Dynamic bio-economic simulation model for assessing whole-farm performance and impacts of innovation options

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ABSTRACT

Many farming systems throughout Australia are facing numerous problems because of continuing intensification and socio-economic pressures, including resource constraints and variability in climate and changes in prices of inputs or outputs. Available evidence indicates that these challenges have lowered the overall efficiency, performance and sustainability of most farms. Reconfiguration of farming systems to reach various productive and environmental objectives while meeting farm and policy constraints is complicated by the large array of farm components involved, and the multitude of interrelations among these components (Groot et al., 2012). This hampers the evaluation of relations between various farm performance indicators and of consequences of adjustments in farm management. Recently developed innovations may improve the economic and environmental sustainability of many production systems. However, models are needed to assess the impact of innovations on farm performance. Without this, there are clear limits to what can reliably be said about the wider impacts of intervention and change on these types of production systems (Thornton and Hererro, 2001). Moreover, in any decision-making process, some system performance objectives may be in conflict, and in such cases, whole-farm models realistically ensure that trade-offs among conflicting measures of system performance are identified and that positive synergies are considered.

In this work in progress session, we will describe a modelling analysis of the functioning of broadacre farms in Australia. Our specific intention is to investigate how the profitability of individual farm enterprises are driven by biophysical processes (soil, water), resource constraints (e.g., financial and labour), whole-farm risk and the impact of farming system innovations. In particular, we will describe our emerging dynamic hypothesis, in the form of a causal loop diagram that captures the most critical whole-farm factors and constraints considered to lower farm efficiency and profitability and critical feedback loops at play in the system, based on an integration of the scientific literature and group model building efforts with diverse growers and farm advisers. We will introduce and welcome feedback on our process of building a dynamic bio-economic simulation model that links the major biophysical, socio-economic components and decision-making processes of the farm, to determine the whole-farm performance and sustainability. We will present a range of innovative strategies or scenarios and demonstrate how the model could be used as a virtual environment to explore and evaluate various system outcomes and trade-offs among these scenarios generated by the relationships between the key components of the farm. This, for example, includes trade-offs among water use efficiency, maximising farm profitability and minimising whole-farm risk. Finally, we will discuss our approach to implementing the intended model in diverse crop and livestock farm enterprises in the northern grain-growing region of Australia.

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