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Rules of thumb or models: exploring diversity in growers' nitrogen fertiliser decisions

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Abstract: Nitrogen fertiliser decisions are central to grain farming profitability, risk management, and environmental outcomes, yet Australian growers make these choices amid considerable uncertainty around weather, prices, and crop responses. Understanding how risk, uncertainty, and diverse grower preferences influence decision-making is critical for shaping research, development, and extension strategies that improve practice change.

This study examines Australian growers' decision processes through Kahneman's System 1 ('fast', intuitive) and System 2 ('slow', analytical) frameworks (Kahneman, 2011). Using survey data from over 300 growers, we apply a three-step Latent Class Analysis (LCA) to group decision styles. Step one determines the optimal number of classes; step two assigns growers to their most probable class; step three explores associations with risk aversion, confidence, farm size, and location.

For nitrogen decisions, two classes emerge: More-analytical growers (47%), who use spreadsheets, calculations, and probabilistic reasoning (System 2), and Less-analytical growers (53%), who rely on intuition and heuristics (System 1). When broader decisions (e.g., machinery or land purchases) are included, three groups arise: More-analytical (29%), Advisor-oriented (47%), and Less-analytical (24%), with the Advisor-oriented group relying on advisers while reviewing decisions. Class membership correlates with farm size, confidence in current decision processes, and self-reported risk preferences.

Historically, growers have relied on nutrient budgeting and rules-of-thumb, while advanced decision support systems (DSS) such as APSIM or Yield Prophet® remain underutilised due to complexity, data demands, and reliance on 'best guess' inputs. Emerging data-driven methods—including remote sensing, machine learning, and on-farm experimentation—could lift profitability but require extensive data infrastructure (Colaço et al., 2024). Future DSS must pair analytical rigour with usability, communicate risk–reward trade-offs, and support the "4Rs" —applying the right product, at the right rate, at the right time, and in the right place—while incorporating behavioural insights to ensure tools are practical, intuitive, and widely adaptable.

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