Towards addressing …
'Postharvest Quality Issues of Mandarins in Pakistan and Australia'

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ACIAR · Queensland Government · THE UNIVERSITY OF QUEENSLAND AUSTRALIA

Introducing … **"Improving smallholder well-being through participation in modern value chains: Sustaining future growth in the Pakistan citrus industry"**

Aim: 'The project aims to achieve sustained improvement in the well-being of smallholder citrus families by enabling their men, women, and youth to benefit from participation in inclusive value chains that meet market needs and provide equitable returns to farmers.'
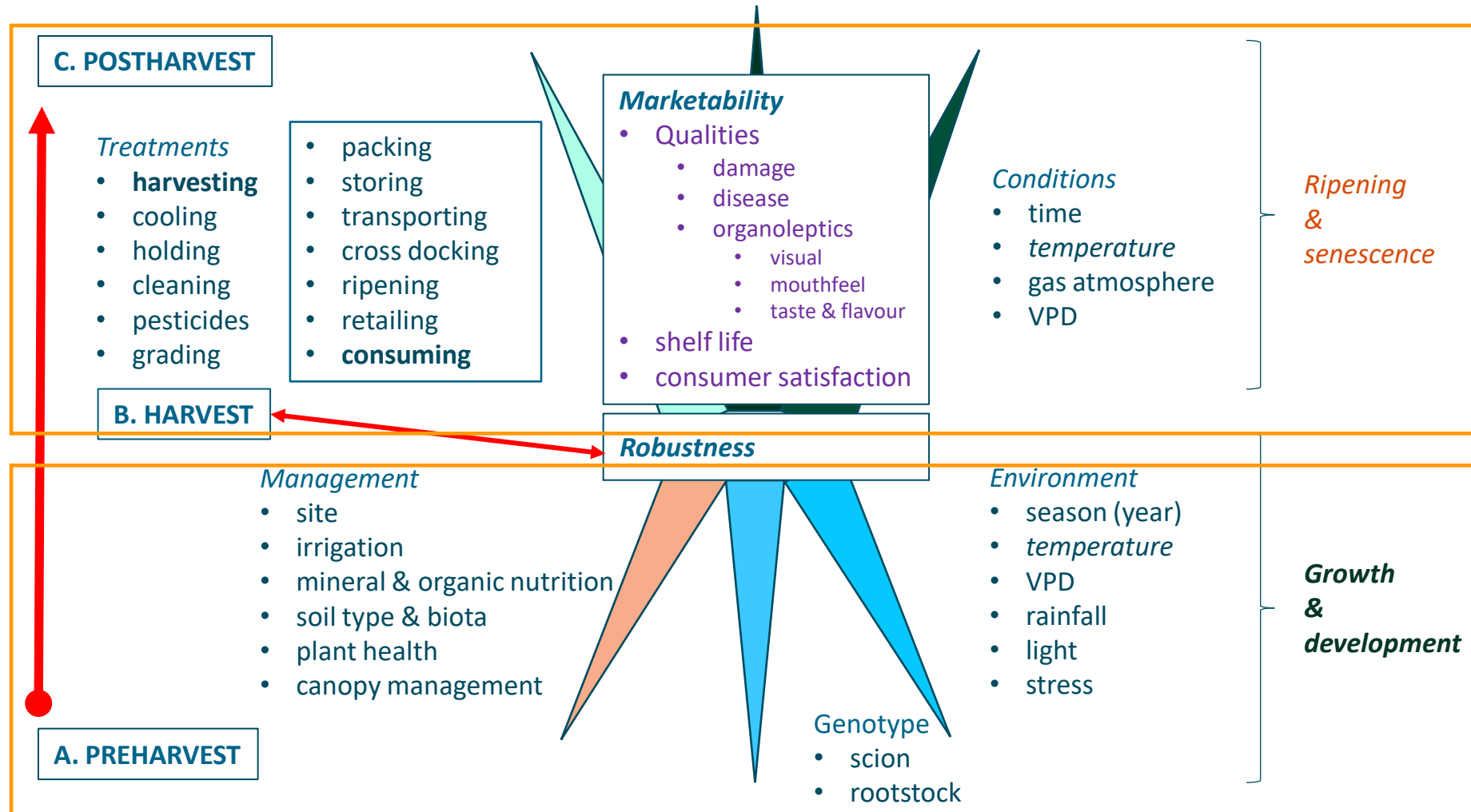
Benefits to Australia: "The collaborative international programs and partnerships underpinning ACIAR-supported research also serve to improve Australian scientific capabilities and the productivity and sustainability of agricultural systems in Australia." (https://www.aciar.gov.au/benefits-australia)

"Development Issue and Research Opportunity"

- *Research Question (RQ) 2 explores …*
  - Building better performing value chains and using innovative approaches to **empower value chain effectiveness and efficiency**
  - Emerging **decision support tools** to monitor, measure, and predict through-chain quality of fruit
  - Holistic models to measure and **predict** citrus fruit qualities, including TSS:TA, flavour, and disorders
  - Measuring, monitoring, and modelling for predicting fruit quality **from conception to consumption** is empowered
  - Objective approaches to **reducing loss and waste**, **securing good returns**, and **consensus** among producers and other chain members around integrating fruit quality prediction with market and financial information

SYSTEM … mandarin production, handing, and marketing

C. POSTHARVEST

Treatments
- **harvesting**
- cooling
- holding
- cleaning
- pesticides
- grading

- packing
- storing
- transporting
- cross docking
- ripening
- retailing
- **consuming**

Marketability
- Qualities
  - damage
  - disease
  - organoleptics
    - visual
    - mouthfeel
    - taste & flavour
- shelf life
- consumer satisfaction

Conditions
- time
- *temperature*
- gas atmosphere
- VPD

Ripening & senescence

B. HARVEST

Robustness

Management
- site
- irrigation
- mineral & organic nutrition
- soil type & biota
- plant health
- canopy management

Environment
- season (year)
- *temperature*
- VPD
- rainfall
- light
- stress

Growth & development

Genotype
- scion
- rootstock

A. PREHARVEST

Quality issues: 'Kinnow' mandarin

Canker

Mites

Greening

Wind injury

Stylar end deformity

Melanose

Scab

Quality issues: 'Afourer' mandarin

Data dictionary (Excel™)
a "common language" data base

	Trait	Value	Units	Type	Description
20	CEC	10.43	meq/100g	numeric	Cation Exchange Capacity (CEC) is a soil property that describes its capacity to supply nutr
21	ECEC	14.455	meq/100g	numeric	Effective Cation Exchange Capacity (ECEC).
22	Organic_Matter	6.2	%	numeric	Soil organic matter or soil organic carbon content.
23	NH$_4$_Soil	9.000	mg/kg	numeric	Ammonium Nitrogen concentration in soil sample.
24	NO$_3$_Soil	9.000	mg/kg	numeric	Nitrate Nitrogen concentration in soil sample.
25	N_Soil	4.330	mg/kg	numeric	Nitrogen concentration in soil sample.
26	P_Soil	81.500	mg/kg	numeric	Phosphorus concentration in soil sample.
27	K_Soil	529.000	mg/kg	numeric	Potassium concentration in soil sample.
28	Ca_Soil	2340.000	mg/kg	numeric	Calcium concentration in soil sample.
29	Mg_Soil	388.000	mg/kg	numeric	Magnesium concentration in soil sample.
30	S_Soil	17.380	mg/kg	numeric	Sulphur concentration in soil sample.
31	Zn_Soil	24.520	mg/kg	numeric	Zinc concentration in soil sample.
32	Mn_Soil	54.710	mg/kg	numeric	Manganese concentration in soil sample.
33	Cu_Soil	9.040	mg/kg	numeric	Copper concentration
34	Fe_Soil	32.900	mg/kg	numeric	Iron concentration in
35	B_Soil	2.650	mg/kg	numeric	Boron concentration i

All | Genotype | Environment | **Management** | Trial | Postharvest | Timelines | Qua …

Management Tab

	Category	Trait list	Example	Units	Type	Description
1	Category	Trait list	Example	Units	Type	Description
2	Harvest	Harvest_Timing	Early	-	character	The timing of harvest within the harvest period on a single site. **Dropdown list** with sing
3		Harvest_Method	Select	-	character	The method of harvest. **Dropdown list** with single selection, options include select or st
4		Pesticides	Yates citrus and ornamental spray	-	character	Name of the Pesticides if used.
5		Grade	A, 1	-	character	Grade of the fruit.
6	Logger	Datetime	2022-08-18 15:45	-	POSIXct	Date time stamp from a logger.
7		Temp	10.5	°C	numeric	Air temperature data from a logger. If there are multiple air temperature columns, label
8		RH	92.3	%	numeric	Relative humidity data from a logger.
9	Time	Day_from_Harvest	8	day	numeric	Current day from harvest.
10		Day_from_Tmt_End	3	day	numeric	Current day from removal.
11	Temperature	Temp_Avg	10	°C	numeric	The average temperature from harvest to the current time.
12	TTU	TTU_Current	6359.8	°C·h	numeric	The total heat sum from harvest ur
13		TTU_Intake	1975.0	°C·h	numeric	The total heat sum from harvest ur
14		TTU_Tmt_End	4424.8	°C·h	numeric	The total heat sum from harvest ur
15		TTU_PHL	12128.5	°C·h	numeric	The total heat sum from harvest until ESL. Base temperature is 0 °C.

Postharvest Tab

| Tabs |
|---|
| All |
| Genotypes |
| Environments |
| Management |
| Trials |
| Postharvest |
| Timelines |
| Quality |
| Images |

Value chain context …

- **Value chain**: *value creation*

  Full range of value adding activities required to bring a product or service from conception, through the different phases of production and distribution to end users (Wei 2011).

1 Quality Production

Harvest

2

5

Processing

Local Market

2

7

6

3 Storage

4

Export

7
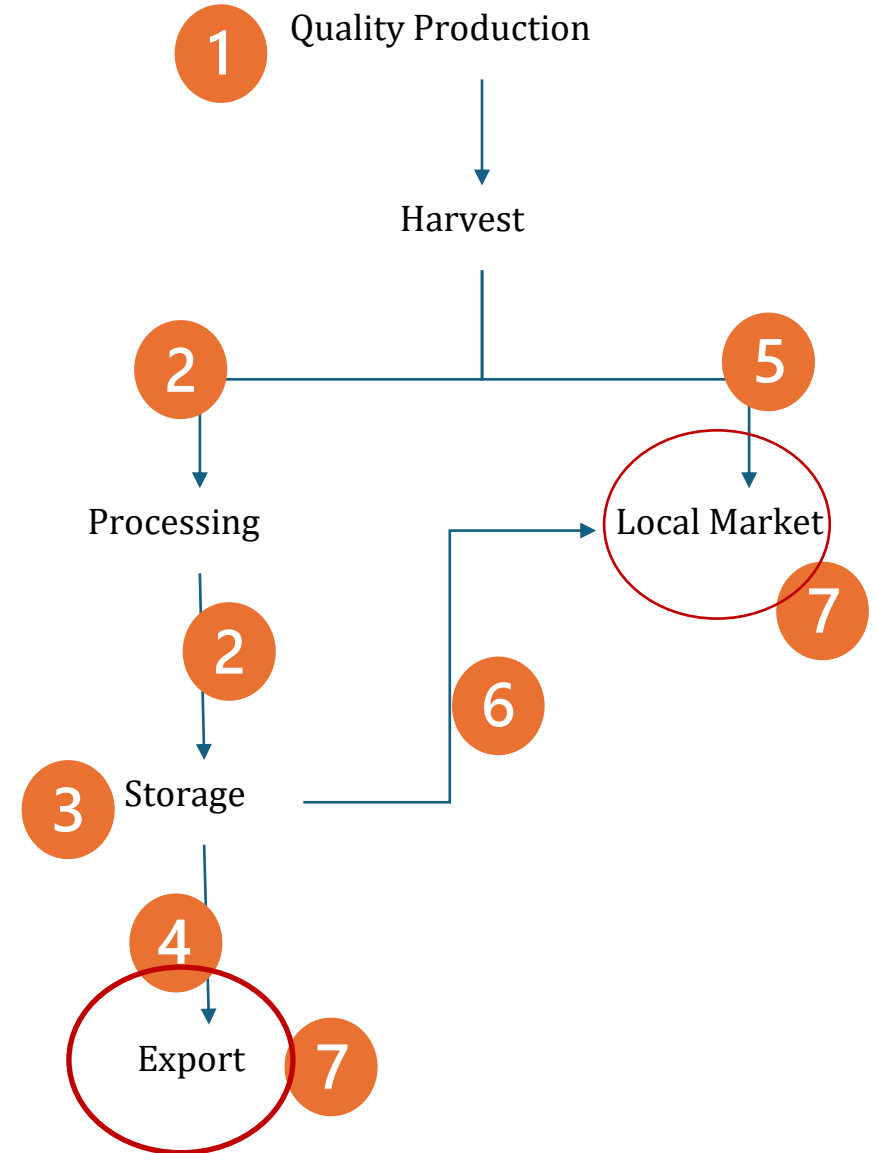
Measuring, monitoring, and modelling
… based on simulation, verification, and validation

'Afourer' simulation:
Remaining shelf life (days)
vs. time by temperature (TTU)
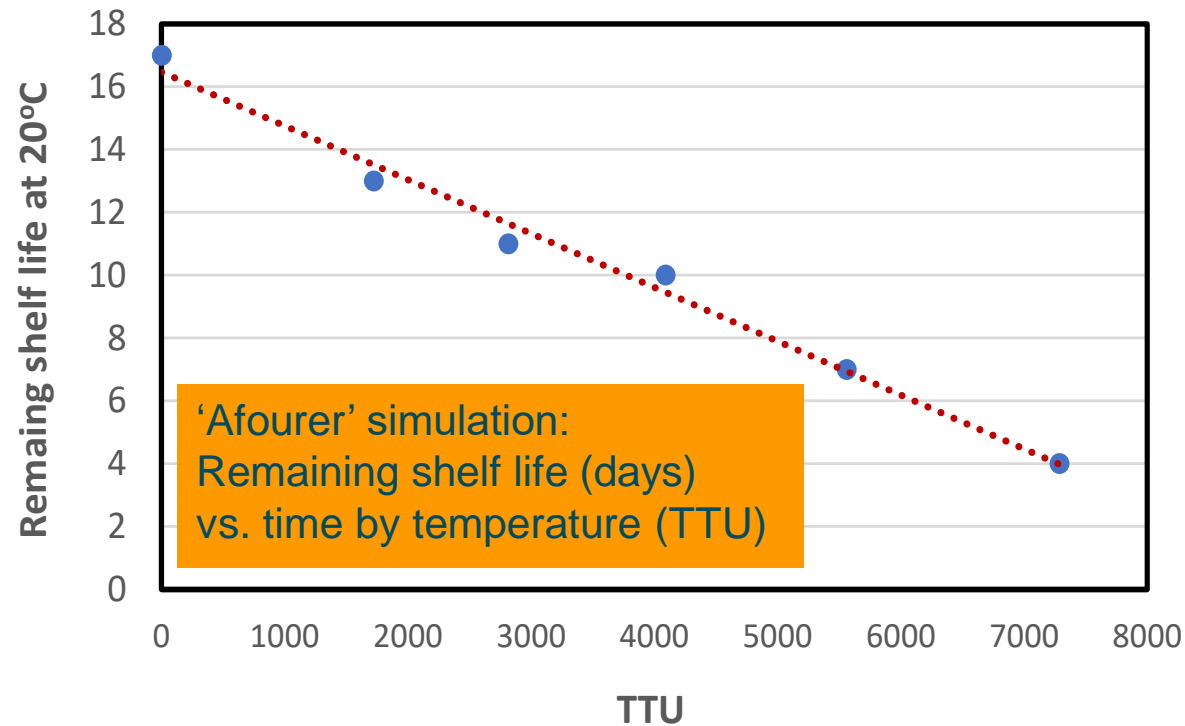
Anticipated impacts …

- Improvements in production practices attributable to project interventions
- Improvements in out-turn quality attributable to addressing key product attributes
- Improvements in export / domestic performance due to use of modelling and allied data-based decision aid tools
- Improvements in the use of proposed technologies; e.g. real-time temperature loggers in real-world shipments
- Improvements in levels of collaboration along the value chains attributable to the project

Legend

Connections between on-farm variables

R — Reinforcing Loop

B — Balancing Loop
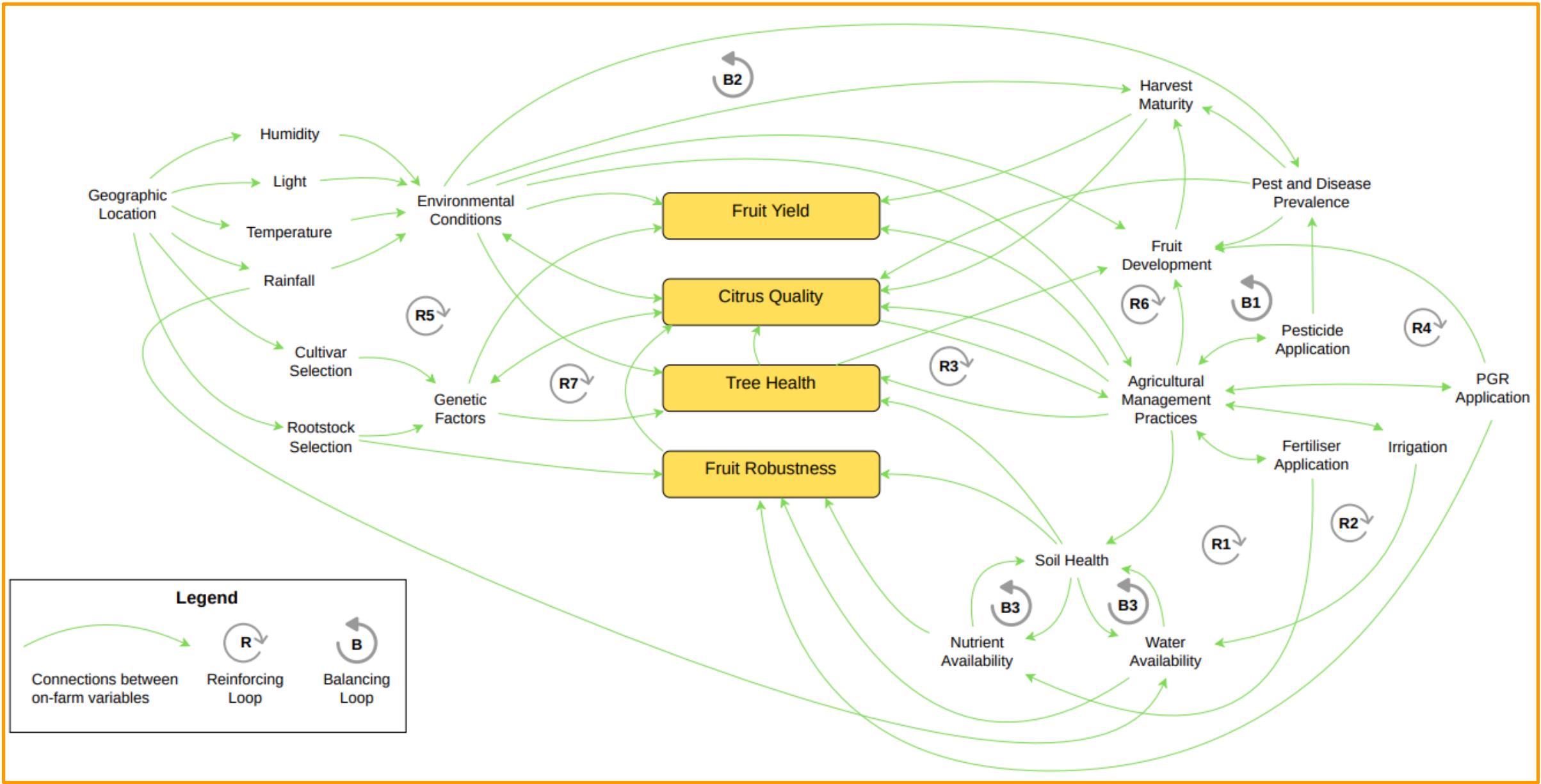
Sharing learnings …

- Reports (e.g., ACIAR)
- Technical & scientific journal publications (e.g., Postharvest Biology & Technology)
- Articles (e.g., Australian Tree Crops)
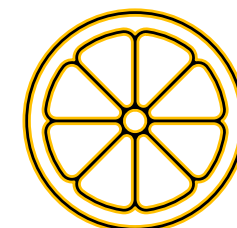- Presentations (e.g., Citrus Australia) and workshops (TBC)

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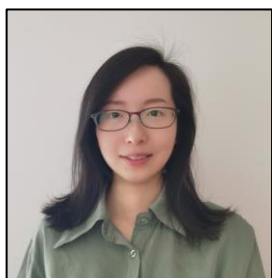
Acknowledgement of
First Nations peoples

I would like to respectfully acknowledge the Traditional Owners and Custodians of the land on which we meet today, and I pay my respects to their Elders past, present and emerging.

I extend that respect to all Aboriginal and Torres Strait Islander peoples here today.