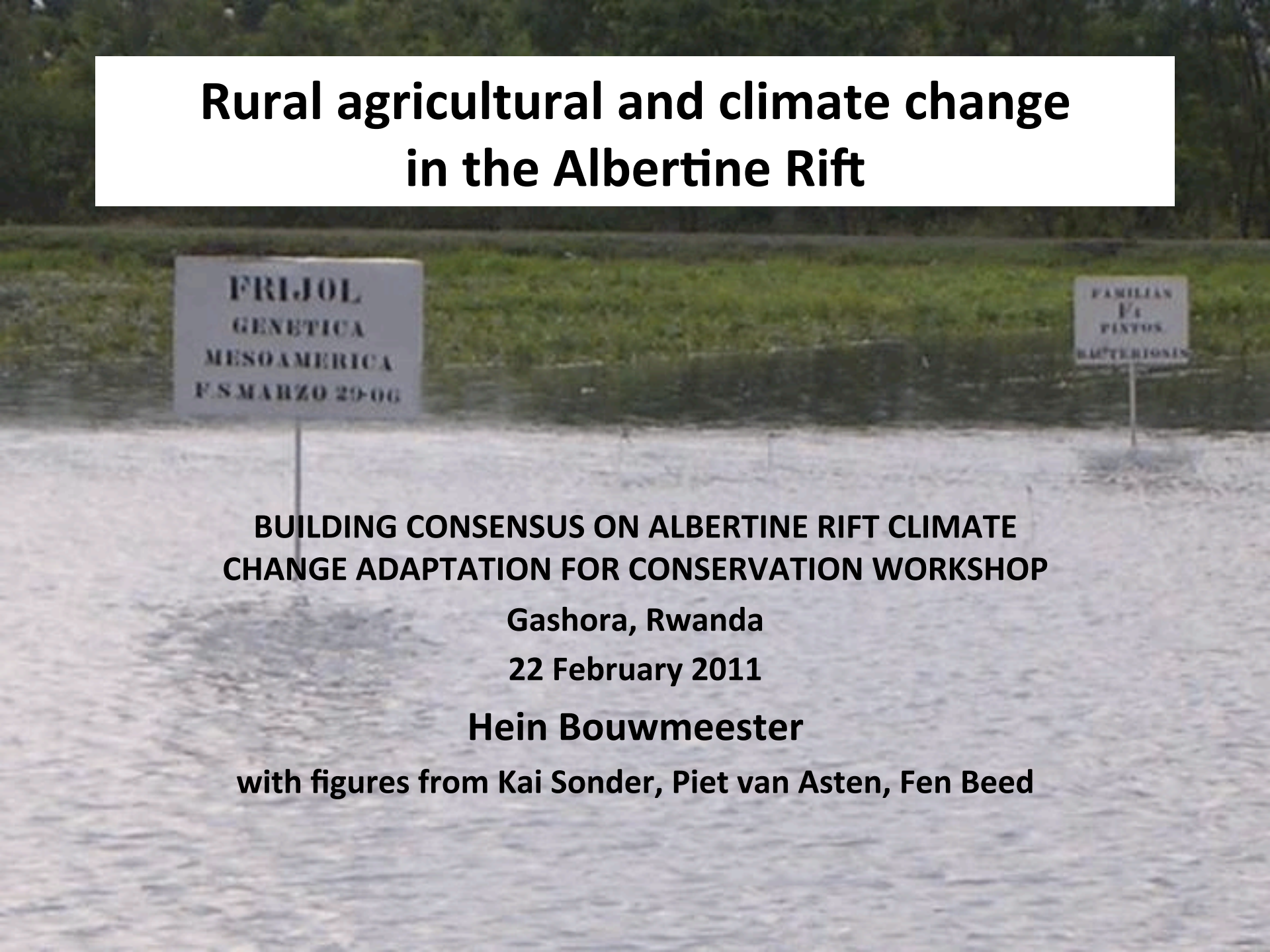
Rural agricultural and climate change in the Albertine Rift



BUILDING CONSENSUS ON ALBERTINE RIFT CLIMATE CHANGE ADAPTATION FOR CONSERVATION WORKSHOP

Gashora, Rwanda

22 February 2011

Hein Bouwmeester

with figures from Kai Sonder, Piet van Asten, Fen Beed

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Contents:

1. Climate change definition
2. Climate change and CGIAR
3. Climate change and IITA

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1 of 3
Climate change definition

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Global Climate Models
General Circulation Models

- CM1
- BCM2.0
- CGCM3
- CM3
- Mk3.0
- ECHAM5-OM
- ECHO-G
- FGOALS-g1.0
- CM2.1
- AOM
- E-H
- E-R
- CM3.0
- CM4
- MIROC3.2 hires
- CGCM2.3.2
- PCM
- CCSM3
- HadCM3
- HadGEM1
- SXG 2005

+ 40 scenarios

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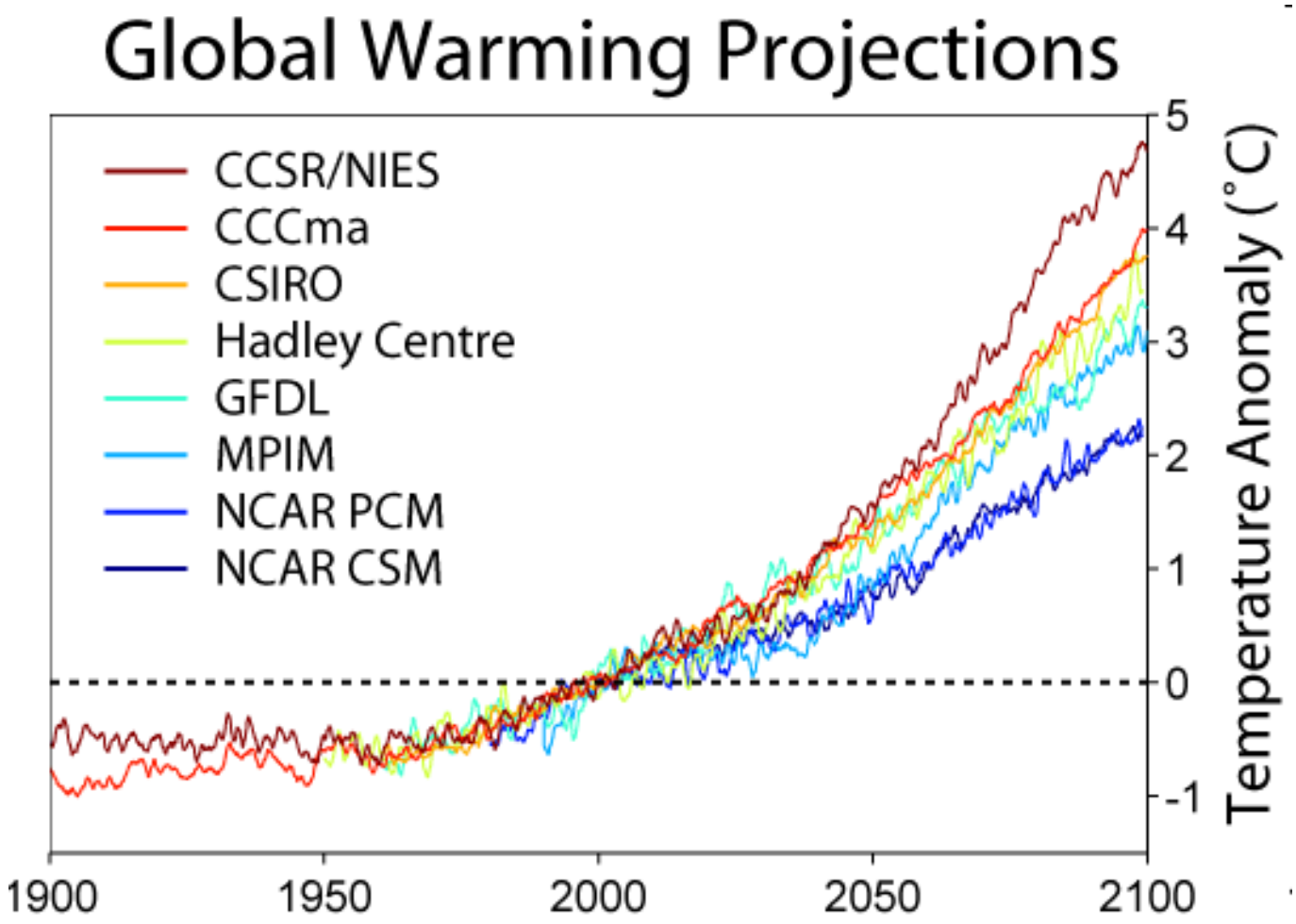
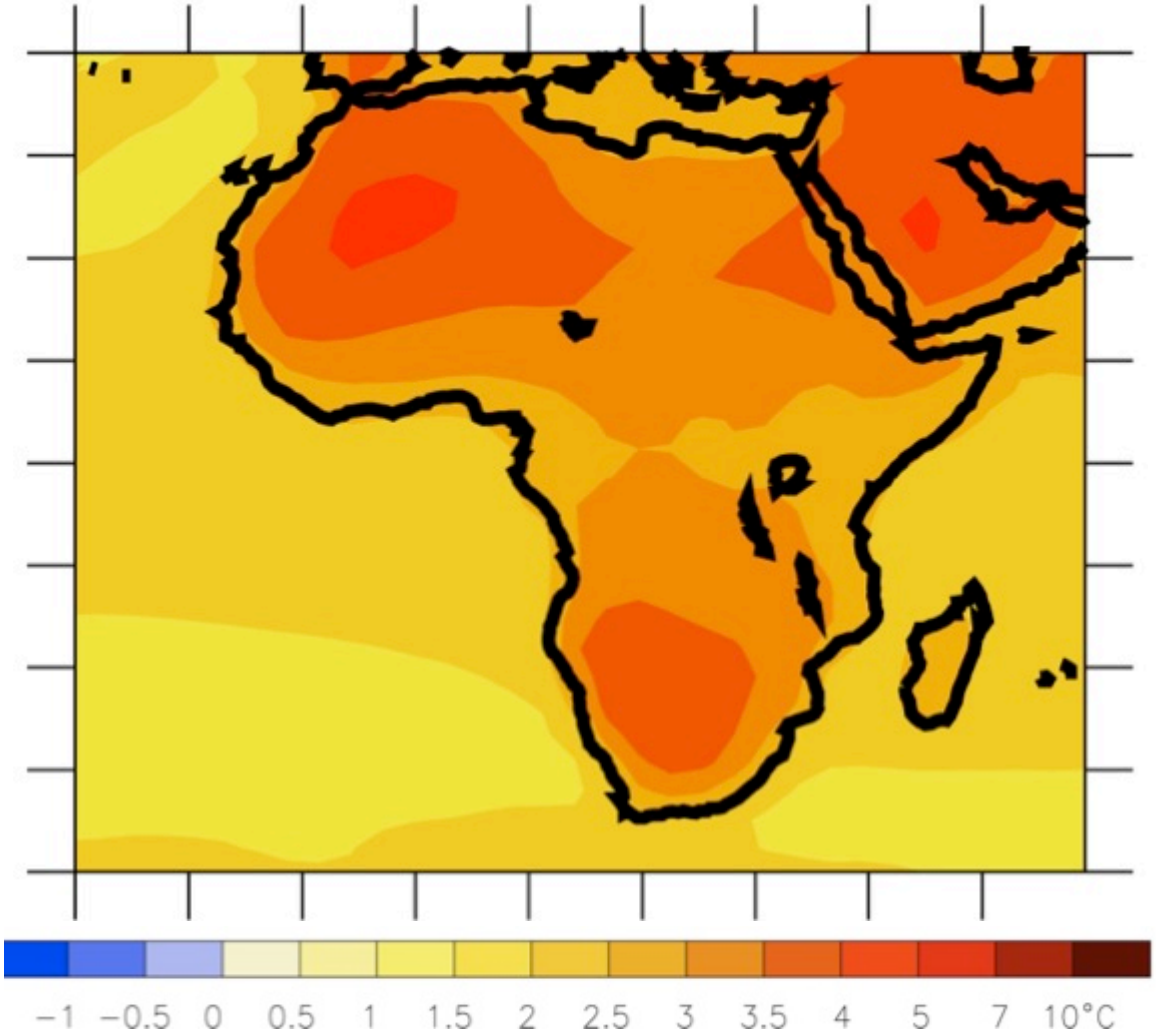
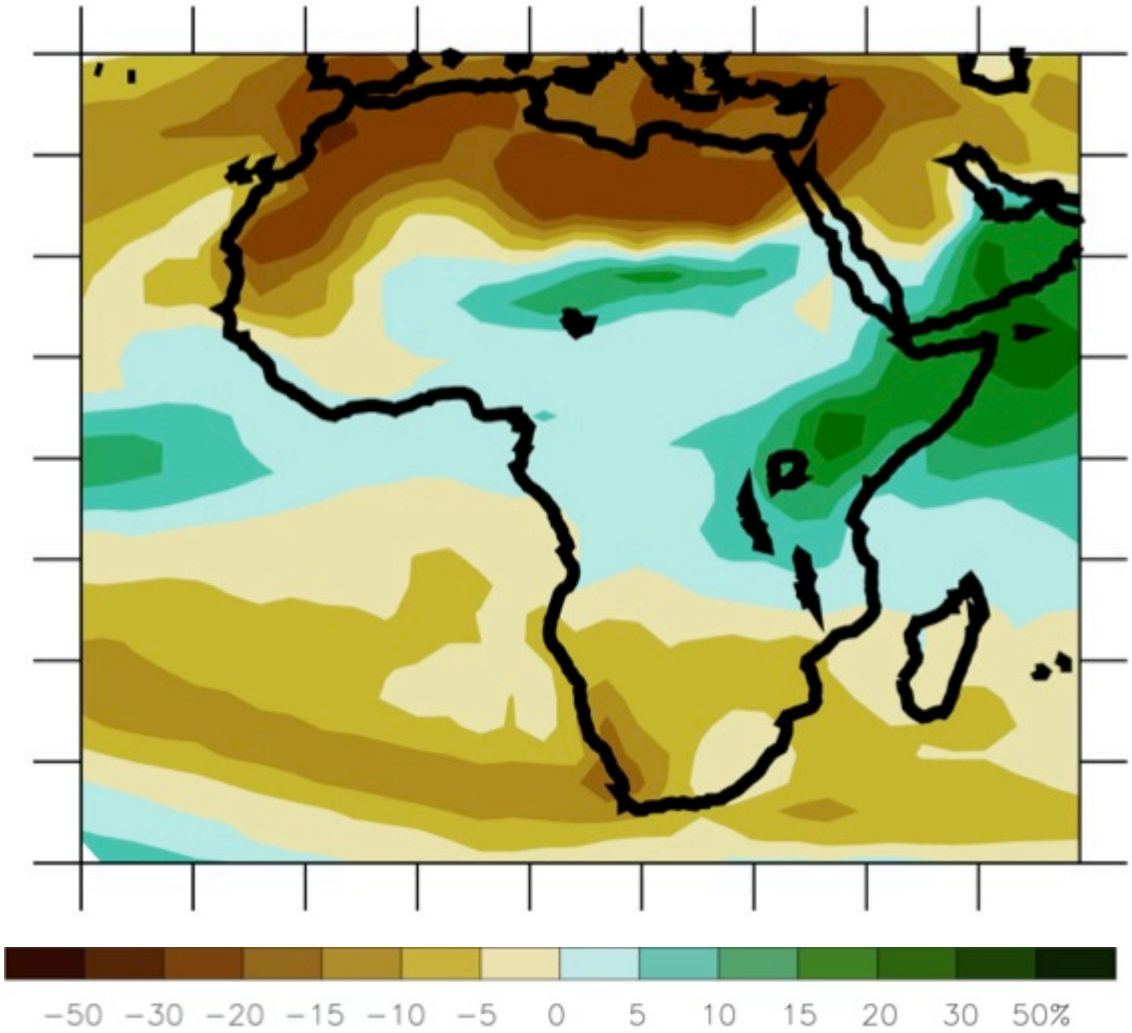
Global Warming Projections



IPCC AR4 Working Group 1, 2007



Predicted temperature change for Africa 2100 (mean of 21 models)
IPCC AR4 Working Group 1, 2007



Predicted rainfall change for Africa 2100 (mean of 21 models)
IPCC AR4 Working Group 1 (2007)

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2 of 3
Climate change and CGIAR

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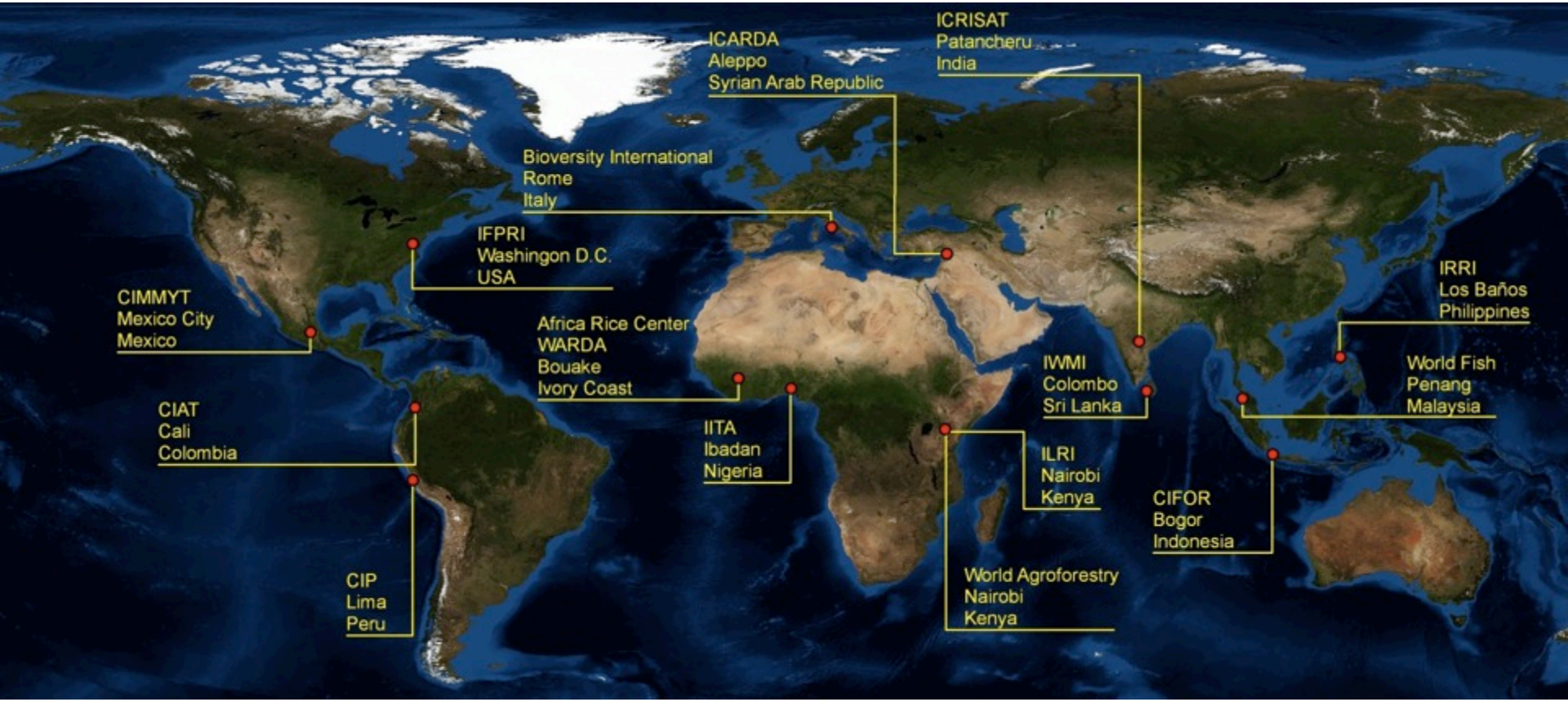
CGIAR = Consultative Group for International Agricultural Research



Agriculture suffers from climate change

Climate change has far-reaching consequences for agriculture

(and will disproportionately affect poor and marginalized groups who depend on (rainfed) agriculture for their livelihoods and have a lower capacity to adapt. In Burundi agricultural production accounts for 35% of GDP and involves more than 90% of the population (source: CIA, 2009). Rwanda is similarly dependent on agriculture.)

Climate change causes economic losses and undermines food security

(through crop failures, fishery collapses and livestock deaths)

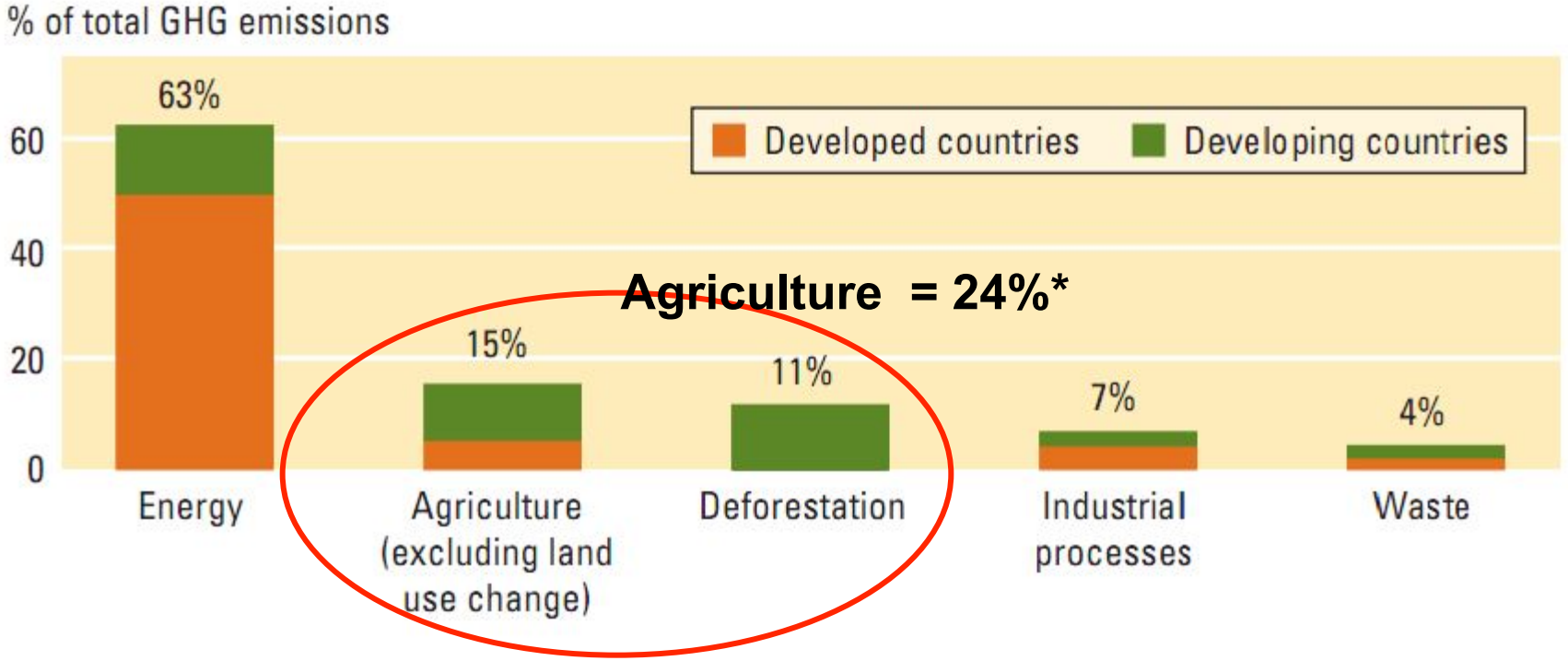
These effects are likely to become more severe as global warming continues.

Estimated costs of adapting to climate change in the agricultural sector > US$ 7 billion/yr
(Nelson et al., 2009: *Climate Change: Impact on Agriculture and Costs of Adaptation. Food Policy Report 19*)

Climate Change effects (on agriculture)

Increases in rainfall
Decreases in rainfall
Increase rainfall intensity (floods and erosion)
Increases in crop failures
Overall decreases in Length of Growing Period
Increases in temperature (pest and disease spread)
Increase in CO_2 pressure

Agriculture contributes to climate change



Source: WDR 2008 team, based on data from the United Nations Framework Convention on Climate Change, www.unfccc.int.

*Around 80% of deforestation can be attributed to agriculture

Agriculture faces challenges

In 2050 global population will likely be 9 billion

as a consequence

Food production may need to increase by 70% in 2050

Source: World Bank, 2007: Population Issues in the 21st Century: The Role of the World Bank. Health, Nutrition and Population Discussion Paper.

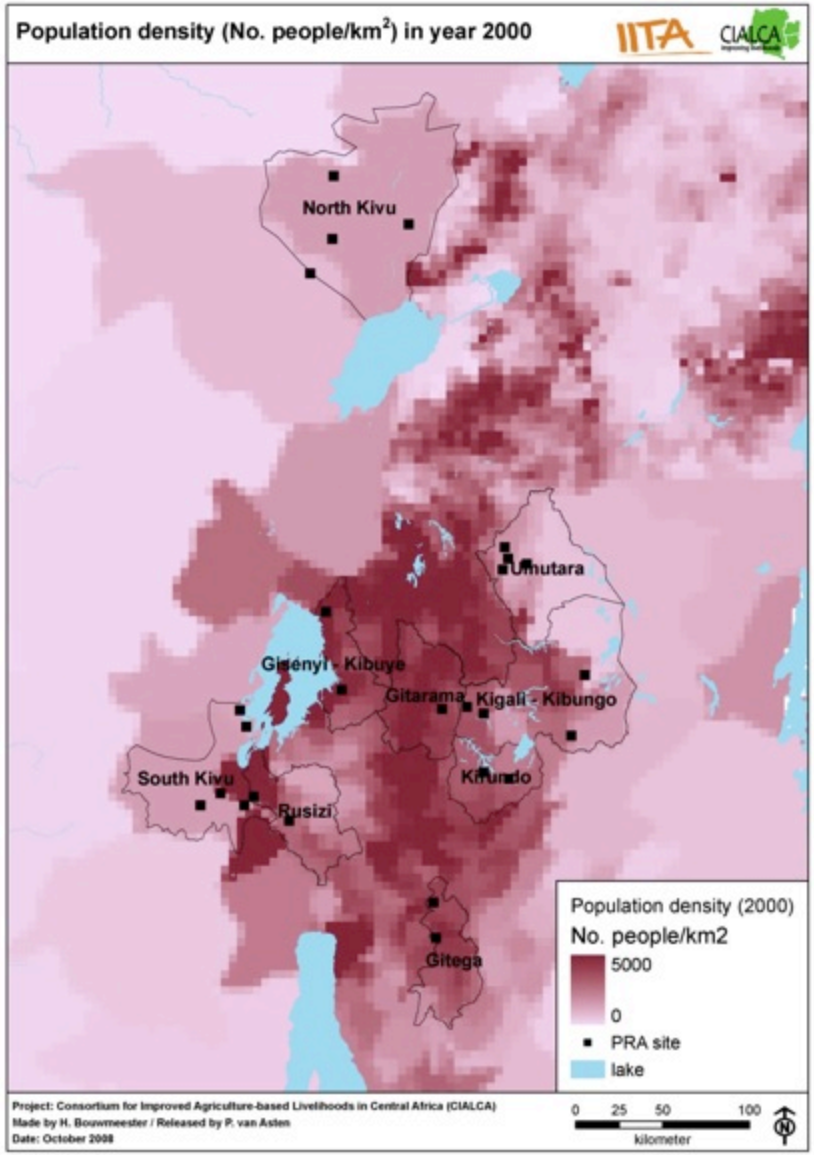
Crop yields are expected to decrease by 10-20% in Africa by 2050 , locally much more

Source: Thornton et al., 2009: Spatial variation of crop yields response to climate change in East Africa. Global Environmental Change 19, 54-65.

Agriculture faces challenges

Population Pressure

	Population mid-2008 (millions)	Population mid–2050 (millions)	Projected Population Change	Total Fertilty Rate
Burundi	**8.9**	**28.3**	**220**	**6.8**
DRC	**66.5**	**189.3**	**185**	**6.5**
Rwanda	**9.6**	**21.7**	**126**	**6**
Tanzania	**40.2**	**82.5**	**105**	**5.3**
Uganda	**29.2**	**106**	**263**	**6.7**



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Production = Yield x Area

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Proposal for

CGIAR Research Program 7:

Climate Change, Agriculture and Food Security (CCAFS)

Lead Center: Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture – CIAT)

January 2011

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Proposal for

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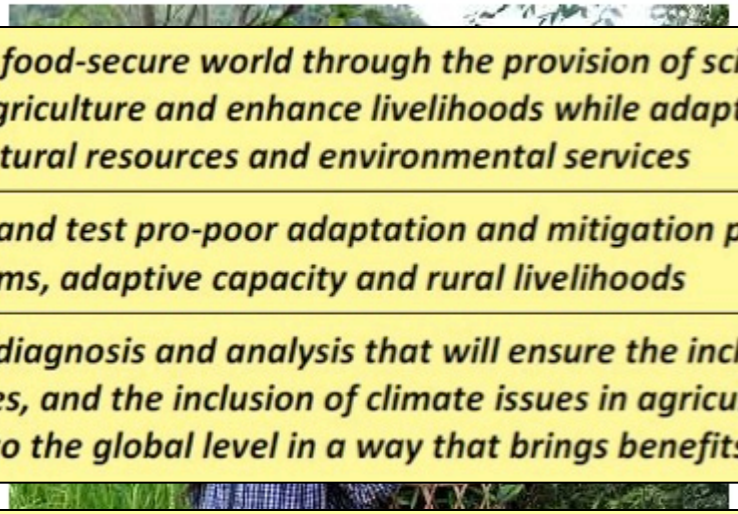

CRP7 Goal	*To promote a food-secure world through the provision of science-based efforts that support sustainable agriculture and enhance livelihoods while adapting to climate change and conserving natural resources and environmental services*
CRP7 Sub-goals	*1. To identify and test pro-poor adaptation and mitigation practices, technologies and policies for food systems, adaptive capacity and rural livelihoods*
	2. To provide diagnosis and analysis that will ensure the inclusion of agriculture in climate change policies, and the inclusion of climate issues in agricultural policies, from the sub-national to the global level in a way that brings benefits to the rural poor

Budget: USD 392.5 million for period 2011 to 2015
(worldwide for all CG centers combined)

Lead Center: Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture – CIAT)

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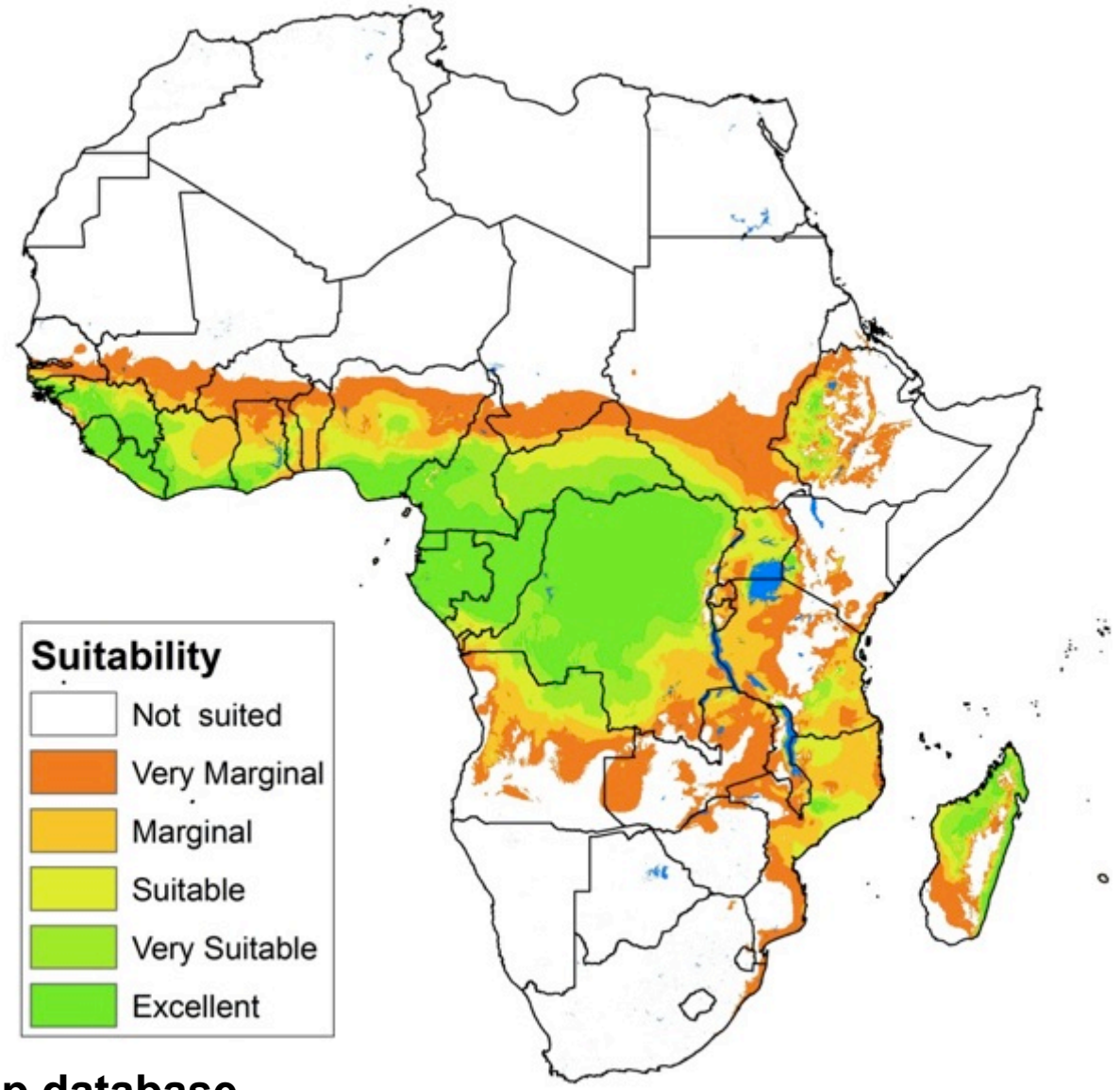
3 of 3
Climate change and IITA

Climate Change and IITA

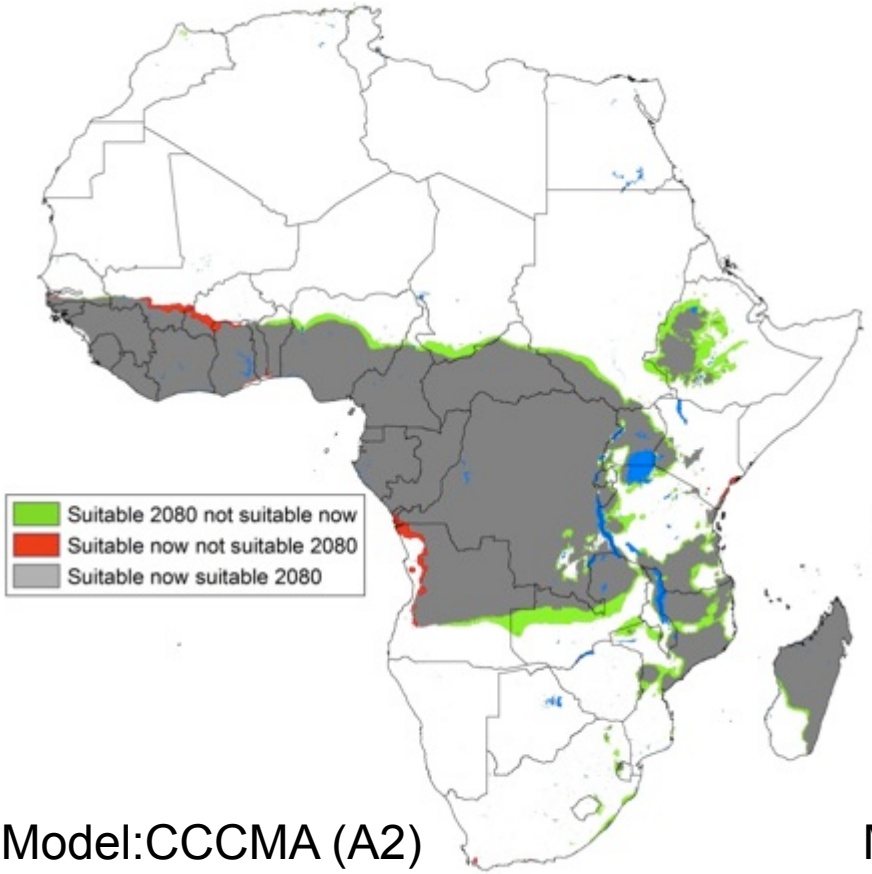
1. Crop suitability modelling (for targeting and identification)
2. Review impact of climate change
3. Development of drought tolerant crop varieties and seeds (maize, cowpeas, soybeans, cassava, yams, banana)
4. Improvement of farming systems (diversification, intercropping and agro forestry)
5. Researching pest-plant interactions

Changes in banana suitability

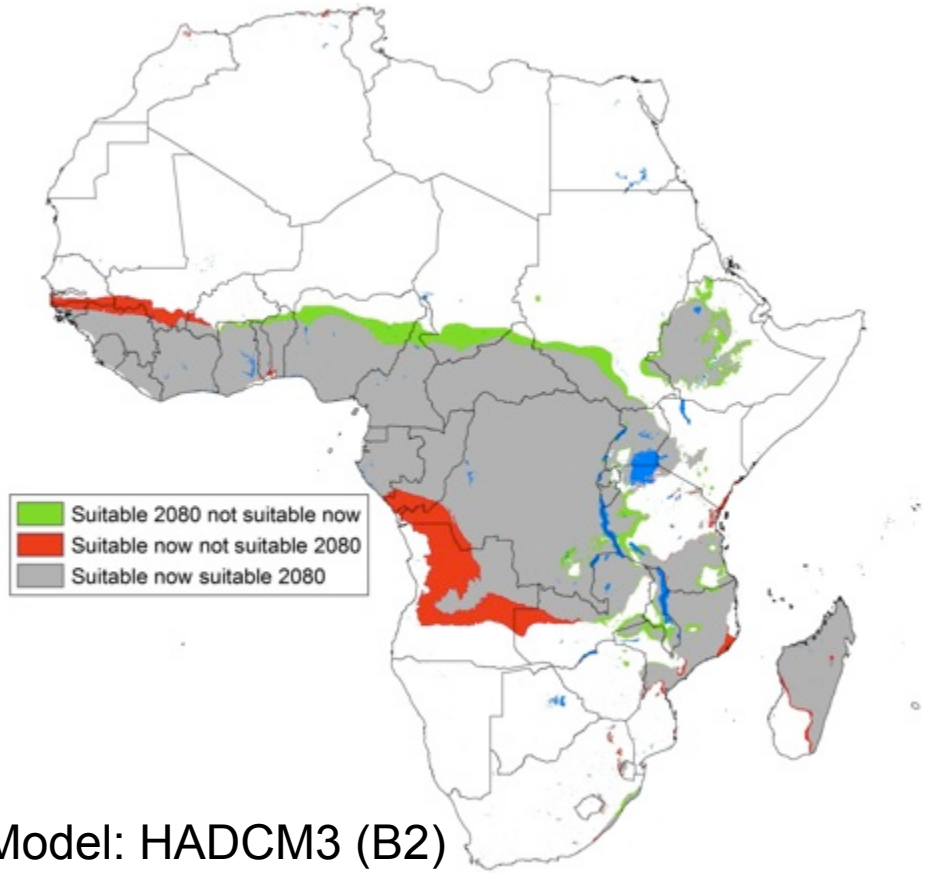


Source: FAO Ecocrop database

Relative changes in banana suitability



Model:CCCMA (A2)



Model: HADCM3 (B2)

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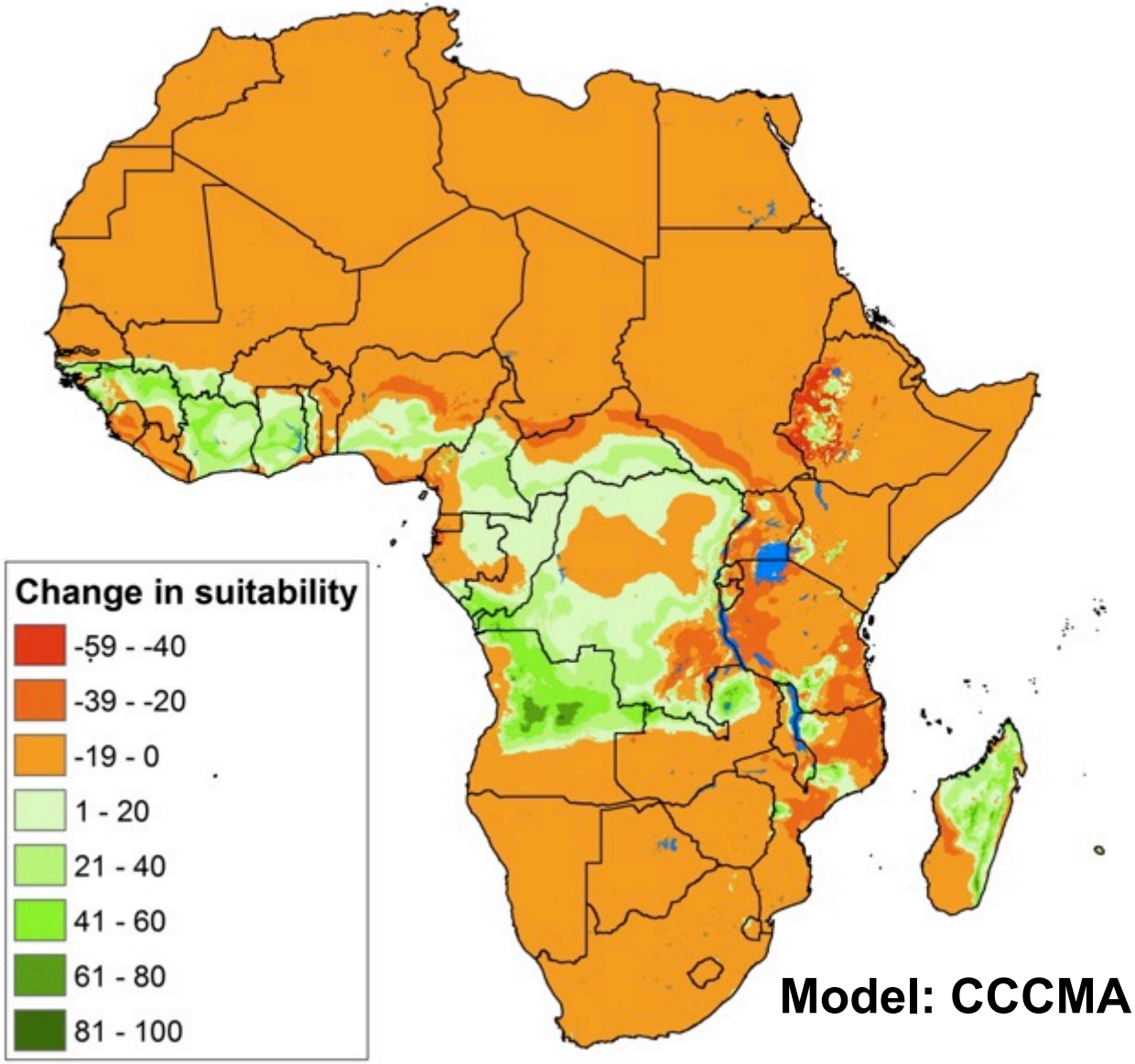
Banana suitability changes in 2080



Model: CCCMA (A2)

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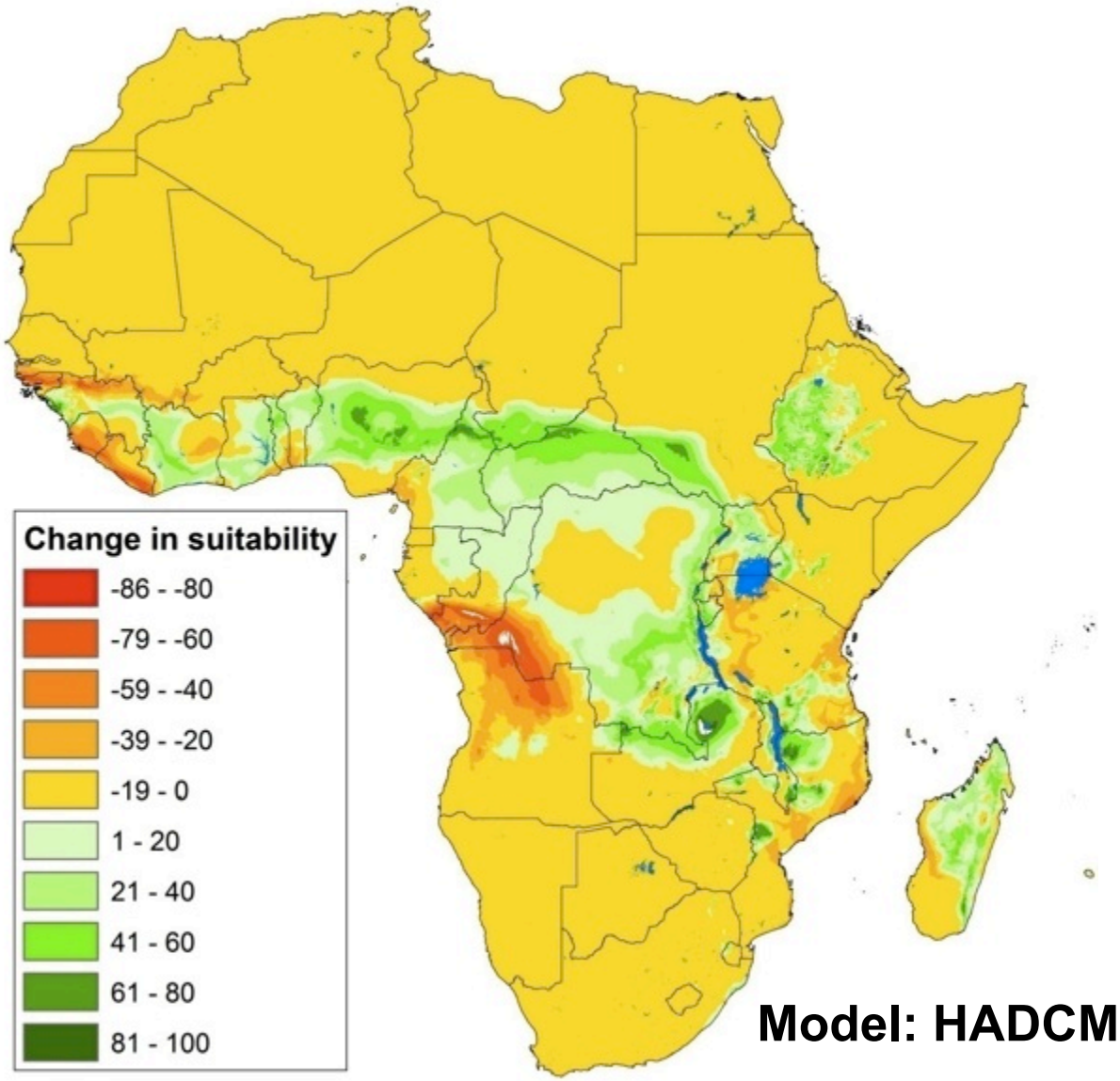
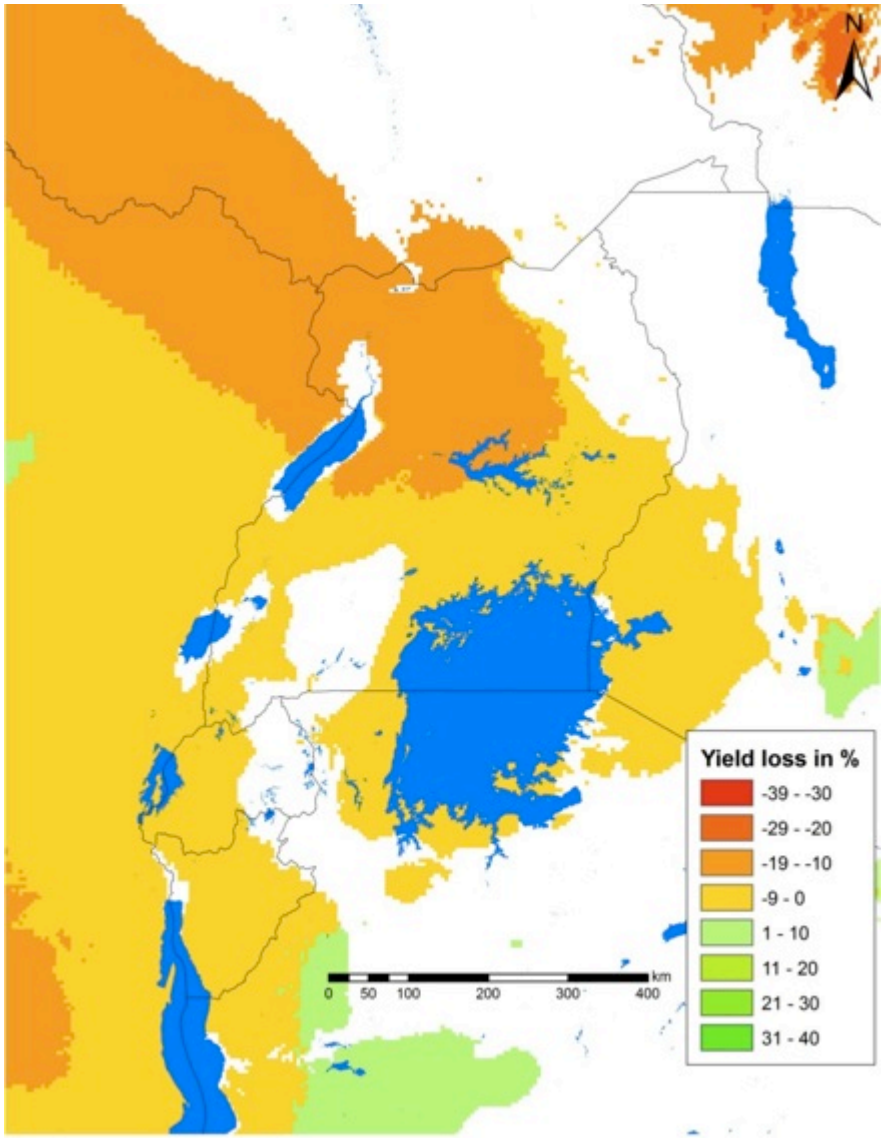
Banana suitability changes in 2080



Model: HADCM3 (B2)

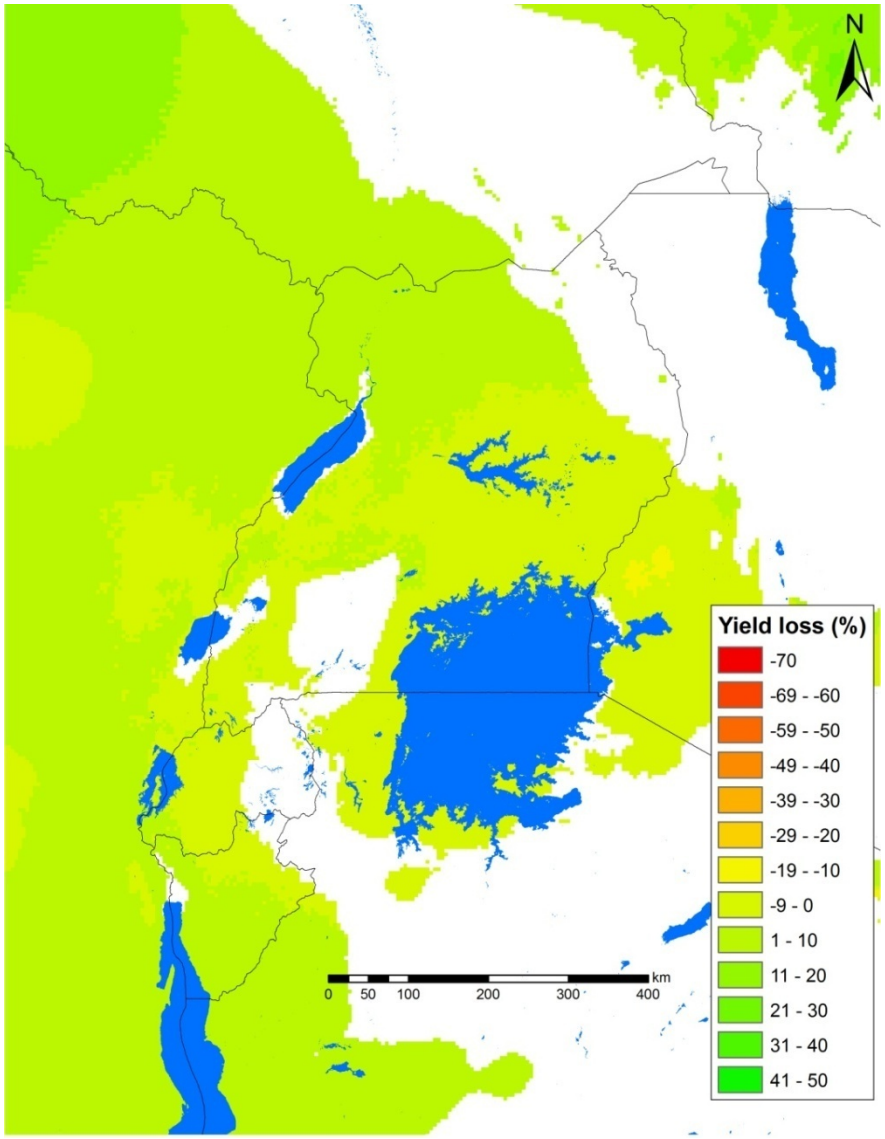
Banana yield reduction in 2080



Model: CCCMA (B2)

Data on yield rainfall relation
Van Asten et al.

Banana yield reduction in 2080



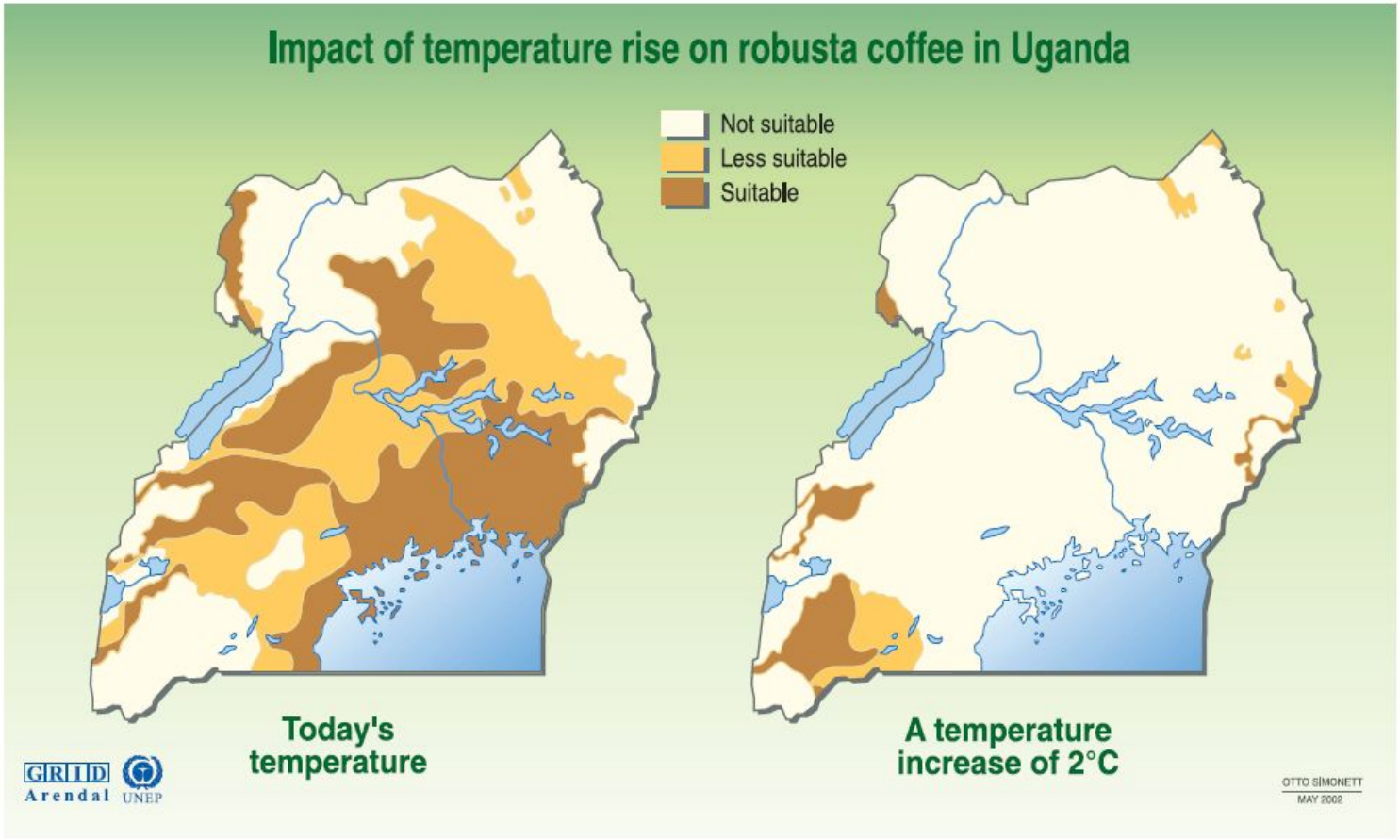
Model: HADCM3 (B2)

Data on yield rainfall relation
Van Asten et al.

Review impact of climate change

Planned research

Arabica coffee is widely grown in the great Lakes region. Current threshold levels are 1300-1400 m. Increases in temperature could devastate coffee production by increasing threshold altitudes.



Source: Otto Simonett, Potential impacts of global warming, GRID-Geneva, case studies on climatic change. Geneva, 1989.

Improvement of farming systems

Banana Coffee intercropping

Decrease farmer dependency on one crop
Increase of overall yields
Increase above and below ground Carbon storage (20%)
Increase firewood availability

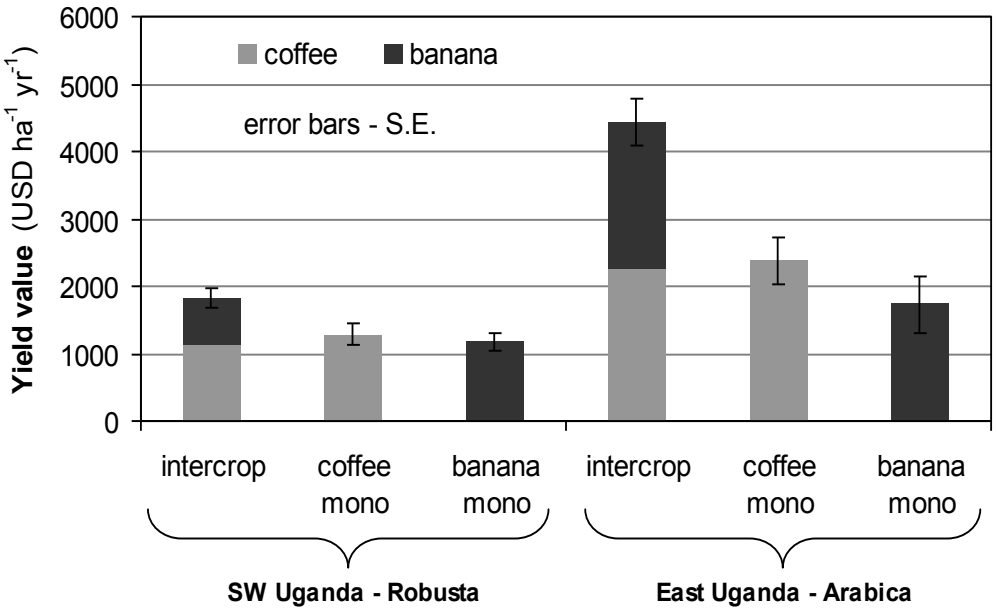


Figure 1: The total yield value of intercropped fields was much higher than monocropped coffee or banana in farmer control fields

Source: P. van Asten et al., 2011: Agronomic and economic benefits of coffee–banana intercropping in Uganda's smallholder farming systems.

Improvement of farming systems

Intensification of cocoa production through Agro forestry and 'Fertilizers for the Forest'

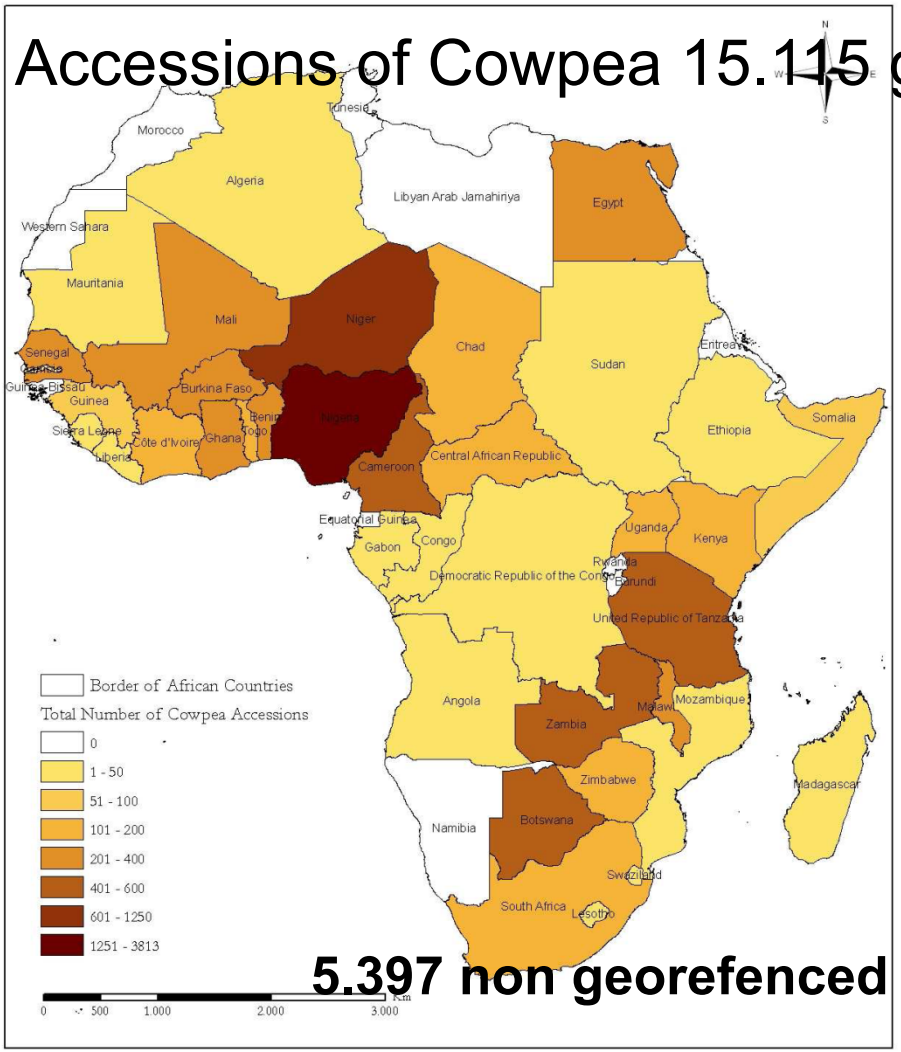
Increase of cocoa yields
Decrease deforestation
Increase above and below ground Carbon storage
Increase firewood availability

Novel farming systems needed to conserve the remaining 18% of the Guinean Rain Forest

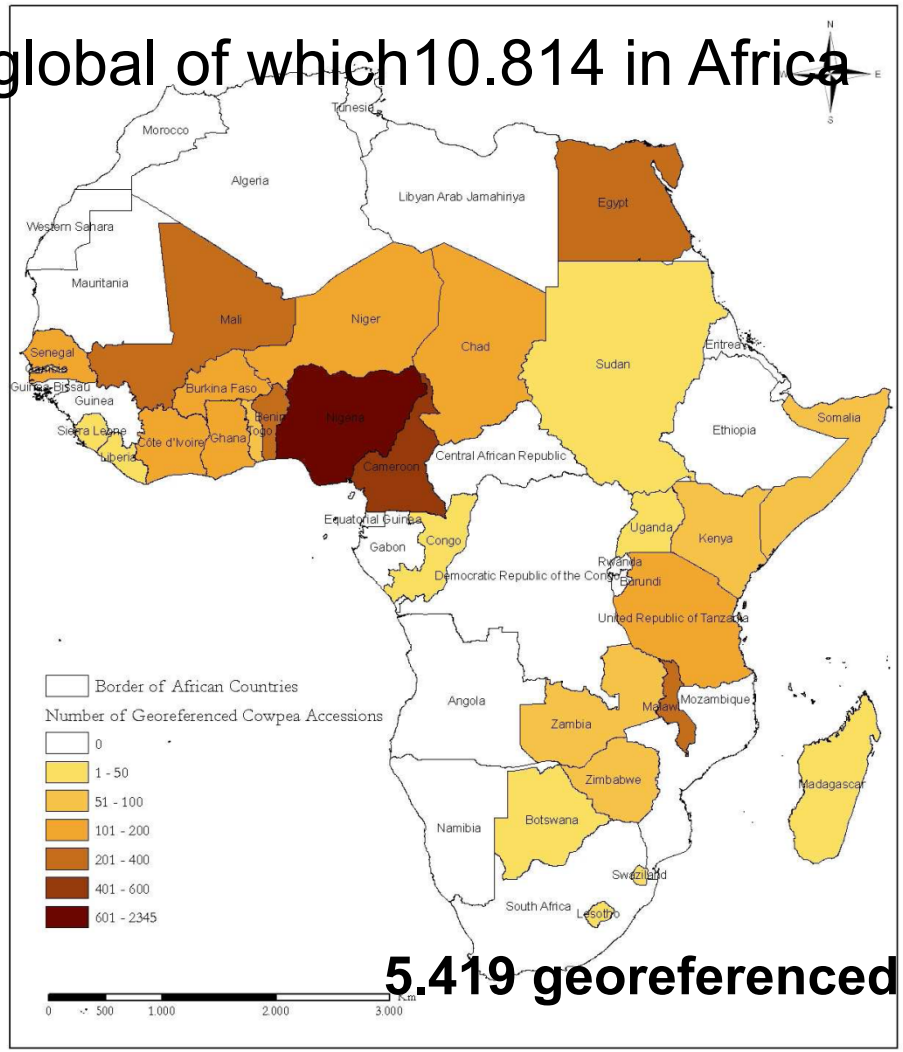
Source: J. Gockowski et al., 2010: Cocoa Intensification Scenarios and Their Predicted Impact on CO2 Emissions, Biodiversity Conservation, and Rural Livelihoods in the Guinea Rain Forest of West Africa

Development of drought tolerant crop varieties and seeds

Accessions of Cowpea 15.115 global of which10.814 in Africa



5.397 non georefenced



5.419 georeferenced

•Source: Anne Rysavy, 2009: GIS Based Gap Analysis as a Tool for Biodiversity Conservation Optimization: The IITA Cowpea Collection

Development of drought tolerant crop varieties and seeds

Cowpea/Black eyed peas

15.115 accenssions
10.814 within Africa
5.419 georeferenced in 28 countries

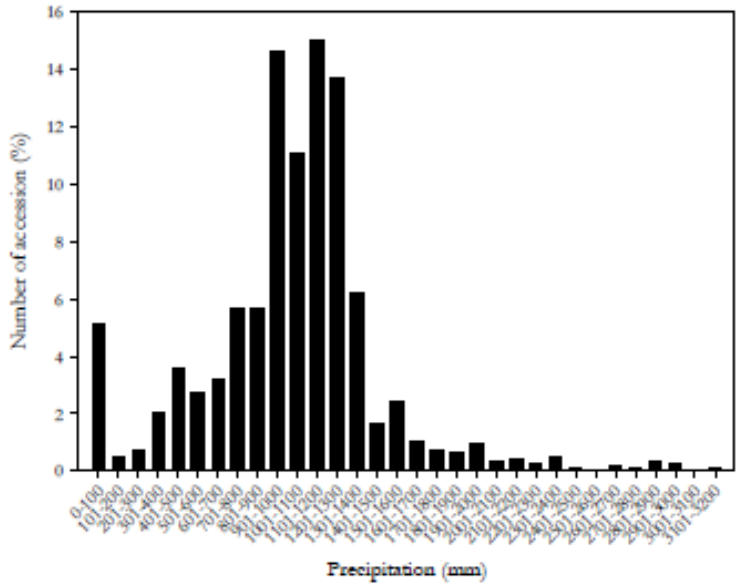
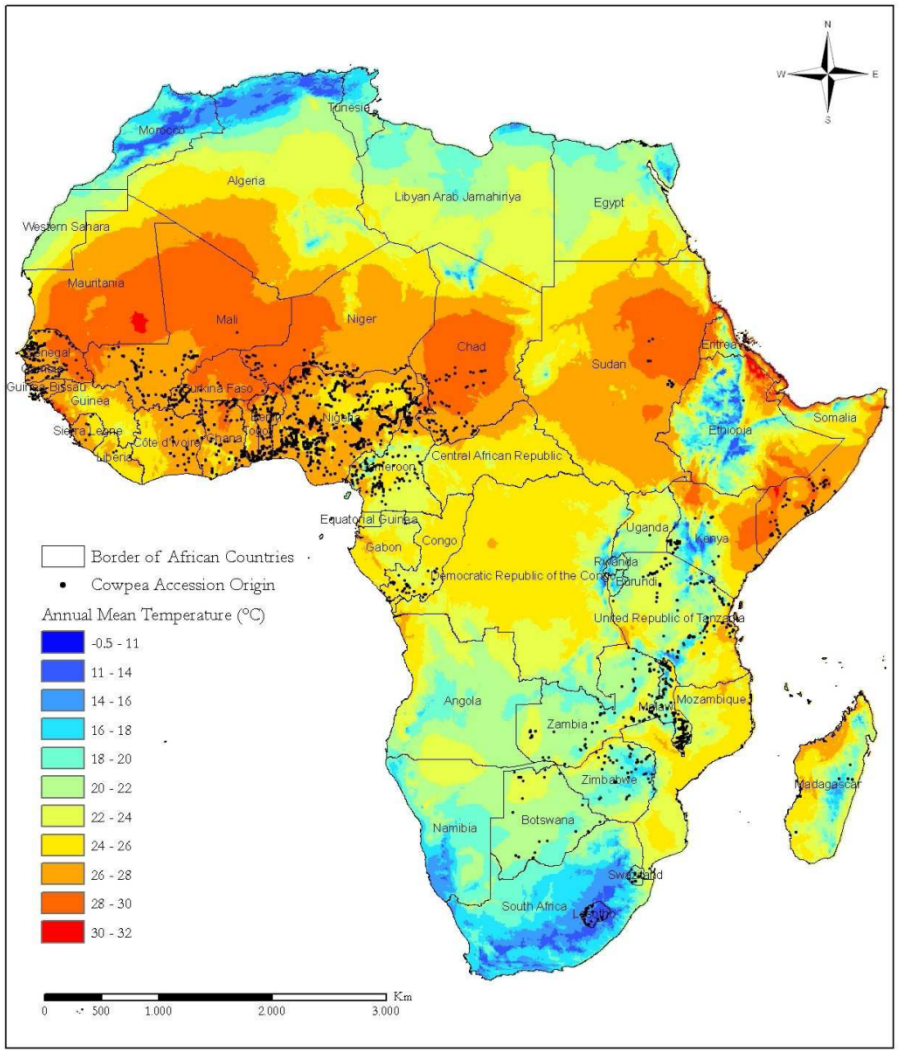


Fig. 13 Distribution of cowpea accessions according to annual mean precipitation (mm)



•Source: Anne Rysavy, 2009: GIS Based Gap Analysis as a Tool for Biodiversity Conservation Optimization: The IITA Cowpea Collection

Importance of Crop Biodiversity to Mitigate against Climate Change Recognized

- The Seed Vault at Svalbard
- Global Crop Diversity Trust

Impact of climate change on pests

- Range expansion
- More rapid crop development
- Extended cropping season
- Increased pest pressure
- Decreased host tolerance/resistance
- Decreased pesticide resistance
- New pest problems
  - Secondary pests => primary pests
- Evolutionary rate?

Abundance of soil organisms

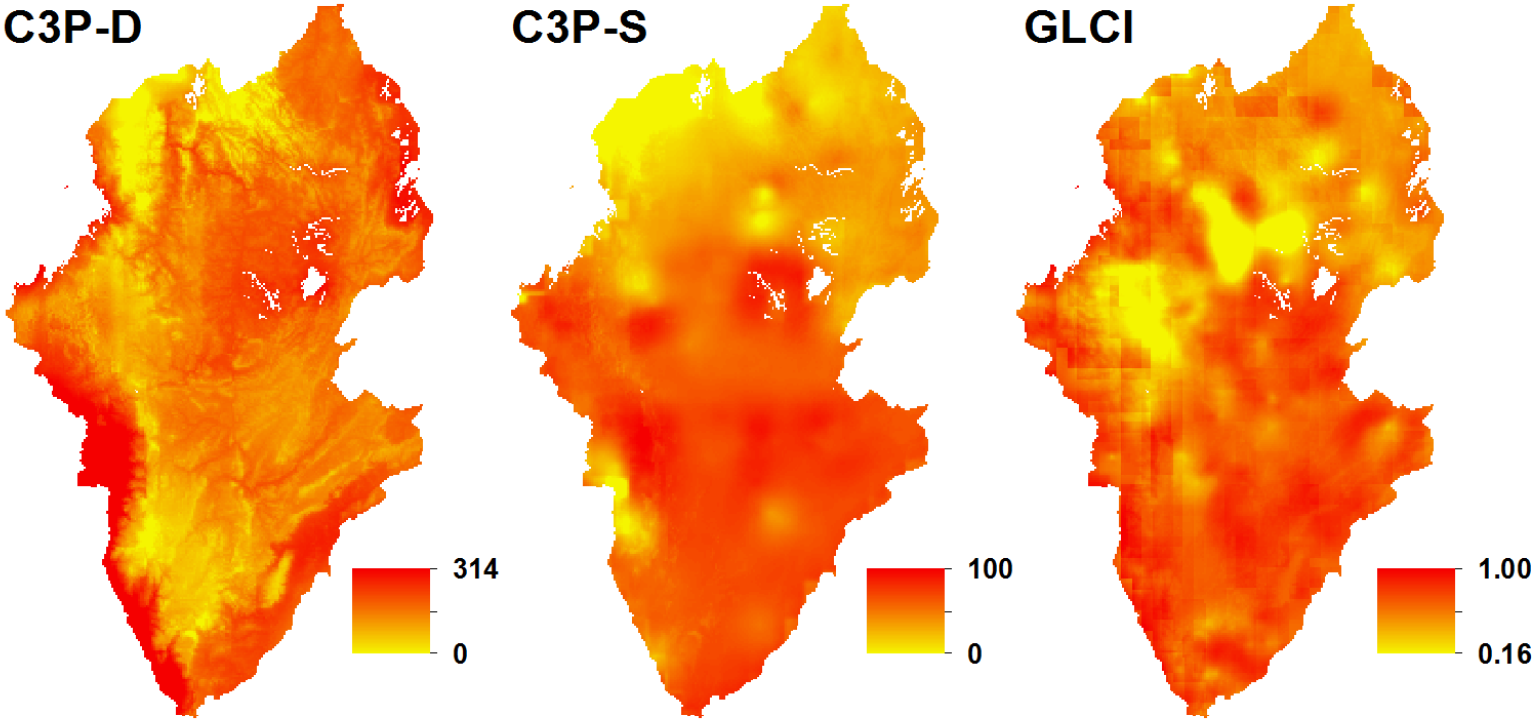
Organism	Number per gram soil (~1 tsp)	Biomass[1] (lbs per acre 6”)
Earthworms	–	100 – 1,500
Mites	1-10	5 – 150
Nematodes	10 – 100	10 – 150
Protozoa	up to 100 thousand	20 – 200
Algae	up to 100 thousand	10 – 500
Fungi	up to 1 million	1,000 – 15,000
Actinomycetes	up to 100 million	400 – 5,000
Bacteria	up to 1 billion	400 – 5,000

[1] Biomass is the weight of living organisms

Impact of climate change on pests

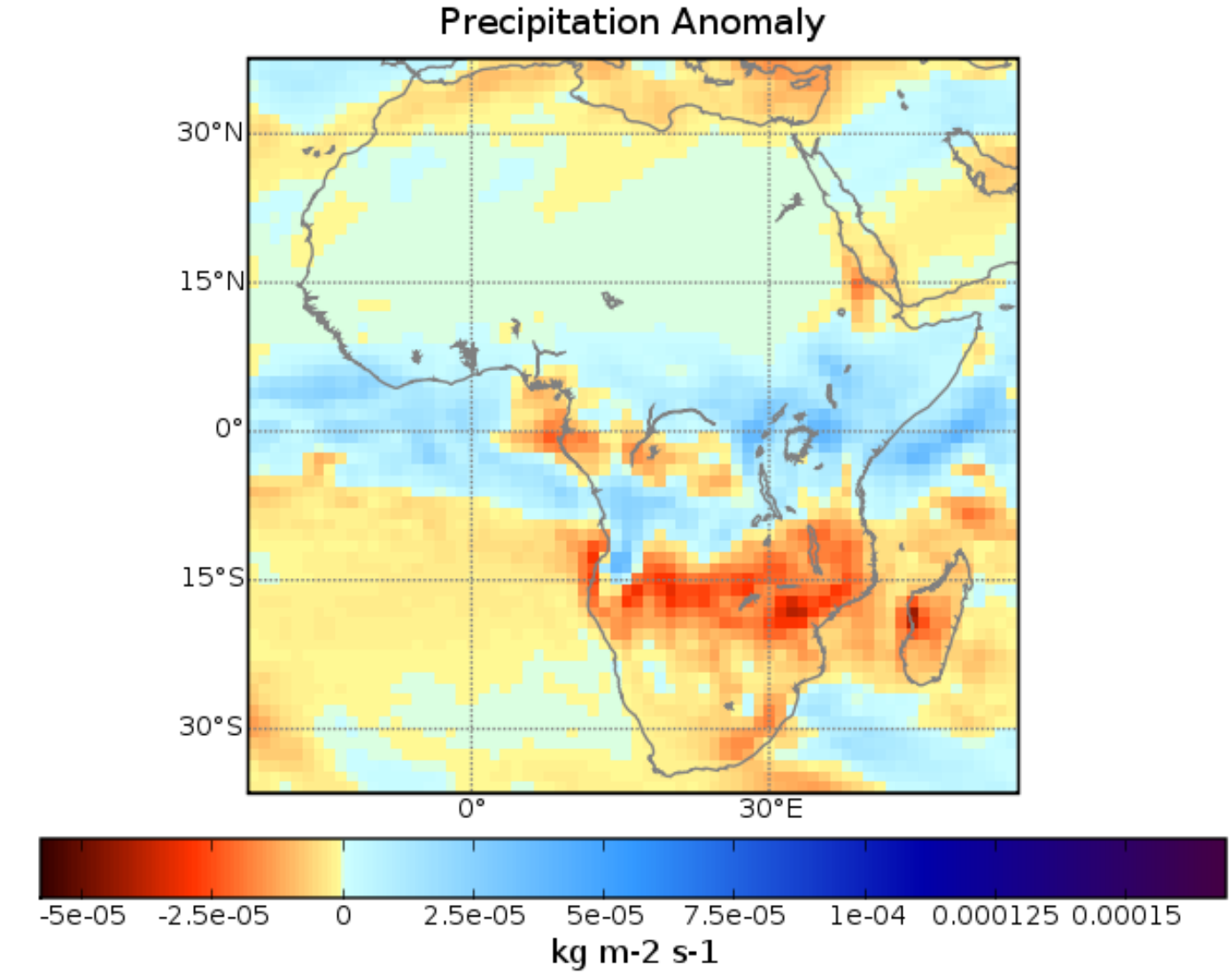
Planned research

Assess effects of climate change on cassava mosaic geminiviruses and the whitefly Bemisia tabaci.



Source: Bouwmeester et al. 2011: Comparison of disease patterns assessed by three independent surveys of cassava mosaic virus disease in Rwanda and Burundi

Need for downscaled models



Precipitation Flux Anomaly, December 2070-2099 mean.
Projected by the Japanese consortium (UoT, NIES, JAMSTEC);
Scenario: A1B (SRES 2000); Model MIROC3.2(hires) (IPCC 2007).
Figure obtained from www.ipcc-data.org, 14 February, 2011.

Conclusions

Climate change causes economic losses and undermines food security

Agriculture is a major cause of climate change and will increase

These effects are likely to become more severe as global warming continues

There is a need for concrete quantitative studies on impacts of CC

Intensification via alternative farming seems the way forward!?

How do we increase yields?

What is the problem climate change or population growth?

.