Effects of climate on the profitability of Australian farms

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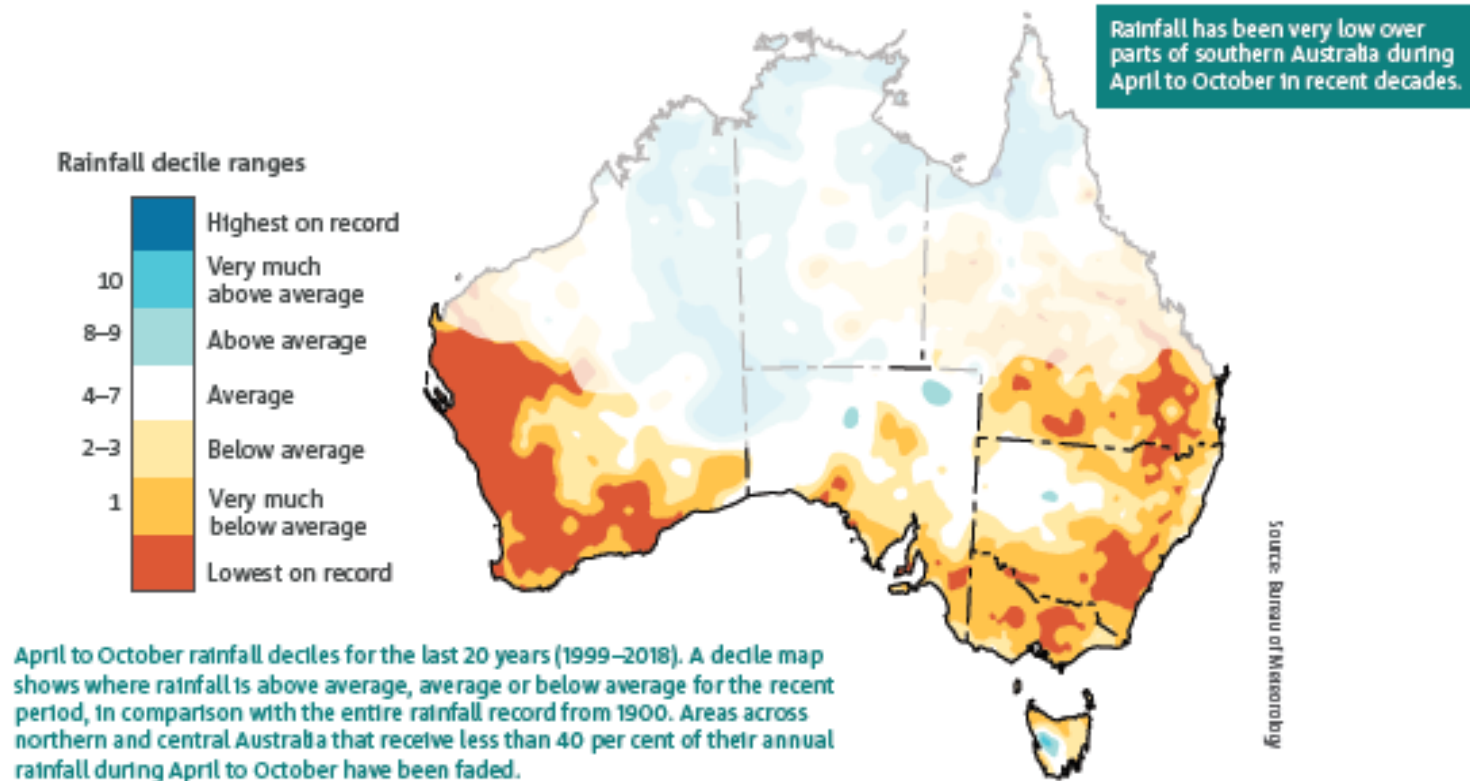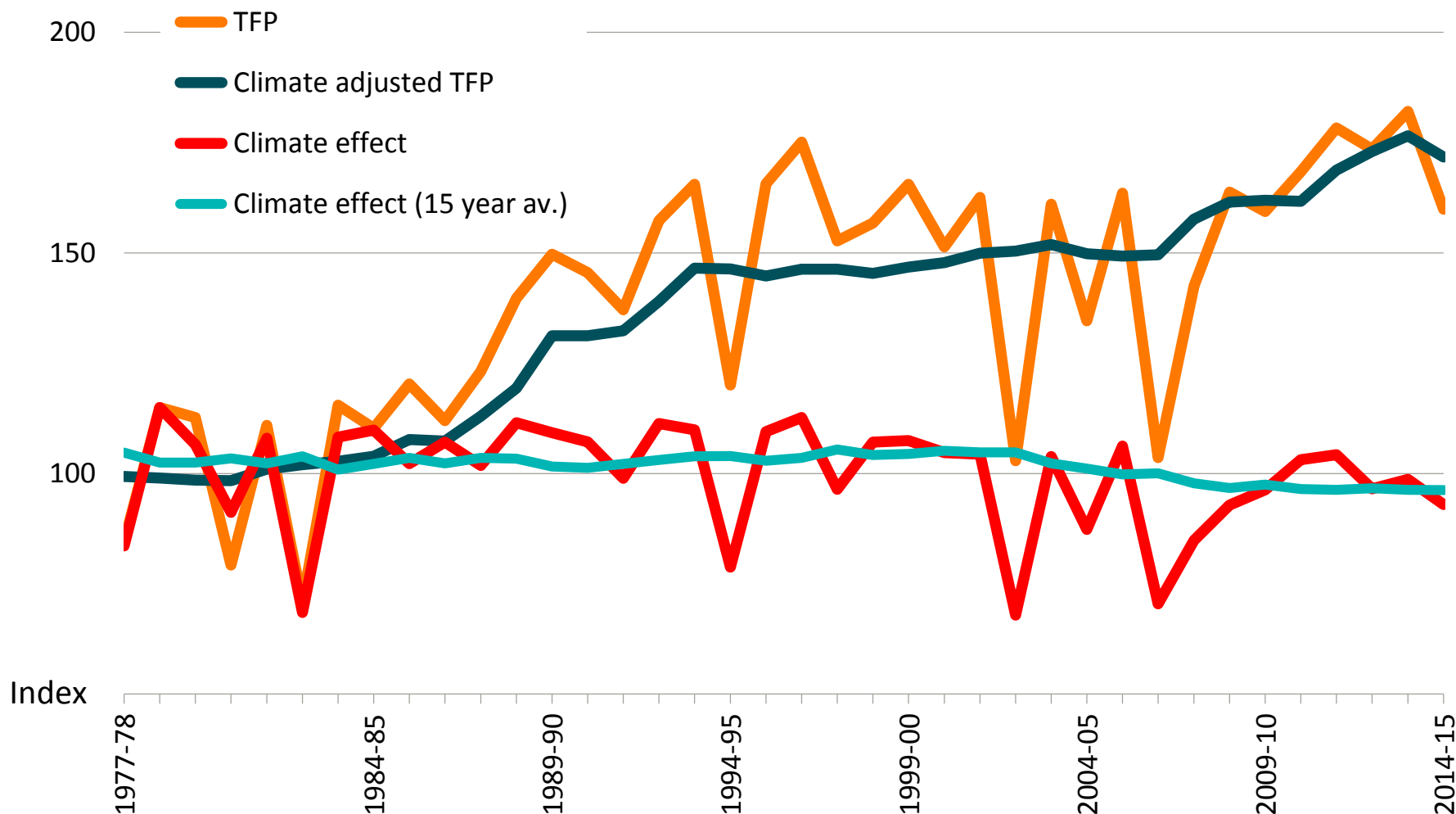
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Outline

- Background: climate change, previous ABARES research, Australian 2018-19 drought, drought policy debate, weather insurance

- *Farmpredict:* a microsimulation model of Australian farms

  - Preliminary results

  - Climate adjusted TFP

  - Climate change projections project (NSW DPI)

- ABS/DIPA 'big data' project: effect of drought on Australian farms (2020)

Climate change trends

Rainfall decile ranges

Decile	Range
	Highest on record
10	Very much above average
8–9	Above average
4–7	Average
2–3	Below average
1	Very much below average
	Lowest on record

Rainfall has been very low over parts of southern Australia during April to October in recent decades.

April to October rainfall deciles for the last 20 years (1999–2018). A decile map shows where rainfall is above average, average or below average for the recent period, in comparison with the entire rainfall record from 1900. Areas across northern and central Australia that receive less than 40 per cent of their annual rainfall during April to October have been faded.

Source: Bureau of Meteorology

Effect of climate on cropping farm TFP

Australian 2018-19 drought

Effect of climate on farm cash income
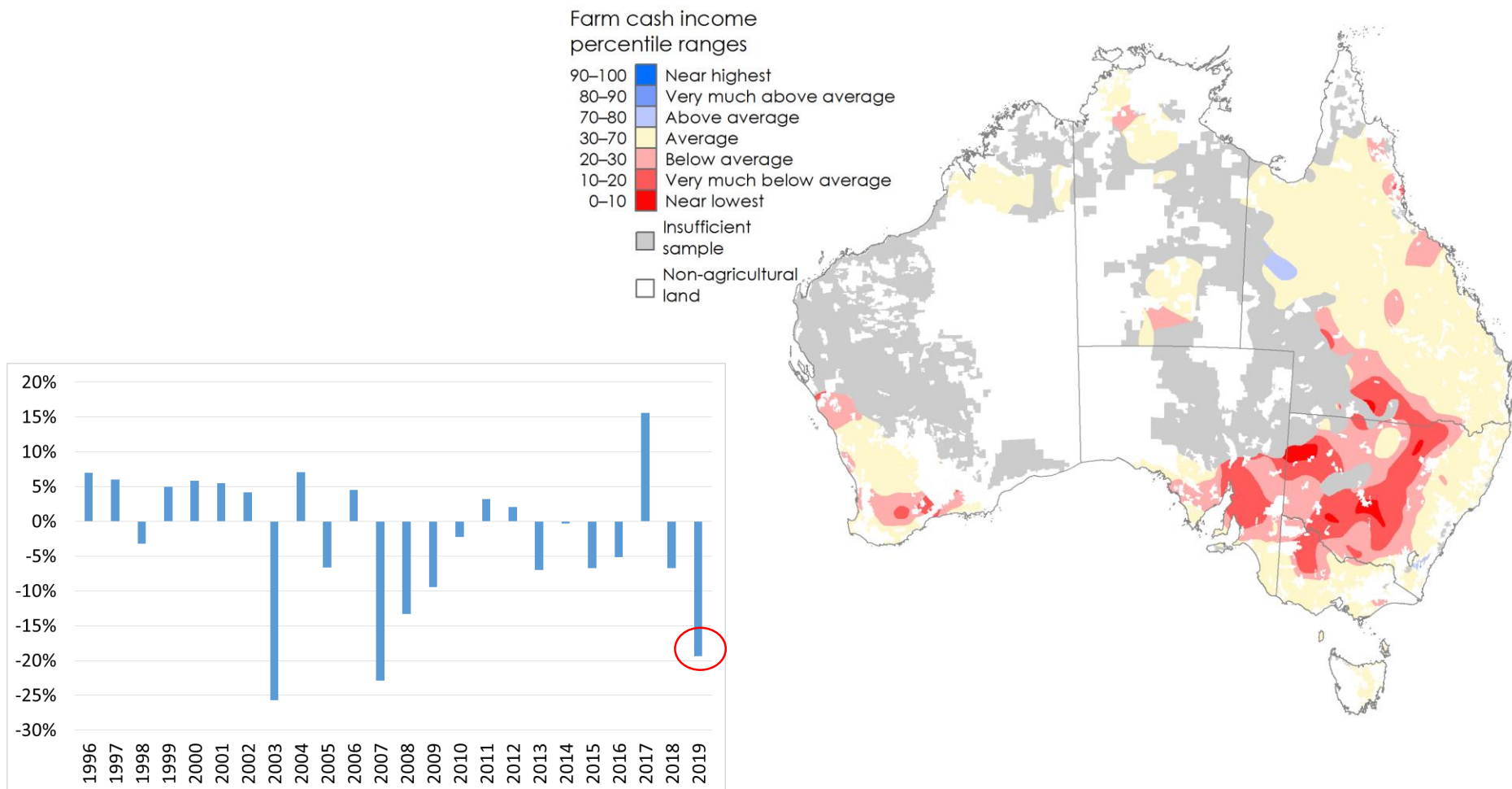
Drought policy as an insurance problem

- Government drought support can weaken industry productivity by:

    - Slowing adaptation and innovation (moral hazard)

    - Slowing structural adjustment (adverse selection)

- Missing market for drought insurance

    - Information problems (moral hazard, adverse selection)

    - Index-based insurance (translates into a technical problem)

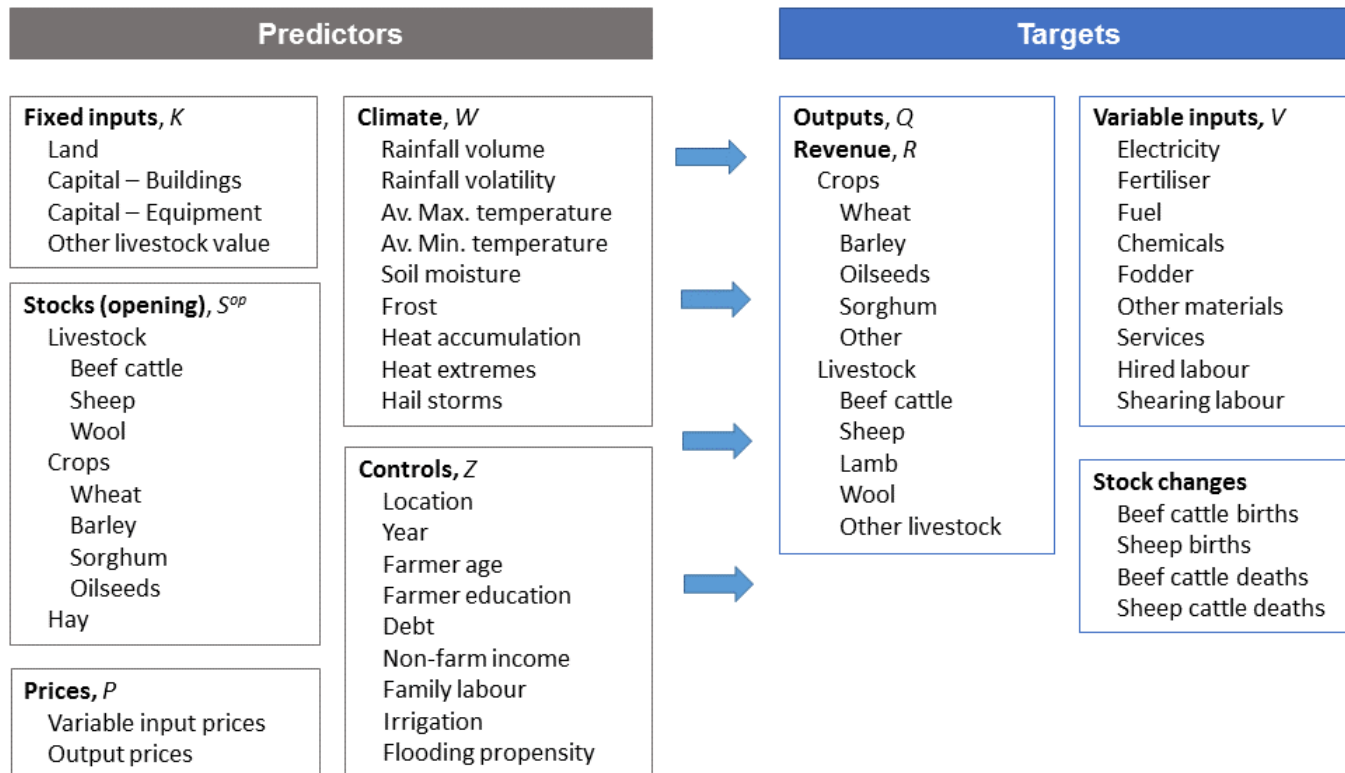   - Big data could help solve this technical problem

ABARES farm survey data

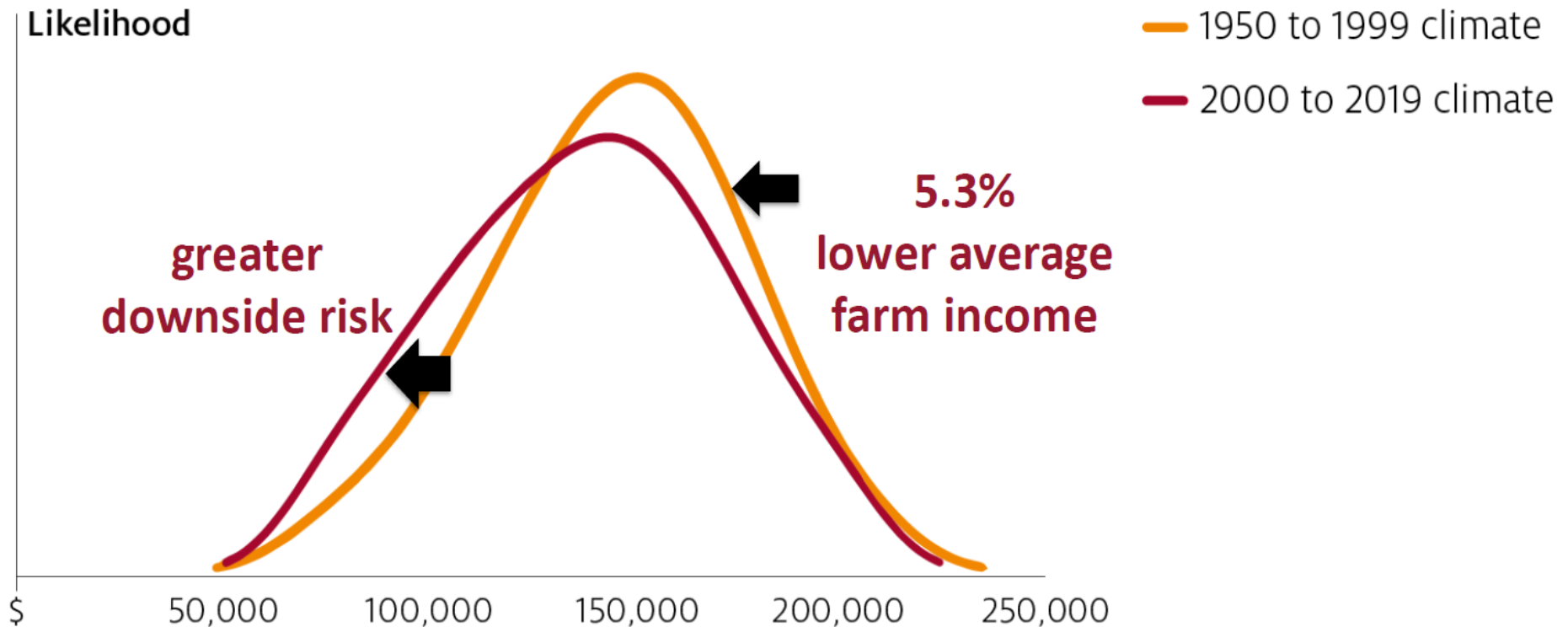AAGIS survey, 1988-89 to 2017-18 (52,000+ obs.)
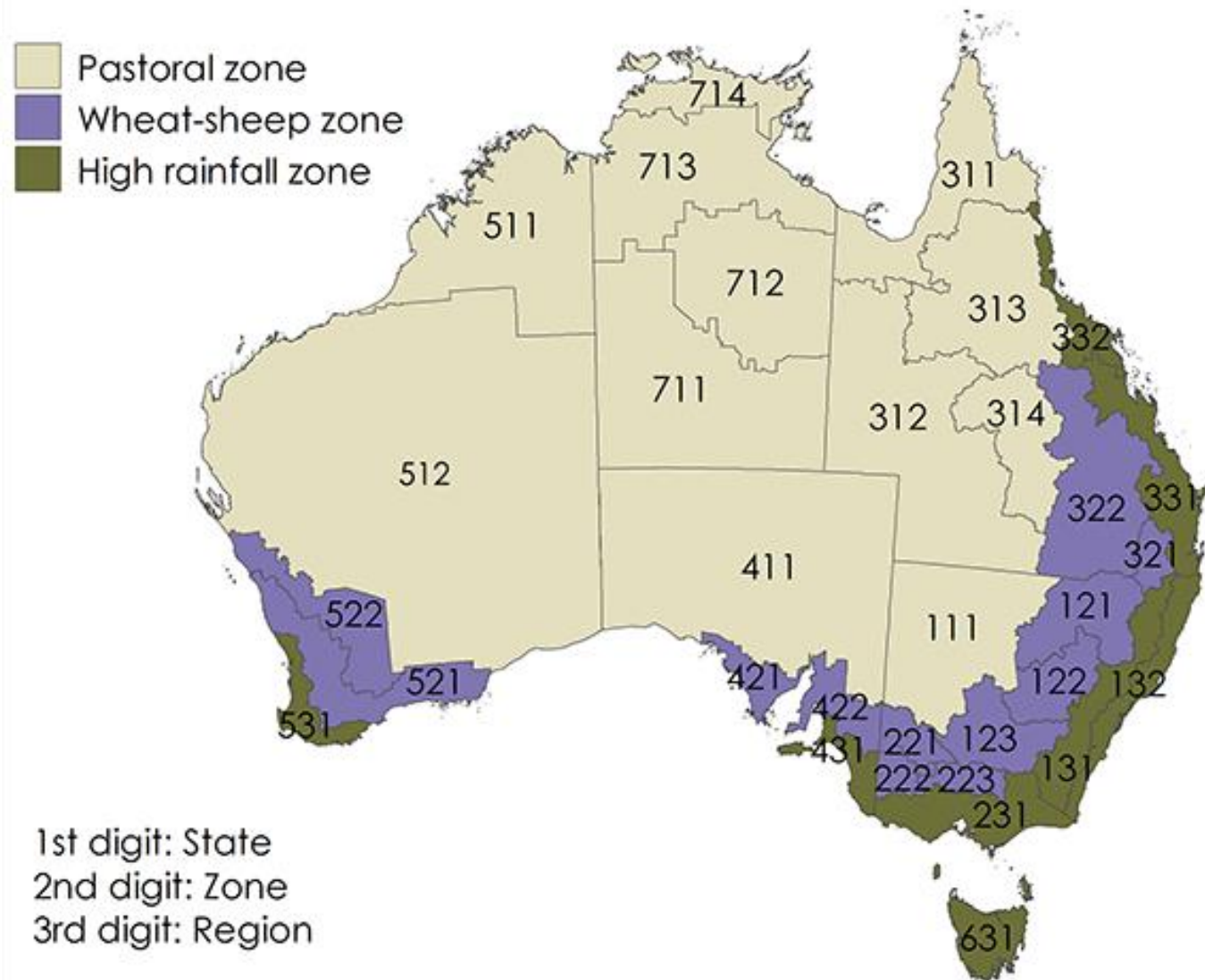
ABARES *Farmpredict*

- A micro-simulation model of Australian farms

  - Predicts input use, output and profit at farm scale, given prices, fixed inputs, climate and other controls

- A 'dual' form production model, with machine learning

Predictors		Targets	

Fixed inputs, K
Land
Capital – Buildings
Capital – Equipment
Other livestock value
	Climate, W
	Rainfall volume
	Rainfall volatility
	Av. Max. temperature
	Av. Min. temperature
	Soil moisture
	Frost
	Heat accumulation
	Heat extremes
	Hail storms
		Outputs, Q
		Revenue, R
		Crops
		  Wheat
		  Barley
		  Oilseeds
		  Sorghum
		  Other
		Livestock
		  Beef cattle
		  Sheep
		  Lamb
		  Wool
		  Other livestock
			Variable inputs, V
			Electricity
			Fertiliser
			Fuel
			Chemicals
			Fodder
			Other materials
			Services
			Hired labour
			Shearing labour

Stocks (opening), S^{op}
Livestock
  Beef cattle
  Sheep
  Wool
Crops
  Wheat
  Barley
  Sorghum
  Oilseeds
  Hay
	Controls, Z
	Location
	Year
	Farmer age
	Farmer education
	Debt
	Non-farm income
	Family labour
	Irrigation
	Flooding propensity
			Stock changes
			Beef cattle births
			Sheep births
			Beef cattle deaths
			Sheep cattle deaths

Prices, P Variable input prices Output prices			

Effect of climate change (last 20 yrs) on farm risk

Distribution of farm cash income for an average broadacre farm

Likelihood

— 1950 to 1999 climate
— 2000 to 2019 climate

greater downside risk

5.3% lower average farm income
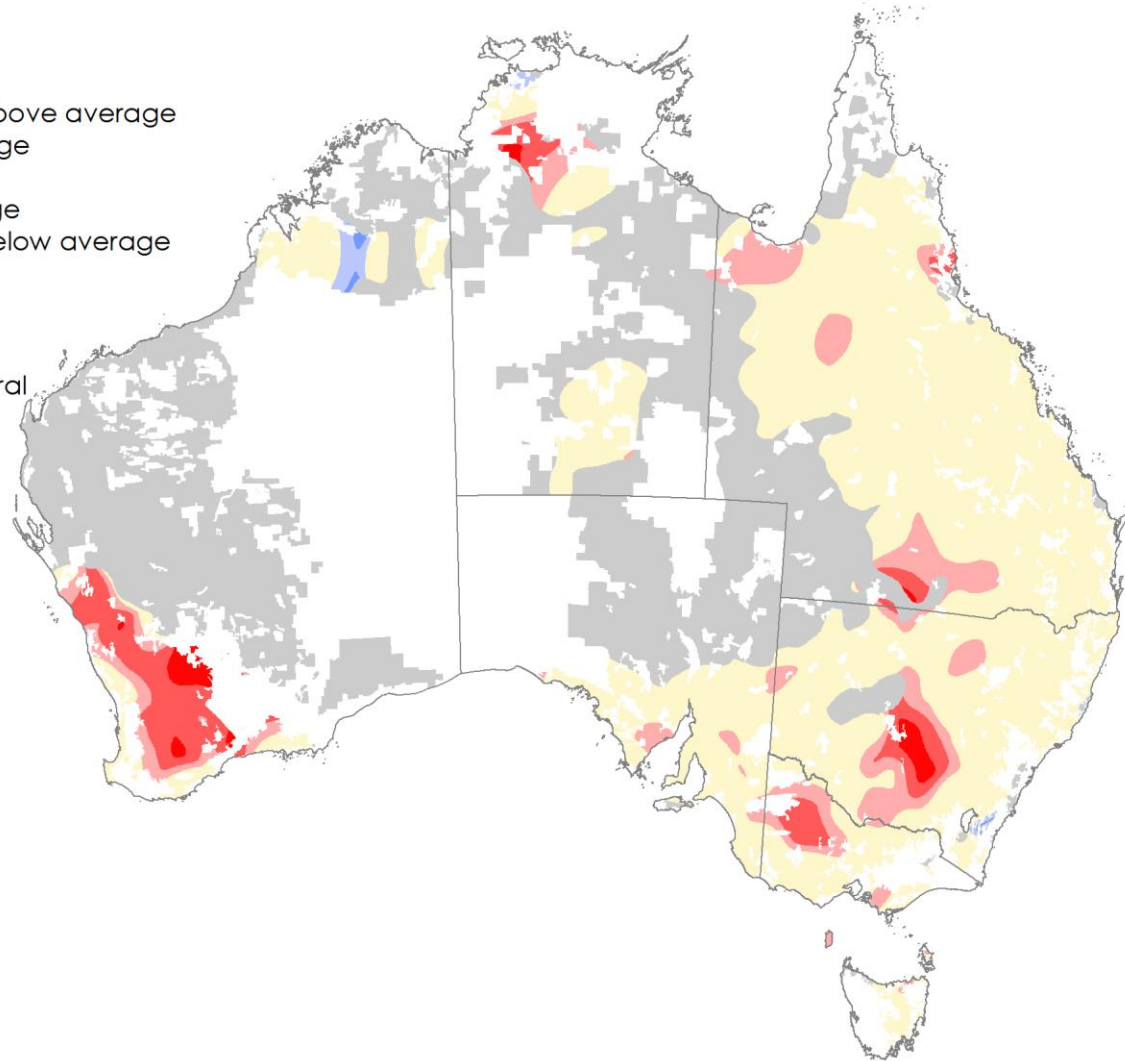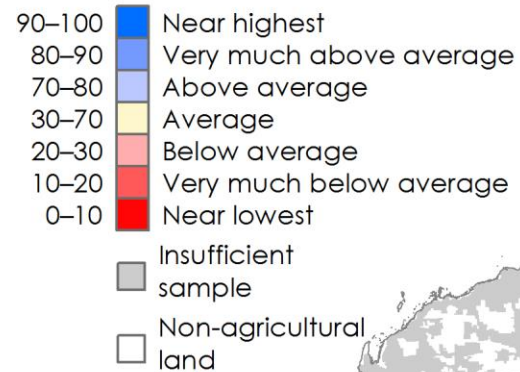
$ 50,000   100,000   150,000   200,000   250,000

Source: ABARES model estimate
Note: Simulated distribution of farm cash income for an average broadacre farm today, with 1950 to 1999 climate and 2000 to 2019 climate

Effect of climate change (last 20 yrs) on farm cash income

Farm cash income percentile ranges

- 90–100 Near highest
- 80–90 Very much above average
- 70–80 Above average
- 30–70 Average
- 20–30 Below average
- 10–20 Very much below average
- 0–10 Near lowest

Insufficient sample

Non-agricultural land

Climate change projections project (NSW DPI)

Winter rainfall change (%), RCP8.5 1986-2005 to 2080-2099
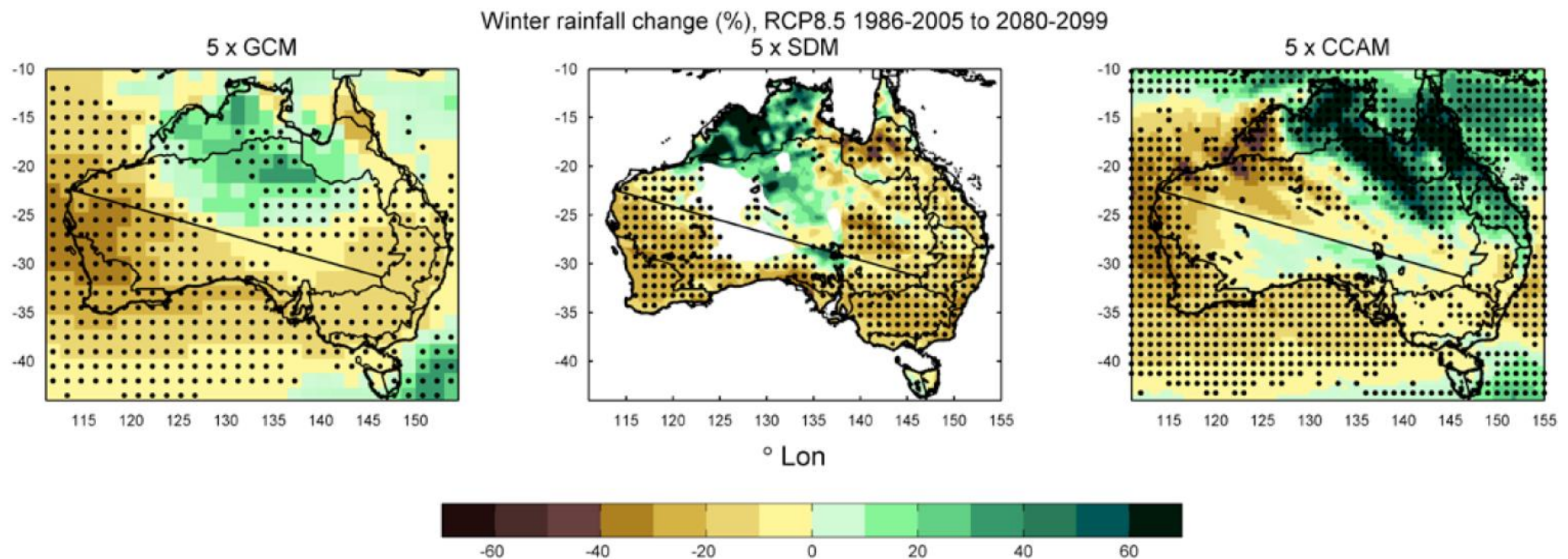
FIGURE 7.2.8: PROJECTED CHANGE IN MEAN RAINFALL FOR RCP8.5 1986–2005 TO 2080–2099 FOR: (TOP ROW) SUMMER AND (BOTTOM ROW) WINTER, IN: (LEFT) FIVE GLOBAL CLIMATE MODELS (GCMS): ACCESS-1.0, CNRM-CM5, MPI-ESM-LR, CCSM4, NORESM1-M, (MIDDLE) BUREAU OF METEOROLOGY STATISTICAL DOWNSCALING USING THE SAME FIVE GCMS AS INPUT, AND (RIGHT) CCAM DYNAMICAL DOWNSCALING ALSO USING THE SAME FIVE GCMS AS INPUT. STIPPLING SHOWS WHERE AT LEAST FOUR OUT OF FIVE SIMULATIONS AGREE ON THE DIRECTION OF CHANGE.

ABS farm census / survey data

2000-01 to 2016-17, 760,922 observations

Wheat farm locations, 2015-16

●   Wheat farms

n =16,304
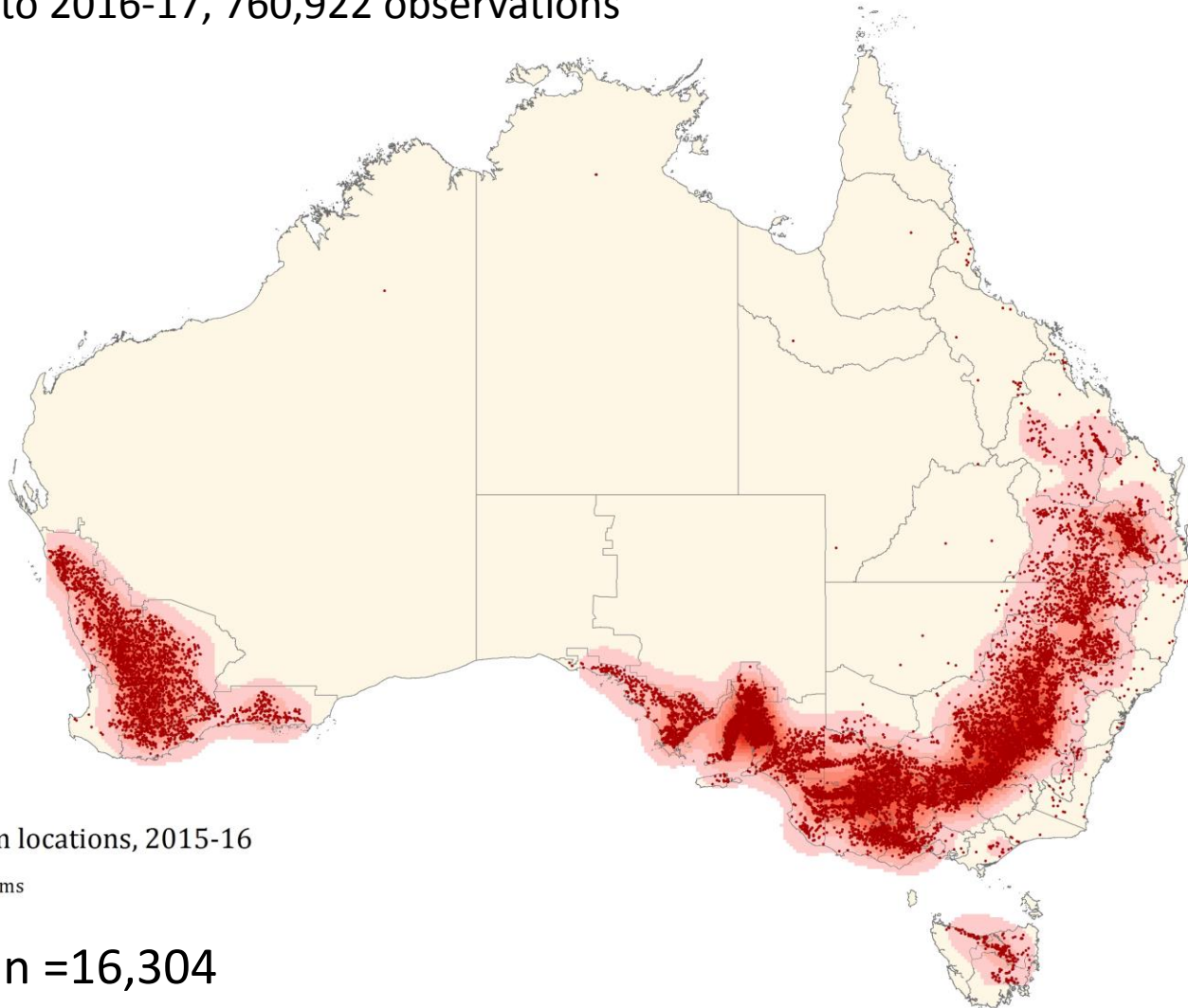
ABARES/ABS 'Big data' project (DIPA)

- Agricultural Data Integration Project (AgDIP)

  - ABS farm data, ABARES farm data, climate data

  - ATO business tax records (via ABS BLADE)

- Effect of drought on Australian farms (predicting crop areas planted, yield and profit)

- Applications

  - Insurance (e.g., indeSohx based contracts)

  - Forecasting

  - Historical trends: crop yield / water use efficiency

  - Statistical outputs

Australian Government
Department of Agriculture and Water Resources
ABARES

agriculture.gov.au/abares