Australian Wheat Sustainability Framework: A Bottom-Up Model

Bruno Rafael de Almeida Moreira *, Joe Eyre, Barbara George-Jaeggli, Sudhir Yadav **

The Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, St Lucia, Brisbane, QLD 4067, Australia, * **b.moreira@uq.edu.au, **** sudhir.yadav@uq.edu.au

Abstract

Sustainability frameworks are essential for assessing the impact of technologies, practices, and policies on agricultural systems, incorporating biophysical, economic, and community values. In Australia, several frameworks, such as the Australian Agriculture Sustainability Framework (ASSF) and the Australian Grains Industry Sustainability Framework (GSF), exist, but they may not fully capture the diversity of grain-based systems or recognise the sustainable practices of growers. New tools and models are required to address these gaps. This paper presents a model that sets sustainability standards for wheat-based systems across various Australian regions. The model consists of six modules: Farm Management, Soil Health Management, Crop Management, Workplace Management, Biodiversity Management, and Capacity and Leadership. Each module uses parameters and a scoring system based on machine-learning models to evaluate sustainability at various geographical levels and within specific market categories. The model incorporates feedback from stakeholders in academia and industry. While initially designed for wheat production, this model can be applied to other crops leviable by the Grains Industry Research and Development Corporation (GRDC), including coarse grains, oil seeds, and pulses, extending its applicability and relevance. In conclusion, this model provides a strategy for improving sustainability within the Australian wheat industry while aligning with macro-level frameworks like ASSF. It offers mechanisms for growers to seek incentives from government, industry, and consumers for their practices, involving them in the sustainability process through a supportive approach. This model represents a significant step forward in the pursuit of sustainability in the Australian grain industry.

Keywords

Sustainability models, adaptative agriculture, farming system, sustainable development, ESG reporting.

Introduction

Sustainable food systems contribute to environmental conservation, health benefits, economic advantages, and resilience to global challenges such as climate change (United Nations, 2023). In Australia, several sustainability frameworks have been established, including the AASF by the National Farmers' Federation (McRobert et al., 2023) and the GSF by GrainGrowers (GrainGrowers, 2021), which are relevant to the grain industry. However, the applicability of these frameworks for most grain growers is unclear. They provide a structure of pillars, principles, and sustainability indicators but do not offer clear guidance on compliance with best management practices and cost/benefit implications.

The evaluation of the sustainability of agricultural practices in grain crops in Australia is an important research area. Ensuring that the consensus on sustainability is backed by science is essential for long-term food security and environmental protection. The Australian grain industries need to secure access to high-value markets and establish sustainability credentials for their products and agricultural practices. Australia can demonstrate its sustainability performance by adopting a science-based approach to developing standards and regulations.

The challenge is to make Australia's Sustainability Frameworks relevant and practical for the grain industries in the Australian context while also gaining global acceptance. The commodity-centric (bottom-up) approach introduced in this paper has the potential to enable growers to seek incentives from government bodies, industry players, and consumers for their sustainable practices. This approach aligns with global sustainability goals, ensuring that the practices are beneficial locally and contribute positively to global sustainability efforts.

This paper introduces a methodology that aligns sustainability assessments with existing Australian frameworks. The model focuses on grain sectors and uses wheat as a model crop. It aims to develop a roadmap for assessing sustainability at crop and farm levels.

Methods

Sustainability Classification Schema Aligning with Existing Frameworks

The methodology for the first objective involved a desk review of AASF and GSF to comprehend the current sustainability practices in the grain sectors and identify potential enhancements. The principles, criteria, and indicators in these frameworks were evaluated for their applicability and effectiveness. Subsequently, a classification schema was developed to categorise sustainability standards based on environmental impact, social implications, and economic viability. This schema was applied to a selected grain crop, using the Queensland agro-environment as a case study. The data used to design this schema was collected from various sources, including literature and citizen science like the National Variety Trials by GRDC, and other relevant national documents. This data was not only used for schema design but also for developing machine-learning algorithms. These algorithms help in weighting and scoring these standards, ensuring an accurate and relevant analytical approach.

Stakeholder Consultation

A number of stakeholder consultations were conducted to understand perspectives and contexts concerning agricultural practices and farming systems. Fuzzy Cognitive Mapping (FCM), a semi-quantitative method, was used to capture and analyse stakeholders' knowledge and beliefs.

Results

The Need for a Grower-Centric Approach

The ASSF and GSF have been analysed for their synergies and limitations concerning the sustainability reporting of specific commodities. While these frameworks offer macro-level positioning of properties such as environmental stewardship, human health, animal welfare, social equity, economic resilience, and fair trading, they do not provide specific guidance for individual crops or farms. Their "umbrella" approach may not account for the diversity of specific production systems in Australia. The absence of clear targets and indicators limits their ability to showcase achievements in improving the sustainability of grain-based systems. As voluntary frameworks, their effectiveness relies on growers' willingness to adopt best practices. Some growers may not perceive the benefits of compliance, particularly if it incurs additional costs. Others may lack the resources or knowledge to comply with the frameworks. To tackle these challenges, a crop-specific model has been devised. This model incorporates measurable standards, machine-learning algorithms for scoring, and support mechanisms. These components address growers' concerns at various levels, offering a more comprehensive sustainability assessment.

The Bottom-Up Model

A tool for monitoring and reporting sustainable practices in grain-based production systems in Australia has been developed, incorporating environmental, economic, and social dimensions. The tool uses an Environmental, Social & Economic (ESE) reporting structure to direct users to pertinent themes, topics, and standards (**Table 1**).

Table 1. Proposed standards for assessing sustainability at crop and farm levels.

Theme	Topic	Standard
Environmental	Climate, Environmental Action & Resilience	S1. GHG Emission; S2. Soil Health; S3. Biodiversity Protection; S4. Water Conservation; S5. Waste Management & Renewable Energy Transition
Social	Work Safety and Wellbeing, Social Justice & Community Engagement	S6. Occupational Safety & Human Health; S7. Skill and Resource Development; S8. Modern Slavery, Discrimination & Harassment
Economic	Crop Productivity and Quality & Profitable Grain Production	S9. Farm Planning & Record Keeping; S10. Crop Variety Selection; S11. Sowing; S12. Farm Input Management; S13. Harvesting; S14. Post-harvest Management & Storage; S15. Market Engagement

The Algorithmic Scoring System

The model, informed by stakeholders from diverse institutions, consists of an inventory of practices at property, farm, and crop levels (**Figure 1**). It is further arranged into six modules: Farm Management, Soil Health Management, Crop Management, Workplace Management, Biodiversity Management, and Capacity and Leadership (**Figure 2**). These modules form the macro-organisational layer. For instance, within the Crop Establishment module, there are detailed submodules such as Crop Nutrition and Nutrient Management, Drainage and Irrigation Management, Pest Management, and Harvest and Postharvest Management, which

form the micro-organisational layer. Each submodule includes elements like Wheat Variety Selection. Algorithms calculate specific parameters within these elements to indicate sustainability performance. For example, in Wheat Variety Selection, parameters like grain yield, disease rating, sprouting index, and approval by Grains Australia are considered. Each parameter has a specific score range and weight, which is dynamic and varies depending on the location and conditions. This dynamic nature is captured by algorithms and represented through user-friendly visuals. The algorithms for computing key performance indicators (KPIs) and modules are continuously refined based on stakeholder insights, ensuring the model remains relevant and effective.

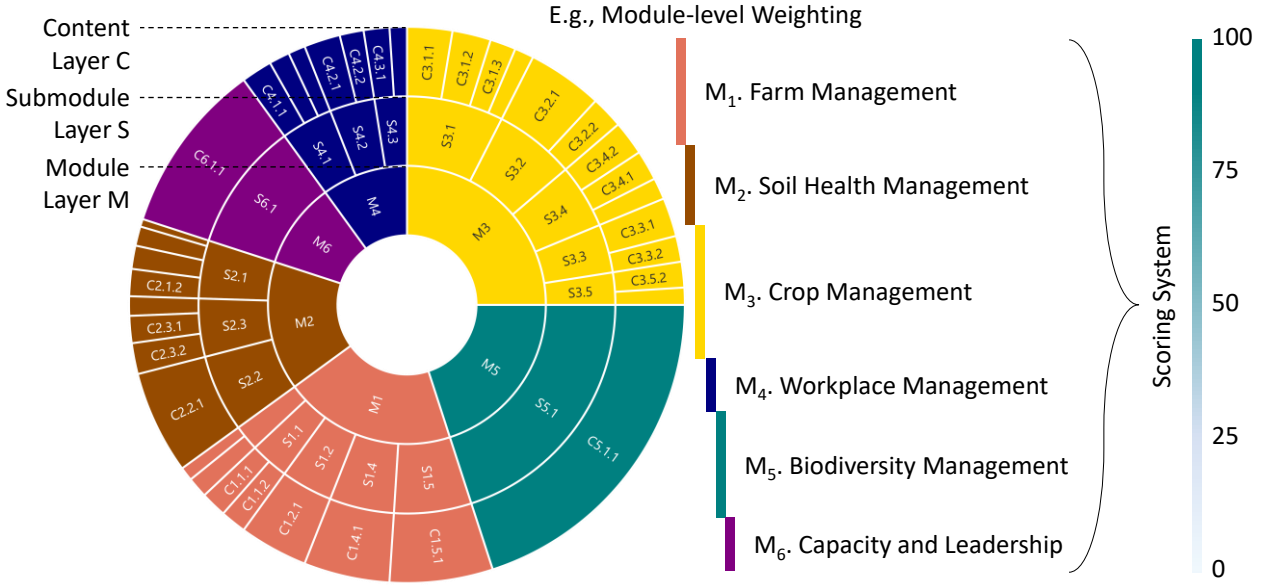

Figure 1. Model layers. The system is divided into six main modules, each with submodules. Parameters within each submodule are computed using machine-learning algorithms. A systematic evaluation process is used, and growers are scored from 0 to 100 for their sustainability practices.

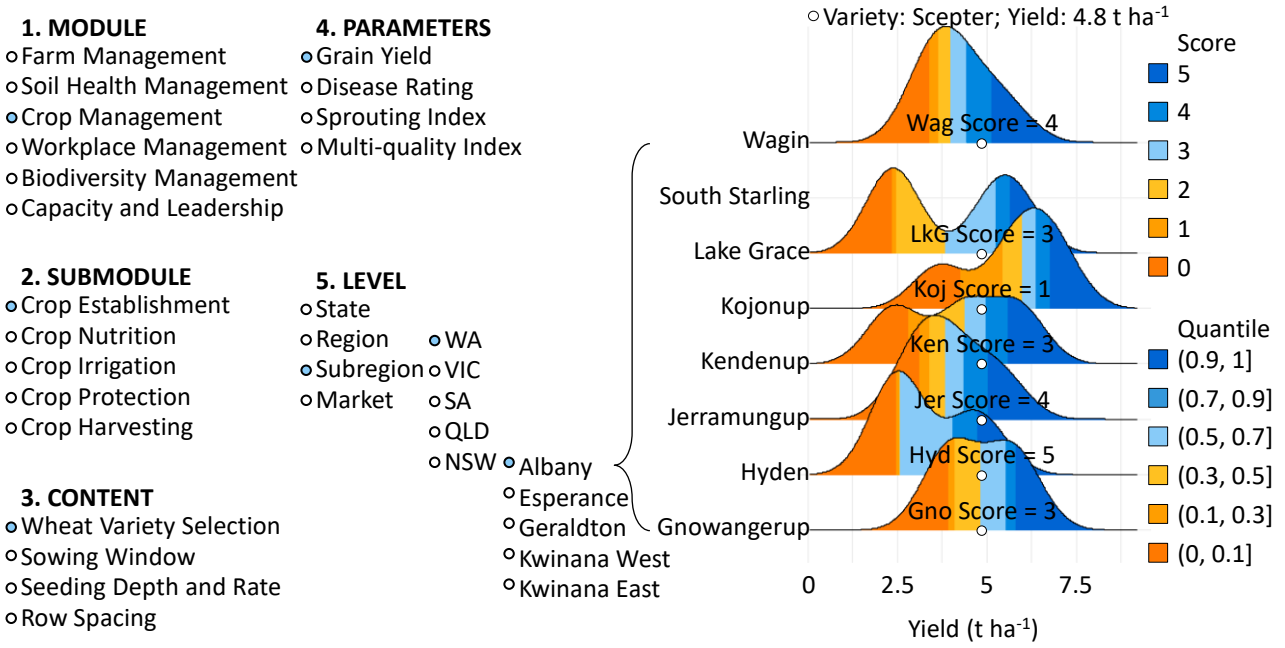

Figure 2. Scoring by context. The system enables sustainability assessments at various levels, considering geographic and market factors. It uses context-specific scoring, which varies based on the conditions and practices of each area. As an example, the scores for a wheat variety like Scepter can vary based on regional factors.

Conclusions

A bottom-up model aligning crop and farm-level sustainability assessment with Australian frameworks, specifically the ASSF and GSF, has been developed. The model, informed by stakeholder expertise, includes

themes, topics, standards, and modules under development. These modules contain submodules, contents, parameters, and machine-learning algorithms. These algorithms facilitate a weighted scoring system for various geographical levels and market categories and aid in developing incentives for sustainable practices. Initially, the model's applicability extends to GRDC leviable crops other than wheat, enhancing its relevance across the Australian grain industry. Plans are underway to expand this project nationally with support from stakeholders across various regions in Australia.

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