study APSIM is used to simulate the potential and attainable yields of surveyed crops from three diverse production systems that are prominent in Australia, China and Zimbabwe. APSIM is well suited to this application, having been widely tested against experimental and farmer field data for the systems of interest in this study. The pathway of closing yield gaps is evident in all three systems. However, for Australian wheat farmers, new technologies and practices are also essential to increase production without added riskiness. In contrast, Chinese farmers can reduce inputs and risks without sacrificing production through more efficient use of their fertiliser inputs. African farmers have the opportunity for significant production increases with current technological inputs but to do so requires acceptance of much higher risks. This paper uses a novel return–risk analysis framework to benchmark contrasting production systems and to identify likely pathways for improving their eco-efficiency.

Keywords: Eco-efficiency, farm yields, systems modelling