

What's the value of rain forecasts for dryland cotton? **Preliminary**

Rebecca Darbyshire
rebecca.darbyshire@dpi.nsw.gov.au

What do you think is your major decision that a seasonal climate forecast would be useful?

What return would you want from using a forecast?

Project Details

3 years (~July 2015 – June 2018)

\$2.7m + \$0.8m in kind

Partners + MCV



Department of
Primary Industries



Australian Government
Cotton Research and
Development Corporation



SOUTH AUSTRALIAN
RESEARCH AND
DEVELOPMENT
INSTITUTE



Department of
Agriculture and Food

AGRICULTURE VICTORIA



UNIVERSITY
OF SOUTHERN
QUEENSLAND



MONASH University



Key Associates



Australian Government
Bureau of Meteorology



Queensland Government
Department of Agriculture
and Fisheries



Project Components

1. Valuing the Forecast

- a) **Economic analyses***
- b) Skill assessment

2. Using the Forecast

- a) Community of Practice
- b) Products & Tools

3. Improving the Forecast

ACCESS-S; Indian Ocean convection

Motivation

“***improved*** seasonal forecasts have an estimated value of to Aust. agriculture of \$958-1930m”
(CIE, 2014)



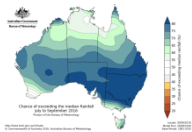
“Seasonal climate forecasts aren’t good enough to rely on but are too good to ignore”
(Chris Sounness, BCG)

“Seasonal climate forecasts are probably useful for some decisions some of the time”
(Peter Hayman, SARDI)

This Chat

1. Overview of approach
2. Dryland cotton case study
 - Your input into methodological design: still time to influence!
3. Forecast description
4. Preliminary results
 - Yield
 - Fallow
5. Next steps

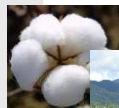




What influences the decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

SCF must change a decision to have value



Value of Seasonal Climate Forecasts?

SCF relevant to the decision?



- SCF

+ SCF

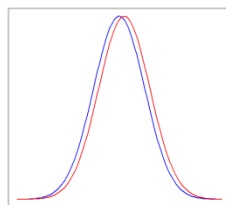
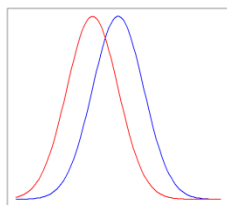
WHAT IF - THEN?

How Often

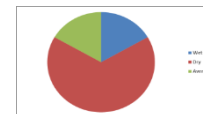
+\$
→

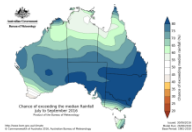
or

~/--\$



Profit





SCF must
change a
decision to
have value

What
influences the
decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

Value of Seasonal Climate Forecasts?

SCF relevant to
the decision?



- SCF

+
SCF

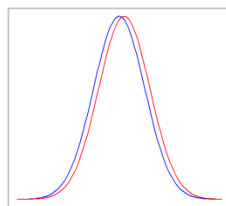
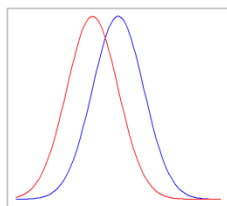
WHAT IF -
THEN?

How Often

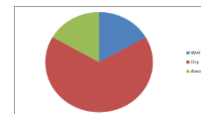
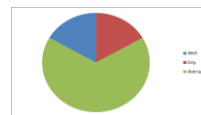
+\$
→

or

~/--\$



Profit



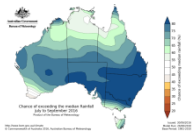
Dryland Cotton Decision

“Will I plant dryland cotton?”

- *row spacing?*

- *area?*

- Value of planting a crop *versus* value of leaving fallow for winter crop



SCF must
change a
decision to
have value

What
influences the
decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

Value of Seasonal Climate Forecasts?

SCF relevant to
the decision?



- SCF

+
SCF

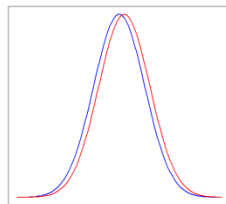
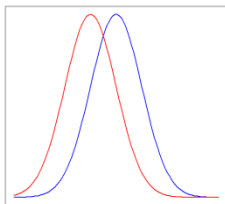
WHAT IF -
THEN?

How Often

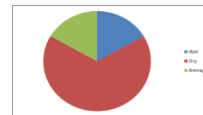
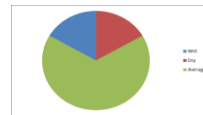
+\$
→

or

~/--\$



Profit



Decision Context

What do
you think?

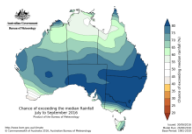
- **Cotton price** ★
High=motivation to plant; low=discourage planting
- **Starting soil moisture** ★
High=motivation to plant; low=discourage planting
- **Sowing rains** ★
Present=motivation to plant; absent=discourage planting
- **Seasonal forecast (Nov-Feb)** ⬡
Wet=motivation to plant; dry=discourage planting



Known known



'Reliable' unknown



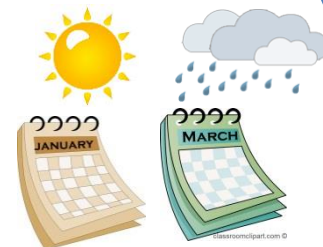
SCF must
change a
decision to
have value

What
influences the
decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

Value of Seasonal Climate Forecasts?

SCF relevant to
the decision?



- SCF

+
SCF

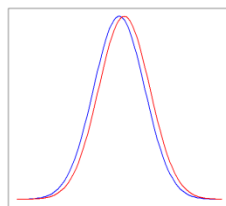
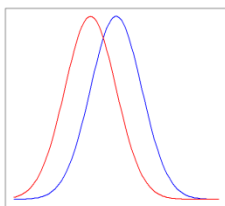
WHAT IF -
THEN?

How Often

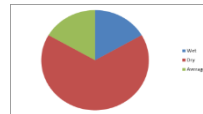
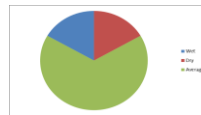
+\$
→

or

~/--\$



Profit



Soil Moisture	Sowing rains	Climate outlook (Nov, Dec, Jan, Feb)	% area planted	Engagement comment
75%	Yes	Average	100%	Important to have sowing rains for successful germination
75%	No	Average	0%	
75%	Yes	Dry	100%	Only if 'soaking' sowing rains
75%	No	Dry	0%	
75%	Yes	Wet	85%	
75%	No	Wet	15%	Plant area up on soil moisture and positive forecast
100%	Yes	Equal chance	100%	
100%	No	Equal chance	0%	Perhaps some sowing without rains, opportunistically
100%	Yes	Dry	60%	On 'normal' sowing rains
100%	No	Dry	0%	Perhaps some sowing without rains, opportunistically
100%	Yes	Wet	100%	
100%	No	Wet	30%	

***Assumption: prices are not prohibitively low

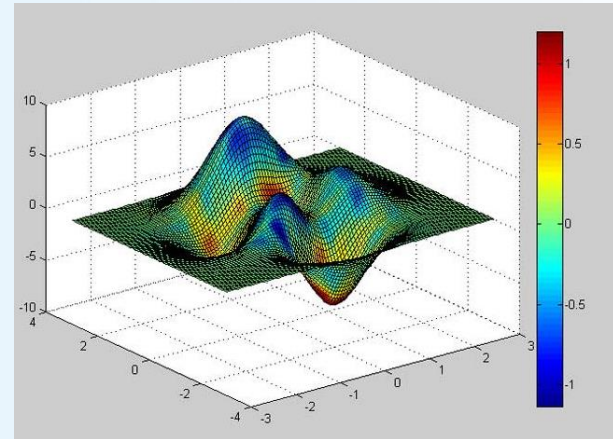
Biophysical Modelling

Three

- ~~Four~~ variables; each with several values
- Difficult for human brains to figure out



\neq



BUT mathematical models can help...

Assumptions

1. Starting soil moisture

%PAWC (25,50,75,100)

2. Sowing rains

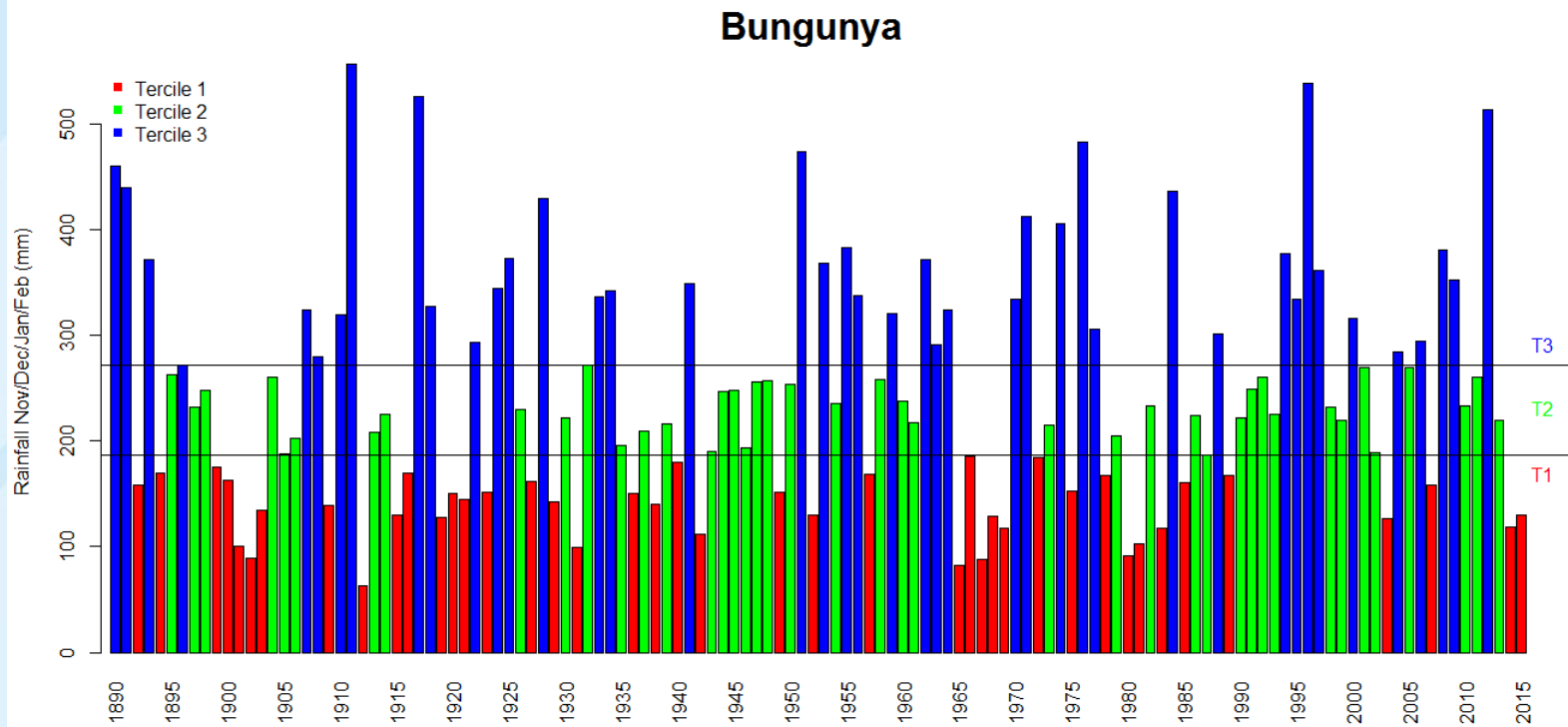
present=10mm (30 Oct); absent=0mm (27 Oct-2Nov)

3. Seasonal “forecast” (Nov-Feb)

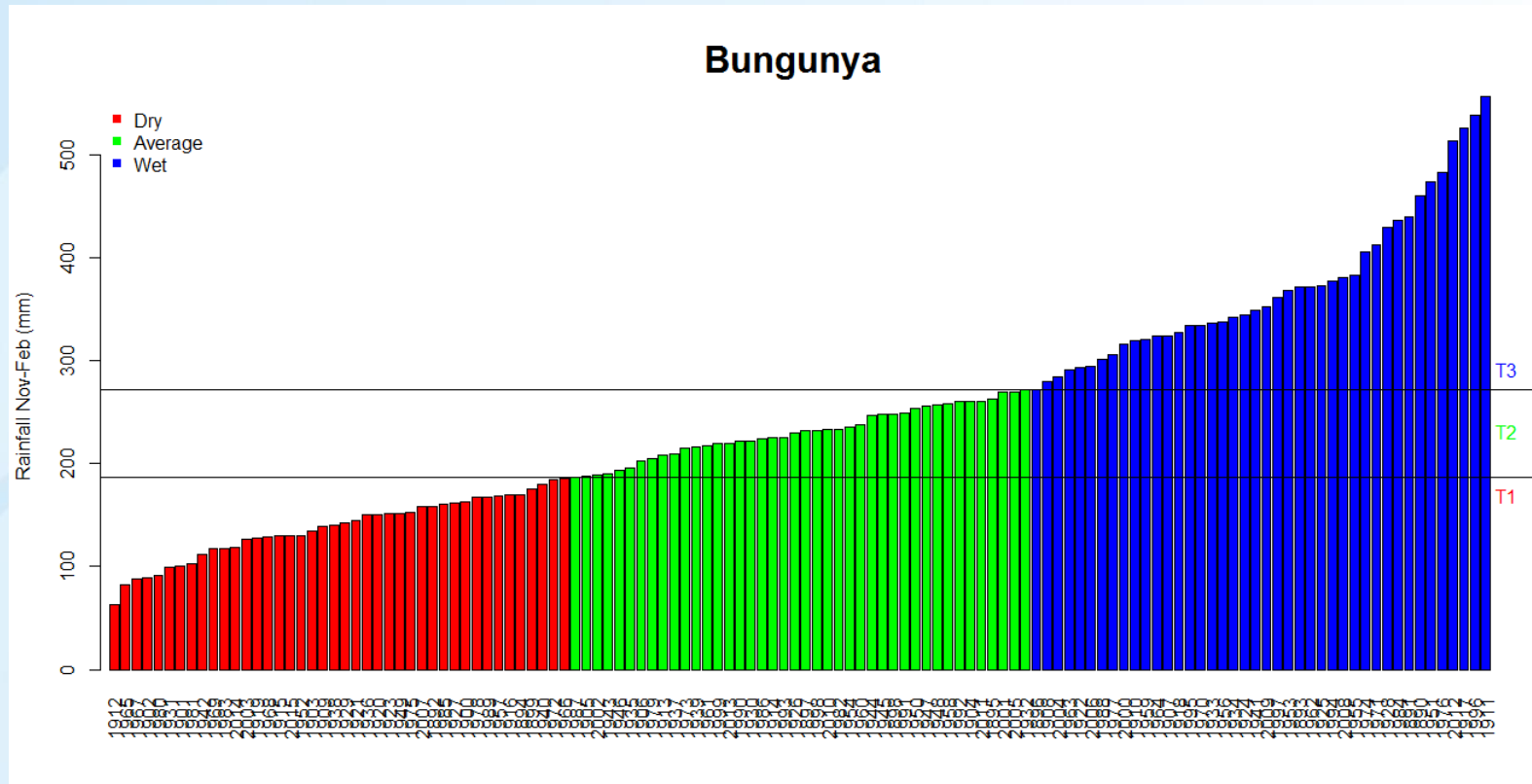
Terciles of historical rainfall (SILO).

Forecast

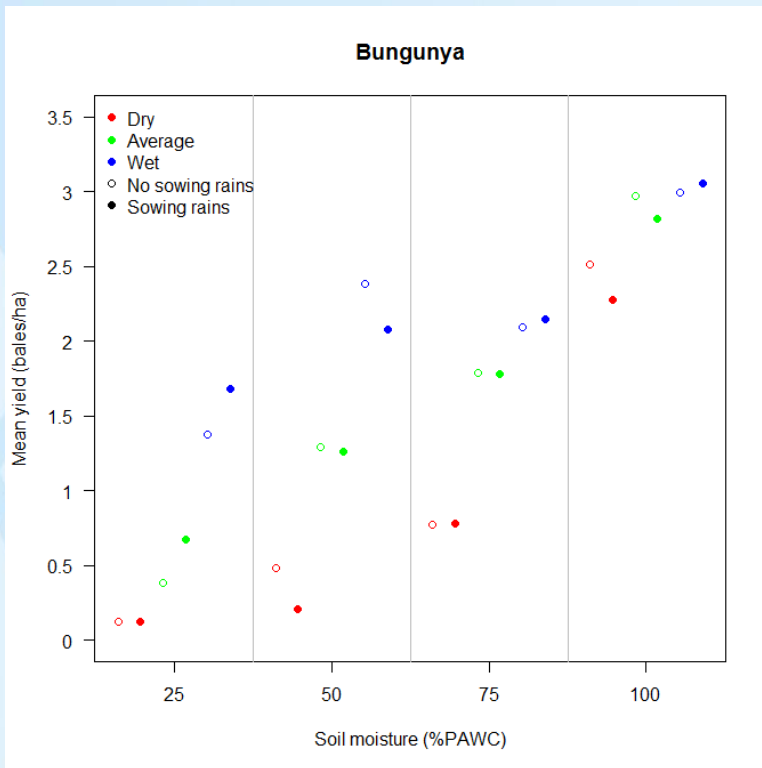
Dry (T1)<186mm
Ave (T2)>186&<271mm
Wet (T3)>271mm



Forecast



Preliminary results: Yield

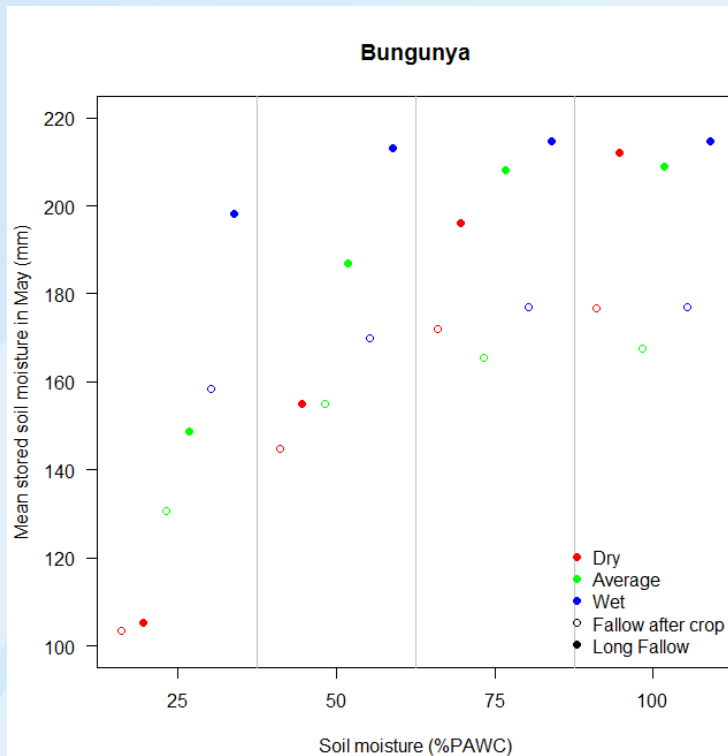


Single skip

PAWCmax = 215mm

- Higher yields Dry<Ave<Wet outcomes (as expected)
 - Higher yields with higher soil moisture (as expected)
 - Sowing rains \neq higher yields (not expected-but should have been!)
1. Dry forecast=rains encourage early growth that cannot be sustained later
 2. 25% PAWC=sowR benefit
 3. 50% PAWC=no sowR better
- NOTE:** these are means. Individual years vary greatly, timing (not volume) of subsequent rainfall key to outcome.

Preliminary results: Stored soil moisture (Crop vs Fallow – decision being weighed)



Single skip

- More stored water with fallow (as expected)
 - Sort of more stored water with higher starting PAWC (as expected)
 - Generally, more stored water $D < A < W$
 - Drop in stored water for Ave 75 and 100% (not expected)
 1. Crop=more water used in Ave season (higher yields)
 2. 100% fallow. All close to PAWC, some super saturation. High influence individual rainfall events.
- NOTE:** these are means. Individual years vary greatly, timing (not volume) of subsequent rainfall key to outcome.

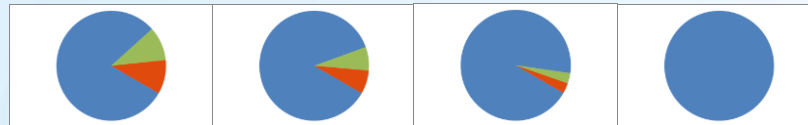
Economics Approach

Evaluate 'no forecast' vs 'forecast' decision

- no forecast = equal chance = climatology
- 10 levels of forecast confidence increasing from no forecast



No forecast



Wet Forecast

Next Steps

Some decisions re: skip row and area
? What do you think?

Continue and complete economic analyses

Report back to industry (finalised ~April 2018)

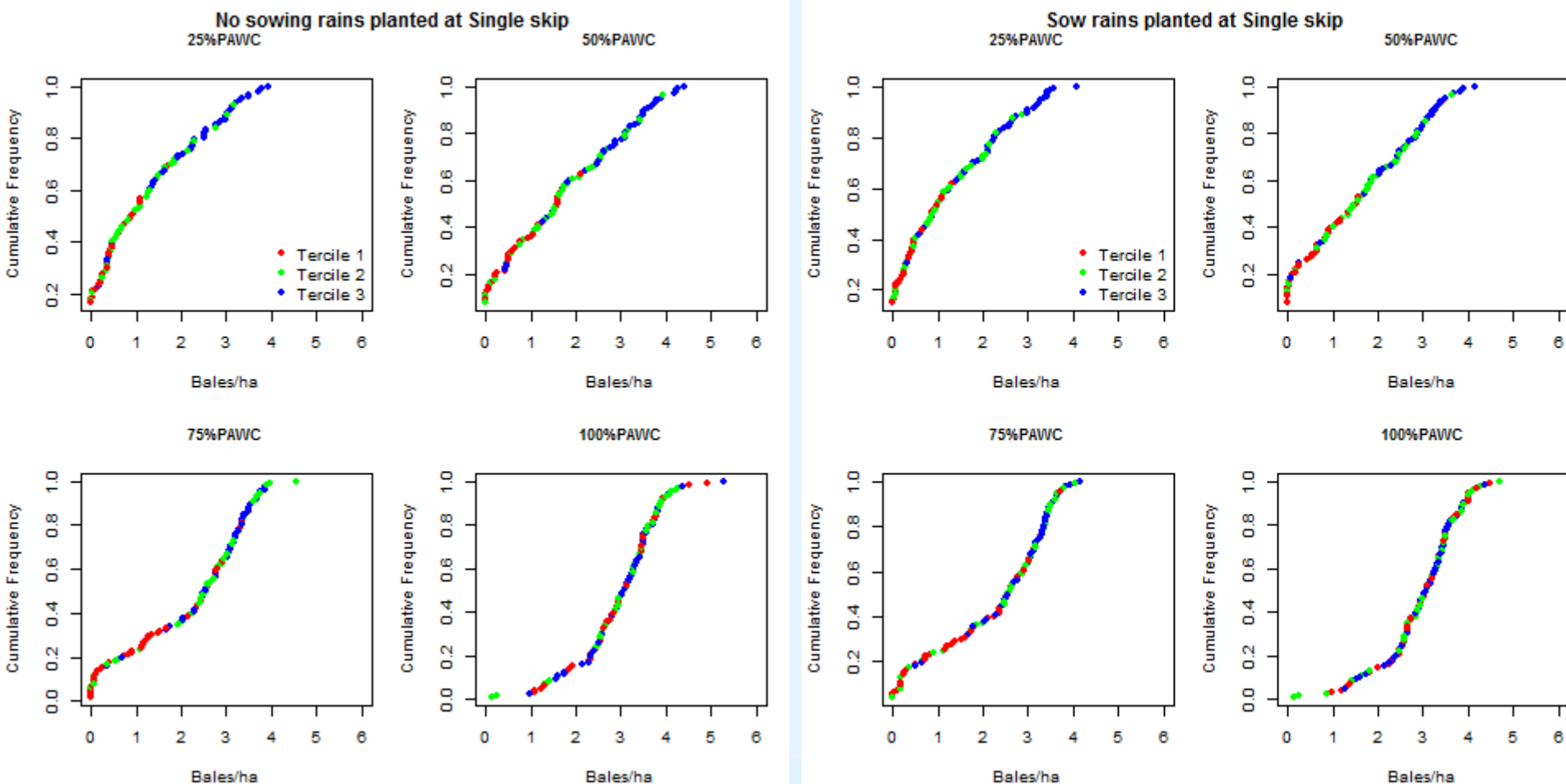
Compare across all 9 case studies

Questions?

rebecca.darbyshire@dpi.nsw.gov.au

0448 185 605

Cotton: APSIM Prelim



What's the value of rain forecasts for dryland cotton? **Preliminary**

Rebecca Darbyshire
rebecca.darbyshire@dpi.nsw.gov.au

What do you think is your major decision that a seasonal climate forecast would be useful?

What return would you want from using a forecast?

Project Details

3 years (~July 2015 – June 2018)

\$2.7m + \$0.8m in kind

Partners + MCV



Department of
Primary Industries



Australian Government
Cotton Research and
Development Corporation



SOUTH AUSTRALIAN
RESEARCH AND
DEVELOPMENT
INSTITUTE



Department of
Agriculture and Food

AGRICULTURE VICTORIA



RURAL
INDUSTRIES

Research & Development
Corporation



UNIVERSITY
OF SOUTHERN
QUEENSLAND



MONASH University

Key Associates



Australian Government
Bureau of Meteorology



Queensland Government
Department of Agriculture
and Fisheries



Project Components

1. Valuing the Forecast

- a) **Economic analyses***
- b) Skill assessment

2. Using the Forecast

- a) Community of Practice
- b) Products & Tools

3. Improving the Forecast

ACCESS-S; Indian Ocean convection

Motivation

“***improved*** seasonal forecasts have an estimated value of to Aust. agriculture of \$958-1930m”
(CIE, 2014)



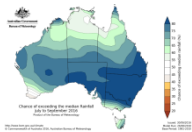
“Seasonal climate forecasts aren’t good enough to rely on but are too good to ignore”
(Chris Sounness, BCG)

“Seasonal climate forecasts are probably useful for some decisions some of the time”
(Peter Hayman, SARDI)

This Chat

1. Overview of approach
2. Dryland cotton case study
 - Your input into methodological design: still time to influence!
3. Forecast description
4. Preliminary results
 - Yield
 - Fallow
5. Next steps

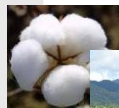




What influences the decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

SCF must change a decision to have value



Value of Seasonal Climate Forecasts?

SCF relevant to the decision?



- SCF

+ SCF

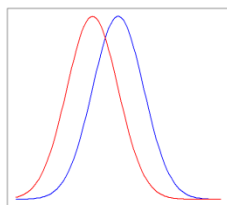
WHAT IF - THEN?

How Often

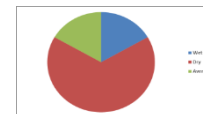
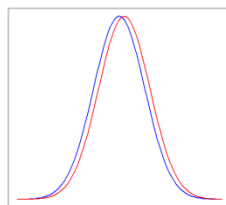
+\$
→

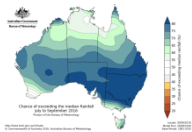
or

~/--\$



Profit





SCF must
change a
decision to
have value

What
influences the
decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

Value of Seasonal Climate Forecasts?

SCF relevant to
the decision?



- SCF

+
SCF

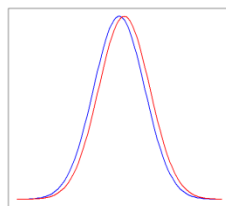
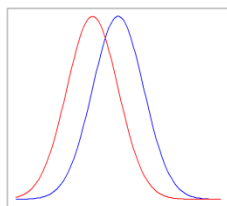
WHAT IF -
THEN?

How Often

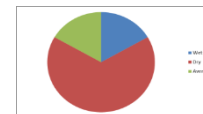
+\$
→

or

~/--\$



Profit



Dryland Cotton Decision

“Will I plant dryland cotton?”

Value of planting a crop *versus* value of leaving fallow for winter crop

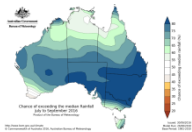
****Amendment:**

Will I plant end of Oct @ double skip

Will I plant end of Nov @ single/double skip

Will I leave fallow

??



SCF must
change a
decision to
have value

What
influences the
decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

Value of Seasonal Climate Forecasts?

SCF relevant to
the decision?



- SCF

+
SCF

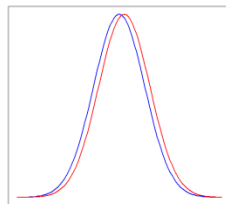
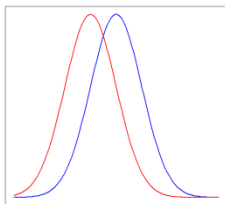
WHAT IF -
THEN?

How Often

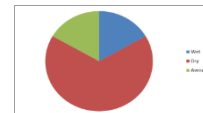
+\$
→

or

~/--\$



Profit



Decision Context

What do
you think?

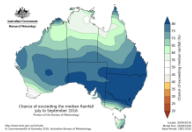
- **Cotton price** ★
High=motivation to plant; low=discourage planting
- **Starting soil moisture** ★
High=motivation to plant; low=discourage planting
- **Sowing rains** ★
Present=motivation to plant; absent=discourage planting
- **Seasonal forecast (Nov-Feb)** ⬡
Wet=motivation to plant; dry=discourage planting



Known known



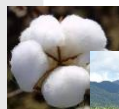
'Reliable' unknown



What influences the decision?

$$\{X_1, X_2, X_3, \dots, X_n\}$$

SCF must change a decision to have value



Value of Seasonal Climate Forecasts?

SCF relevant to the decision?



- SCF

+ SCF

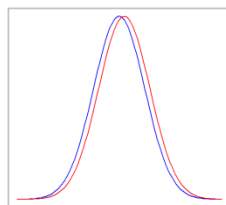
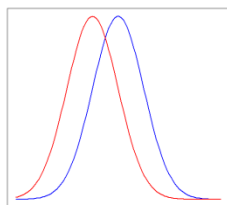
WHAT IF - THEN?

How Often

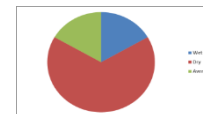
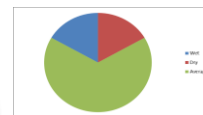
+\$
→

or

~/--\$



Profit



Soil Moisture	Sowing rains	Climate outlook (Nov, Dec, Jan, Feb)	% area planted	Engagement comment
75%	Yes	Average	100%	Important to have sowing rains for successful germination
75%	No	Average	0%	
75%	Yes	Dry	100%	Only if 'soaking' sowing rains
75%	No	Dry	0%	
75%	Yes	Wet	85%	
75%	No	Wet	15%	Plant area up on soil moisture and positive forecast
100%	Yes	Equal chance	100%	
100%	No	Equal chance	0%	Perhaps some sowing without rains, opportunistically
100%	Yes	Dry	60%	On 'normal' sowing rains
100%	No	Dry	0%	Perhaps some sowing without rains, opportunistically
100%	Yes	Wet	100%	
100%	No	Wet	30%	

*****Assumption: prices are not prohibitively low**

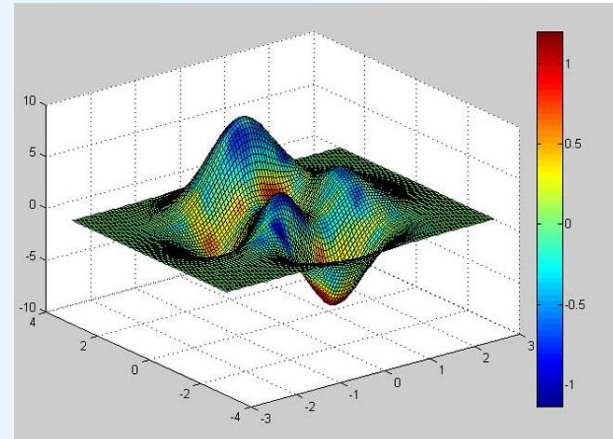
Biophysical Modelling

Three

- ~~Four~~ variables; each with several values
- Difficult for human brains to figure out



\neq



BUT mathematical models can help...

Assumptions

1. Starting soil moisture

%PAWC (25,50,75,100)

2. Sowing rains

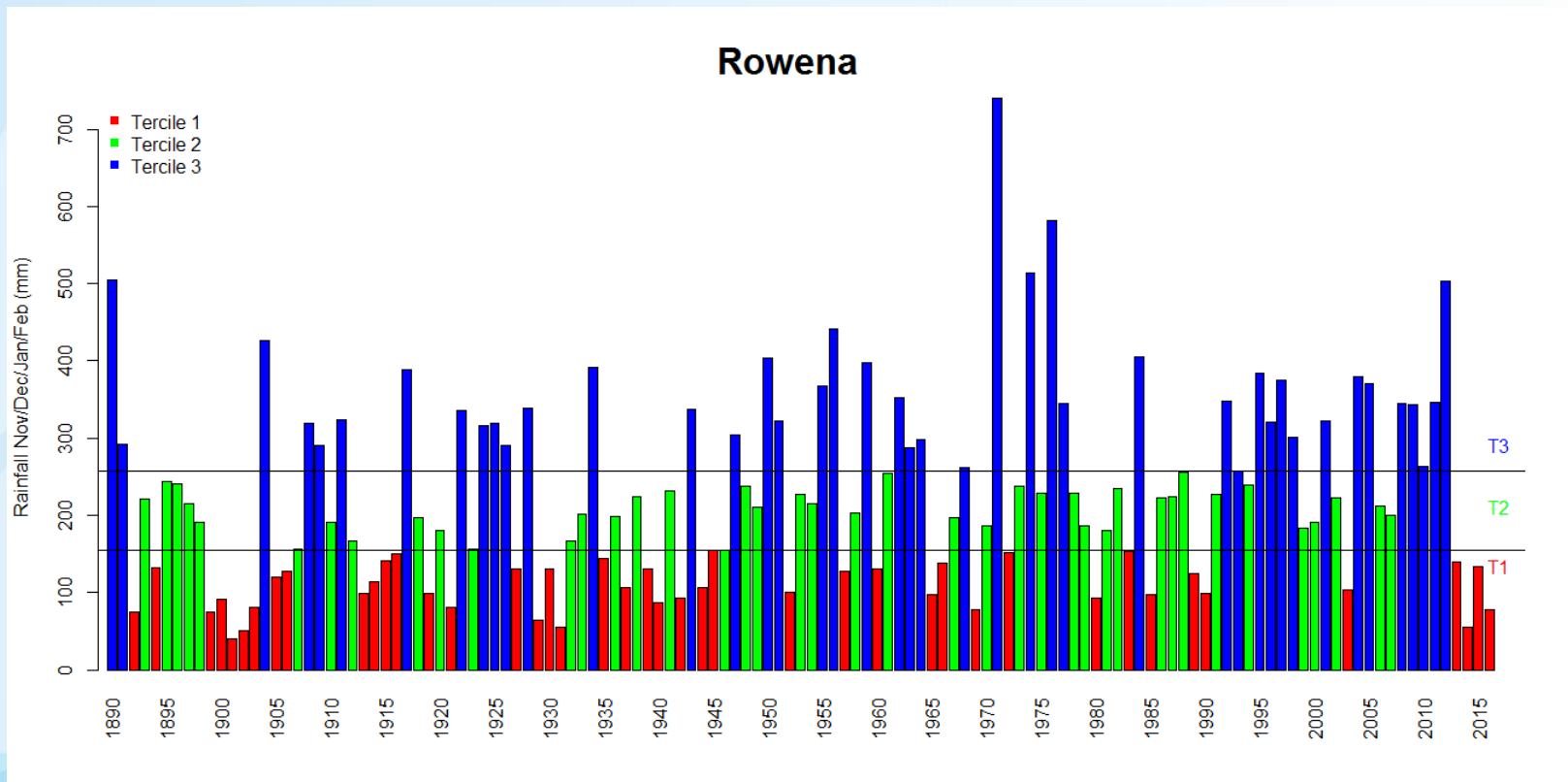
present=10mm (30 Oct); absent=0mm (27 Oct-2Nov)

3. Seasonal “forecast” (Nov-Feb)

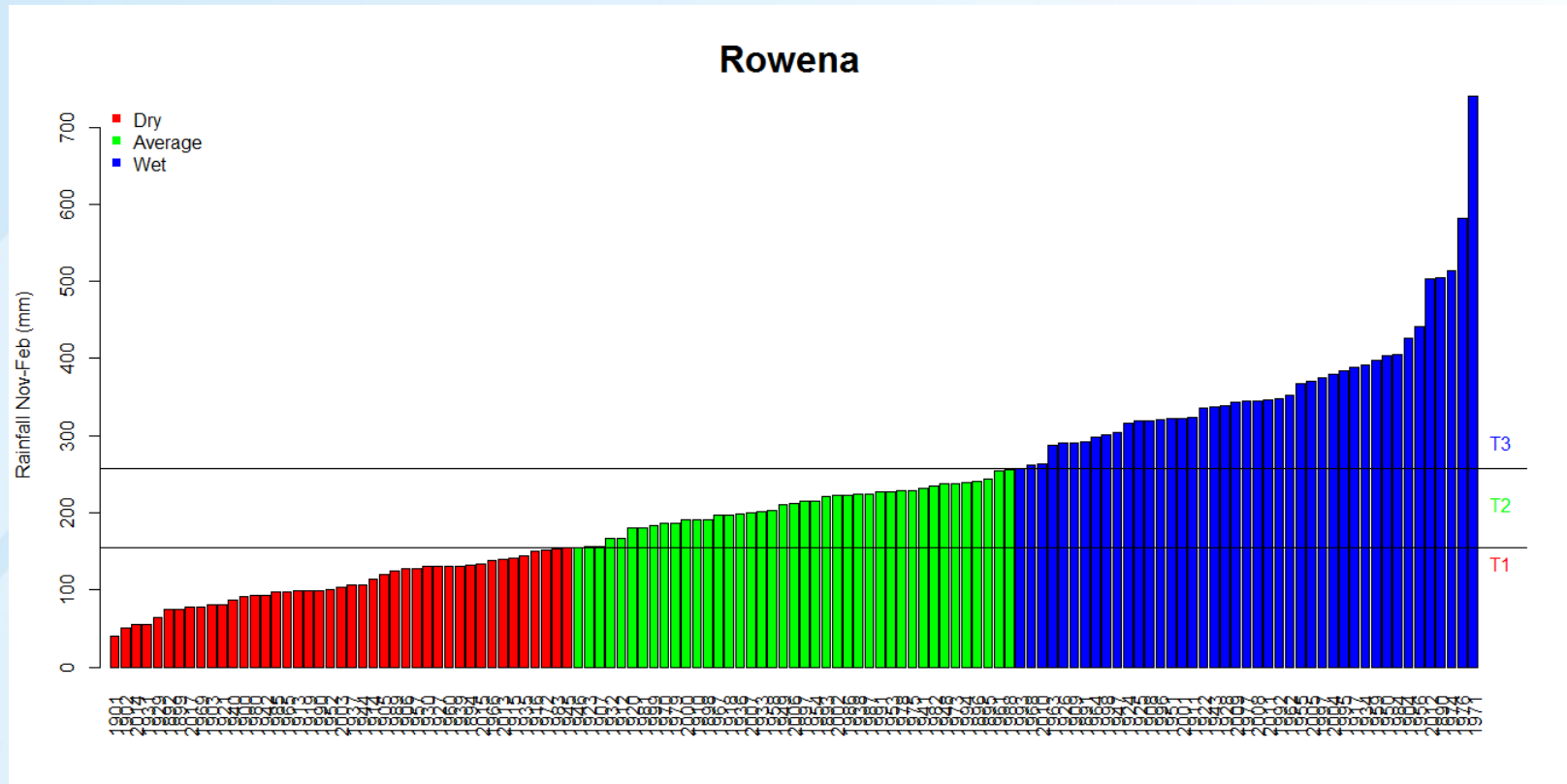
Terciles of historical rainfall (SILO).

Forecast

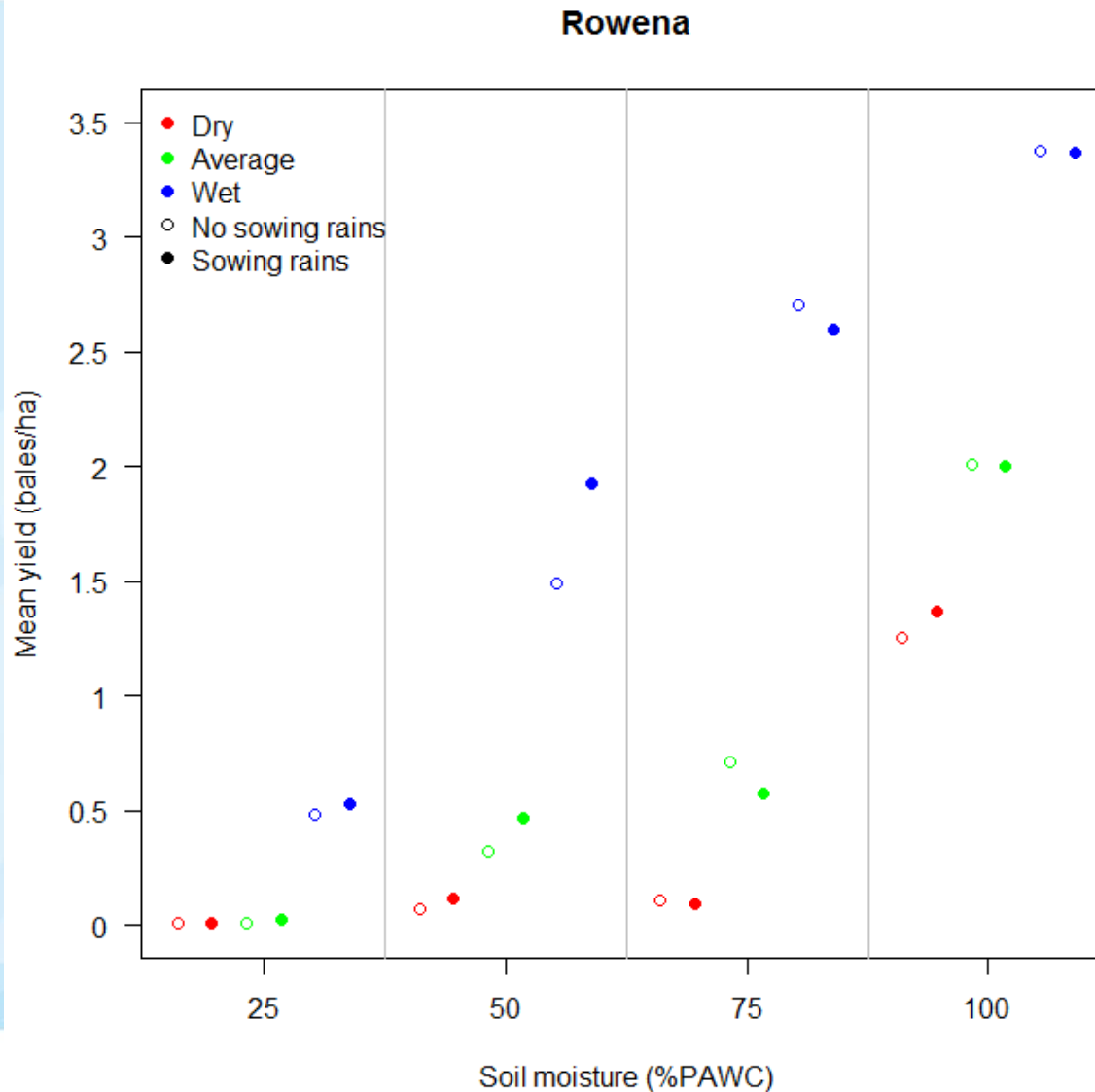
Dry (T1)<154mm
Ave (T2)>154&<257mm
Wet (T3)>257mm



Forecast



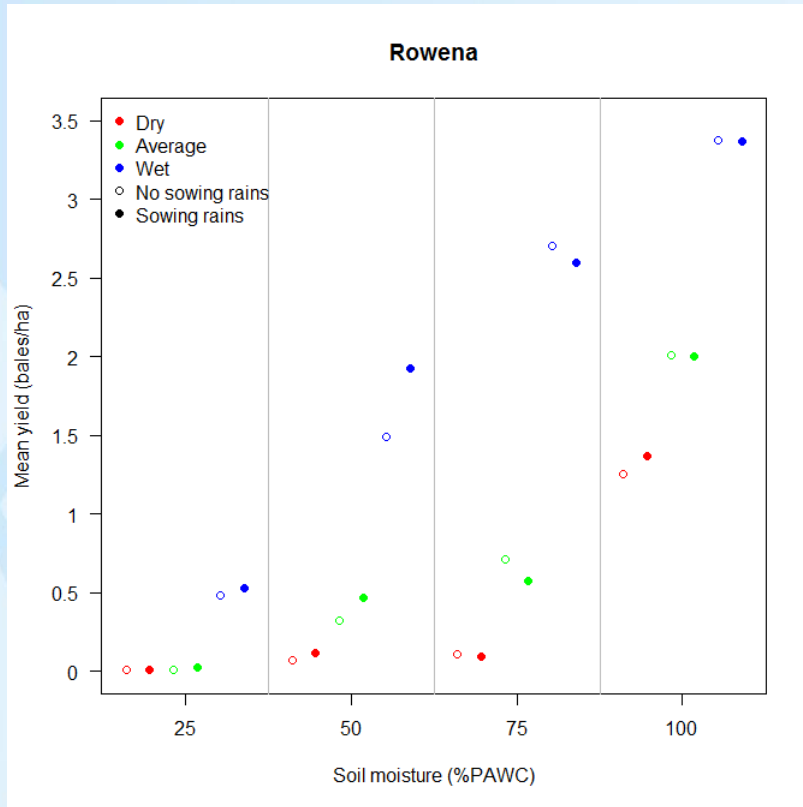
Preliminary results: Yield



Single skip

PAWCmax=293mm

Preliminary results: Yield



Single skip

- Higher yields Dry<Ave<Wet outcomes (as expected)
- Higher yields with higher soil moisture (as expected)

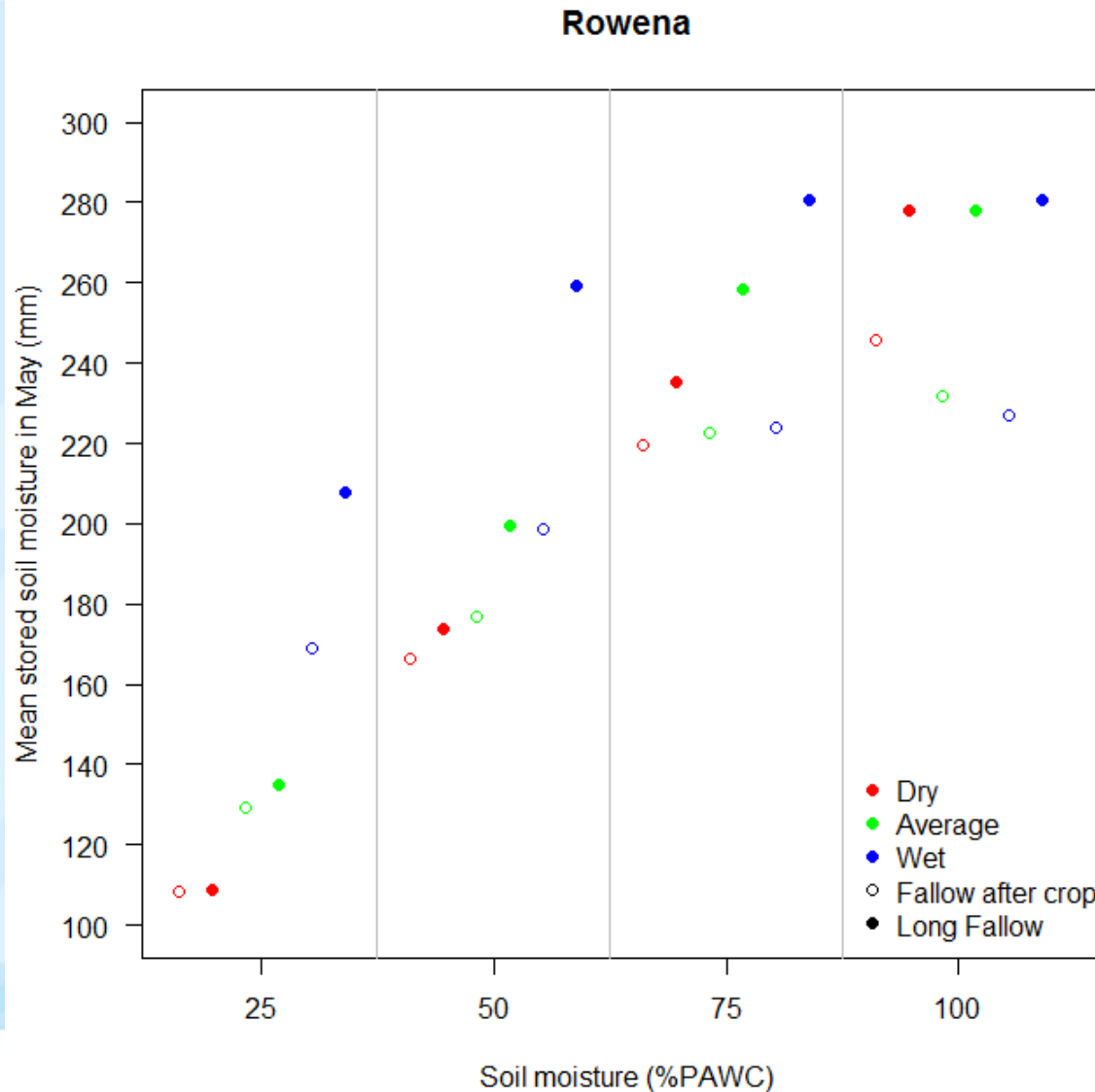
- Sowing rains varied impact (not expected-but should have been!)

1. 50% PAWC=benefit, extra moisture benefit plant establishment
2. 75% PAWC=early growth not sustained by soil moisture

NOTE: these are means. Individual years vary greatly, timing (not volume) of subsequent rainfall key to outcome.

PAWCmax=293
mm

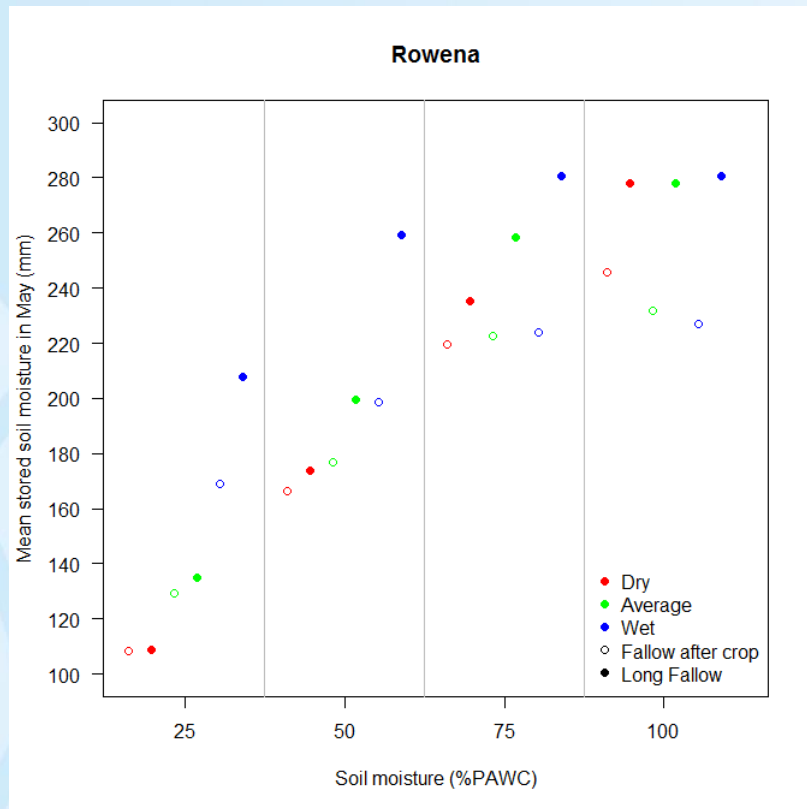
Preliminary results: Stored soil moisture (Crop vs Fallow – decision being weighed)



Single skip

PAWCmax=293mm

Preliminary results: Stored soil moisture (Crop vs Fallow – decision being weighed)



Single skip

- More stored water with fallow (as expected)
 - Mostly more stored water with higher starting PAWC (as expected)
 - Generally, more stored water $D < A < W$
-
- Drop in stored water for Ave & Wet 100% (not expected)
 1. Crop=more water used in Ave & Wet season (higher yields)
 2. 100% fallow. All close to PAWC, some super saturation.
- NOTE:** these are means. Individual years vary greatly, timing (not volume) of subsequent rainfall key to outcome.

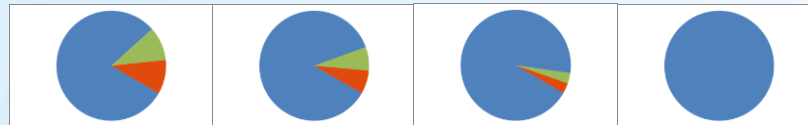
Economics Approach

Evaluate 'no forecast' vs 'forecast' decision

- no forecast = equal chance = climatology
- 10 levels of forecast confidence increasing from no forecast



No forecast



Wet Forecast

Next Steps

Some decisions re: skip row and area
? What do you think?

Continue and complete economic analyses

Report back to industry (finalised ~April 2018)

Compare across all 9 case studies

Questions?

rebecca.darbyshire@dpi.nsw.gov.au

0448 185 605

Cotton: APSIM Prelim (Bungunya)

