Livestock and climate change

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CLIMATE CHANGE
AGRICULTURE AND FOOD SECURITY

ILRI
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Structure of the presentation

- Livestock contribution to climate change
  - GHG contributions
  - Sources
  - Mitigation and relationships with efficiency
- Climate change impacts on livestock and adaptation needs
  - Options and avenues for adaptation
  - Trade-offs
  - Implications for efficiency
- Concluding remarks

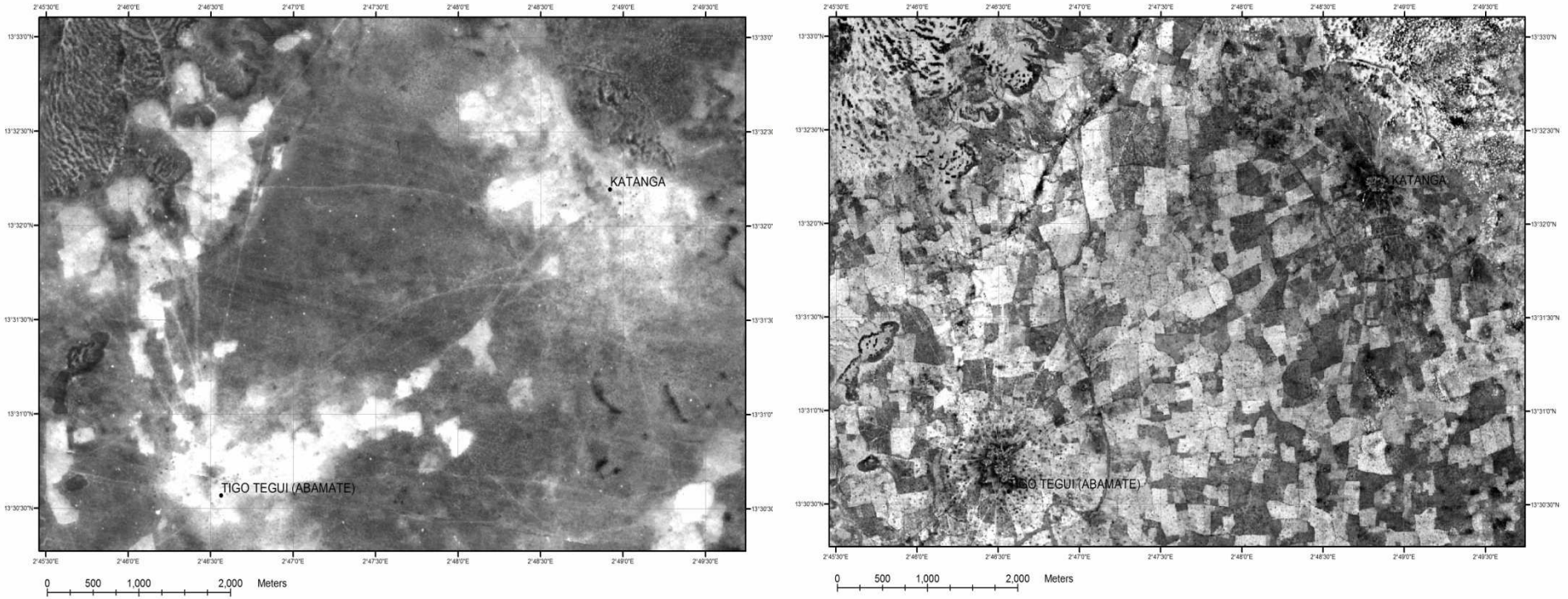
General context

- Population to reach almost 9 billion over the next quarter of a century
- Getting richer and urbanised
- Increased demands for livestock products
- Lots of changes occurring: resources diminishing, climate is changing, economics, technology, intensification

Systems and livelihoods in transition

Can we influence the next transition for the benefit of society and the environment?

W. Africa 1966 – pastoral system ⟶ **2004 – crop-livestock system**



Key concerns for the future

- How to achieve food security
- How to maintain livelihoods
- Protection and maintenance of ecosystems services
- Economic growth
- Reducing the environmental impacts for the livestock sector

Livestock’s contribution to climate change

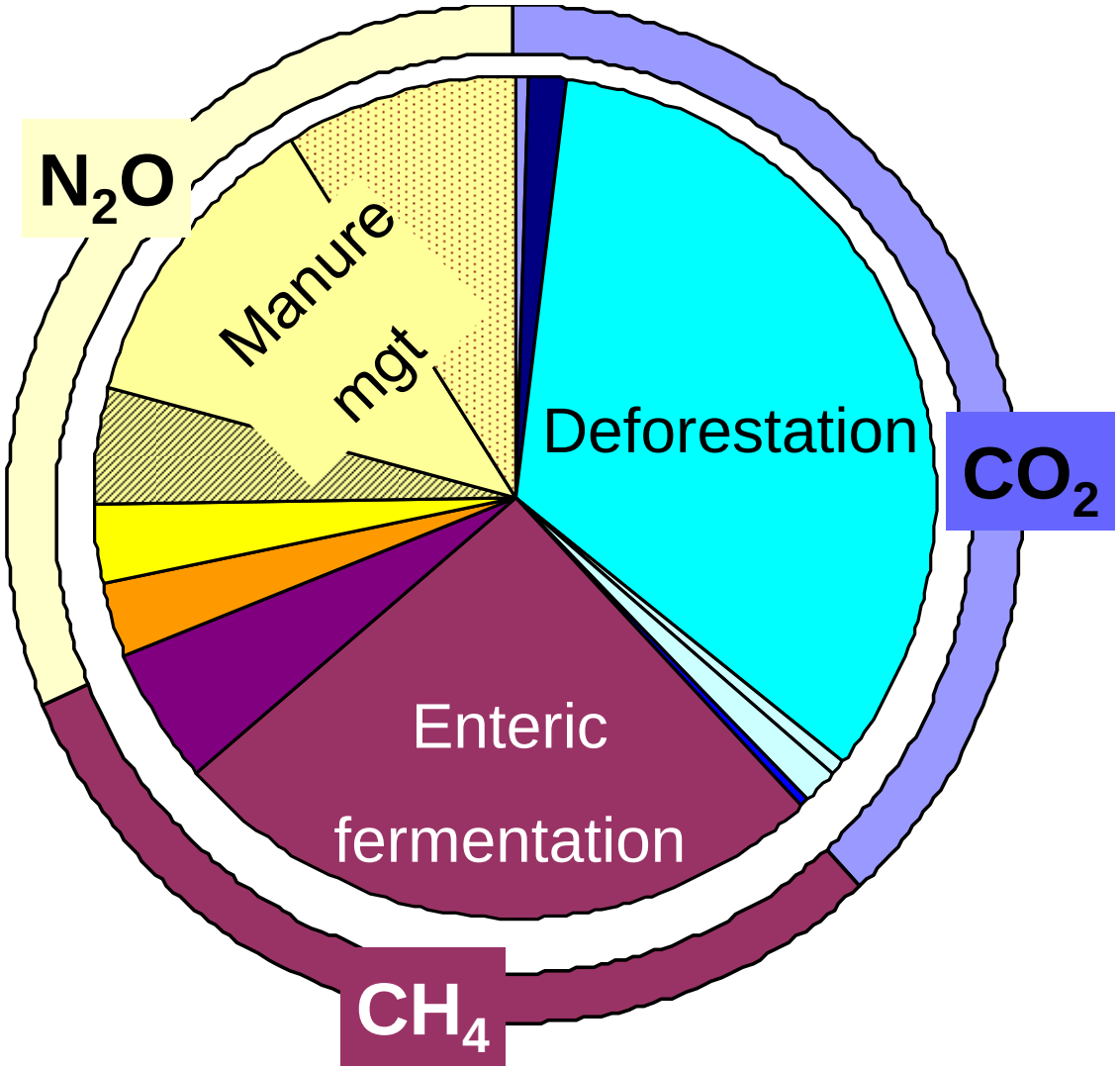
Message 1

Livestock’s contribution to climate is significant

Livestock and GHG emissions

- A range of estimates – 10 -18% of global anthropogenic GHG
- Range arises from methodological differences
  - Inventories vs life cycle assessment
  - Attribution of land use to livestock

Livestock and GHG: 18% of global emissions



- Chemical N. fert. production
- On-farm fossil fuel
- Deforestation
- OM release from ag. soils
- Pasture degradation
- Processing fossil fuel
- Transport fossil fuel
- Enteric fermentation
- Manure storage / processing
- N fertilization
- Legume production
- Manure storage / processing
- Manure spreading / dropping
- Manu indirect emissions

FAO 2006

Message 2

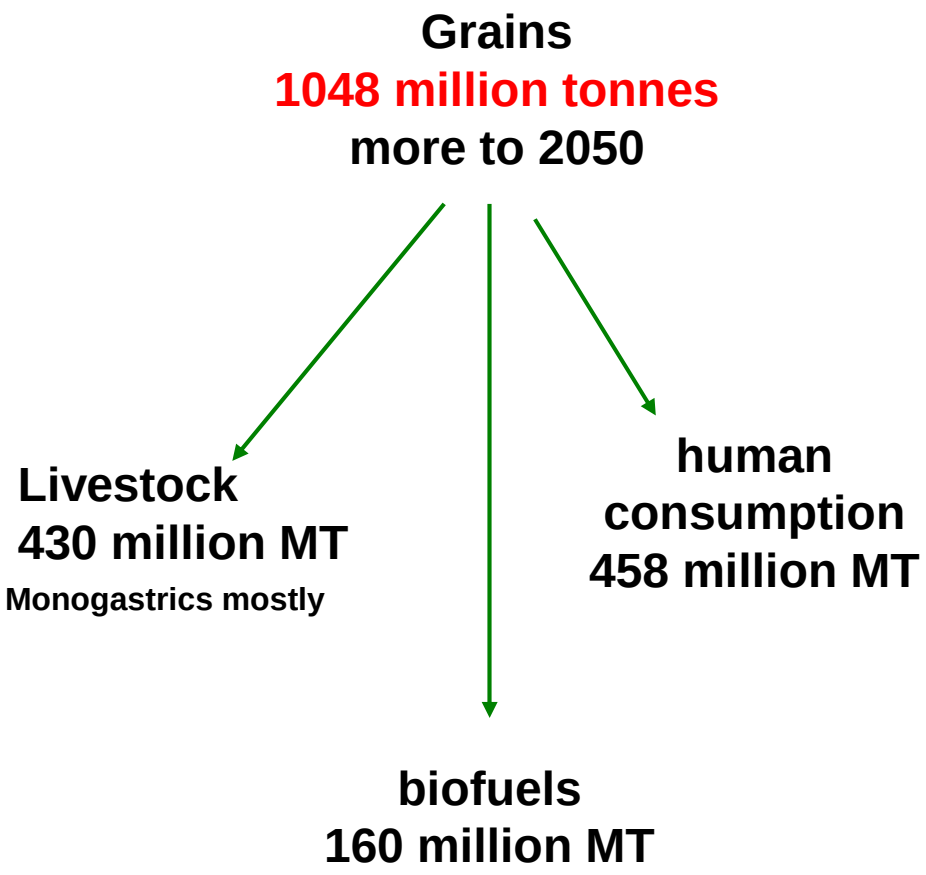
The potential to reduce the contribution of livestock to GHG is also significant

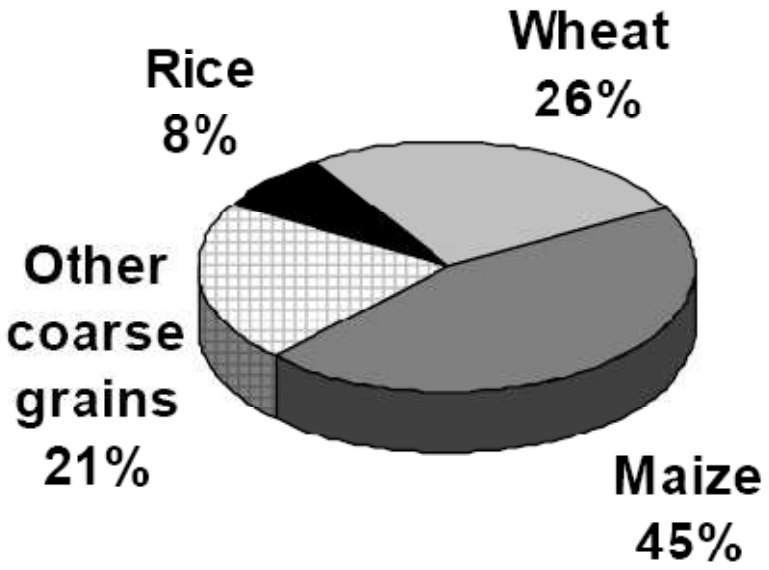
Mitigation options

- Reductions in emissions: significant potential!
  - Managing demand for animal products
  - Improved / intensified diets for ruminants
  - Reduction of animal numbers
  - Reduced livestock-induced deforestation
  - Change of animal species
  - Carbon sequestration
  - Feed additives to reduce enteric fermentation
  - Manure management (feed additives, methane production, regulations for manure disposal)

Herrero et al. (Current Opinion in Environmental Sustainability 2009, 1: 111-120)

The world will require 1 billion tonnes of additional cereal grains to 2050 to meet food and feed demands (IAASTD 2009)





Changing diets

Consuming less meat or different types of meat could lower GHG emissions

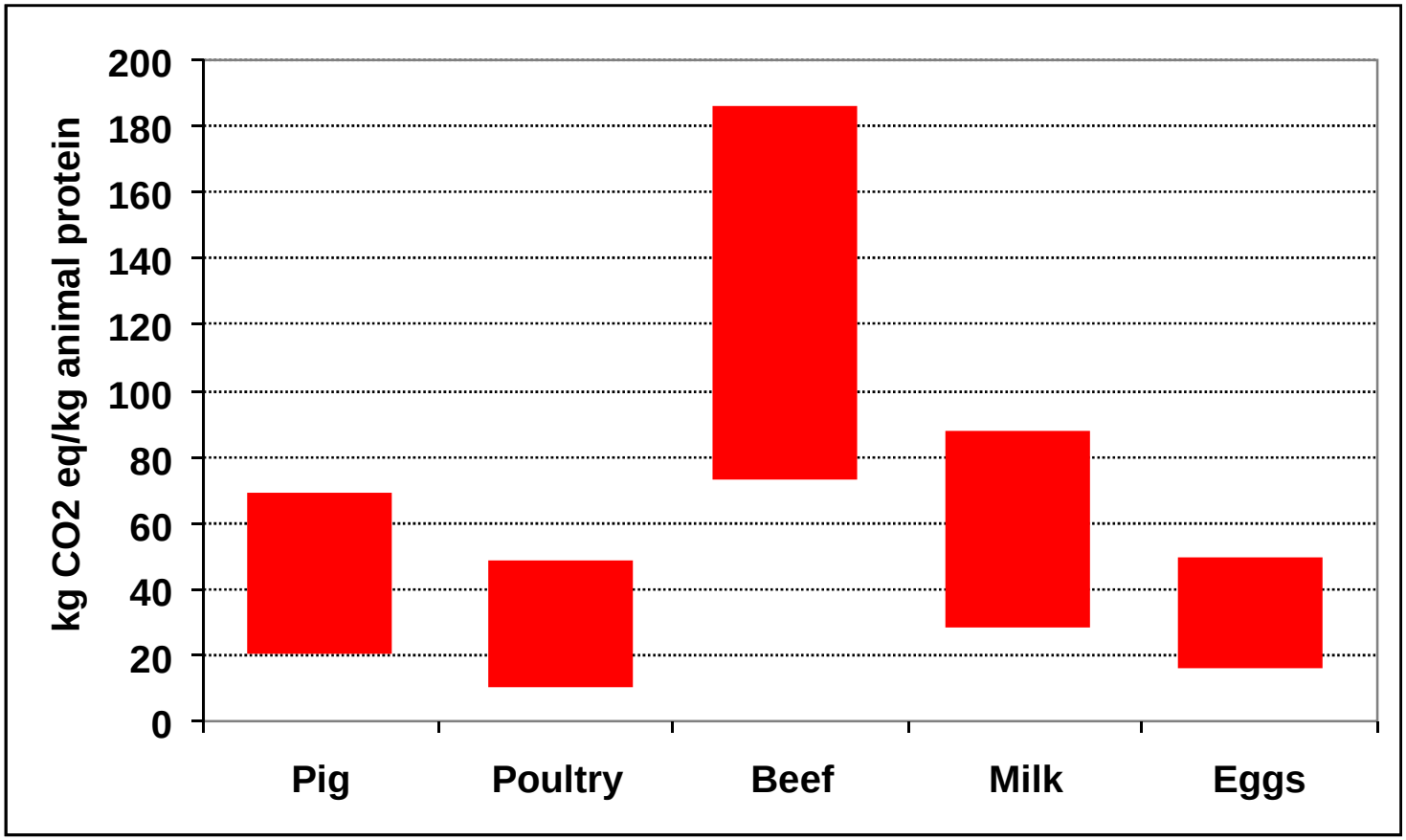
Table 5 Land-use emissions in 2000 and 2050 for the reference scenario and four dietary variants

	GtC eq.
2000	3.0
2050-Reference	3.3
2050-NoRM	1.7
2050-NoM	1.5
2050-NoAP	1.1
2050-HDiet	2.1

Potentially difficult to implement

Stehfest et al. 2009. Climatic Change

Range of GHG intensities for commodities in OECD-countries



de Vries and de Boer (2009)

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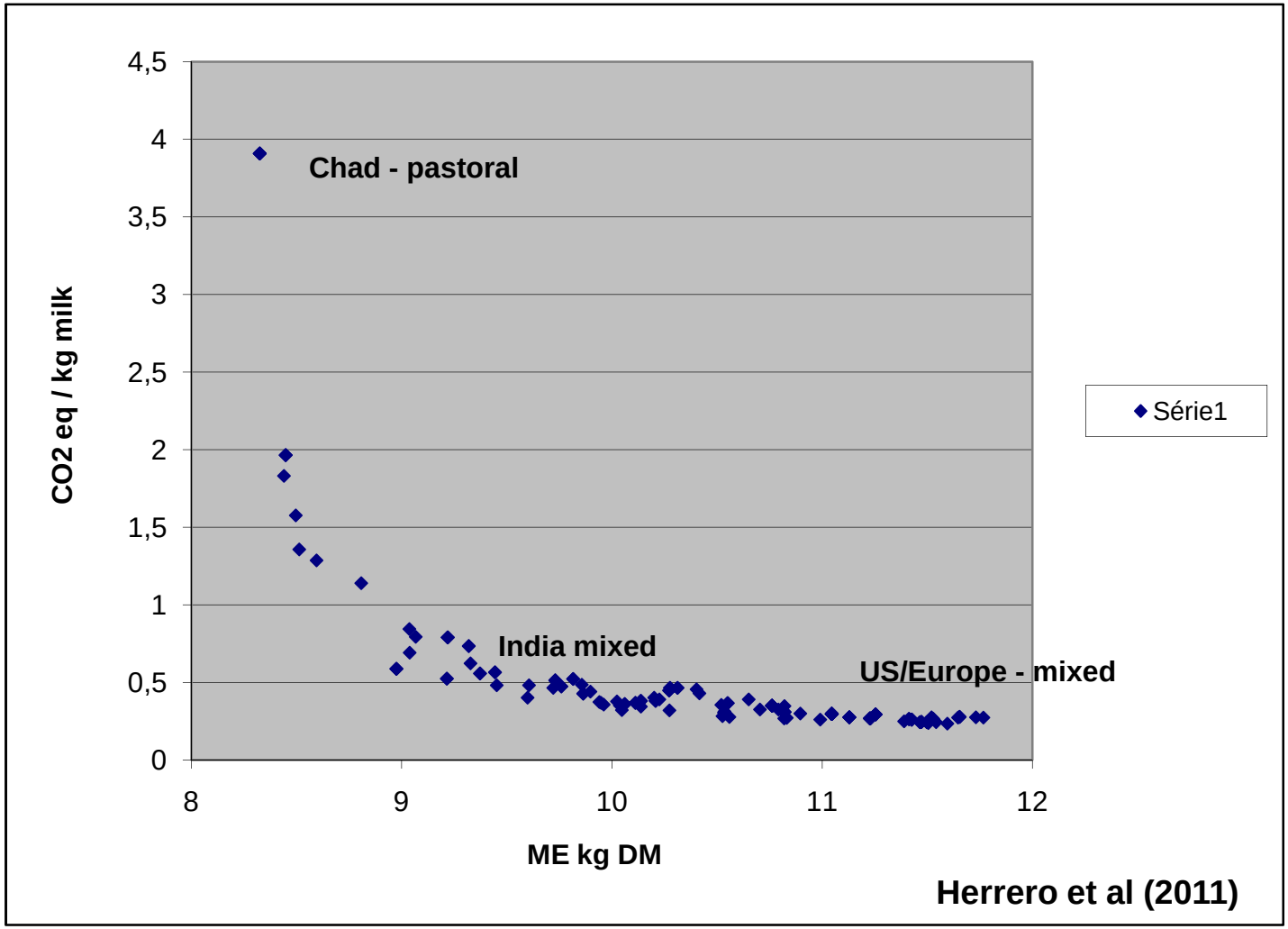
Less land needed
....but social and economic impacts?
....displacement of people?

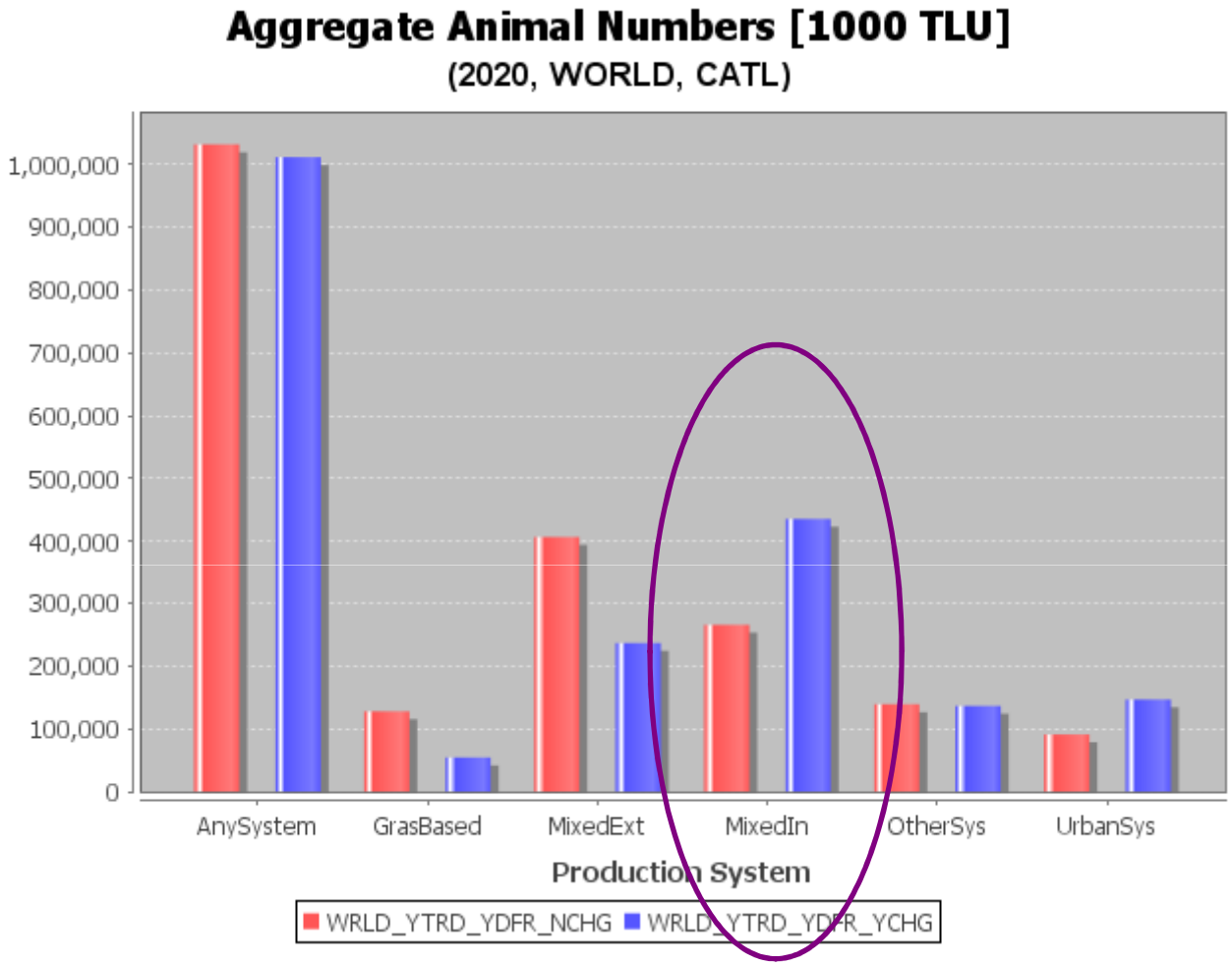
Stehfest et al. 2009. Climatic Change

Mitigation 101 – intensification is essential

The better we feed ruminants the less methane per kg of product they produce



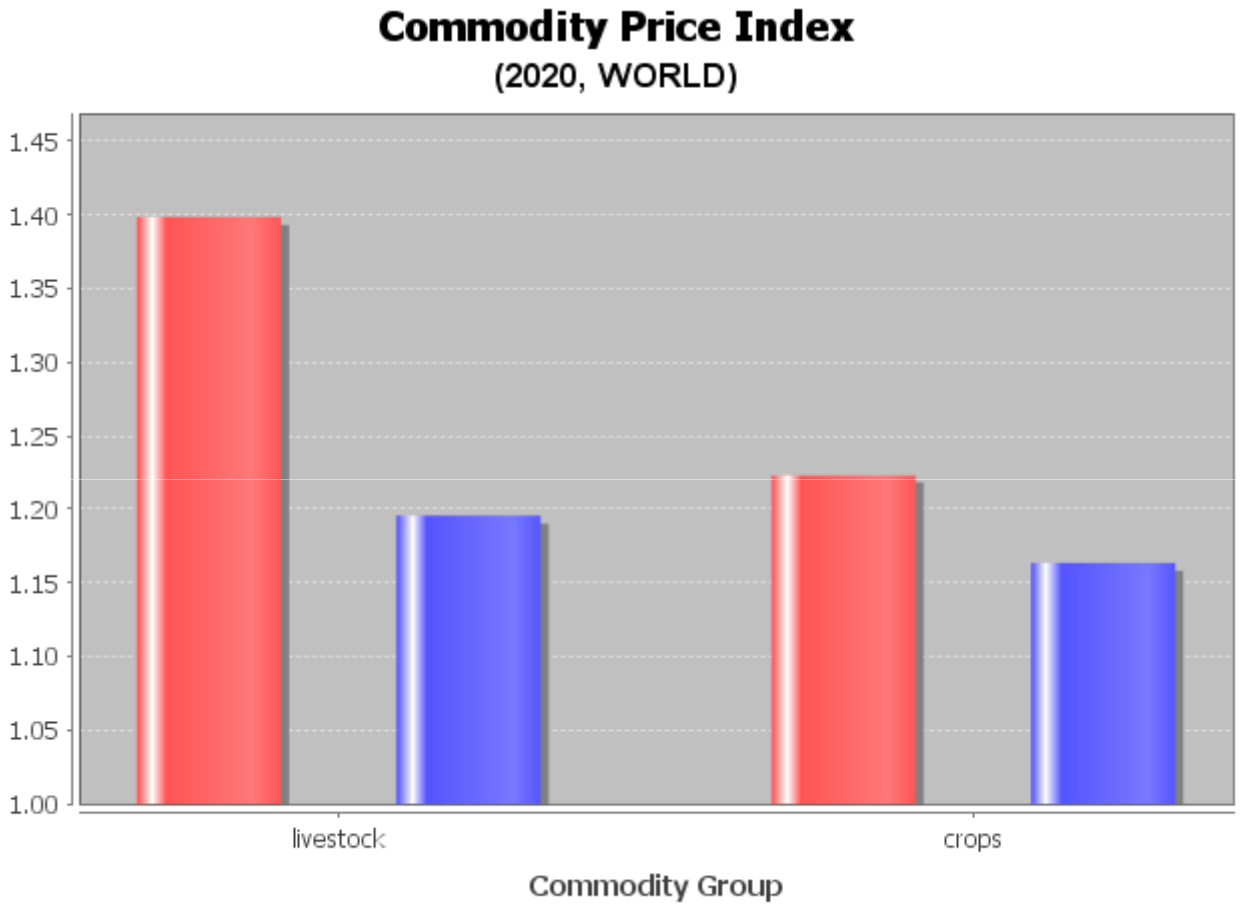
Production systems changes



STICKY x FLEXIBLE

IF system change possible → shift to intensive production systems

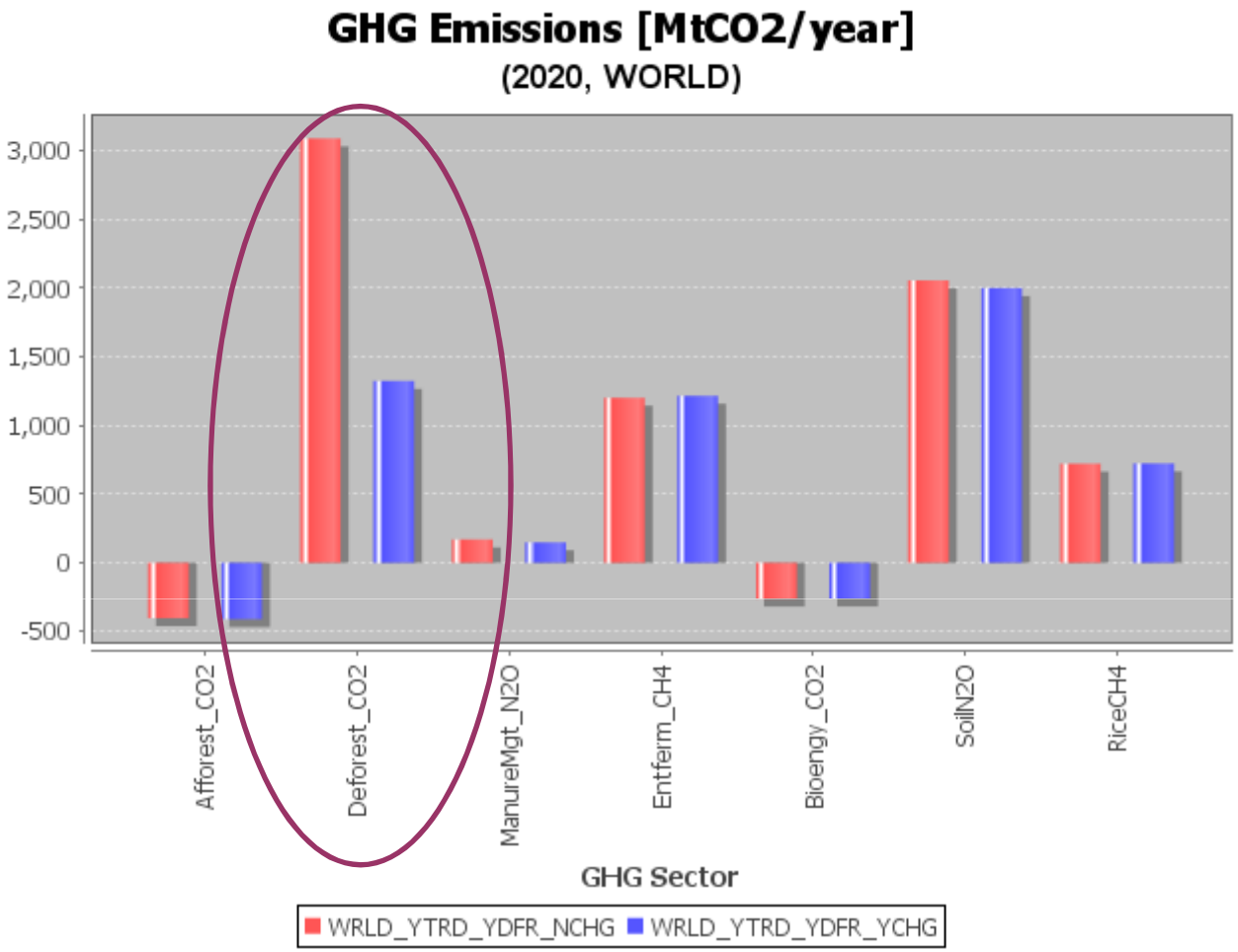
Havlik, Herrero, Obersteiner et al, COP15, 2009



STICKY x FLEXIBLE

Adjustments in production systems help to keep commodity prices low

Havlik, Herrero, Obersteiner et al, COP15, 2009



STICKY x FLEXIBLE

RED through livestock does not have negative effect on non-CO2 emissions.

Havlik, Herrero, Obersteiner et al, COP15, 2009

Can we tap the potential for carbon sequestration in rangeland systems?

Largest land use system

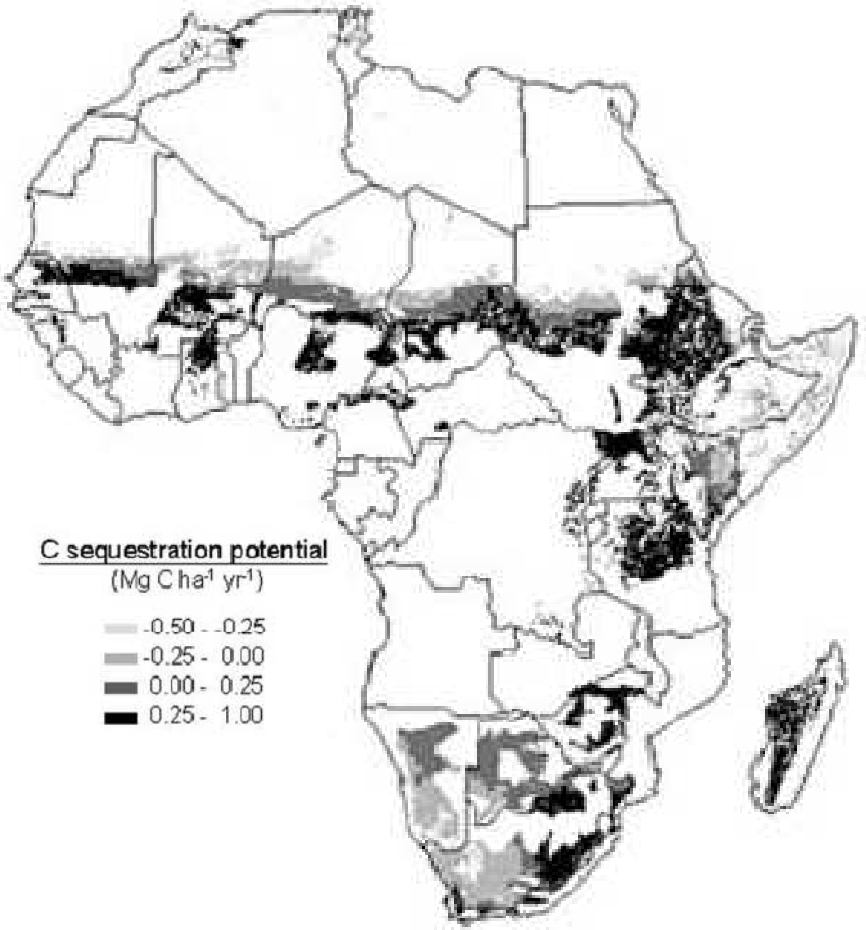
Potentially a large C sink

Could be an important income diversification source

Difficulties in:
Measuring and monitoring C stocks

Establishment of payment schemes

Dealing with mobile pastoralists



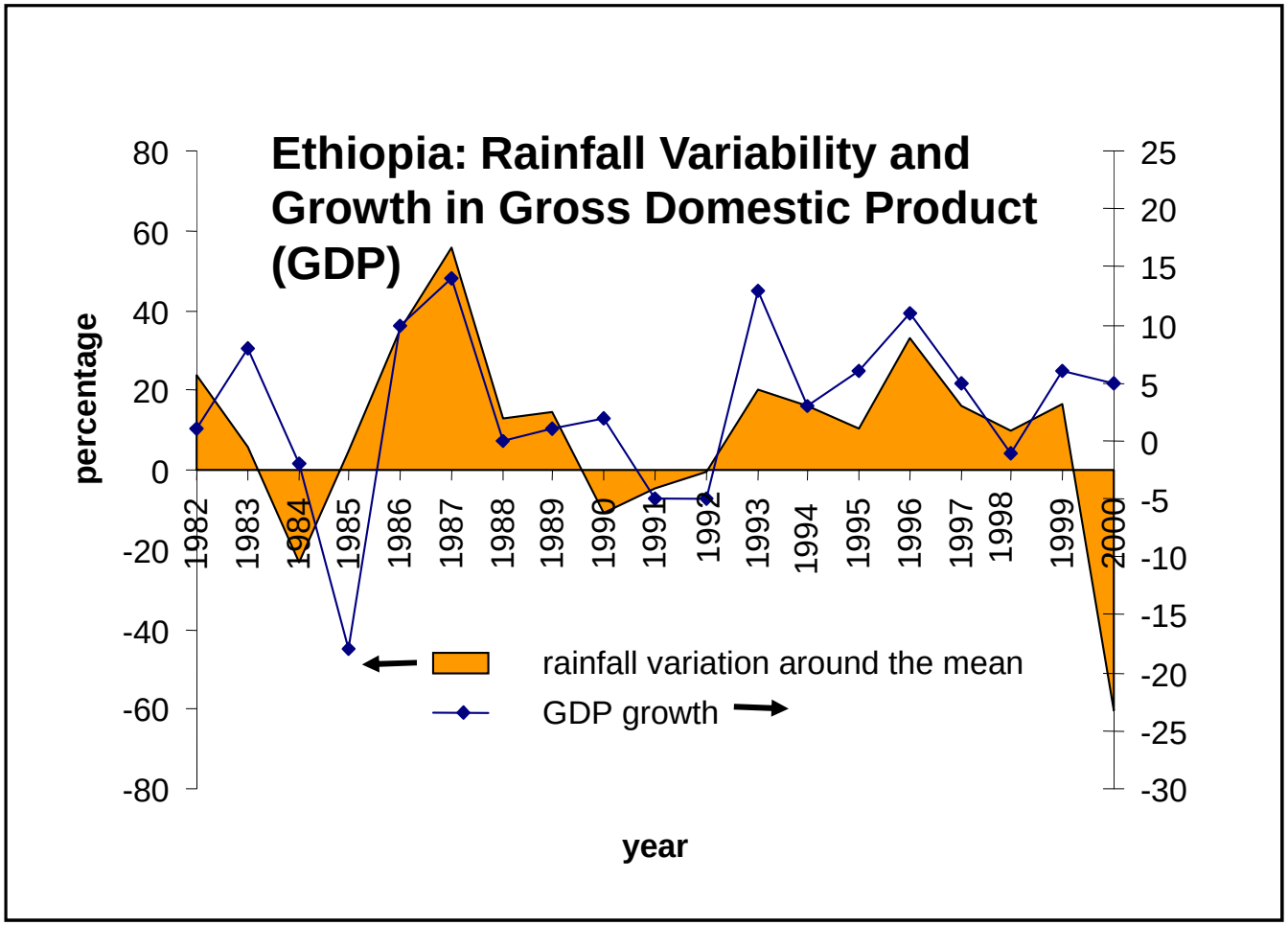
Potential for carbon sequestration in rangelands (Conant and Paustian 2002)

Impacts of climate change and adaptation of livestock systems

Message 3

The impacts of climate change on livestock systems could be severe in places

Why is climate change so important in developing countries?



de Jong (2005), World Bank (2005)

Impacts on livestock systems

- Feed availability and quality
- Disease distributions
- Impaired reproduction / increased mortality
- Rangeland species composition (grass/browse)
- Reduced productivity due to heat stress

There may be winners as well as losers …

Simulated percentage maize production changes to 2030 and 2050, by country and system

	National Production		Mixed rainfed temperate		Mixed rainfed humid		Mixed rainfed arid	
	2030	2050	2030	2050	2030	2050	2030	2050
Burundi	9	9	14	18	-2	-9	-	-
Kenya	15	18	33	46	-5	-10	-1	-8
Rwanda	11	15	13	19	5	4	1	3
Tanzania	-3	-8	7	9	-2	-6	-5	-11
Uganda	-2	-9	5	3	-5	-13	-1	-6

Mean of 4 combinations of GCM and emissions scenarios

Winners
Losers

Thornton et al. (2010)

Exposure: several thresholds

1 Length of growing period (LGP) declines by >5%

2 Flip from LGP > 120 days in the 2000s to LGP < 120 in the 2050s

3 Flip from Reliable Crop Growing Days per year > 90 days in the 2000s to RCGDs < 90 in the 2050s

4 Flip from an average annual temp < 8℃ in the 20 00s to Tav > 8℃ in the 2050s

5 Flip from an average annual maximum daily temp < 30℃ in the 2000s to Tmax > 30℃ in the 2050s

6 As above, but for the 150 days from the start of the primary growing season

7 Rainfall per rainday decreases by >10% to the 2050s

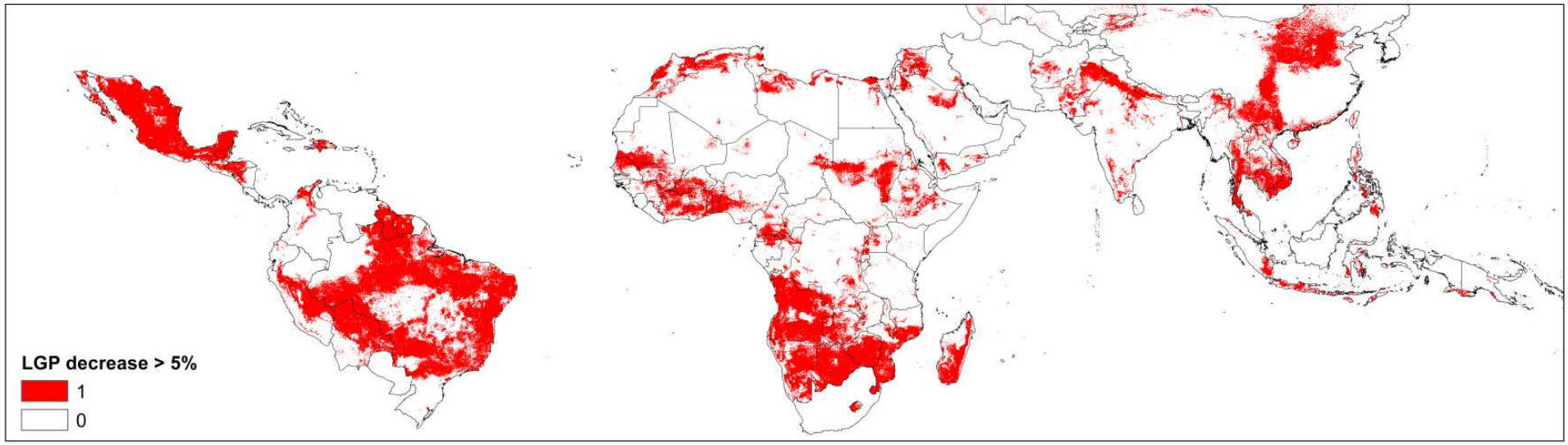
8 Rainfall per rainday increases by >10% to the 2050s

9 Areas in which current annual rainfall CV is >21%

Ericksen et al 2011

Exposure 1

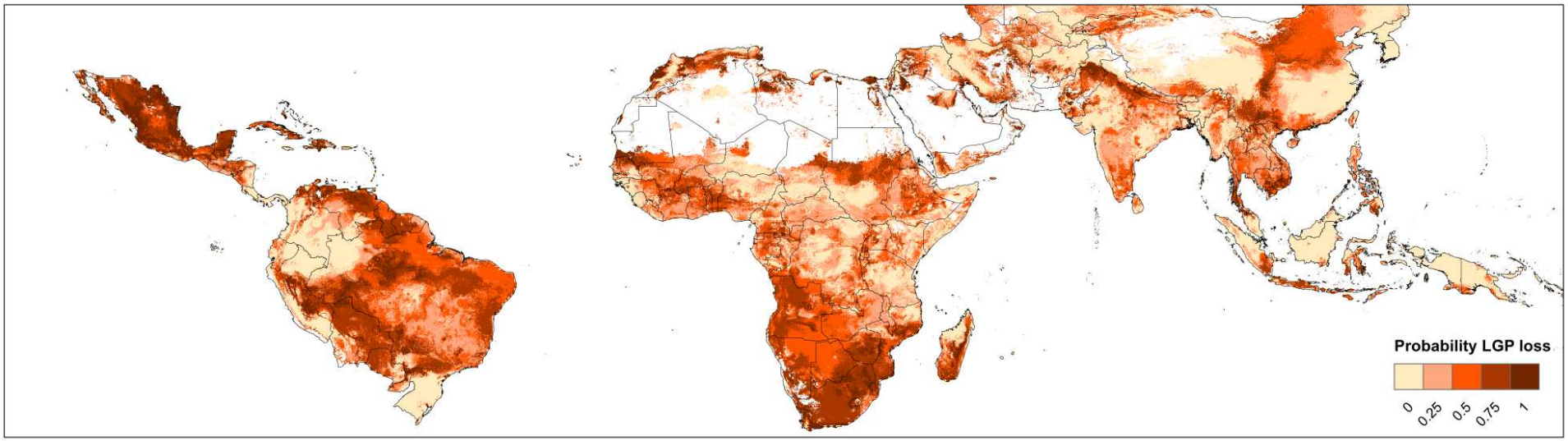
Areas in which the length of the growing period (LGP), days per year, is projected to decrease by 5% or more by the 2050s



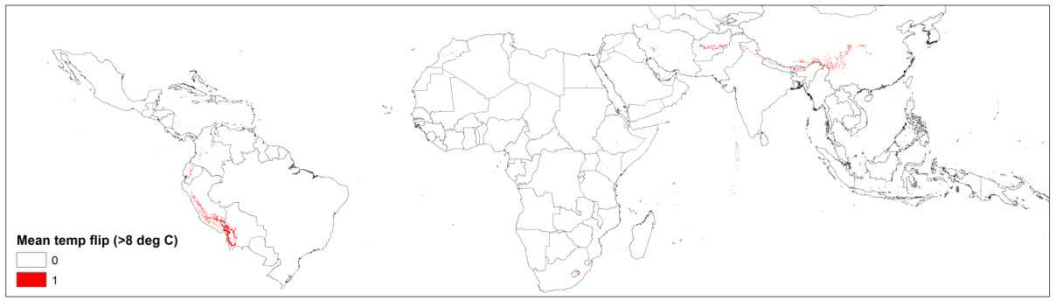
Exposure 1

Uncertainty

Probability of LGP declining by 5% or more by the 2050s (from an ensemble of 4 climate models)



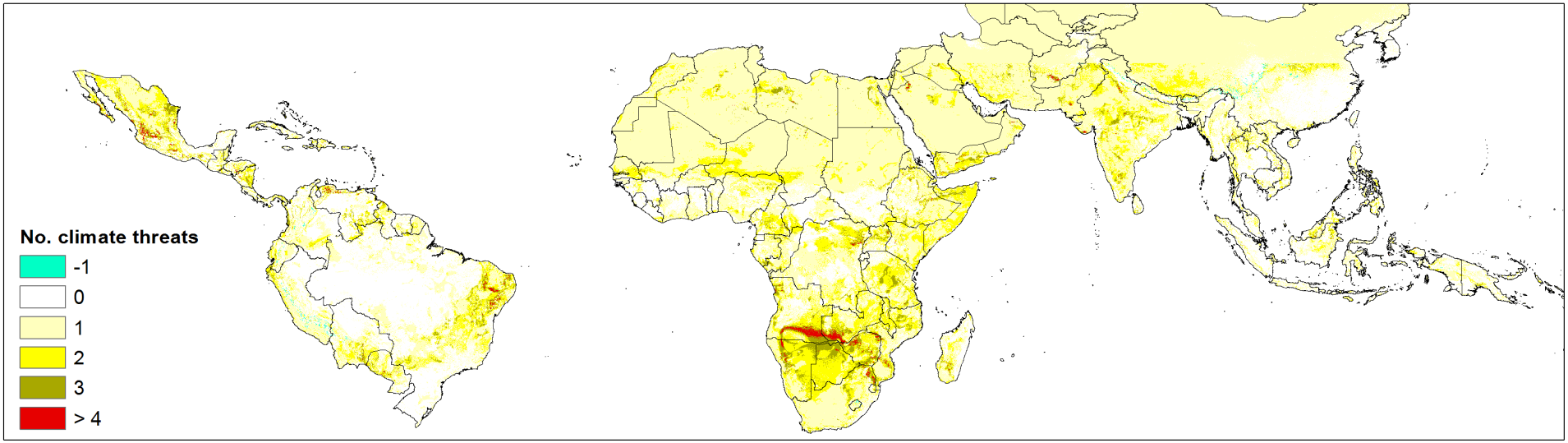
Multiple Exposures



Mapping the number of these 9 potential climate threats that apply in each pixel

Expanded crop suitability? Andes, parts of Central and highland South Asia, Southern China

For the positive temperature flip (from < 8 °C to > 8 °C), we reduced the number of threats by one



Message 4

Adaptation options exist, at different costs, and for different systems

...all require mixtures of technology, policies and incentives

Are there effective adaptation options?

- Dependent on different pathways of development and how these play out in different regions: scenarios, uncertainty
- Different views of agricultural development (industrial vs pro-poor smallholders, large vs family farms)
- Globalisation, trade patterns, consumption patterns
- Carbon constraints
- Technology development, roles and incentives for technology adoption

What are the options?

- Sustainable intensification / extensification
- Income / livelihood diversification
- Better risk management
- More transformative change (e.g. exit from agriculture)

All require a mixture of technology & supporting policies and investments

No single path best: mixtures of these required in different parts of the world

Different ways to manage risk: from cows to camels

- **Northern Kenya: reduction in cattle numbers and adoption of camels widespread**

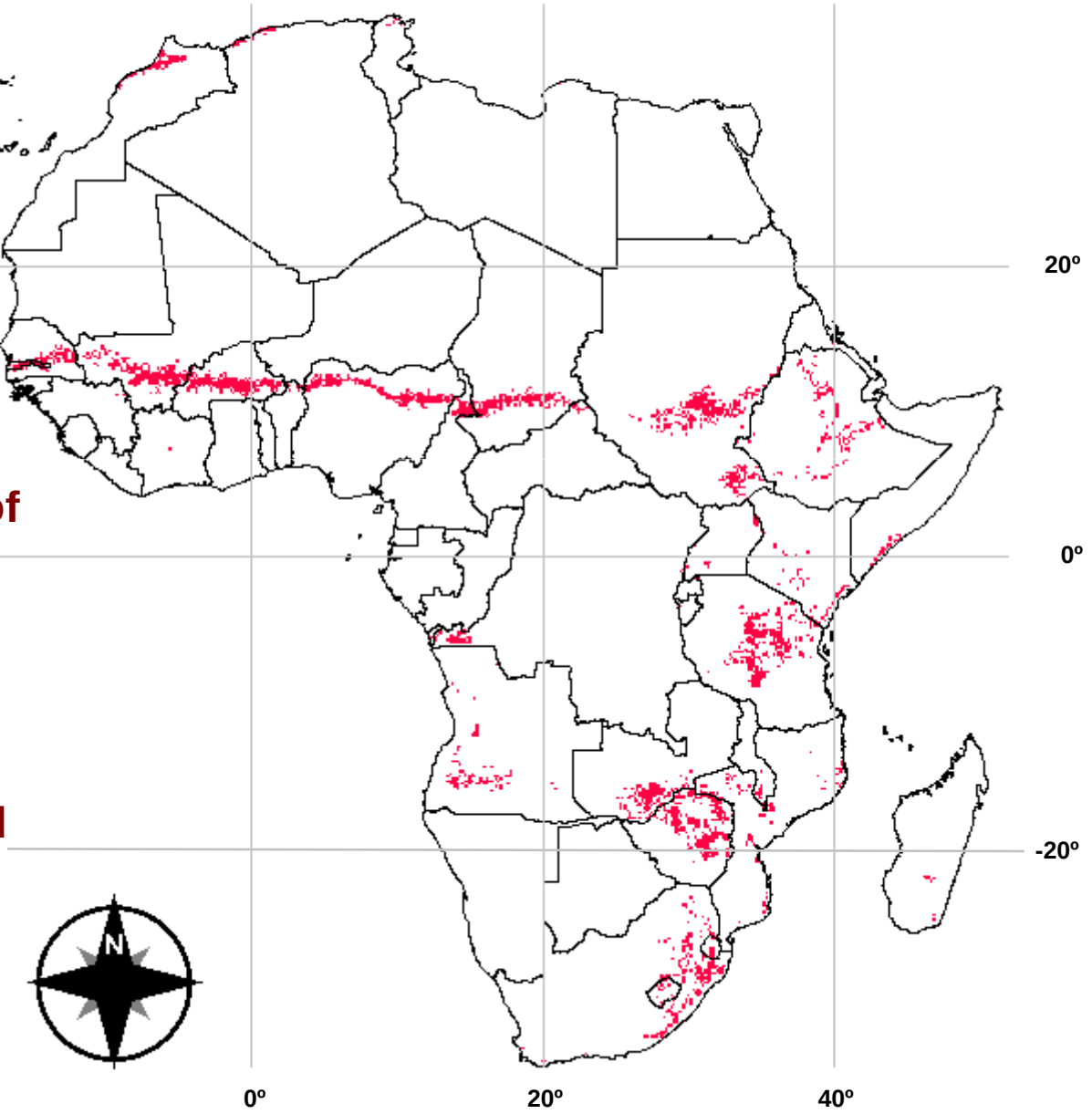
- **Lower mortality, more milk = more food and income security**

- **Healthier children (reduced infant mortality)**

- **Government supported programmes**

An example of climate-induced livelihood transitions

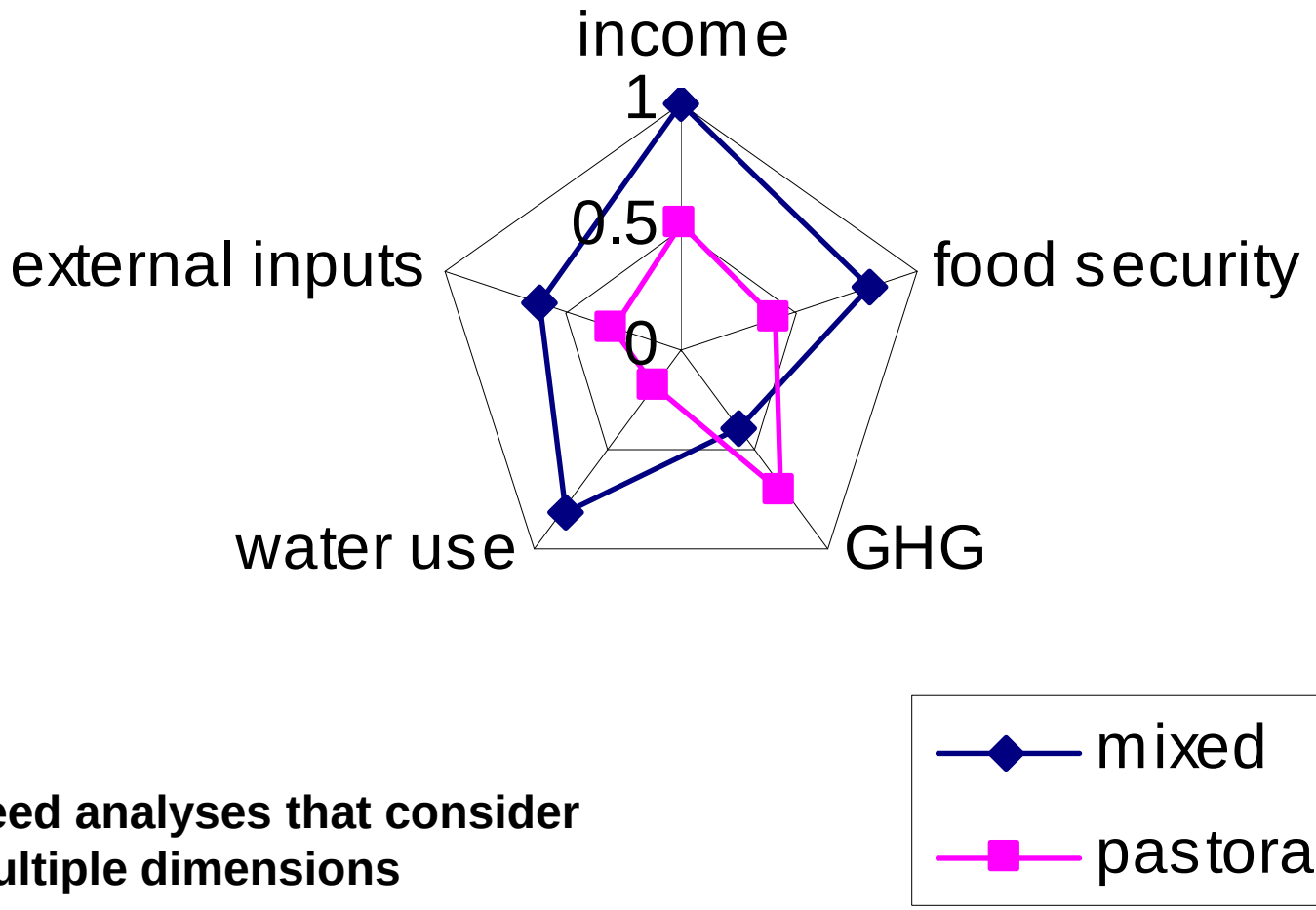
Areas where cropping of an indicator cereal may become unviable between now and 2050 and where farmers may have to rely more on livestock as a livelihood strategy



Jones & Thornton (2008)

Message 5

There are always trade-offs and synergies



Need analyses that consider multiple dimensions

Concluding remarks

- Livestock's contribution to climate change is significant
- But there is also a significant mitigation potential. Some options more simple than others and at different costs. Mixtures of these are likely to prevail
- The impacts of climate change on livestock systems can be severe, but these will vary widely from place to place
- Adaptation of options exist but there are no silver bullets. All will require a mixture of technology, policy, regulation and incentives
- Livestock and climate change interactions need to be studied using a range of dimensions, beyond environmental.
- Livelihoods and economic indicators also essential.

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