Critical traits to deliver resilient, productive and profitable primary production systems with improved environment outcomes

Tranche 2 concept

Leads: Paul Johnstone, Dave Leathwick et al.

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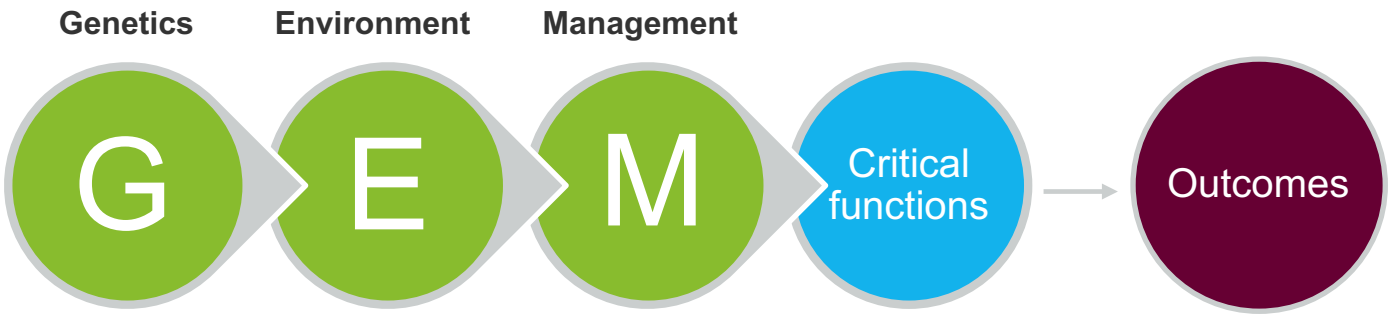
- **Delivering to Challenge imperatives**
  - Double economic value from our land and water resources
  - Productive environment managed to achieve values here and abroad
  - By showing that we are all kaitiaki for future generations

What do we mean by critical traits?



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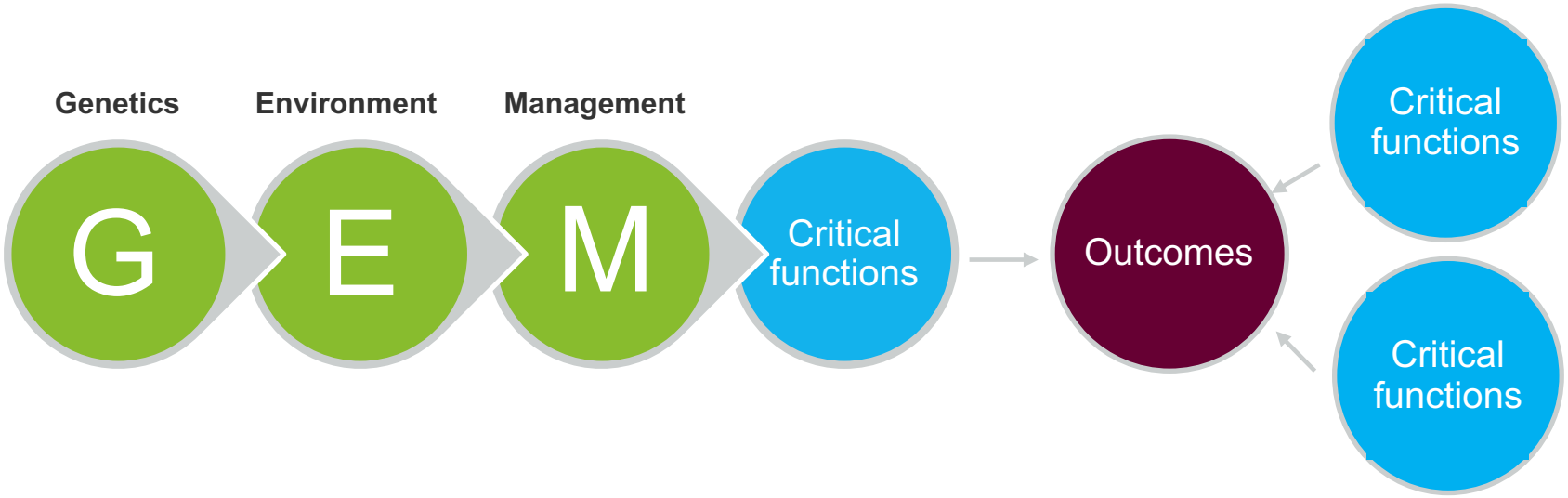

How important might critical traits be?

Feed composition influences N excretion

Context: N rich feeds ≈ N rich soils
Example: Species like plantain help maintain milk productivity but can reduce urinary N concentration by ~50%

Water use efficiency varies between cultivars

Context: Cereal yields are linked to irrigation
Example: Between cultivar differences in wheat offer improvements in water use efficiency of ~15%

Regional adaptation to climate change

Context: CC expected to reduce maize yields
Example: Adaptation using hybrid selection x planting date combinations can offset this by ~20%

...Outcomes are real: result from managed and imbedded traits

...Are there still significant gaps?

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- **Some gaps:**
  - What plant, animal or soil microbe traits will help achieve **environmental** or **welfare targets**?
  - How will these targets be influenced by **current and future climates**, **regulatory**, **market** and **social norms**?
  - How could critical traits aggregate **across spatial** (fields, catchments and nationally) and **temporal** (days, seasons, years) scales to deliver better outcomes?

Examples of areas that could be considered

Plant traits to stabilize and restore vulnerable and degraded soils

Species mixes to manipulate soil microbes, nutrient transformations and reduce rumen emissions

Animal traits or feeds that reduce disease pressure and prophylactic use of chemicals

Adaptive plant traits to address water scarcity and extreme climatic events

New insights
New tools
New methods

Sector solutions

What might that look like in more detail?

An exemplar objective: catch crop traits for reduced N leaching

Problem: N losses following grazing high, catch crops have shown potential

Q1: Which inter- and intra- species traits deliver the biggest impact in current and future climates?

Q2: Which management practices ensure traits deliver the biggest benefit?

Approach

Develop and test models to test impact of traits (e.g. $R_{density}$, R_{depth}, B_{Temp}) and interactions with soils and climate	Validate and refine models through experimentation to inform 'trait pipelines'	Test new traits (where available) and management practices on-farm*

Work with breeders, industry groups and farmers

* Could be through industry-led SFF's / commercial projects

How can the idea be developed together?

Industry groups	• **Complement existing initiatives** • **Expertise in production systems**
Breeding companies	• **Expertise in traits (pre-competitive)** • **Connect to breeding initiatives**
Systems modeller and data scientists	• **Development / application of models** • **Big data analytics**
Production systems scientists	• **Plant, animal and soil science** • **Expertise in systems redesign**
Land and climate scientists	• **Skills in environmental science** • **Data layers that influence traits**

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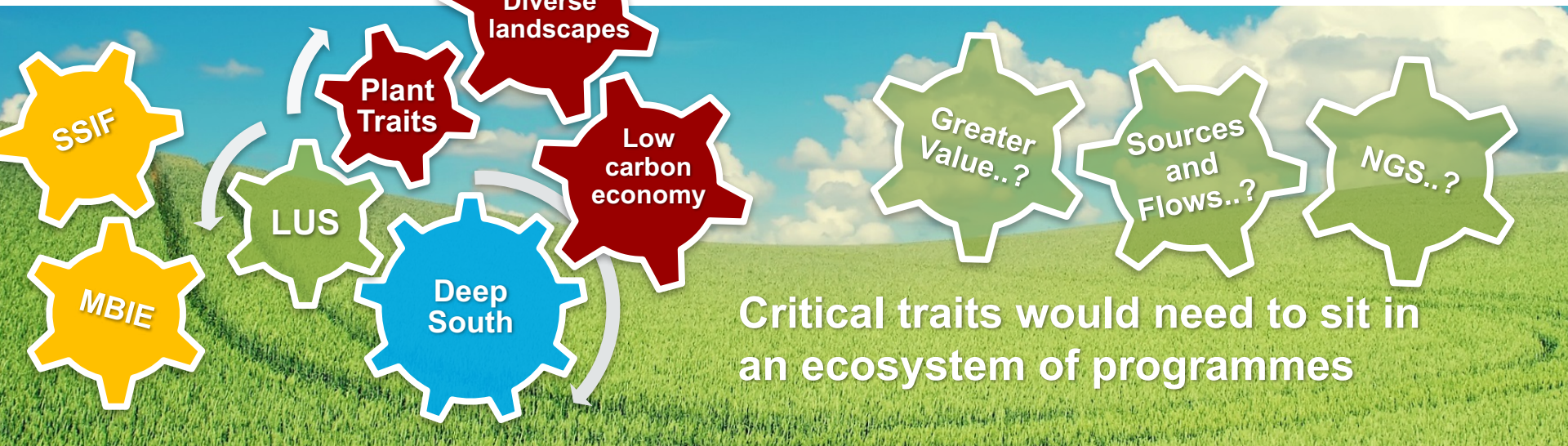

What Challenge drivers could traits address?

Challenge drivers	How traits could contribute?
Climate change	• Mitigation of emissions • Adaptation to new climates
ETS	• Reducing emissions • Offsetting emissions
A scarcity of good water	• Better water use efficiency • Cleaning polluted water
Reclaiming a social license	• Sustainability of practices
Diverse, potentially radically different land use options	• Mixed enterprises

...While maintaining or growing the economy to achieve land owner, industry and government targets

Your ideas on filling the gaps?

- **Some gaps:**
  - What plant, animal or soil microbe traits will help achieve environmental or welfare targets?
  - How will these targets be influenced by current and future climates, regulatory, market and social norms?
  - How do critical traits aggregate across spatial (fields, catchments and nationally) and temporal (days, seasons, years) scales to deliver better outcomes?
- **Some questions:**
  - Which are the highest priorities for the Challenge?
  - What connections are needed to existing initiatives?
  - How could we manage tensions between traits and breeding programmes?

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