Transitioning Cereal Systems to Adapt to Climate Change

November 13-14, 2015

Funded through Award #2011-68002-30191 from USDA National Institute of Food and Agriculture

Understanding the importance of managing climate risk in the restoration and conservation of natural capital in the dryland cereal systems

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Understanding the importance of managing climate risk in the restoration and conservation of natural capital in the drylands

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Outline

- The importance of the Drylands to socio-political situation and development.
- Where ICRISAT works
- Strategic and tactical responses to managing climate
  - Examples from Australia
  - Examples from India

Dryland Systems

- 65 % of the worlds agricultural lands fall into the category of Drylands
- 2.5 billion people live in the Drylands
- The majority of the poorest people live in semi-arid areas
- 644 million people are the poorest of the poor
- 1/3 of these rely on agriculture for their livelihoods
- 42% (27) of children in the Drylands of Asia (SSA) are malnourished
- Mixed (crop-livestock) farming systems are predominant agricultural system

Tradeoffs and scale

Markets

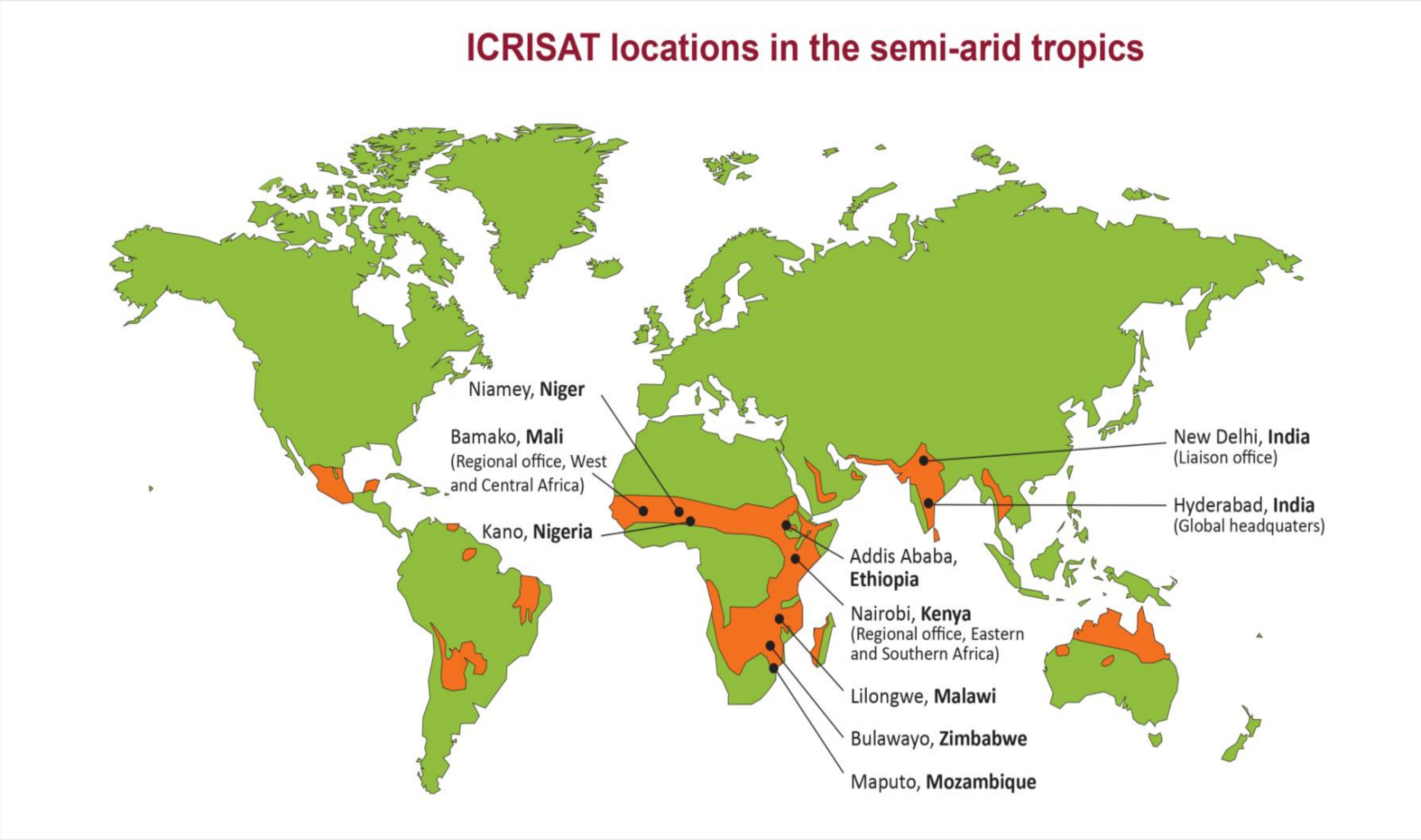
Community,
watershed,
region…

Farm, household,
livelihood…

Field, flock, forest

Microbe-plant

ICRISAT


ICRISAT locations in the semi-arid tropics
Niamey, Niger
Bamako, Mali
(Regional office, West and Central Africa)
Kano, Nigeria
Addis Ababa, Ethiopia
Nairobi, Kenya
(Regional office, Eastern and Southern Africa)
Lilongwe, Malawi
Bulawayo, Zimbabwe
Maputo, Mozambique
New Delhi, India
(Liaison office)
Hyderabad, India
(Global headquaters)

Dryland Systems

Global challenges

- Poor governance and political instability
- Lack of political will in putting Drylands on the agenda
- Lack of infrastructure, institutions and human capacity
- Market failure or unfair policies creating skewed markets
- Gender inequality

Farm level challenges

- Land fragmentation (e.g. Eastern Ethiopia- land size 0.5-0.25 ha)
- Labour cost and availability
- Conflict for resources (water, grazing rights)
- Severe environmental degradation
- High inherent climate variability and severe threat of higher temperatures/lower rainfall and higher variability due to climate change

Managing climate
Strategic and tactical responses

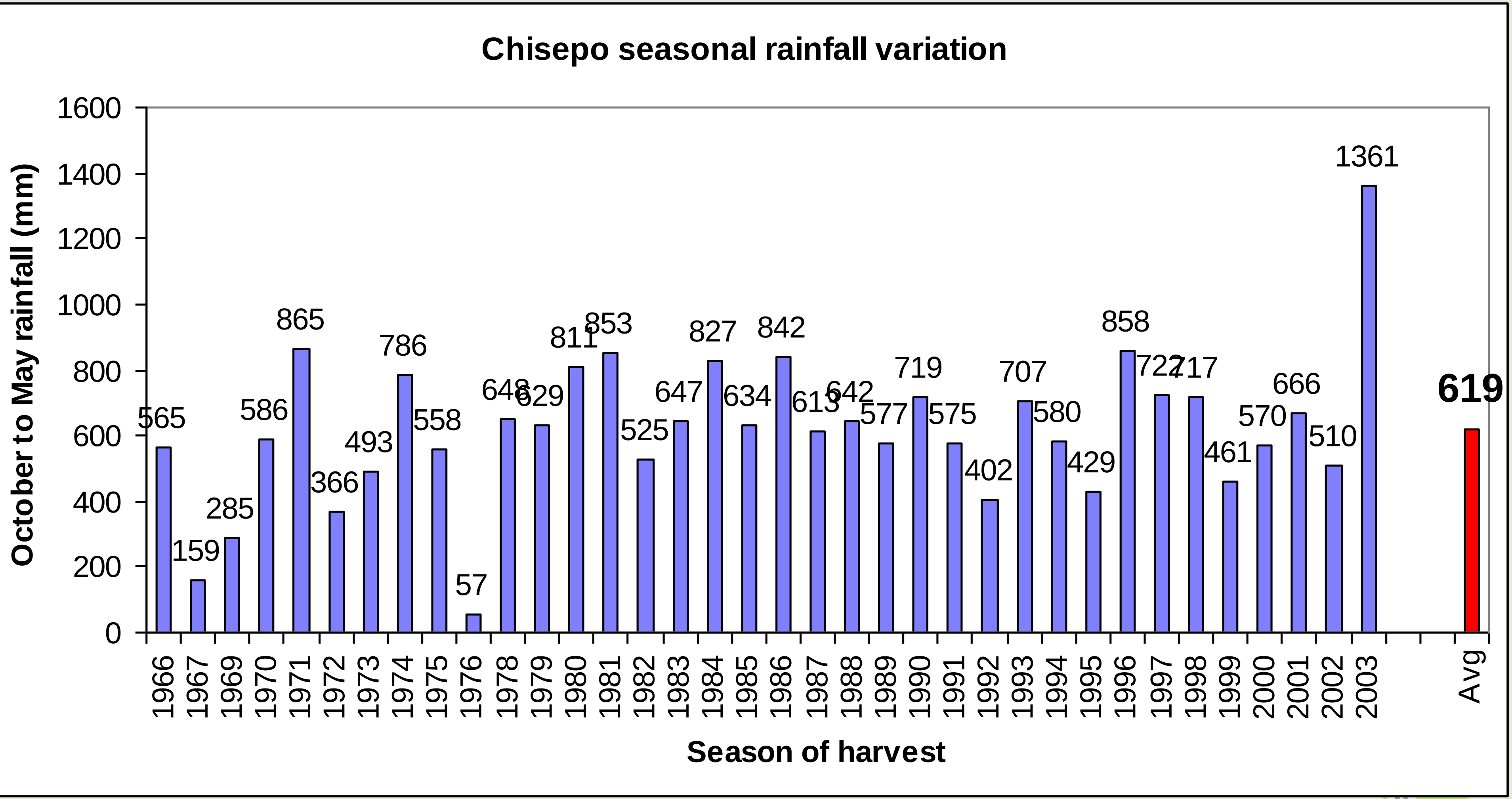
Strategic

- Historical and future climate analyses
- Design of the farm system for resilience (extreme events/ food security) and market opportunities (commercialisation)
- Infrastructure to enhance resilience.

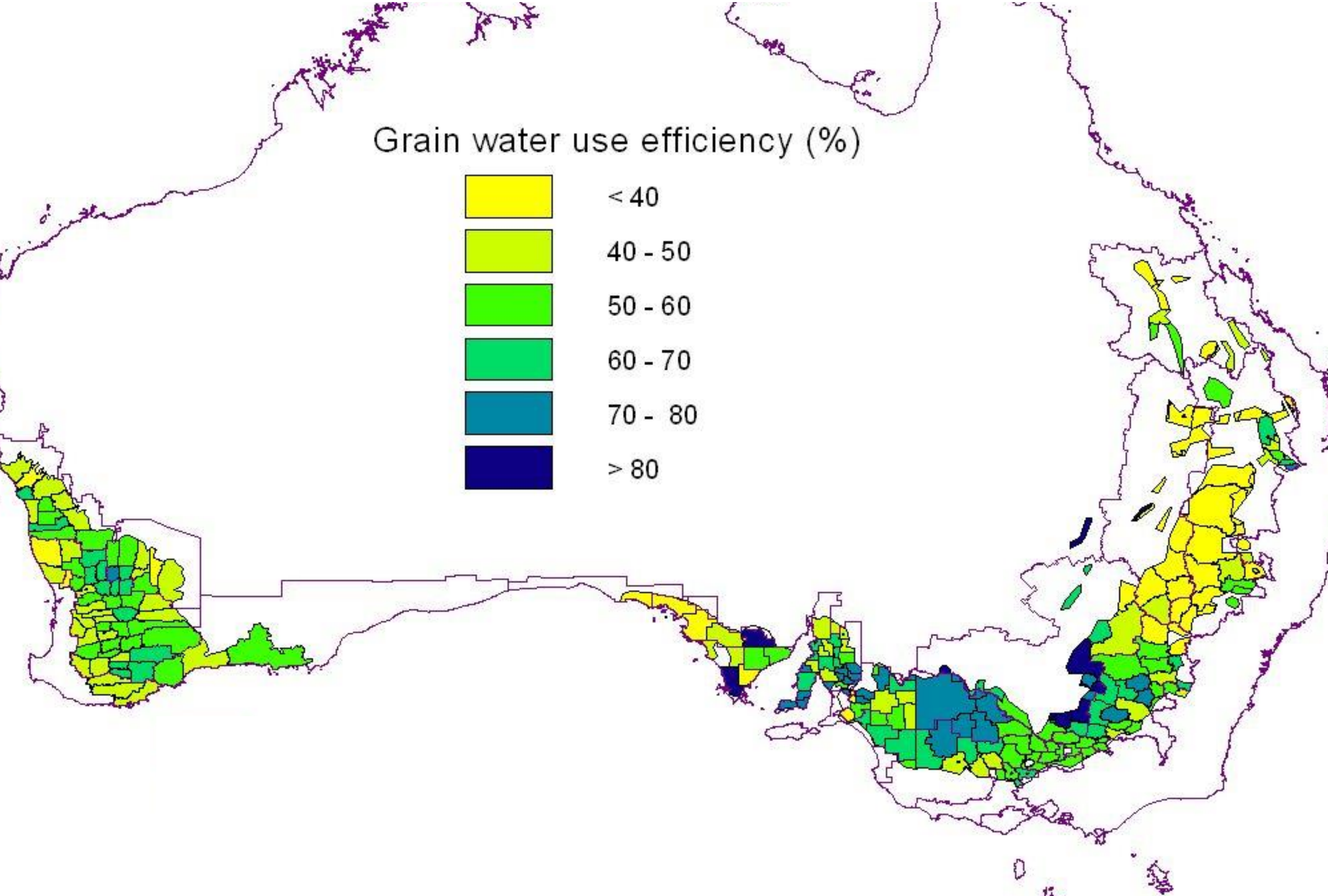
Tactical (pre- and in-season responsive management)

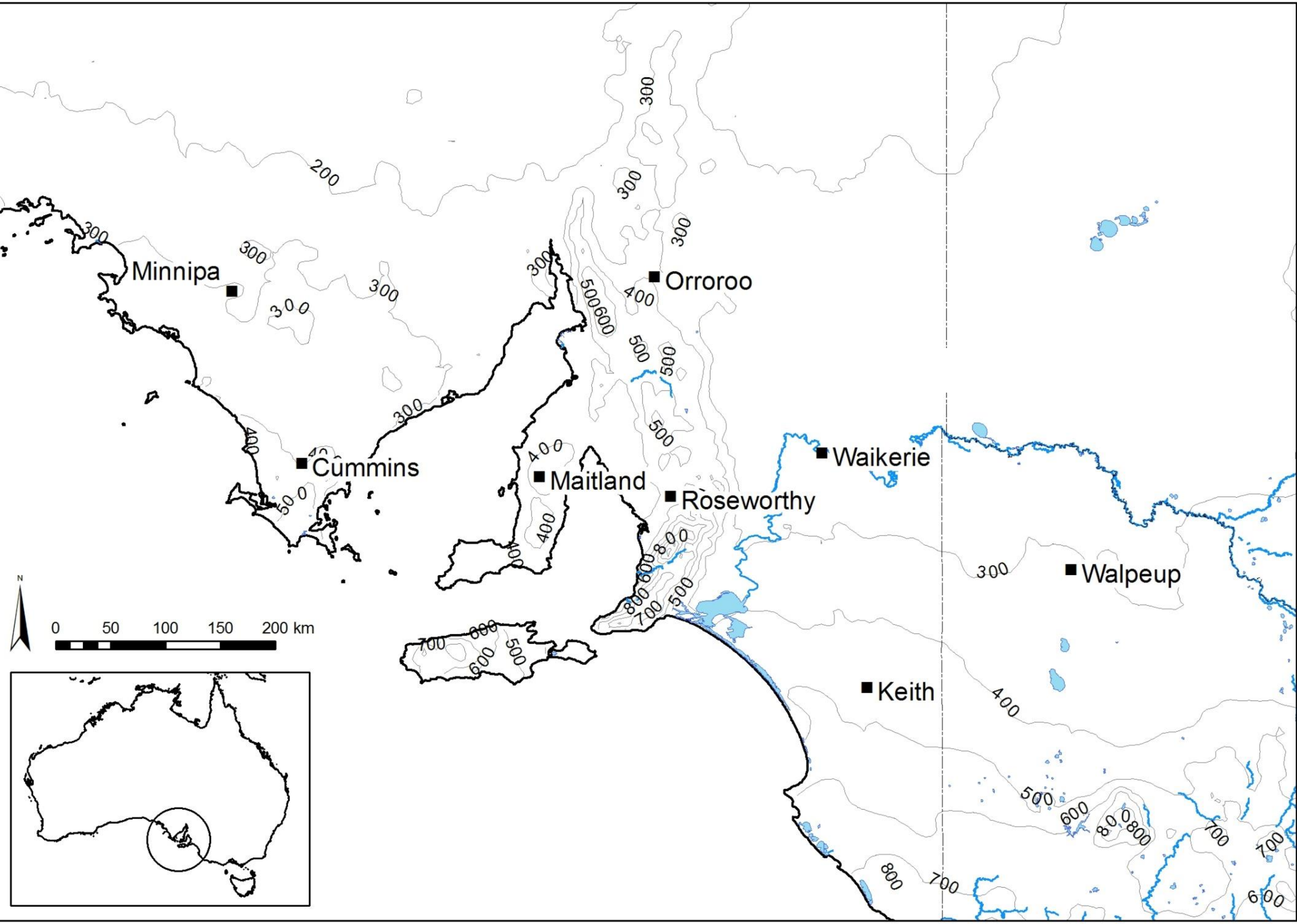
- Climate forecasting (long, medium and short term)
- pre-season enterprise planning
- in-season responses to prevailing weather

In the drylands, there is no average



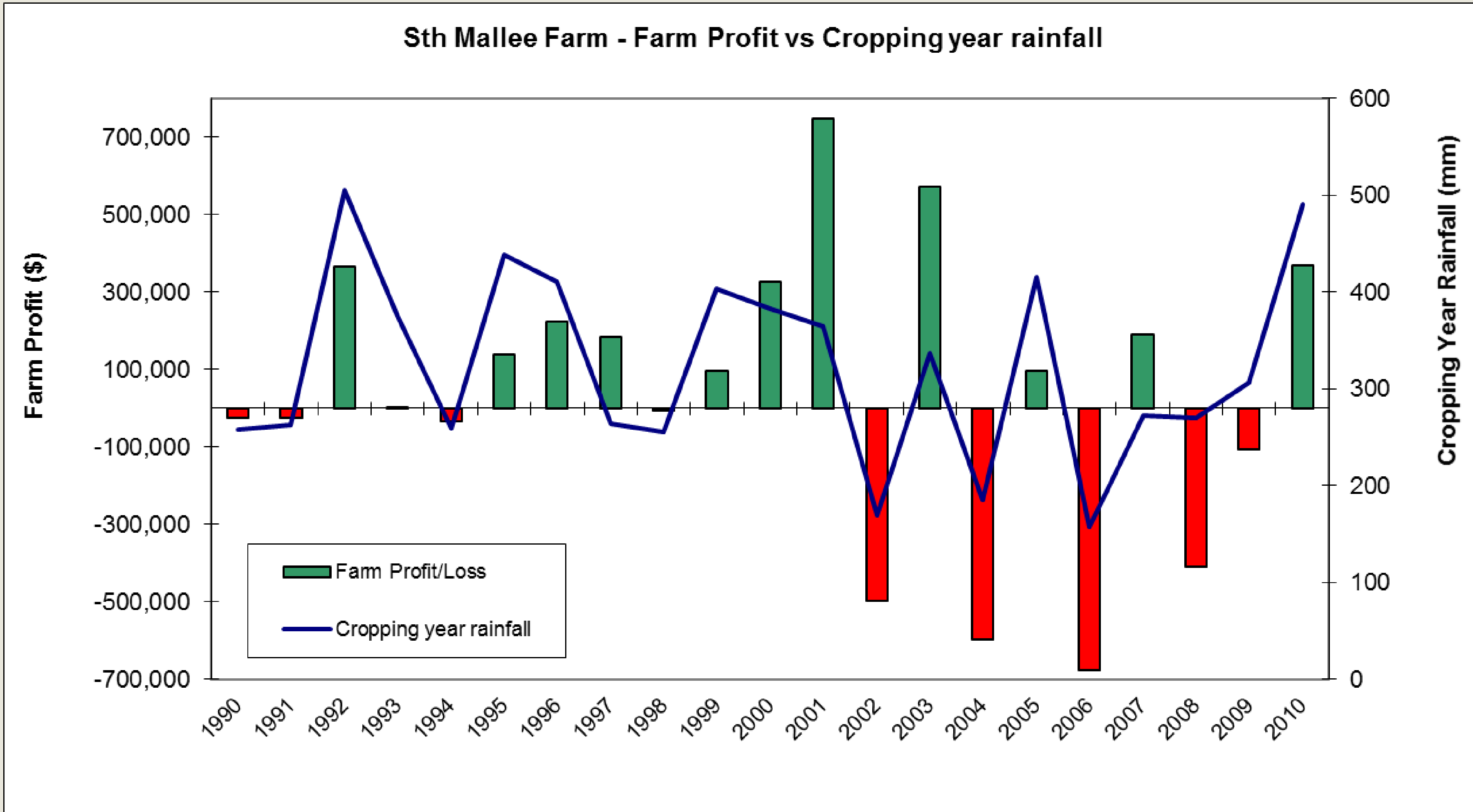
Wheat water use efficiency: 1983-2002



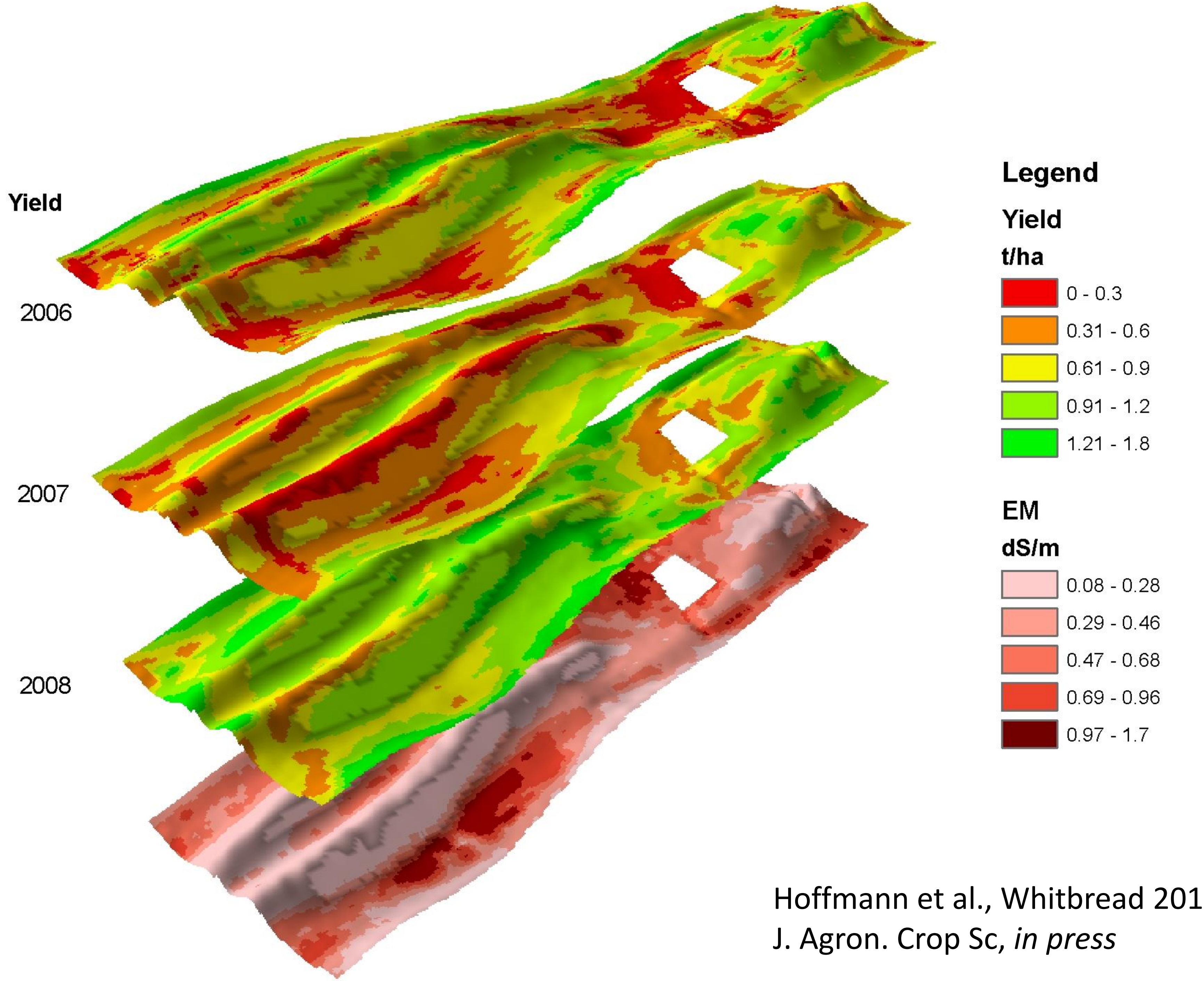

Minnipa
Orroroo
Cummins
Maitland
Waikerie
Roseworthy
Walpeup
Keith
N
0 50 100 150 200 km

Australian farming is risky

75% profits in 25% years; losses in 50% years

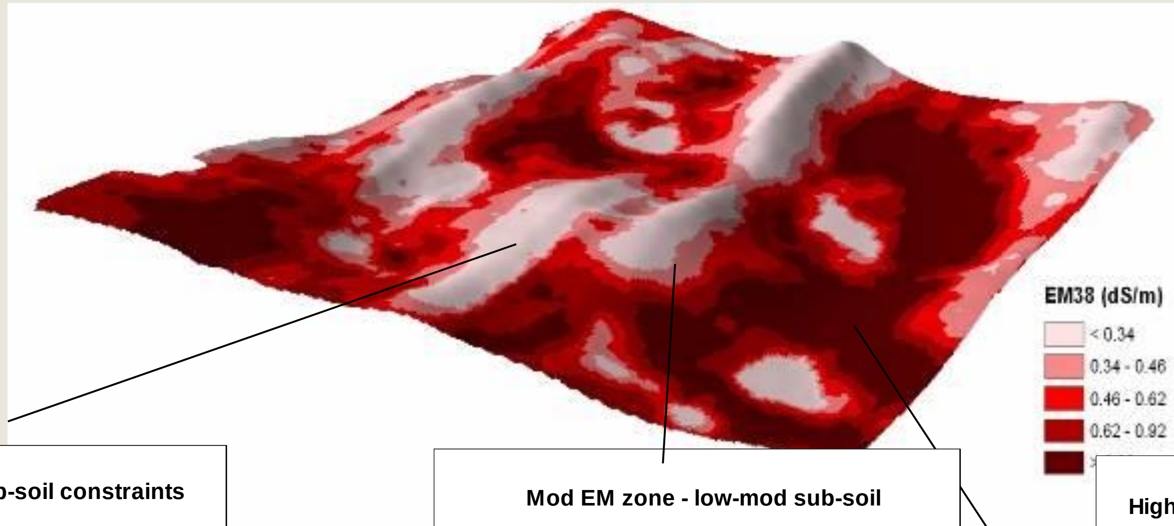


- Actual farm data – southern Mallee farm (5200ha), 80% crop and 20% livestock (by area)
  Costs: Inputs, Machinery, Labour and Financial
- Data courtesy of Harm van Rees (CropFacts



Hoffmann et al., Whitbread 201
J. Agron. Crop Sc, *in press*

Carwarp EM & elevation map with soil characterisation in zones of low, moderate and high EM.



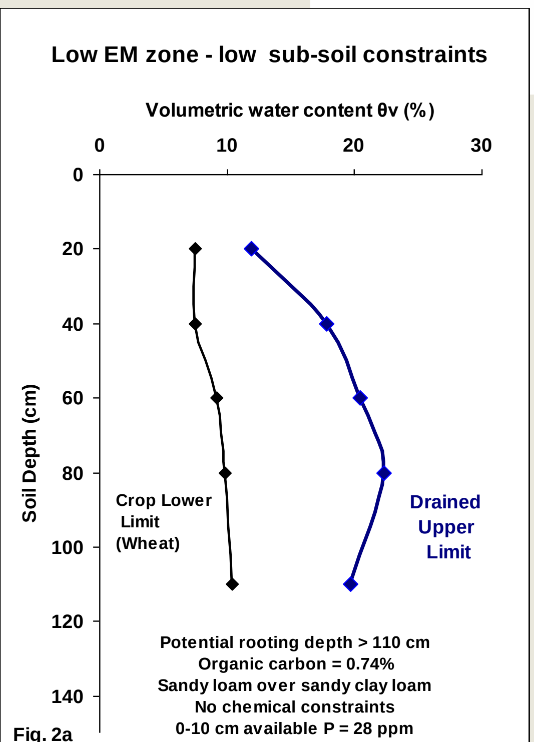


Fig. 2a

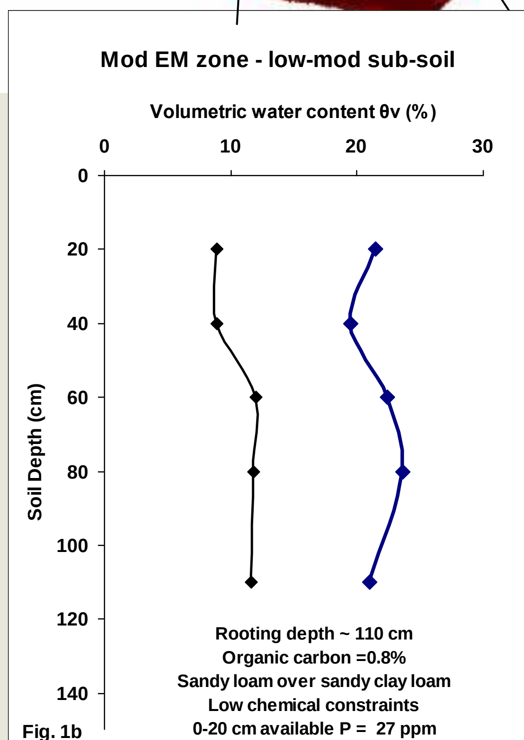


Fig. 1b

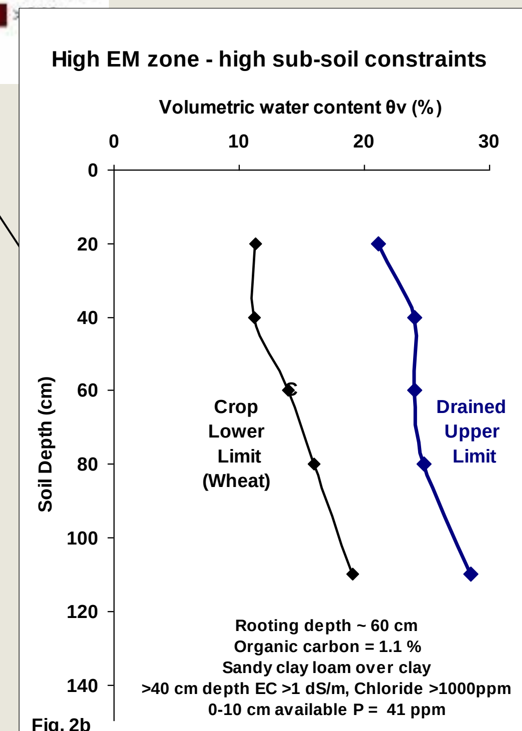
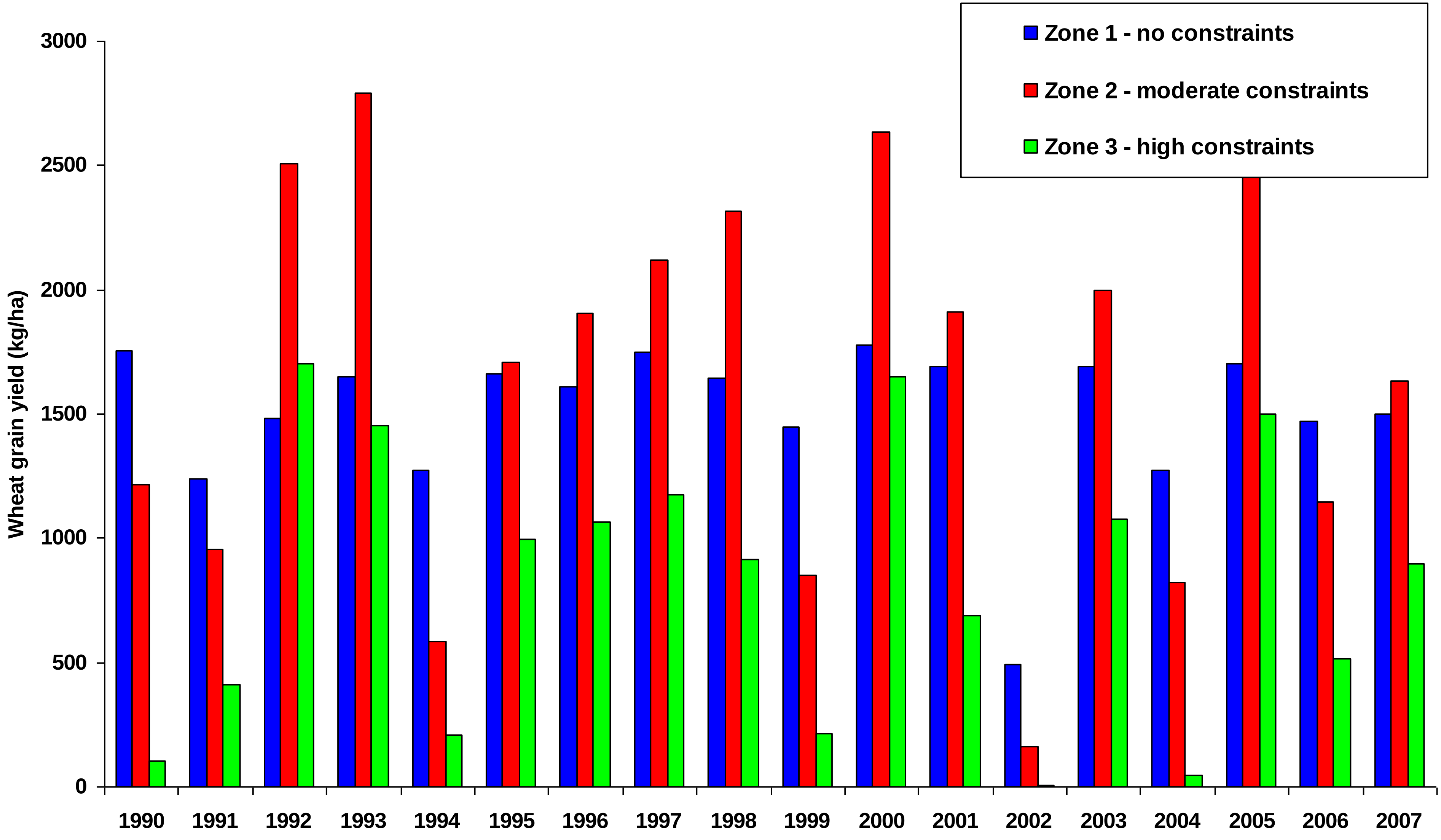


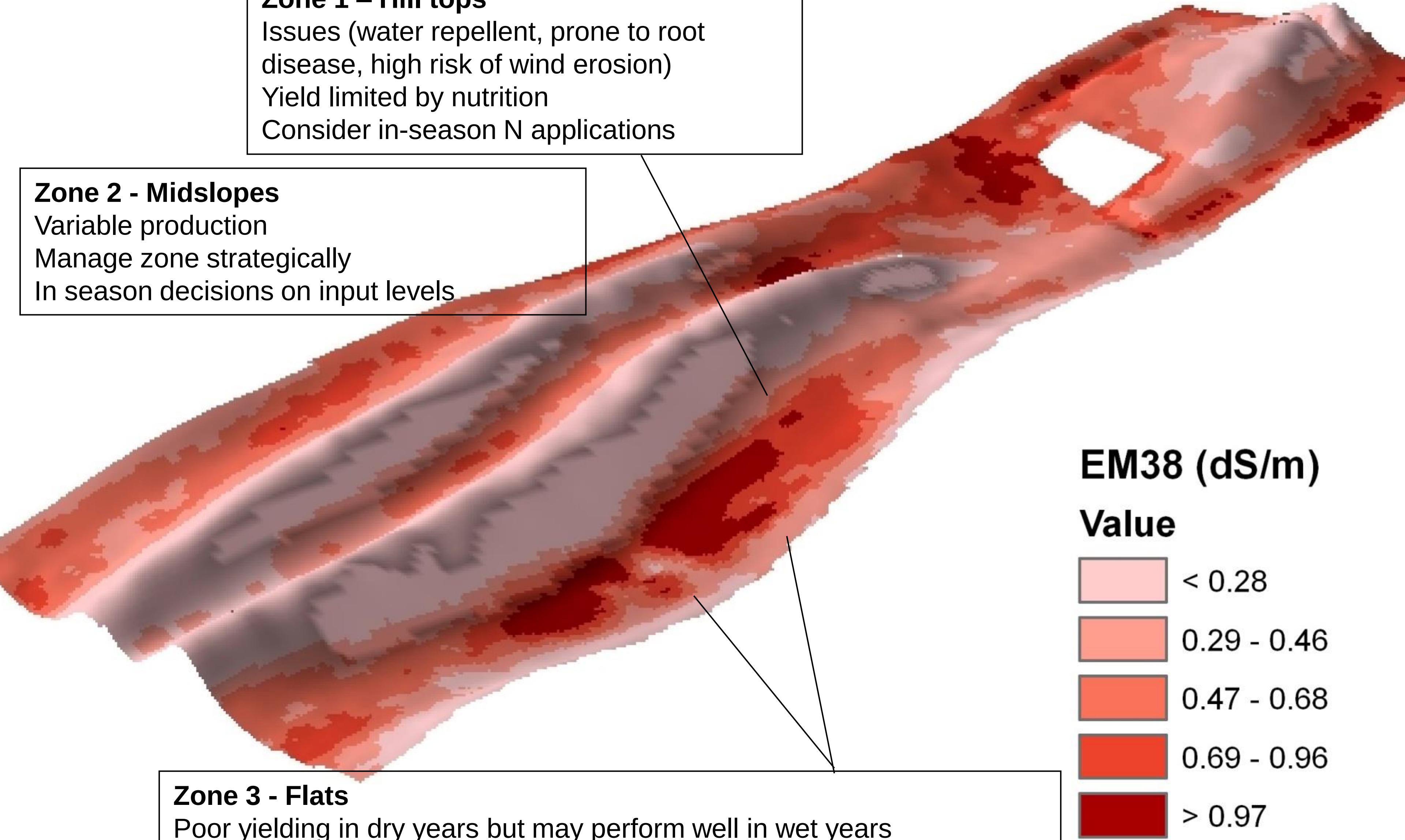
Fig. 2b

Modelled wheat yield 1990-2007 for 3 zones at Loxton (+30 kg//ha N)



Zone 1 – Hill tops
Issues (water repellent, prone to root disease, high risk of wind erosion)
Yield limited by nutrition
Consider in-season N applications

Zone 2 - Midslopes
Variable production
Manage zone strategically
In season decisions on input levels

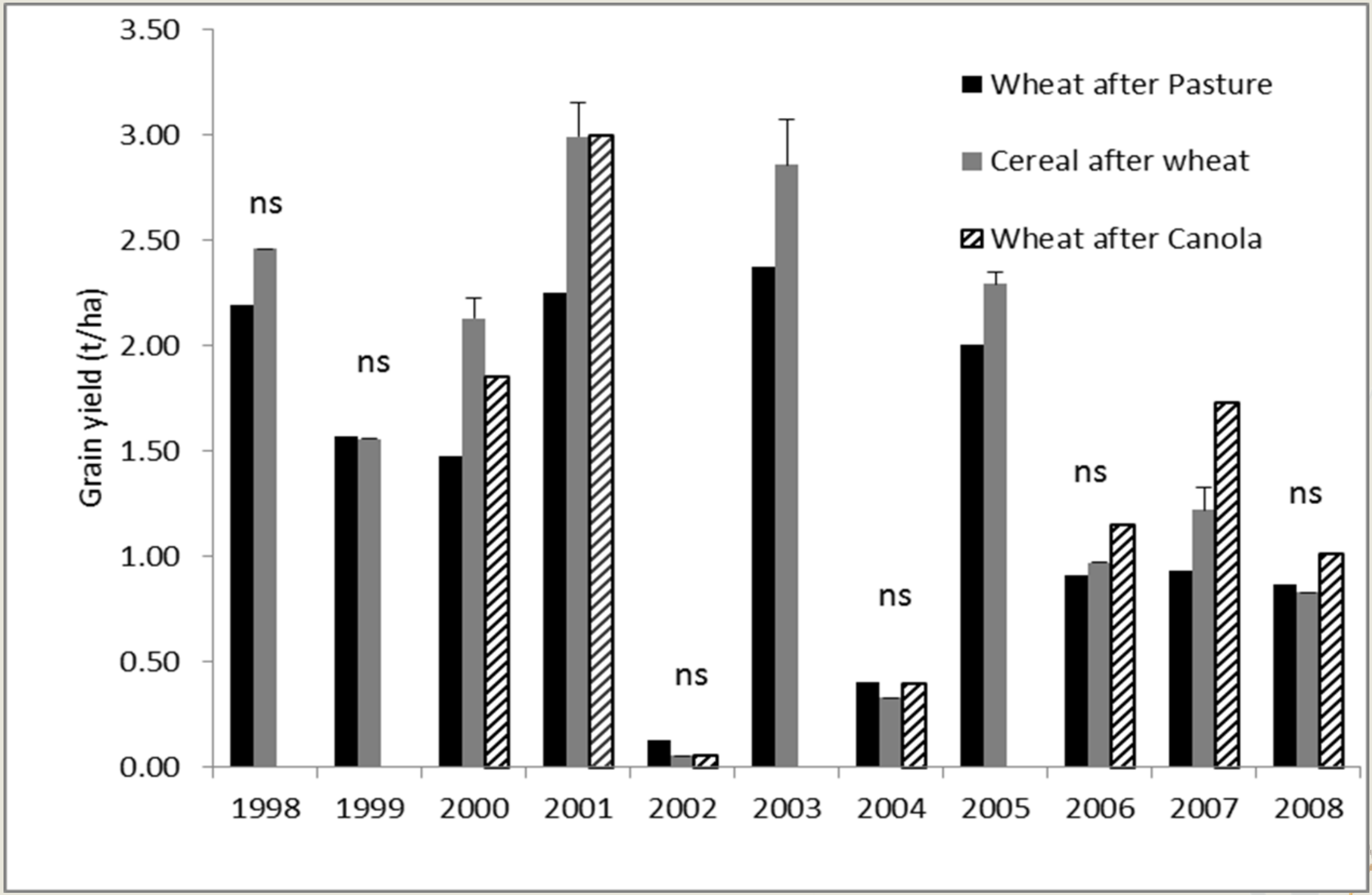


Zone 3 - Flats
Poor yielding in dry years but may perform well in wet years
Seldom nutrient limited so reduce inputs
In season decisions on end use (graze/hay/grain)

Hoffmann et al., Whitbread 2015. J. Agron. Crop Sc, *in press*

Long term rotation experiment

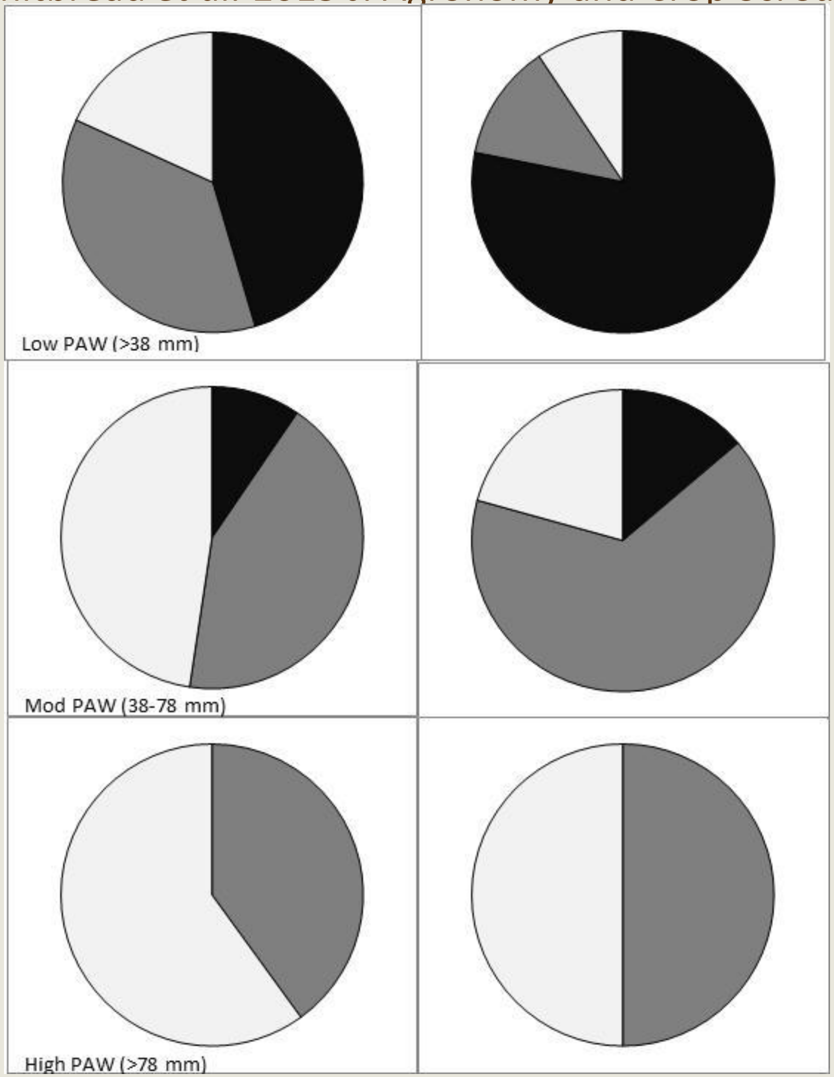
Whitbread *et al.* 2015 Crop & Pasture Sc. 66, 553-565.



Calcarosol, PAWC = 70 mm
Treatments comparing district practice (pasture-wheat) Vs opportunity and intensive cropping
11 seasons 1998-2008

Effect of variations in PAW and seeding opportunity on percentage of modelled yields- ’Triggers’

Whitbread *et al.* 2015 J. Agronomy and Crop Sc. *Submitted.*



Upper tercile (white)
Middle tercile (grey)
Lower tercile (black)

Planting opportunity: Early Late


22/09/2014

Smallholder farm livelihood systems are diverse

<u>Systems have:</u>

Structural complexity of components

Availability of a variety of natural resources

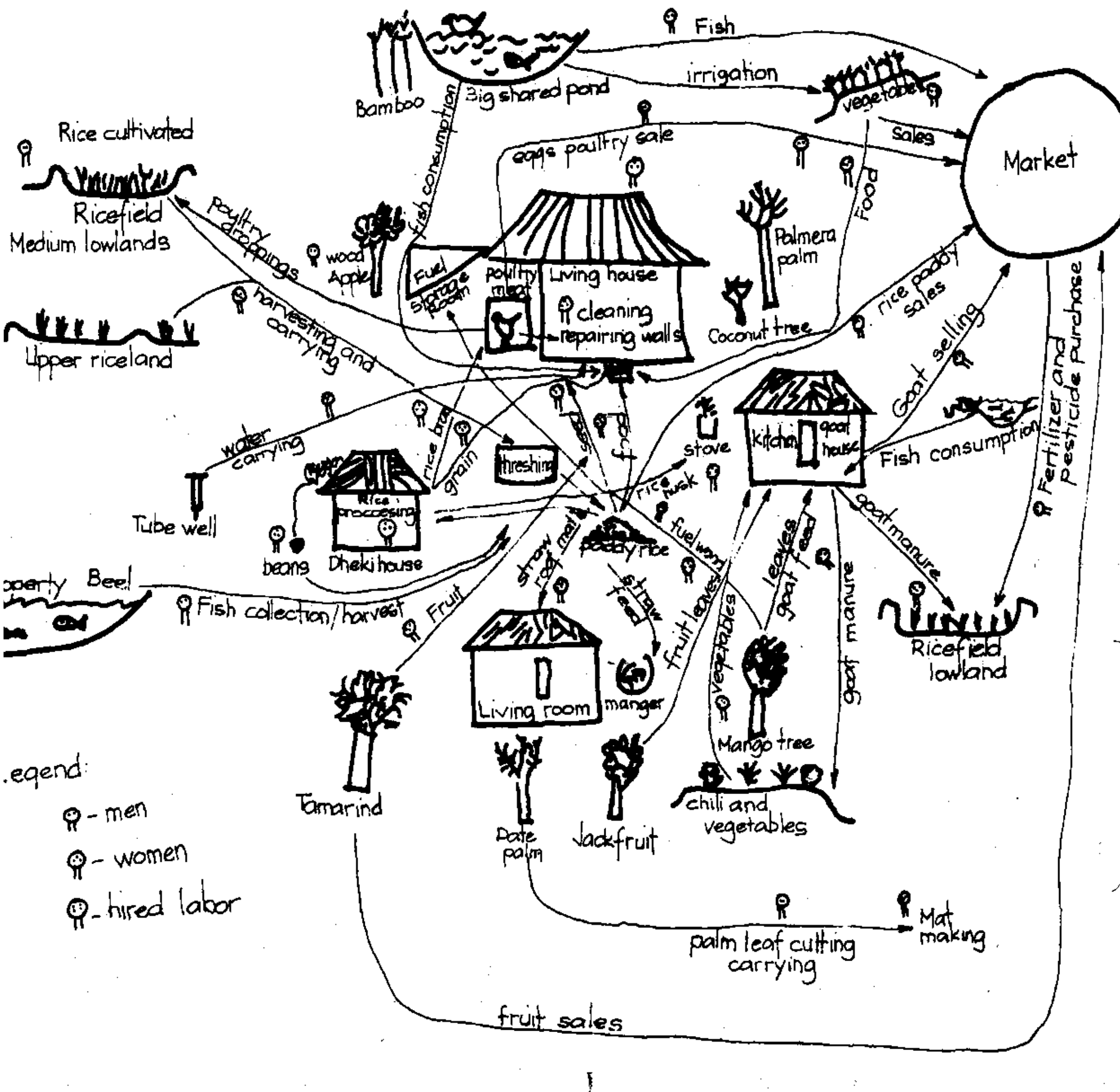
Land types, water resources, Common Property Resources (CPR)

Climate, Biodiversity

Human, social & financial capital

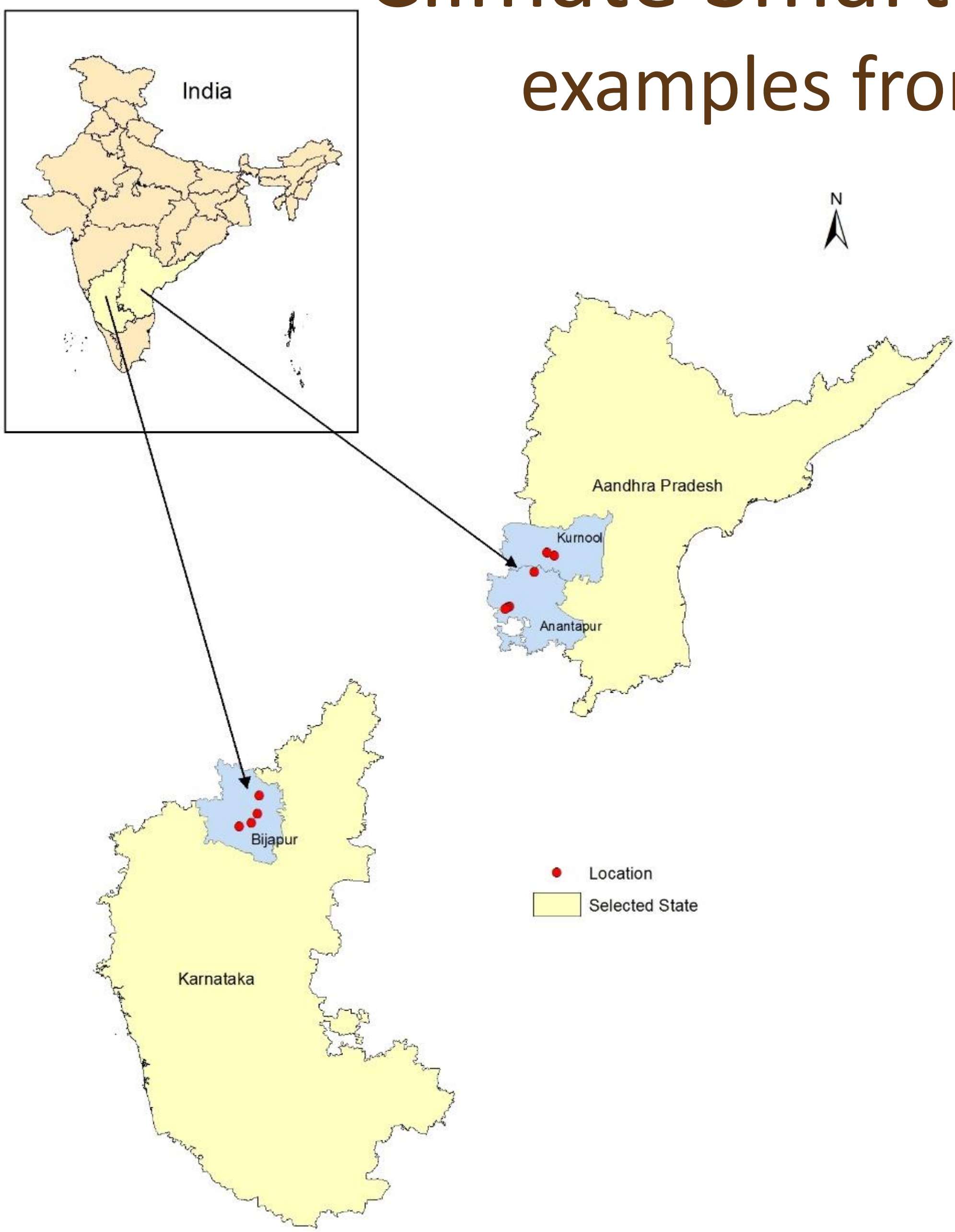
Interactions with markets

Other drivers of change



Climate Smart Agriculture (CSA)

examples from semi-arid India



Major climatic stresses and opportunities

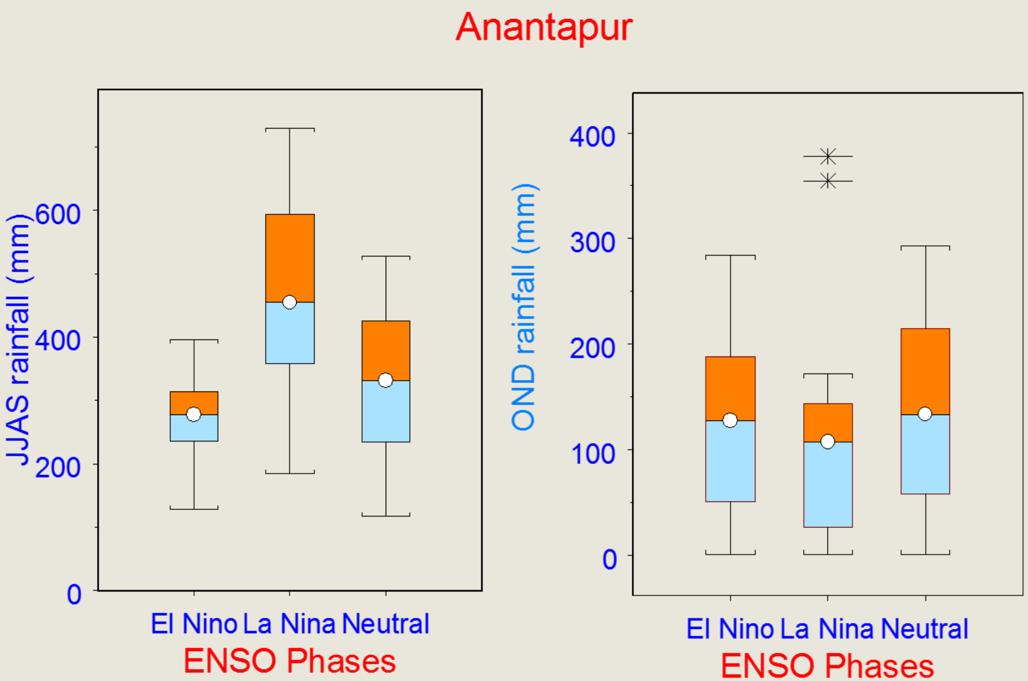
Climate related stresses

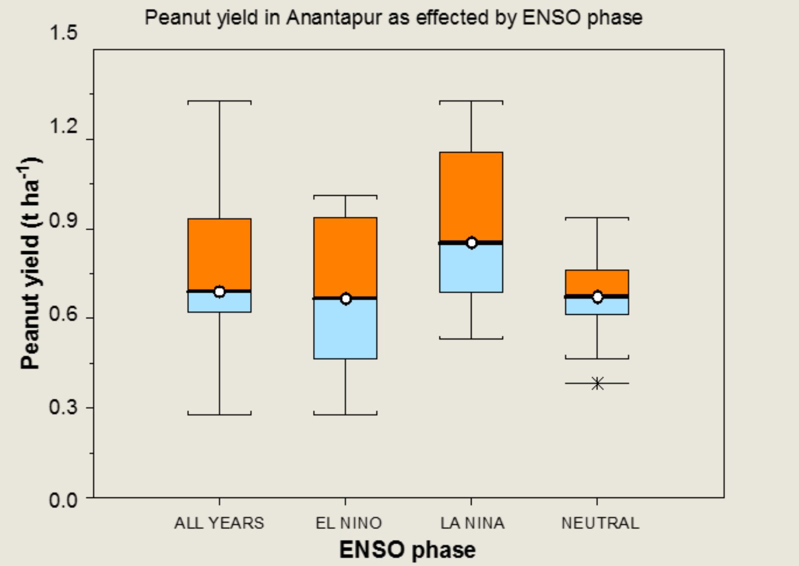
- Delayed onset and early withdrawal of monsoon
- Unseasonal/erratic rains
- Long dry-spells
- Extreme rainfall events
- Related biotic stresses
- Land degradation

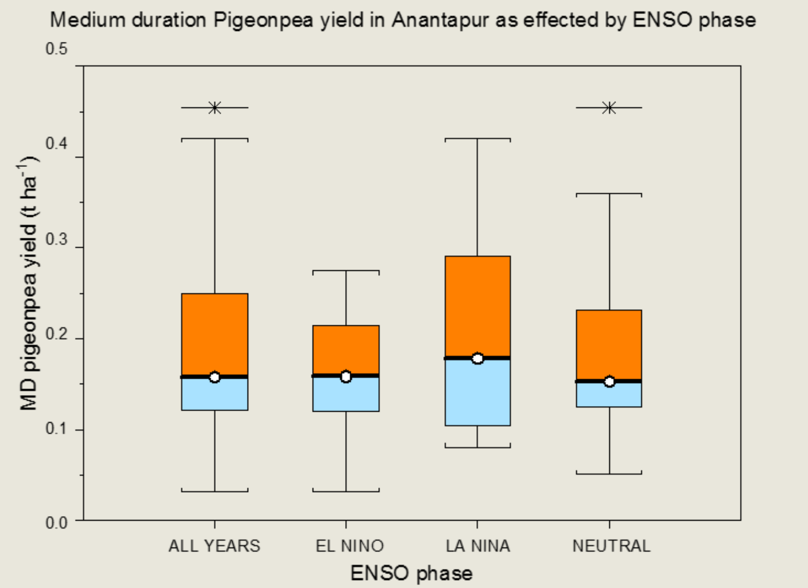
Opportunities

- Large kharif fallows (esp. Bijapur)
- Seasonal and short term rainfall forecasts/ crop modelling options
- Farm mechanization
- In-situ and ex-situ rainwater harvesting & utilization
- Conservation agriculture
- Favourable policy environment
- ICT tools for climate information

ENSO phase dependent Rainfall variability influenced crop yields in Ananthapuram, AP

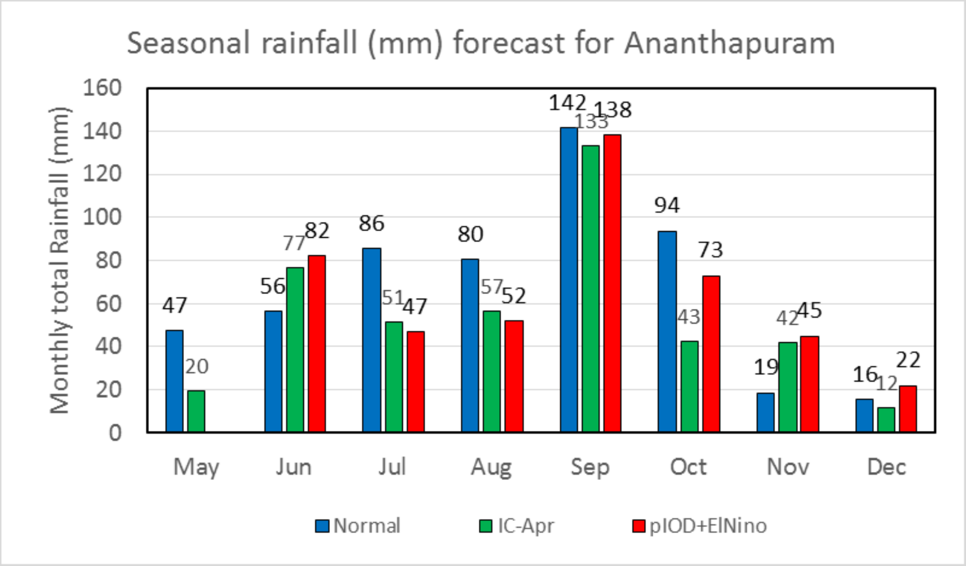






Smith and Reynolds (2003) Extended Reconstructed SSTs of (1971-2002) 3.4 region (El Nino 16, La Nina 15, Neutral 22)

Seasonal rainfall forecast and cropping options for Ananthapuram during 2015



- July and August rainfall was expected to be deficit as it is an El Nino/positive IOD year.
- September and October rainfall forecast is near or more than normal.
- Farmers were cautioned to sow crops only if the soil profile is fully filled in the month of June.
- Since the total rainfall for the season is expected to be deficit, green gram/pigeonpea, foxtail millet/pigeonpea intercrops for crop intensification, and diversification in stead of peanut monoculture were suggested.
- Low input management was suggested.

Farmers’ adopted cropping interventions in Ananthapuram during rainy season 2015

based on rainfall forecast based cropping decisions.

Farmers in Turkapalli, Ananthapuram decided to sown Foxtail millet and peanut in their fields

Innovation platform for participatory learning

- Participatory planning for interventions
- Framework for local adaptation plan for action
- Facilitate upscaling

Members:

NARS: SAUs, ICAR institutes
State line departments
NGOs
Industry, input suppliers
Farmers
Partner CG Centers

ICRISAT
Science with a human face

Conclusions

Strategic

- Historical and future climate analyses
- Design of the farm system for resilience (extreme events/ food security) and market opportunities (commercialisation)
- Infrastructure to enhance resilience.

Tactical (pre- and in-season responsive management)

- Climate forecasting (long, medium and short term)
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Dryland Systems

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Thank you!

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Washington State University

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Oregon State University OSU

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