EAST COAST
NRM CLUSTER

CLIMATE CHANGE IN AUSTRALIA

IMPACTS & ADAPTATION
INFORMATION
FOR AUSTRALIA'S NRM REGIONS

Climate Change and Agriculture: a study for the Burnett Mary Regional Group July 2014

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Climate Change and Agriculture

Burnett Mary Region

Background

- In the 2012-2013 period, grazing in Australia comprised 340,163,891 ha and cropping 31,610,962 ha *(Figure 1)* The country produced approximately 52,982,401 kg of avocado *(Figure 2) (ABS 2014).*
- In 2012-2013, Queensland had 3,466,012 ha of land mainly used for cropping, and 132,364,260 for grazing and produced 20,285,977 kg of avocado *(ABS 2014).*
- The Burnett Mary Region encompasses a land area of more than 56,000 square kilometres. Extensive agricultural production within the region includes grain crops, avocado production and grazing *(BMRG 2014).*
- In 2010-2011, the Wide Bay Region had 159,117 ha of land mainly used for cropping, 3,648,162 ha for grazing and produced 8,384,055 kg of avocado *(ABS 2014).*

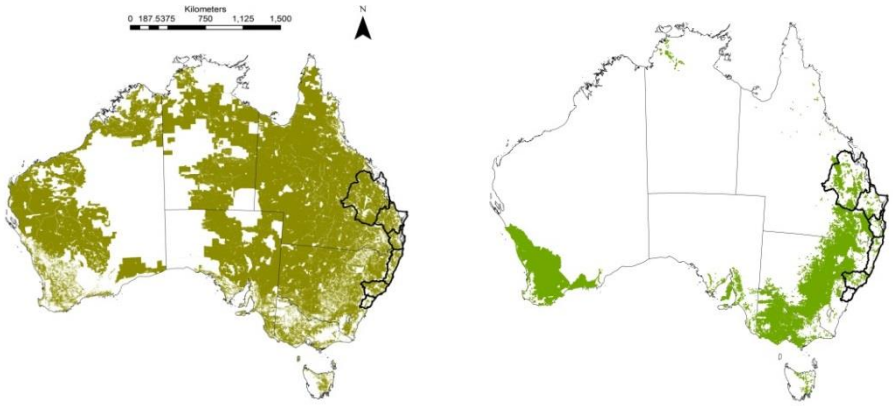


Fig. 1 Current extent of grazing (left) and cropping (right) (ABARES 2012) . East Coast Cluster NRM regions defined in black.

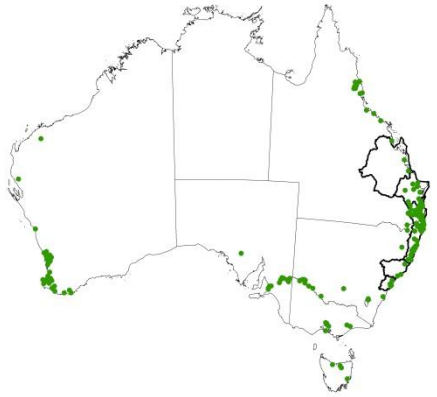


Fig. 2 Avocado production in Australia (Avocados Australia 2014). East Coast Cluster NRM regions defined in black.

Climate Change and Agriculture

Burnett Mary Region

Aim

- To investigate the potential impacts of future climate change on cropping production, avocado production, and grazing
- To provide information to NRM groups regarding planning for climate change adaptation in a changing agricultural landscape

Methods

We developed potential 'best' and 'worst' case climate change impact distribution models for future cropping and grazing using software called MaxEnt *(Phillips et al. 2006*). MaxEnt predicts the probability that an area will be suitable for agricultural production based on changes in the climate variables most appropriate for each commodity.

We considered two Global Climate Models (GCM) under the current (baseline) climate and the A1FI emission scenario for 2025 and 2035 representing: 1) a 'worst' warmer and drier future (CSIRO Mk3.5) and 2) a 'best' cooler and wetter future (CSIRO MIROC-M) *(CSIRO 2014).*

Climate data used in the suitability models

The A1FI emission scenario

Describes a future world of very rapid economic growth, global population growth that peaks a mid-century with a fossil fuel-intensive energy system (i.e. business as usual)

Global Climate Models

Both of the climate models used here provide plausible projections of the future climate, even though they may differ considerably in their results. They were recommended by the CSIRO climate projections team and reviewed in the scientific literature.

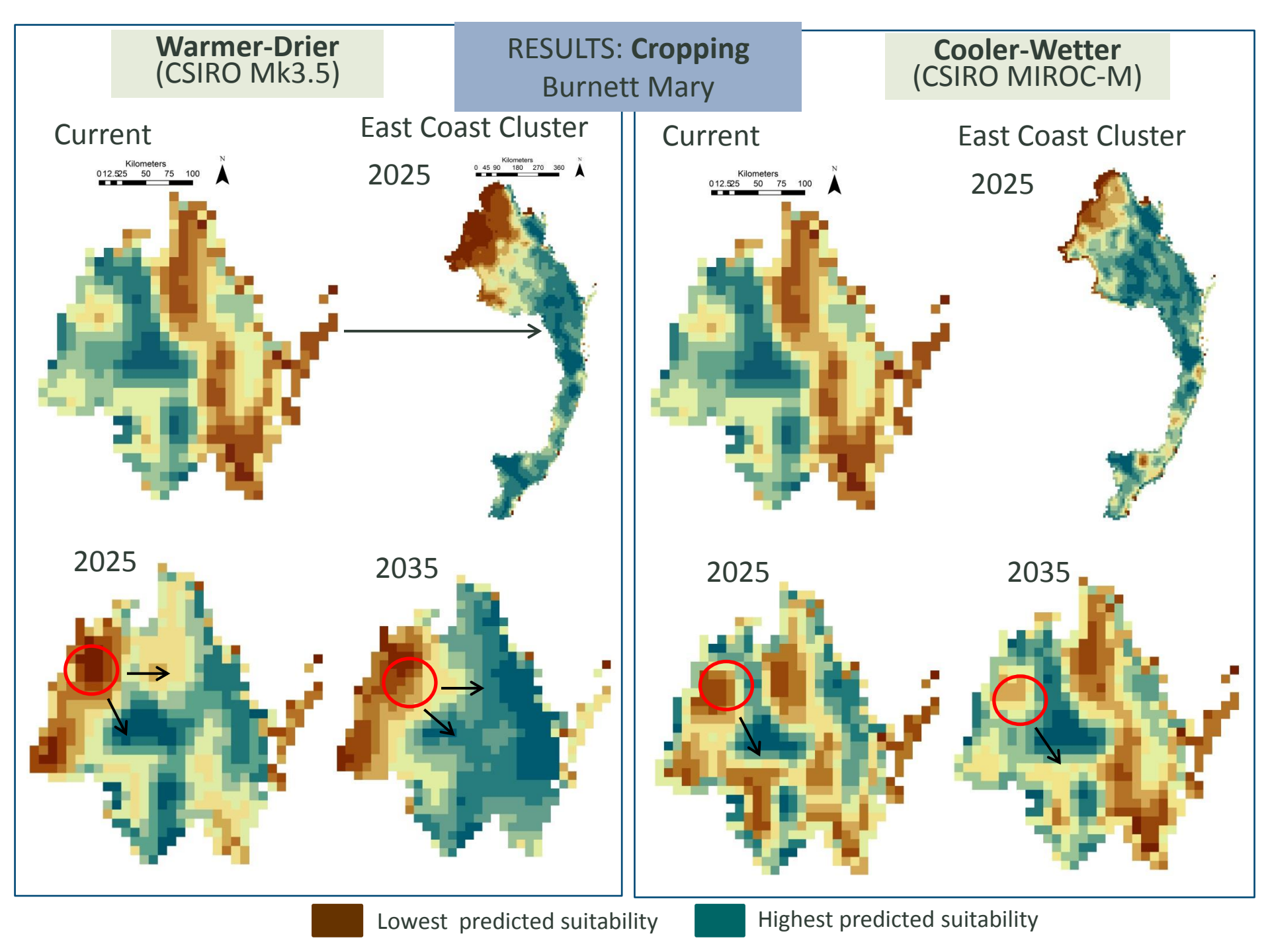
Climate data used in the suitability models

1. Warmer and drier future 'worst' (CSIRO Mk3.5)

- Annual-average rainfall decreases across all of Australia, except for increases along the east coast
- Widespread rainfall decreases in all seasons, but increases in the south and east in summer and over NSW and southern Qld in autumn
- Increases in annual temperature across all of Australia, with smaller increases along the southern coast of Australia

2. Cooler and wetter future 'best' (CSIRO MIROC-M)

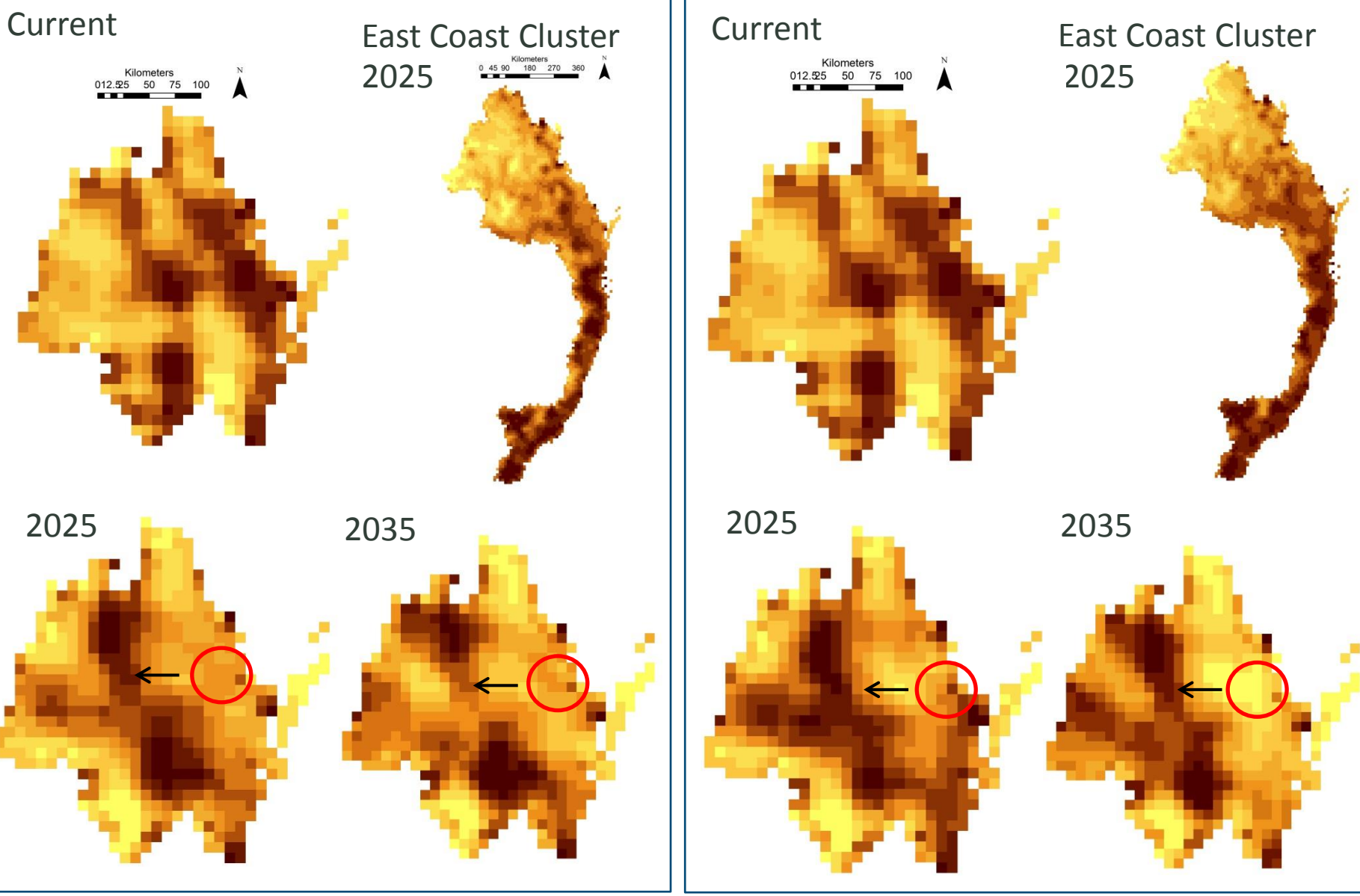
- Decreases in rainfall to the west of Western Australia and increases elsewhere
- Moderate temperature increases across all of Australia, smaller to the south and east


Warmer-Drier
(CSIRO Mk3.5)
RESULTS: Cropping
Burnett Mary
Cooler-Wetter
(CSIRO MIROC-M)
Current
East Coast Cluster
2025
Current
East Coast Cluster
2025
2025
2035
2025
2035
Kilometers
0 12.5 25 50 75 100
Kilometers
0 45 90 180 270 360
Lowest predicted suitability
Highest predicted suitability

Warmer-Drier
(CSIRO Mk3.5)

RESULTS: **Grazing**
Burnett Mary

Cooler-Wetter
(CSIRO MIROC-M)

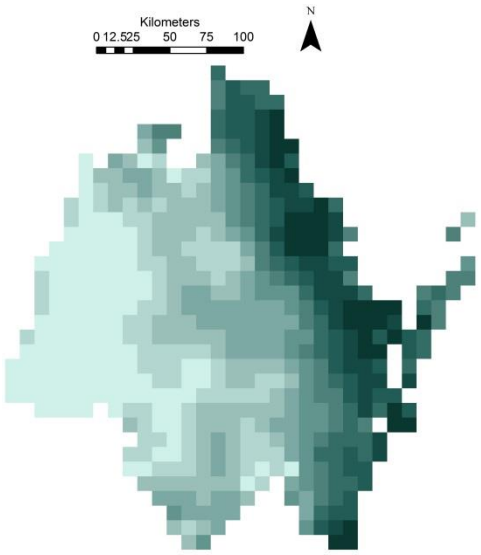


Lowest predicted suitability — Highest predicted suitability

RESULTS: **Avocado** Burnett Mary

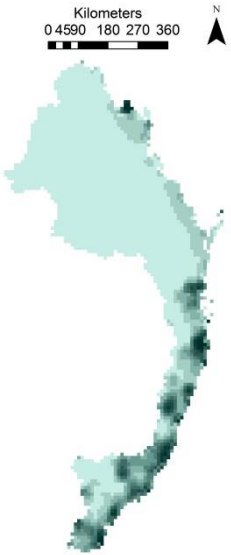
Warmer-Drier (CSIRO Mk3.5)

Current

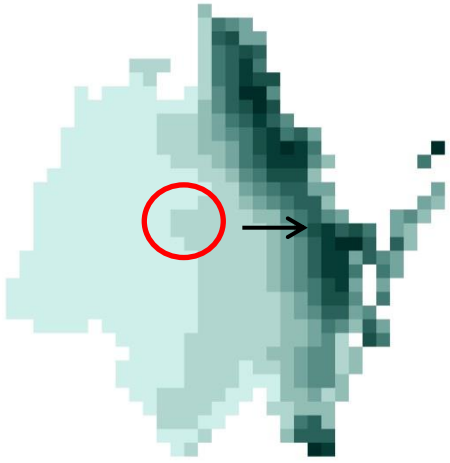


East Coast Cluster

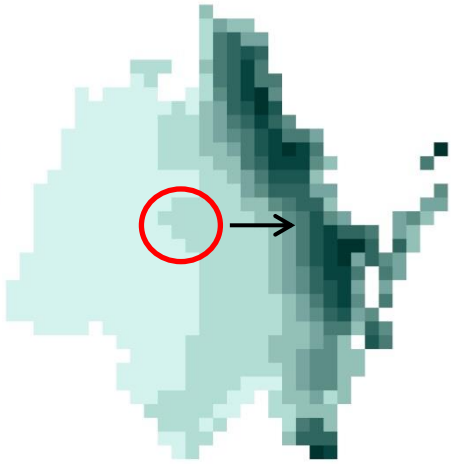
2025



2025

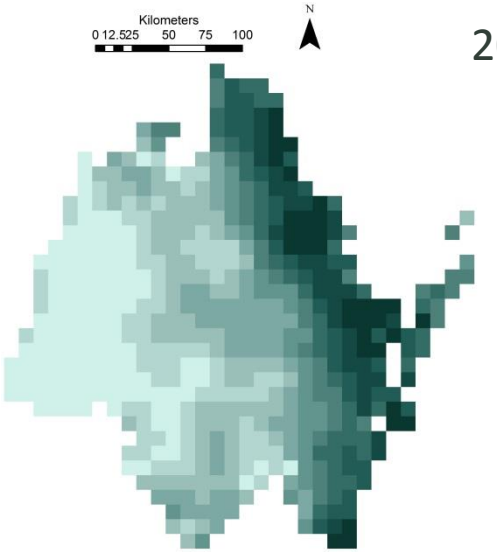


2035



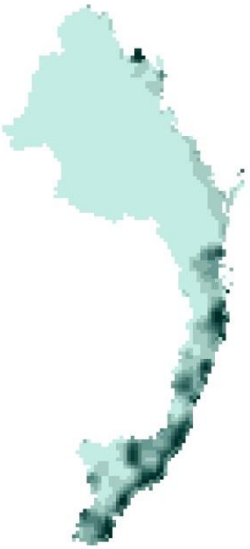
Cooler-Wetter (CSIRO MIROC-M)

Current

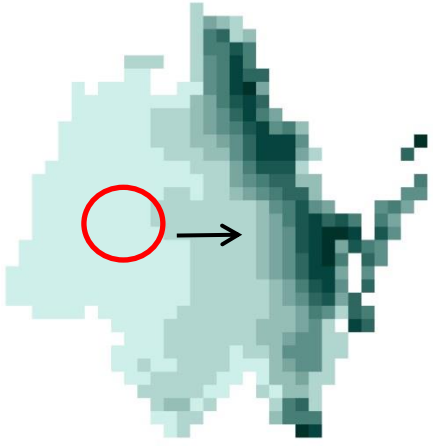


East Coast Cluster

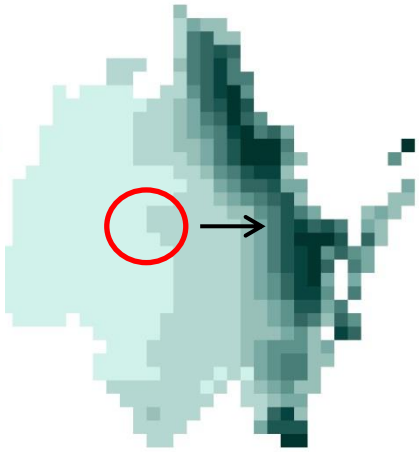
2025



2025



2035



Lowest predicted suitability

Highest predicted suitability

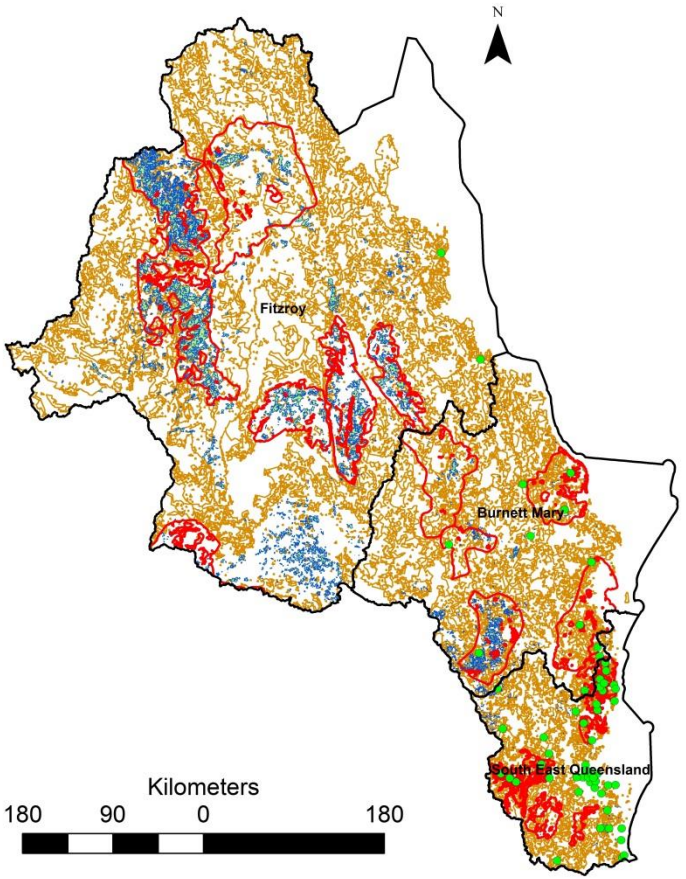
MaxEnt Results: Climate Change and Agriculture

Commodity	Variables incorporated in the model	Reason for inclusion in the model	AUC (no better than random = 0.5)	Contribution to the model (%)
Cropping	Total rainfall May-October	Growing period	0.761	85
	Maximum temperature-summer	Harvesting period		12.6
	Average rainfall-summer	Harvesting period		0.7
	Soil-cracking clay			0.7
	Erodibility			0.5
	Elevation			0.5
	Soil- red duplex			0
	Soil-massive earths			0
	Soil-yellow duplex			0
Avocado	Maximum temperature-November	Flowering/fruiting period	0.967	39.2
	Elevation			18.4
	Soil-yellow duplex			17.8
	Minimum temperature-July	Flower induction affected by frost		10.6
	Average rainfall summer	Growing/harvesting period		7.1
	Soil-cracking clay			2.3
	Erodibility			1.7
	Soil-massive earths			1.3
	Max temp October	Flowering/fruiting period		1.2
	Soil-red duplex			0.3
Grazing	Average annual temperature	Growing period	0.654	54.8
	Average rainfall-summer	Growing periond		15
	Erodibility			10.6
	Soil-yellow duplex			10
	Elevation			5.3
	Soil-cracking clay			1.9
	Minimum temperature-July	Frost-induced fodder protein loss		1.7
	Soil-massive earths			0.5
	Soil-red duplex			0.2

Key Points

- **Cropping is predicted to contract and shift from the west to the east, but with a less pronounced eastwards shift under the cooler-wetter GCM**
- **Areas suitable for grazing are predicted to contract in the east, and, in the wetter-cooler GCM expand in the west.**
- **Avocado is predicted to contract and shift eastwards, but remain suitable in much of its current eastern range**

- **Rainfall (May-October)** was the most important predictor of cropping
- **Average annual temperature** was the most important predictor for grazing
- **Maximum temperature (November)** was the most important variable for avocado production
- This study can help inform NRM planning for future climate change



Grazing (ABARES 2012)
Important Agricultural Areas (DAFF 2013)
Cropping (ABARES 2012)
Avocado (Avocados Australia 2014)

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Assumptions and Limitations

- Future novel climates may vary from those used in this study
- The models presented here are based on the CSIRO A1FI emission scenario that reflects continuing fossil fuel dependence and high population growth, i.e. business as usual
- The two Global Climate Models that were used here were based on the best information available. Different results would occur under different GCMs
- The results of this study are based on particular environmental variables chosen using the best information available. The results will vary if different climatic variables are used when developing the MaxEnt models
- Maxent's mathematical models do not consider human interventions such as future changes to agricultural practices or land use change
- These models were developed at a 10 x 10 km^2 scale to provide indicative information. Finer scale models would potentially provide more site-specific information

Acknowledgements

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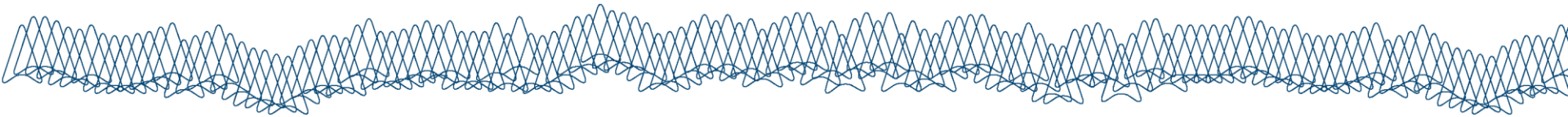
Thank you

From the East Coast Cluster



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