Department of Agriculture and Food

GOVERNMENT OF WESTERN AUSTRALIA

How will climate change affect your farming system? Developing and testing a methodology

Caroline Peek, Kari-Lee Falconer, Megan Abrahams, Daniel Gardiner, Chad Reynolds, Dennis Van Gool and Ian Foster

Australian Government

Department of Climate Change

Key message

Climate, crop & pasture and economic modelling

↓

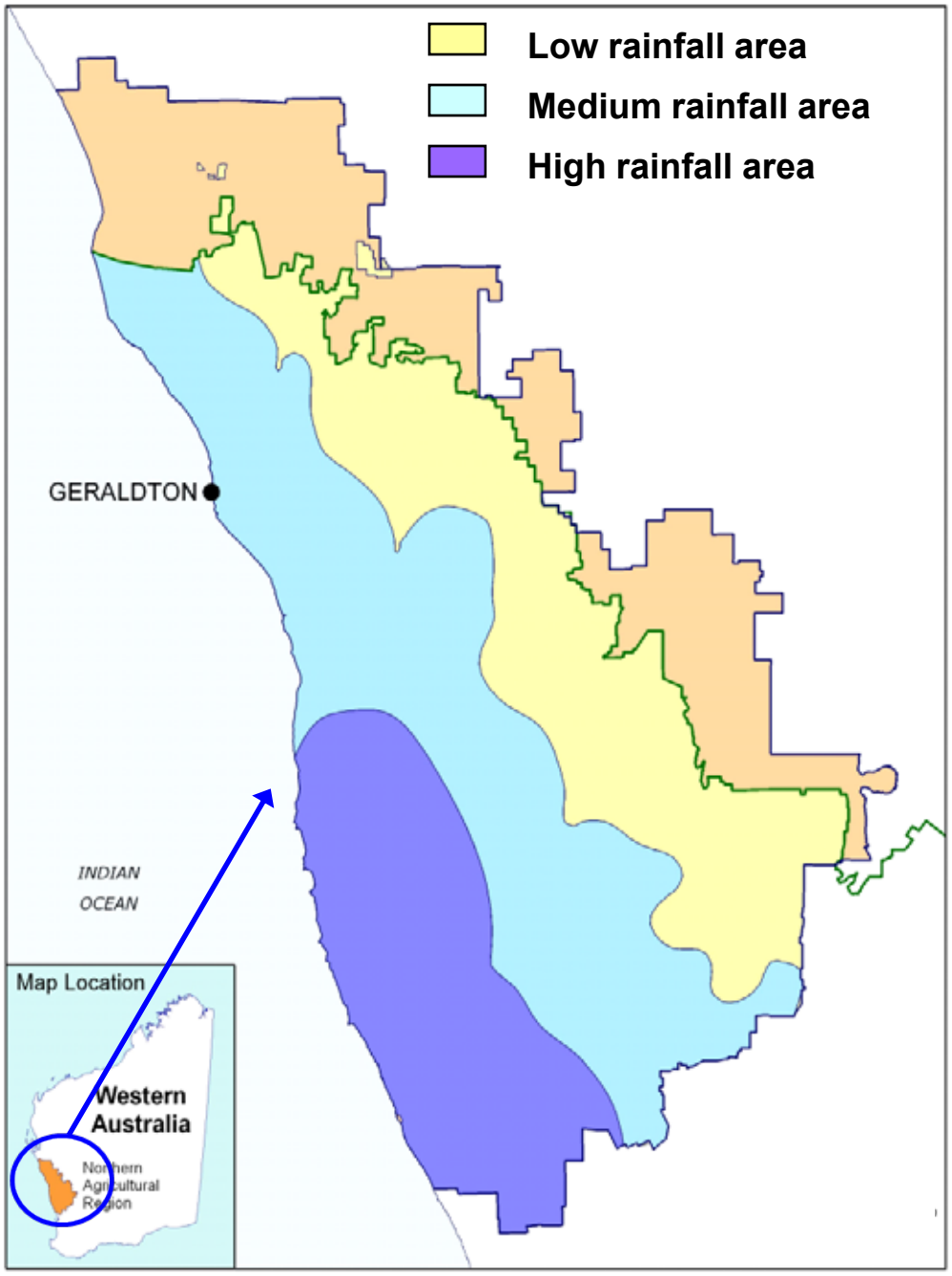
Impact of climate change on a farming system

- Economic performance of farming system under a changing climate
- Transition from current system to a future system

Our process

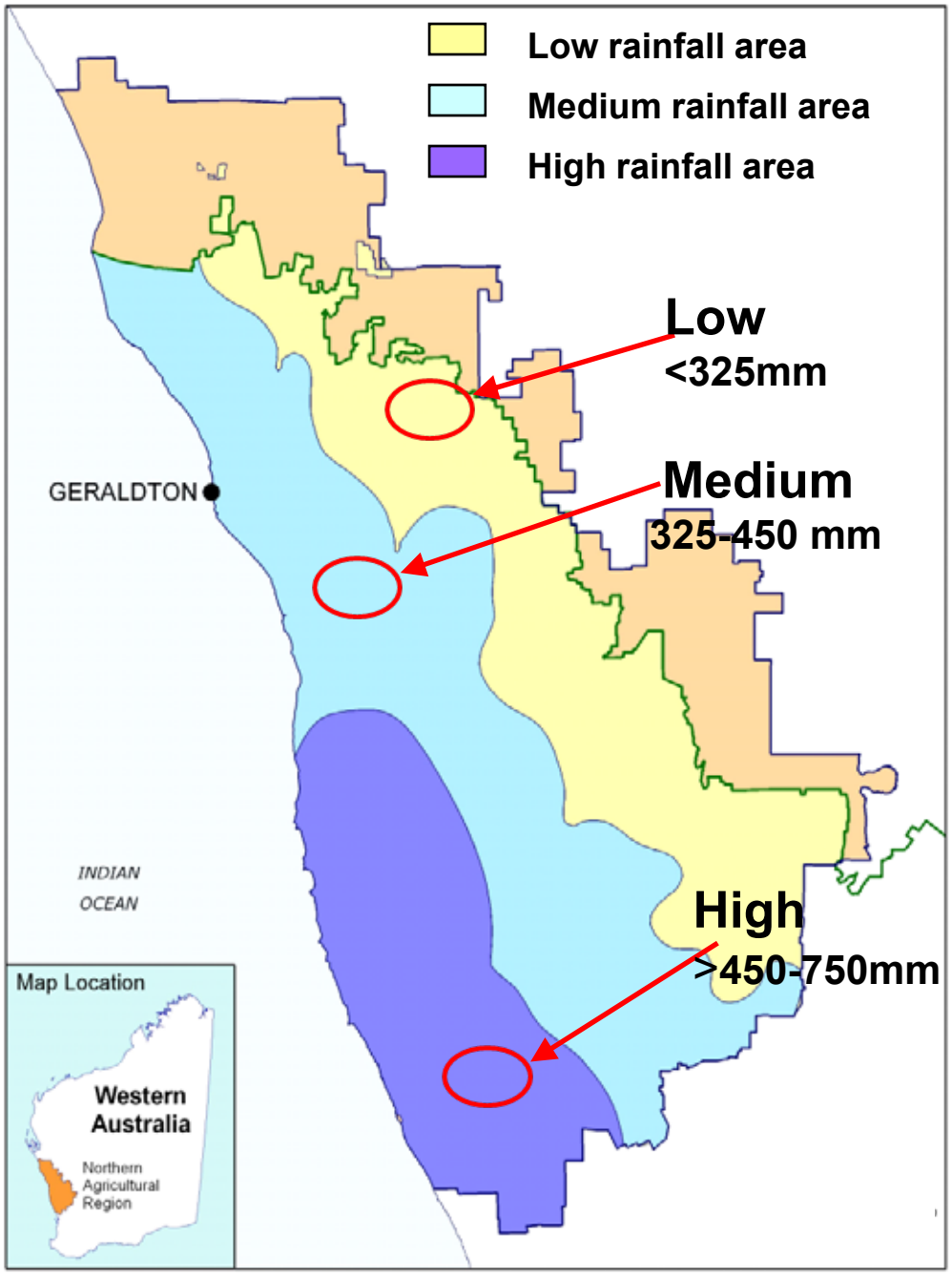
- 1. Develop model farms
- 2. Modelling
  - future climate → farm's production changes → $
- 3. Sensitivity analysis
- 4. Upscale - impact on regional economy
- 5. Evaluate adaptations to climate change
- 6. Consider risk management
- 7. Identify gaps

Testing the process: the scene



- Northern Agricultural Region. Western Australia
- Broadacre agriculture
- Growing season - May to September
- Annual rainfall 250-700mm
- Climate predictions - Rainfall ↓ temperatures ↑
- Recent drought years – crop failure
- Livestock - summer/autumn feed gap

1. Model farms



- Main farming system in each rainfall zone

1. Low rainfall
- climate change most severe
- catchment, farmer survey

2. Medium and high rainfall
- specific farms

- Other financial data from Bankwest & Planfarm benchmarks

2. Modelling impact of climate change on farm – how?

(i) Climate (OzClim)

- CSIRO Mk 2, Hadley
- IPCC SRES A2 emissions scenario
- High sensitivity to emissions

(ii) Crop yields & pasture

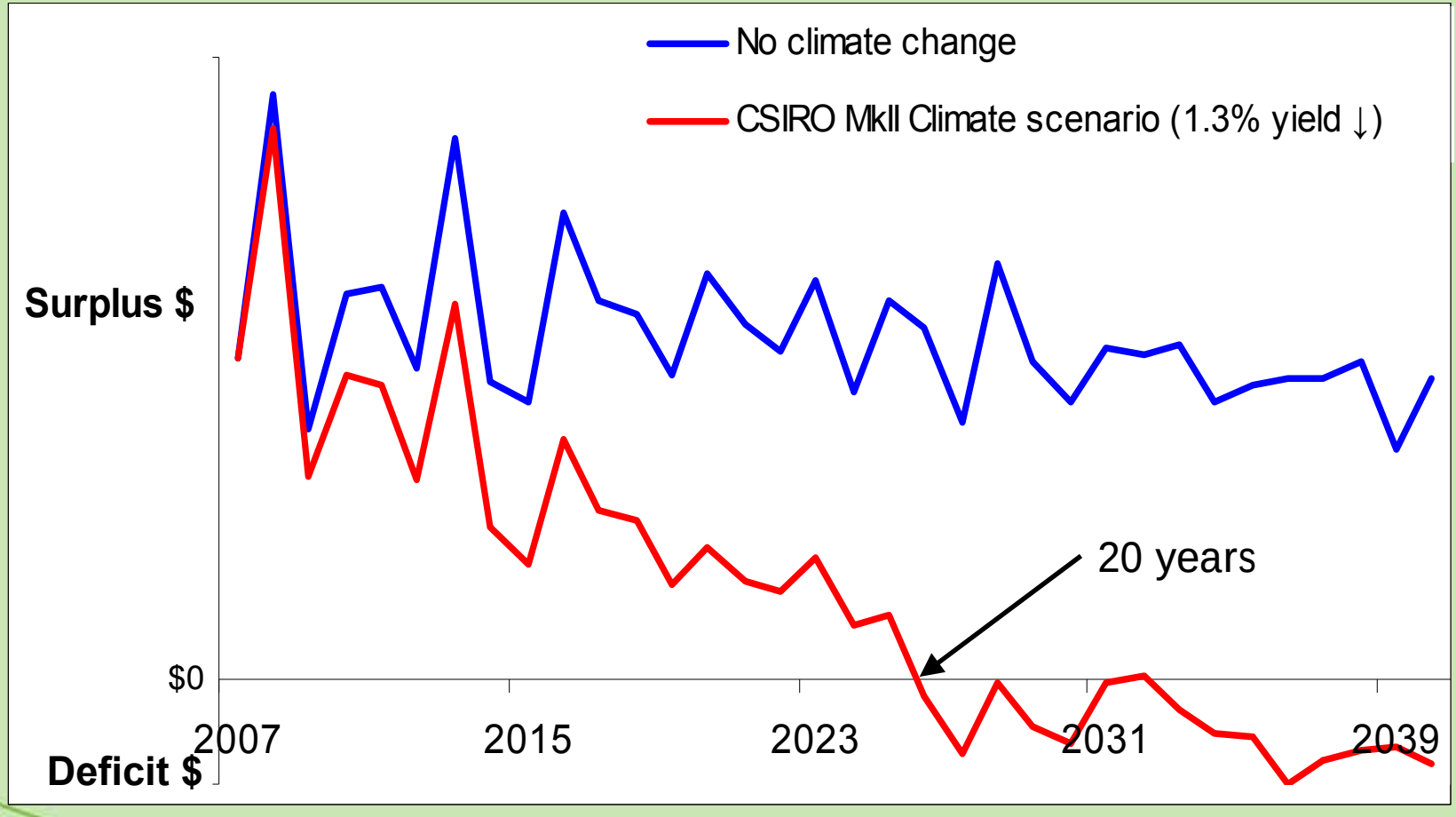
- Modified French- Schultz equation (Van Gool and Vernon, DAFWA)
  - growing season rainfall, temperatures, land capability, other
- APSIM-wheat (Farre and Foster, DAFWA) – climate variability, CO_2
- Pasture modelling - Sustainable Grazing Systems model

(iii) $ Impact on farm (STEP)

- Under linear yield ↓
- Annual surplus or deficit *through time*

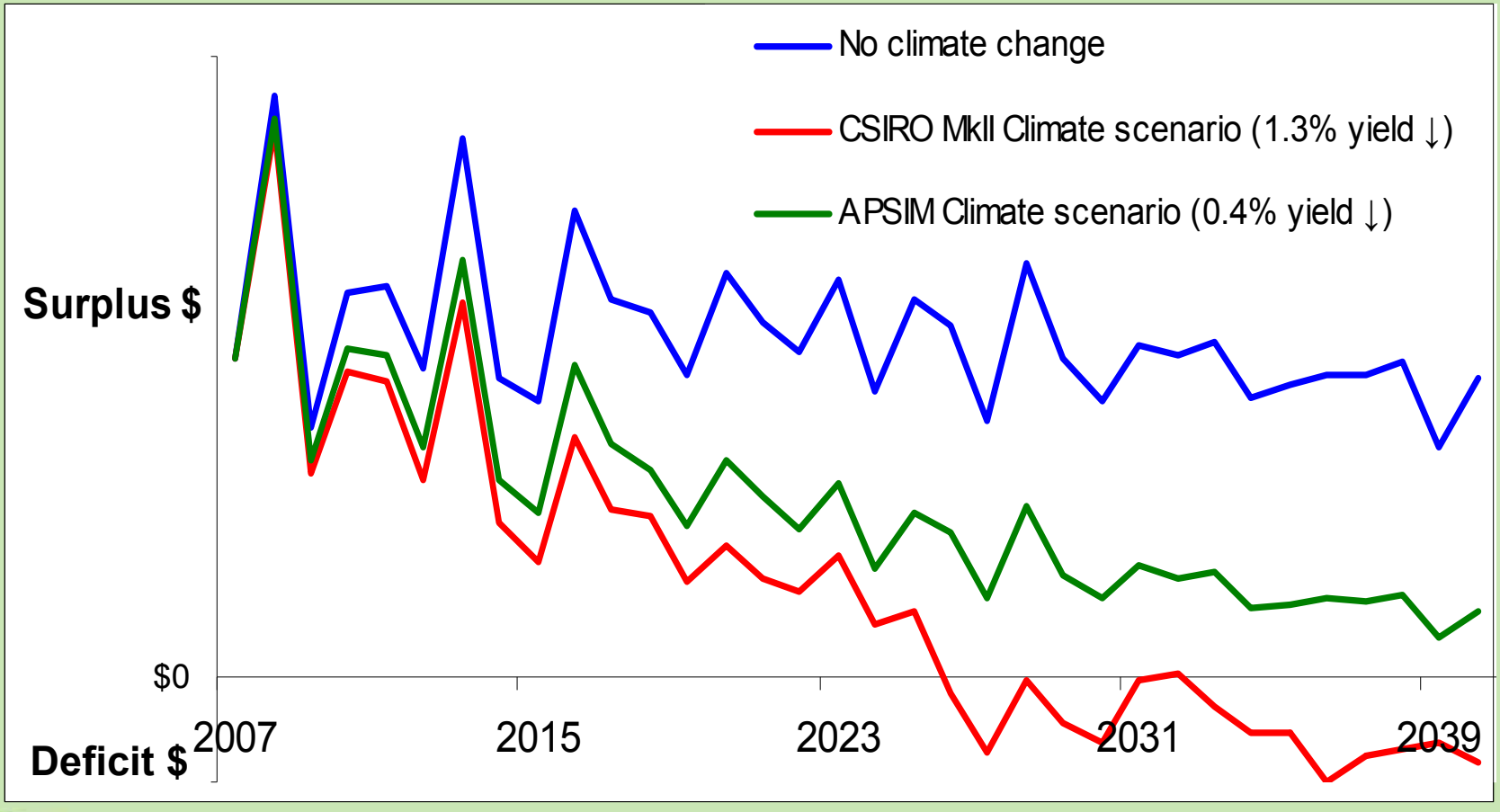
2. Modelling impact of climate change on farm - example

Low rainfall farm, NAR (60% cropping, 40% pasture + sheep)



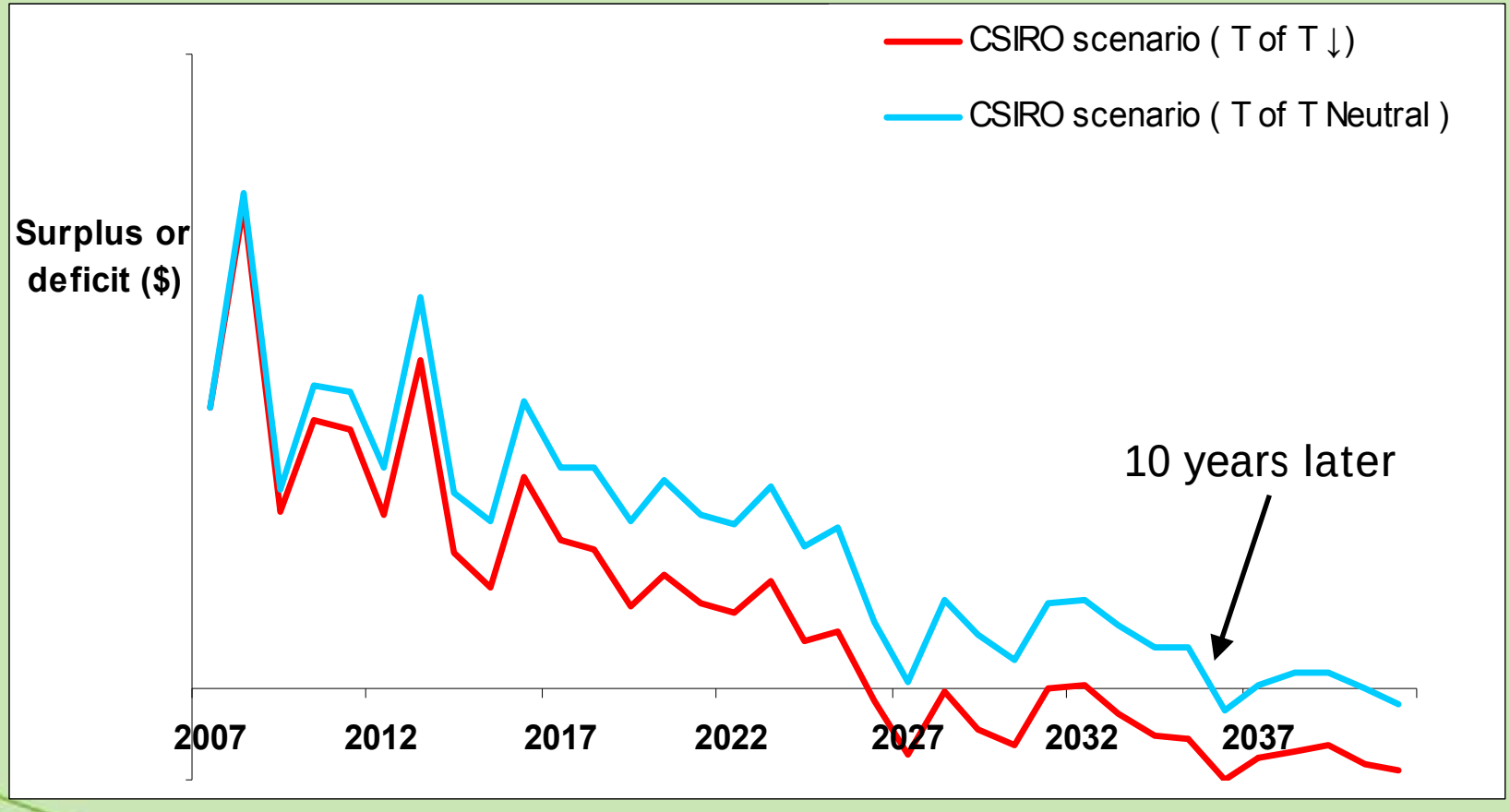
2. Modelling impact of climate change on farm - example

Low rainfall farm, NAR (60% cropping, 40% pasture + sheep)



3. Sensitivity analysis

What if terms of trade no longer decline?



4. Impact on regional economy

Upscaled to regional level

Future modelled crop $/ha x Area (ha)

Estimates compared to the current system ⟶ revenue loss

Real annual revenue in 15 years' time

	No climate change scenario	**CSIRO climate scenario**	**Income loss from climate change**
Low rainfall area	$73 million	$19 million	73%

How can we adapt?

Initial focus in low rainfall area – range of adaptations

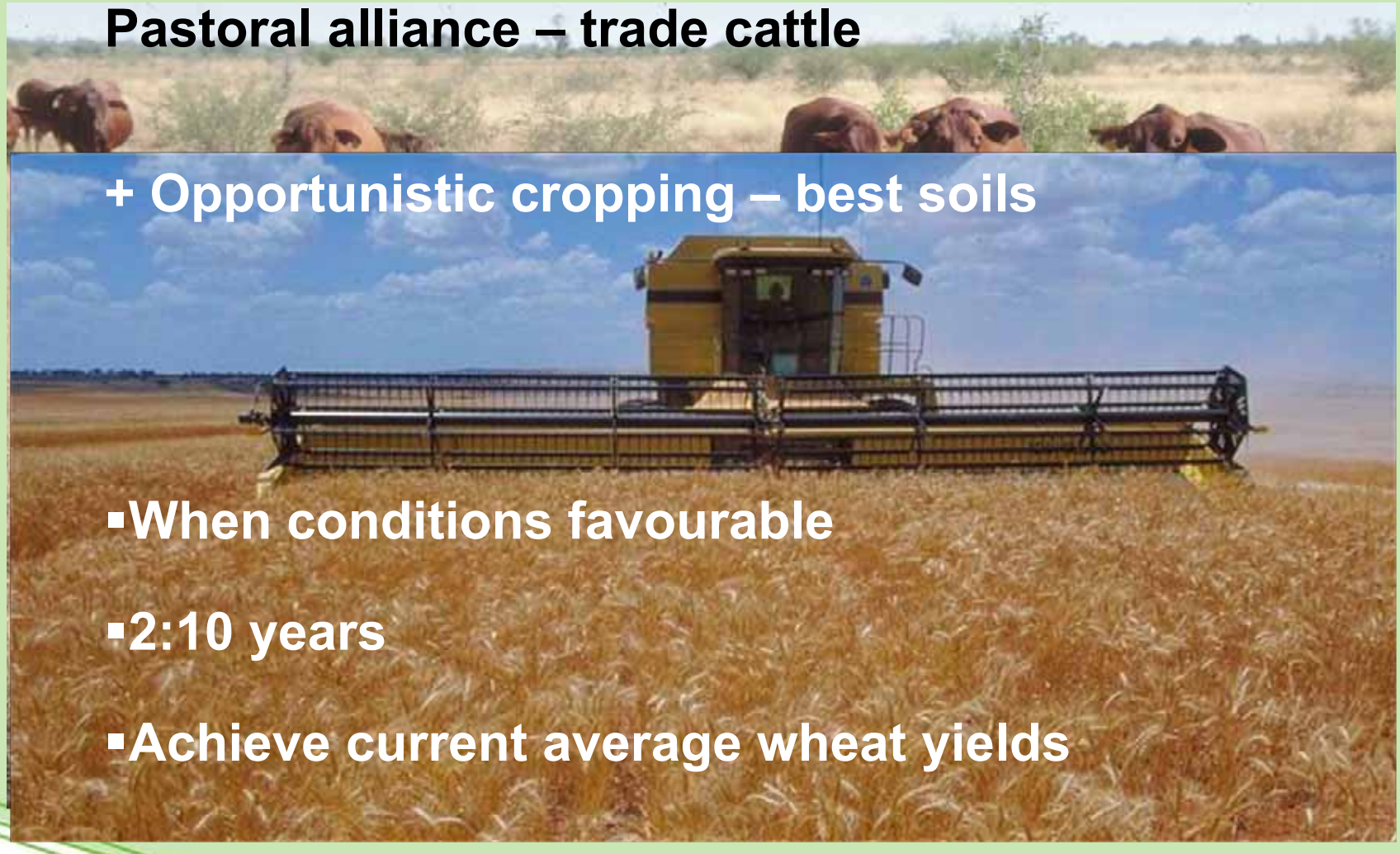
- Reduce investment in cropping
- Minimal capital and input costs
- New skills not required
- Incorporate existing practices and technologies

5. Testing adaptations to climate change

Example
Low rainfall

5. Testing adaptations to climate change

Example
Low rainfall



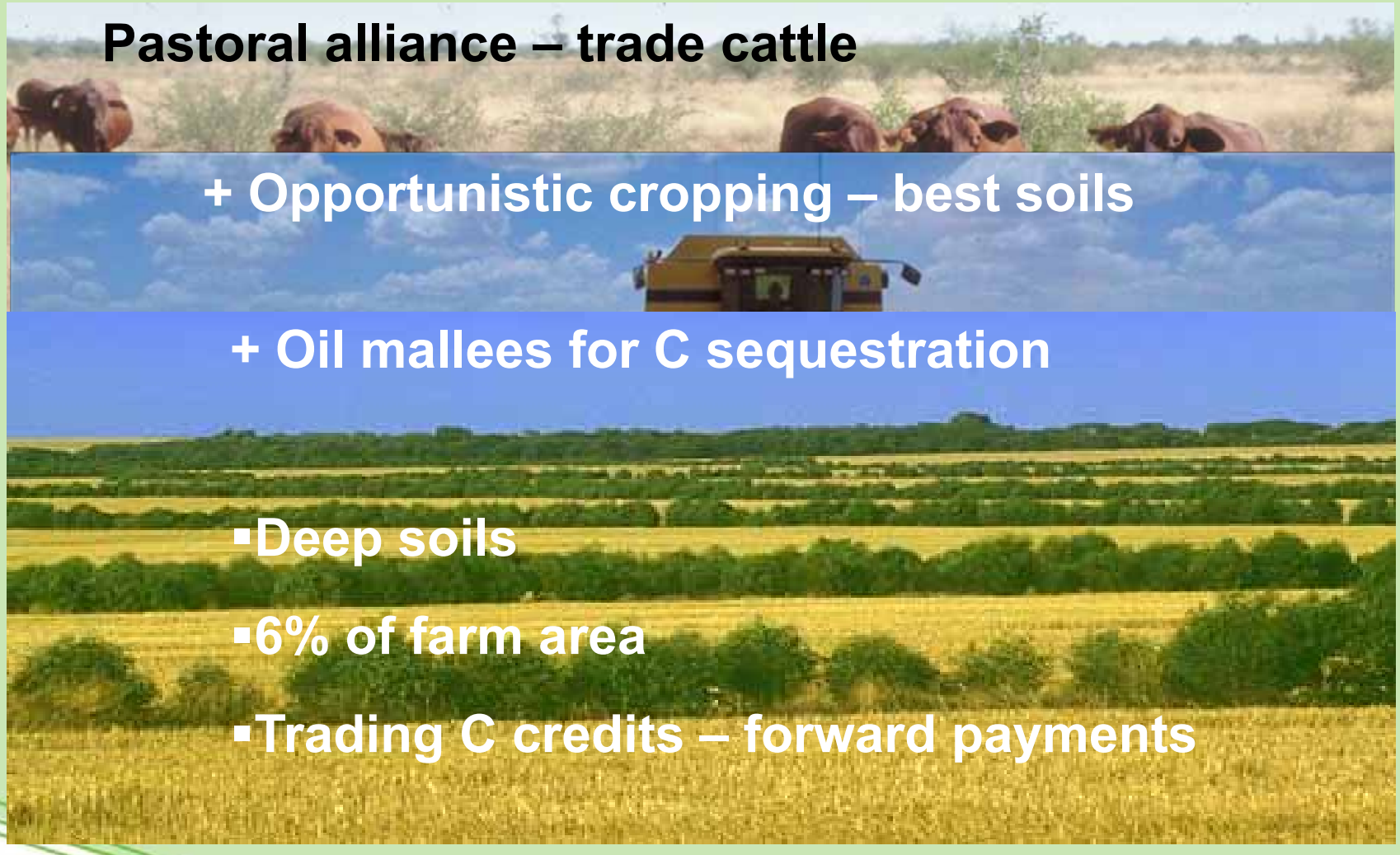
Pastoral alliance – trade cattle

+ Opportunistic cropping – best soils

- **When conditions favourable**
- **2:10 years**
- **Achieve current average wheat yields**

5. Testing adaptations to climate change

Example
Low rainfall



Annual average surplus or deficit (30 yrs)

Example
Low rainfall

Wheat price ($/t)	C returns ($/t CO_2-e /yr)	*Cattle weight gain 120 kg/hd 4 months	*Cattle weight gain 180 kg/hd 4 months
$204	$ 10	-	-
	$ 50	-	+/-
$ 254	$ 10	-	+
	$ 50	+/-	+

- deficit +/- $ 0−10K + $ 10−50K

* Cattle stocked at 3 DSE/ha

Department of Agriculture and Food
GOVERNMENT OF WESTERN AUSTRALIA

6. Consider Risks /Gaps

Example
Low rainfall

We can determine production thresholds for system to work BUT

Trade cattle

- Can we build these relationships?
- Availability of cattle?
- Required animal weight gain? – pasture growth, adaptation of stock to new environment, quality genetics
- Stocking rate - Environmental damage?

Opportunistic cropping

- Depends on accurate interpretation of the season
- Frequency of cropping, yield, price?

Oil mallee

- Can we achieve adequate C sequestration?
- Income from C market?

Conclusions

- Methodology featuring STEP to assess economic impact on farm under changing climate
- Tested range of scenarios for possible impacts
- Scale up on-farm impacts to region – assist in planning
- Evaluate $ of potential adaptations & transition to new system
- Planning, R&D priorities, investment in regions

Department of Agriculture and Food

GOVERNMENT OF WESTERN AUSTRALIA

Australian Government

Department of Climate Change

Acknowledgements

- Department of Climate Change
- Farmers in NAR
- DAFWA staff