

Impacts of Climate Change on Agriculture in Kenya

Presentation

Joseph Maitima

Agricultural Production

- Agriculture includes
 - Cropping – planting of cultivars
 - Animal Agriculture – rearing of livestock
- Production Systems
 - Crops
 - Rain fed farming
 - Irrigation
 - Animal Production
 - Low input – (Rangeland production - open grazing)
 - High input – (tethering, paddocks, zero-grazing etc)

Climate agriculture interactions

- Both crop and livestock agricultural production depend on climate
- Two climatic factors that affect agriculture most are rainfall and temperatures
- Some crops require high rainfall and others low rainfall: some high temperatures and others low temperatures
- Like animal feeds (grasses and shrubs) require rainfall
- Animals also affected by weather conditions.

Recent trends in climate



1974



2007

- Temperatures

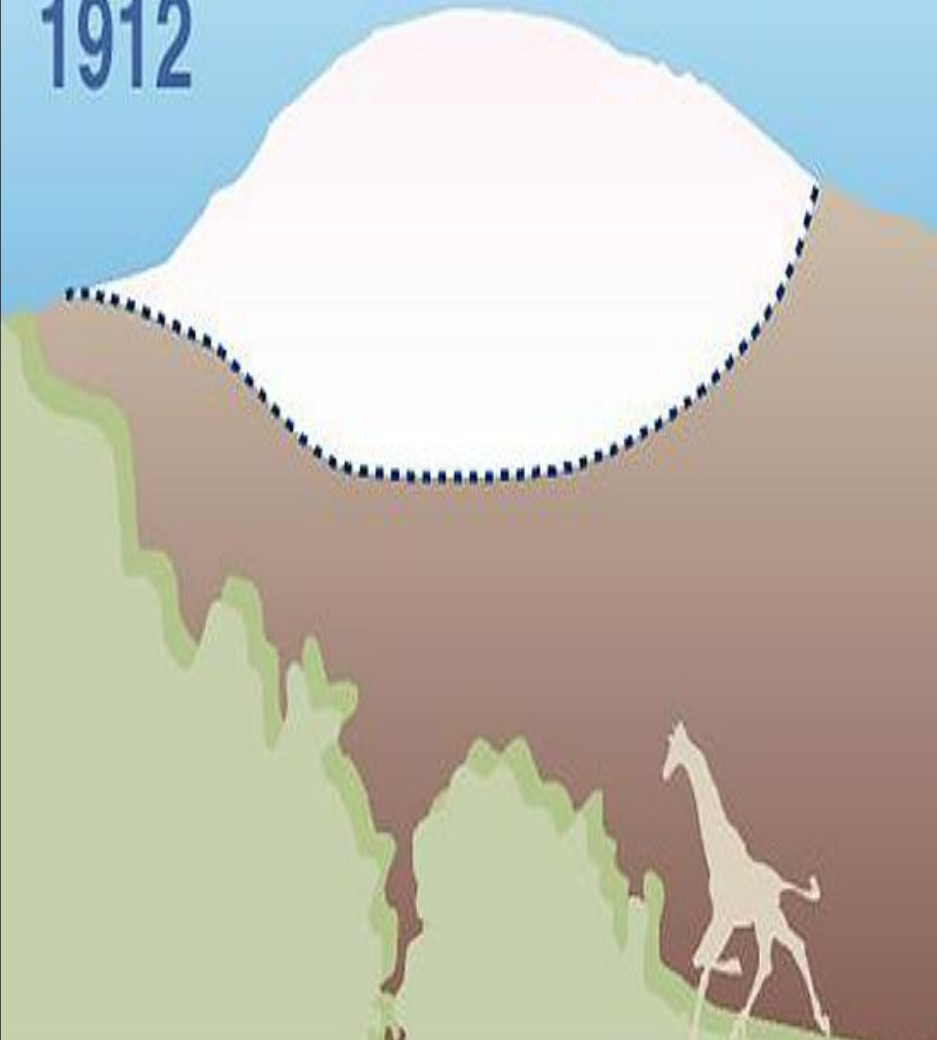
- Warmer temperatures everywhere

- Rainfall

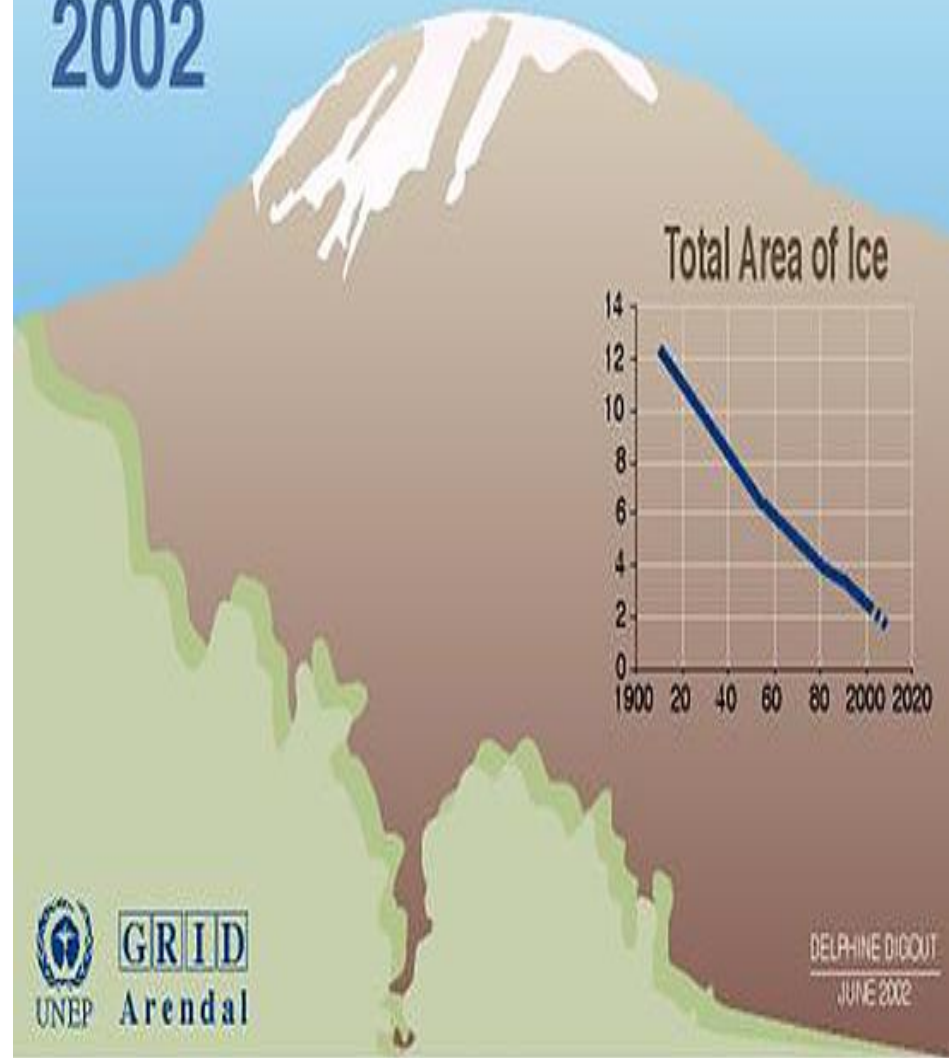
- Some areas receiving more, some less and others same rainfall
- Altered duration and timing of rainy seasons
- More rainfall extremes – droughts, floods

The Melting Snows of Kilimanjaro

1912

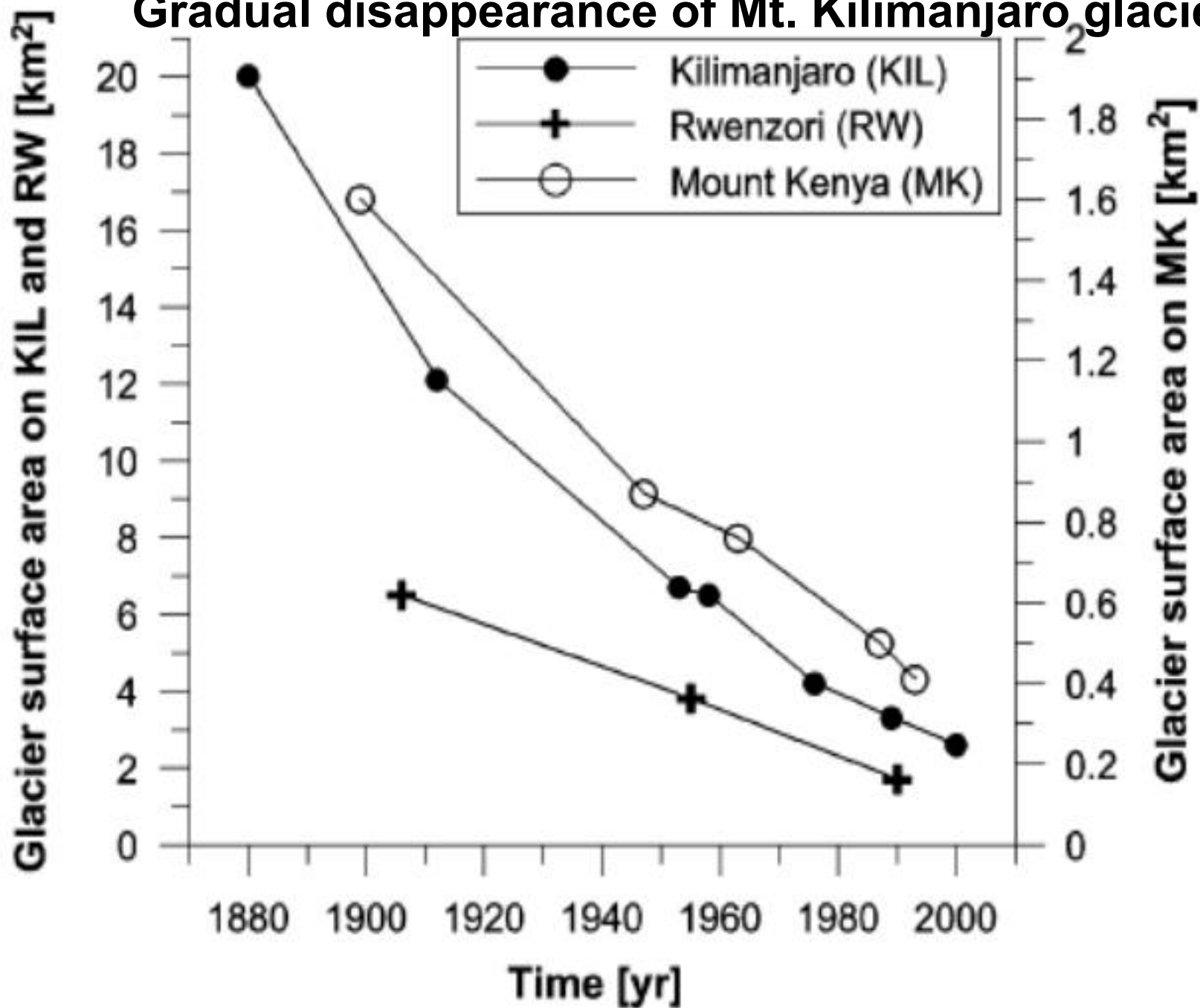


2002

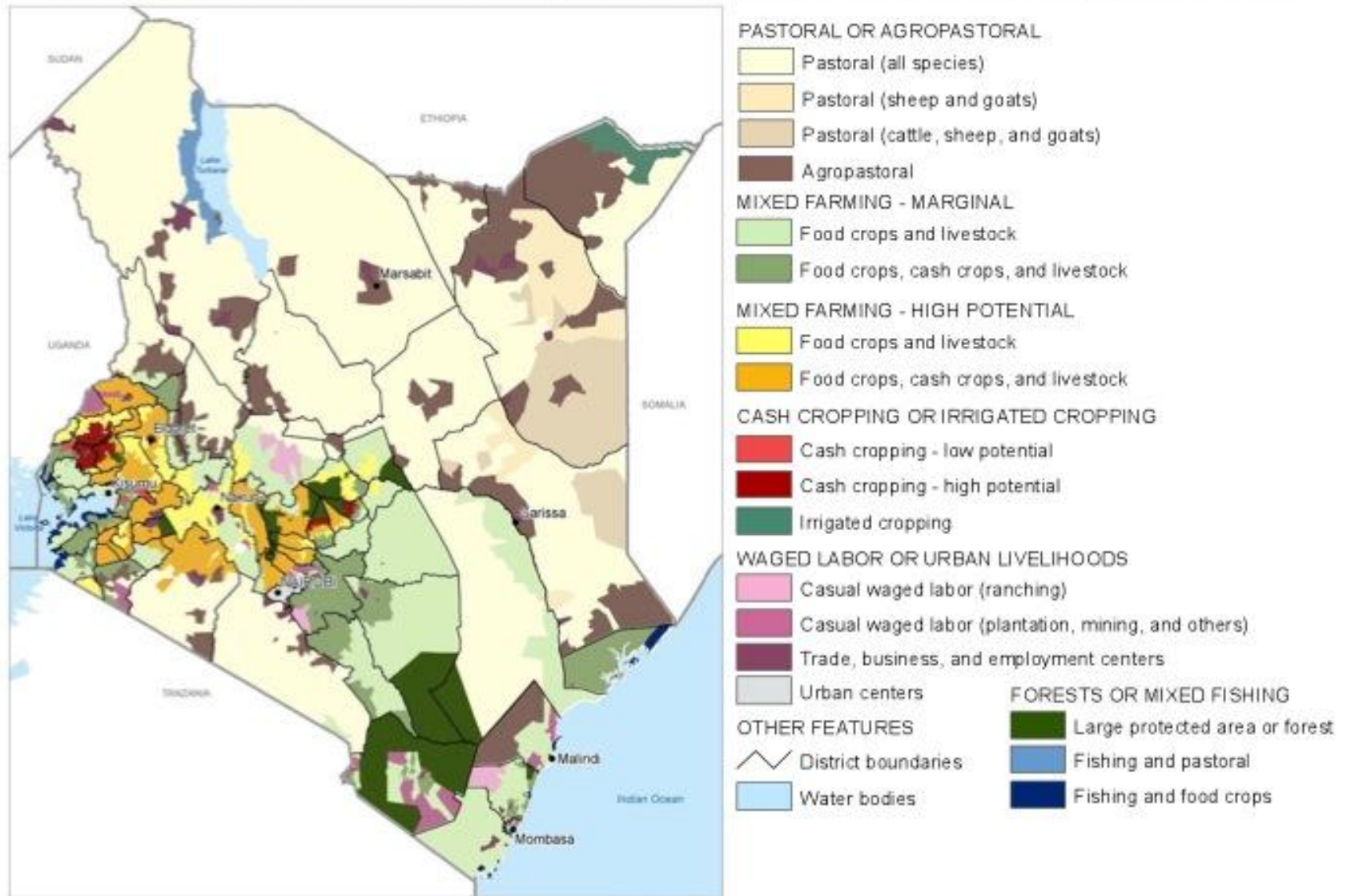


Gradual disappearance of Mt. Kilimanjaro glaciers

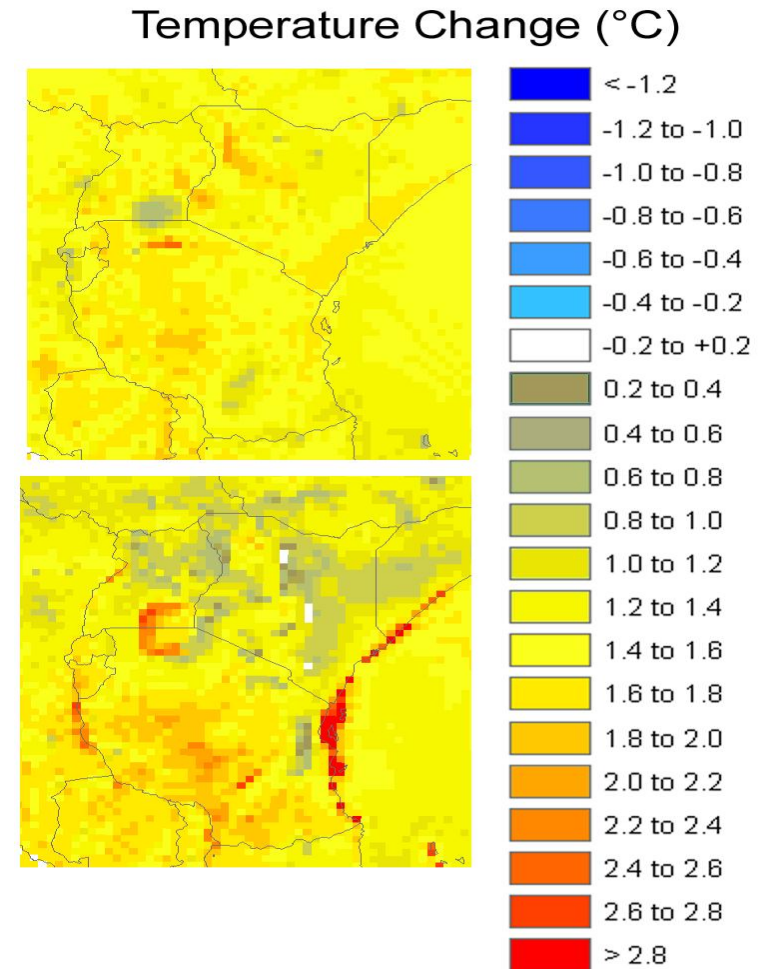
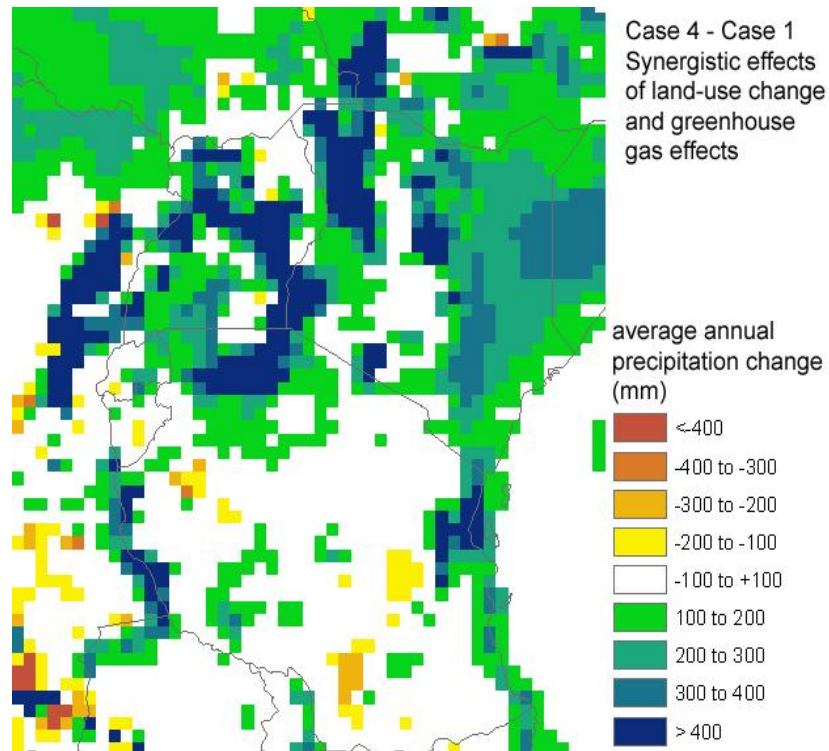
Gradual disappearance of Mt. Kilimanjaro glaciers



Predominant Livelihood Strategies Pursued by Households, 2003-2005

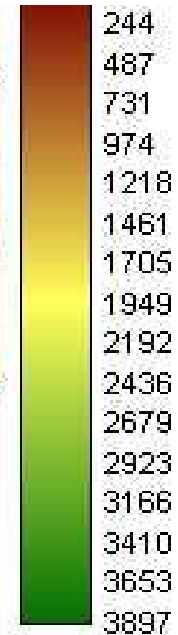
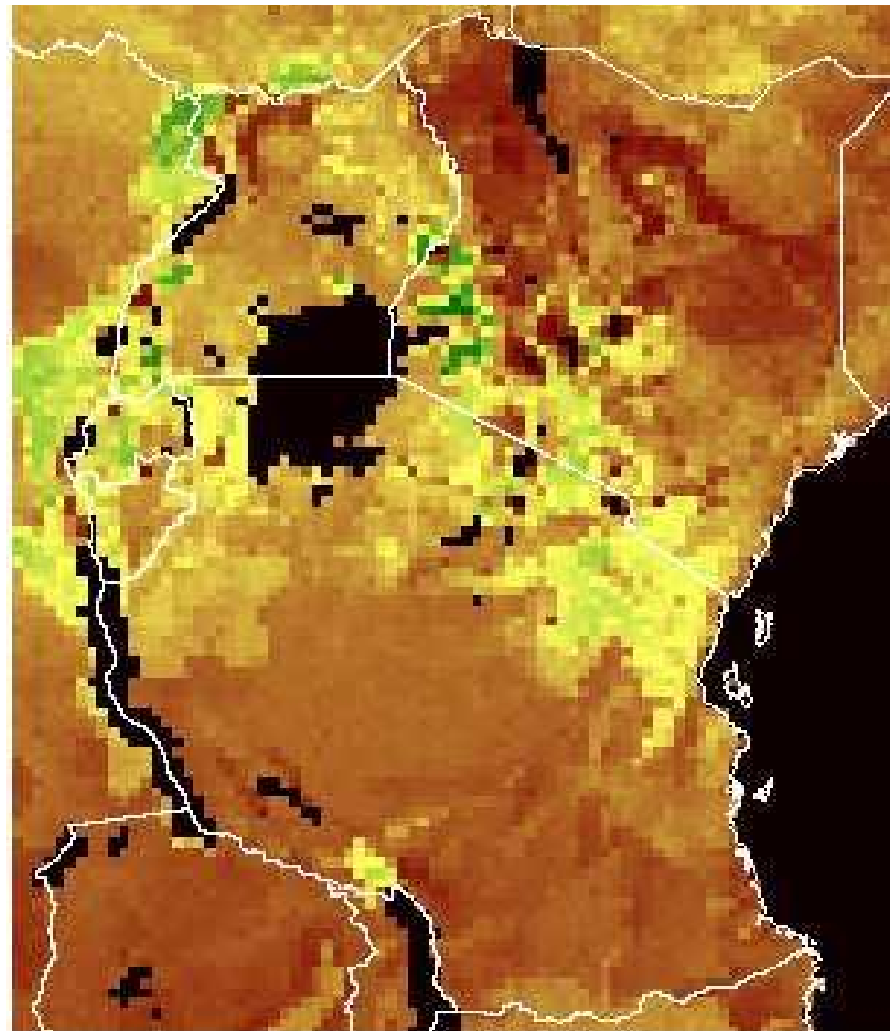


Changes in annual Precipitation Temperatures 2000-2050



Maize yields under current climate conditions

- Rainfall and soils limit production
- Model assumes low input levels

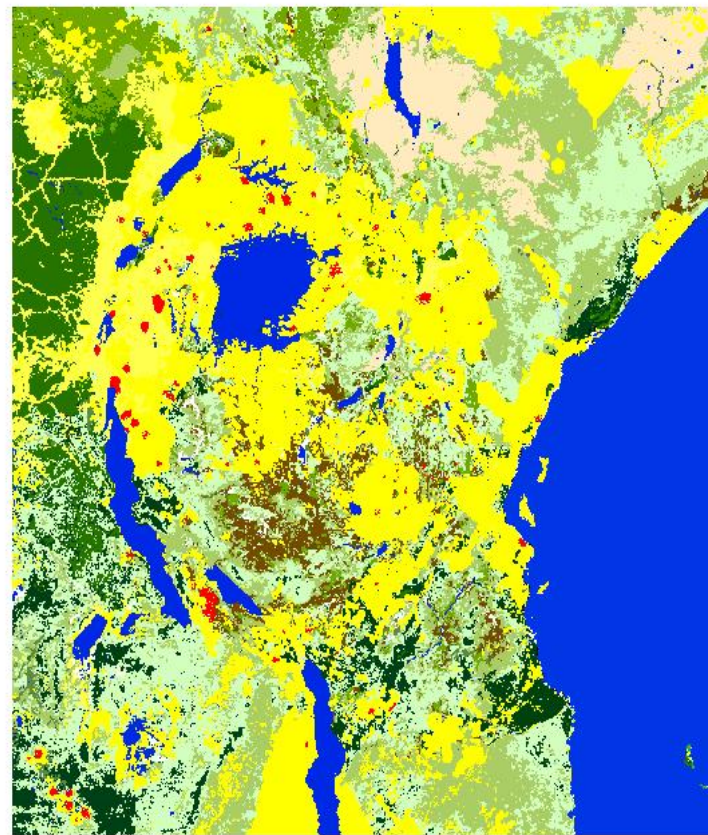
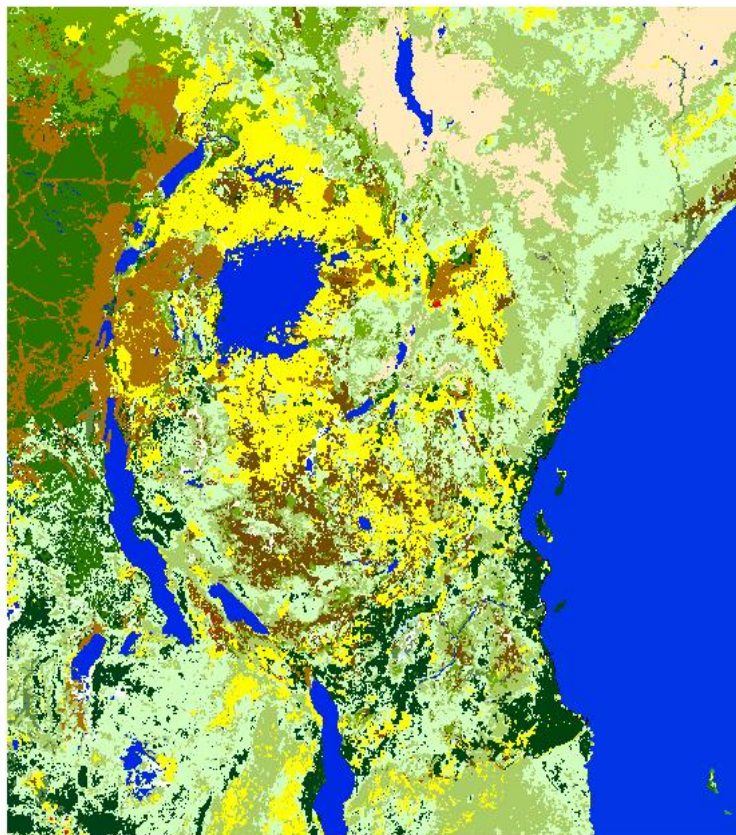


Deterministic process based simulation models (DSSAT CERES); CCSM v4 and WorldClim.

Land Use Change Projections

Land cover in 2000

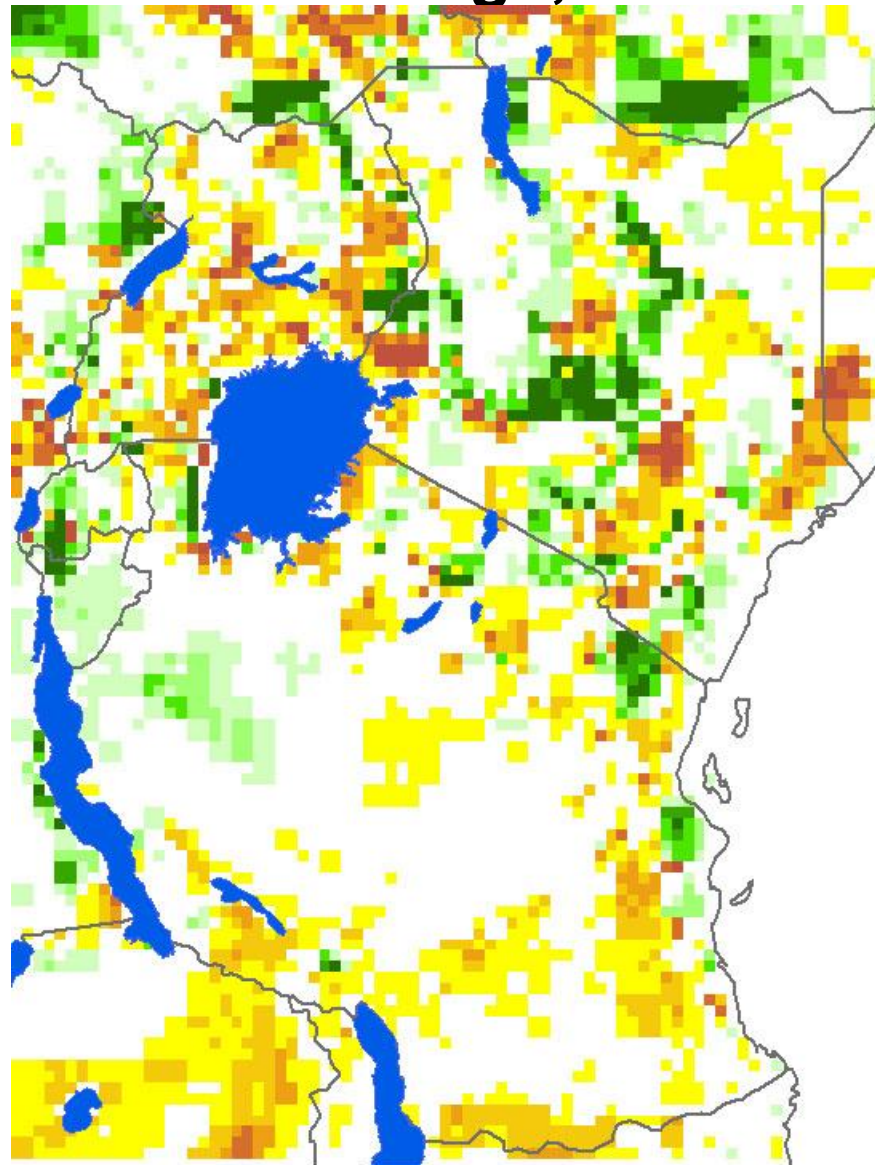
Land cover in 2050 (projected)



Legend

- EV Broadleaf forest
- Mangrove
- Wooded Grassland
- Deciduous broadleaf
- Open shrubland
- Grassland
- Woodland
- Evergreen Broadleaf
- Aquatic Agriculture
- Irrigated Crops
- Semi-desert
- Bog or Marsh
- Bare ground
- Desert
- Lakes and Rivers
- Urban
- Ocean
- mosaic forest/cropland
- Crop mixed farming
- Closed shrubland

Difference in maize yields due to Climate Change, 2000 to 2050

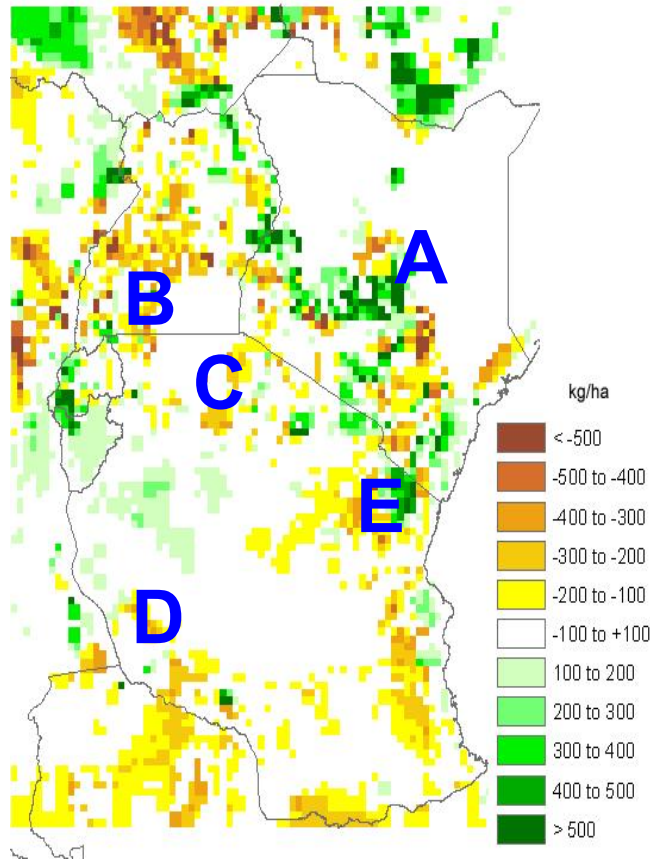


**Green=increase
in yields**
**Brown=decline
in yields**

difference in
maize yield (kg/ha)



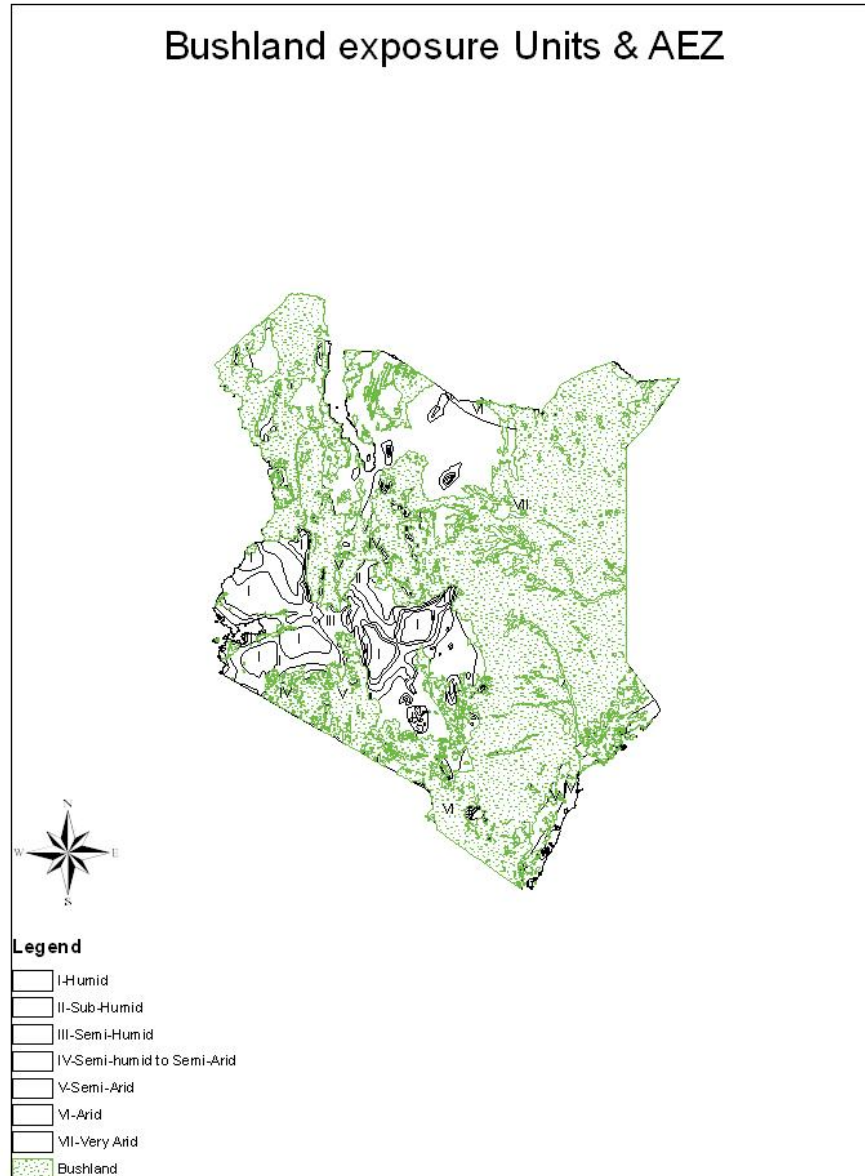
Climate change impacts on maize



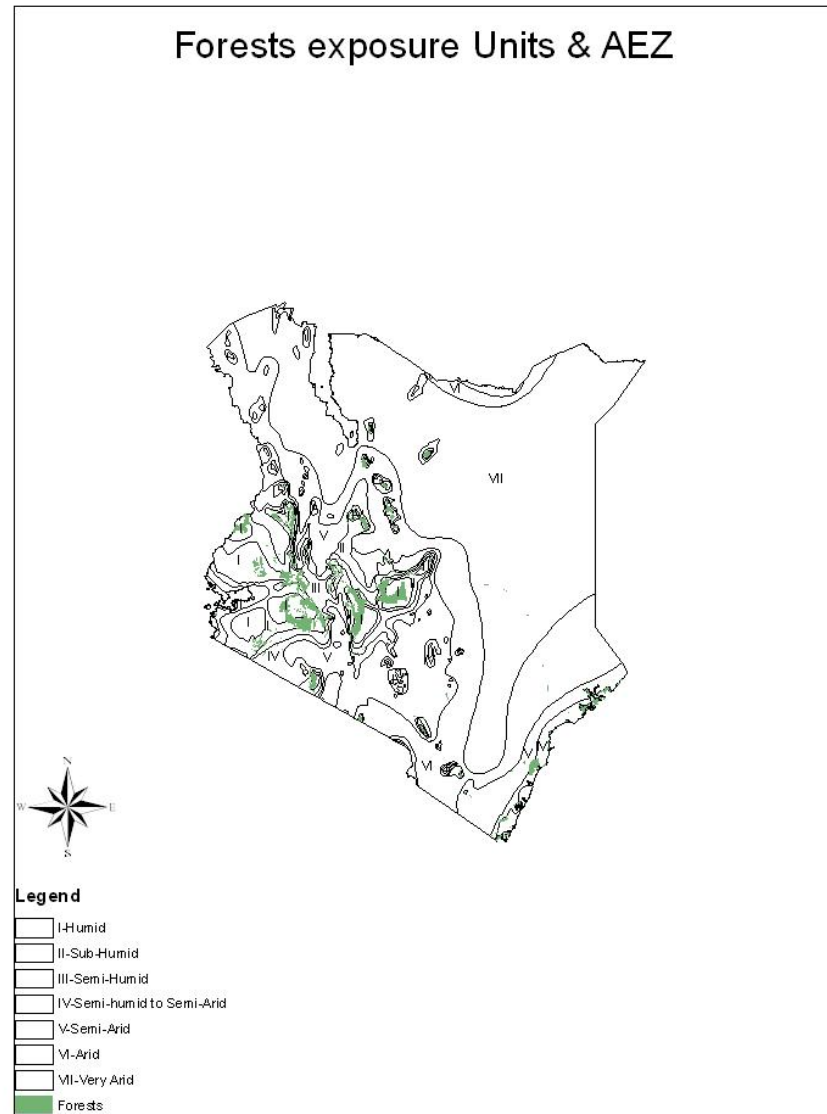
	2000-2009				2050-2059				Yield Change (kg/ha)
	Max temp (C°)	Min temp (C°)	Precip (mm)	LGP (days)	Max temp (C°)	Min temp (C°)	Precip (mm)	LGP (days)	
A. Embu, Kenya	20.1	18.3	171	89	26.1	20.0	287	84	+1348
B. SW Uganda	24.1	18.2	453	94	26.0	20.3	395	85	-979
C. S of Lake Vic, Tanz.	23.9	21.8	503	86	24.1	22.8	320	85	-644
D. SW Tanz	24.5	19.0	681	91	24.7	20.8	754	86	-388
E. NE Tanz	26.4	19.1	306	87	26.9	20.3	298	82	-552

**Primary causal effects of climate
change on specific exposure
units**

- “**Bushland** – Conditions becoming warmer and drier
 - Deterioration of soil and vegetation cover
 - Disruption of hydrological cycle
 - Disruptions in livestock industry
 - Reductions in water supply
 - Dislocations or reductions in wildlife
 - Adverse effects on:
 - Distress, starvation, famine, cessation of economic activity

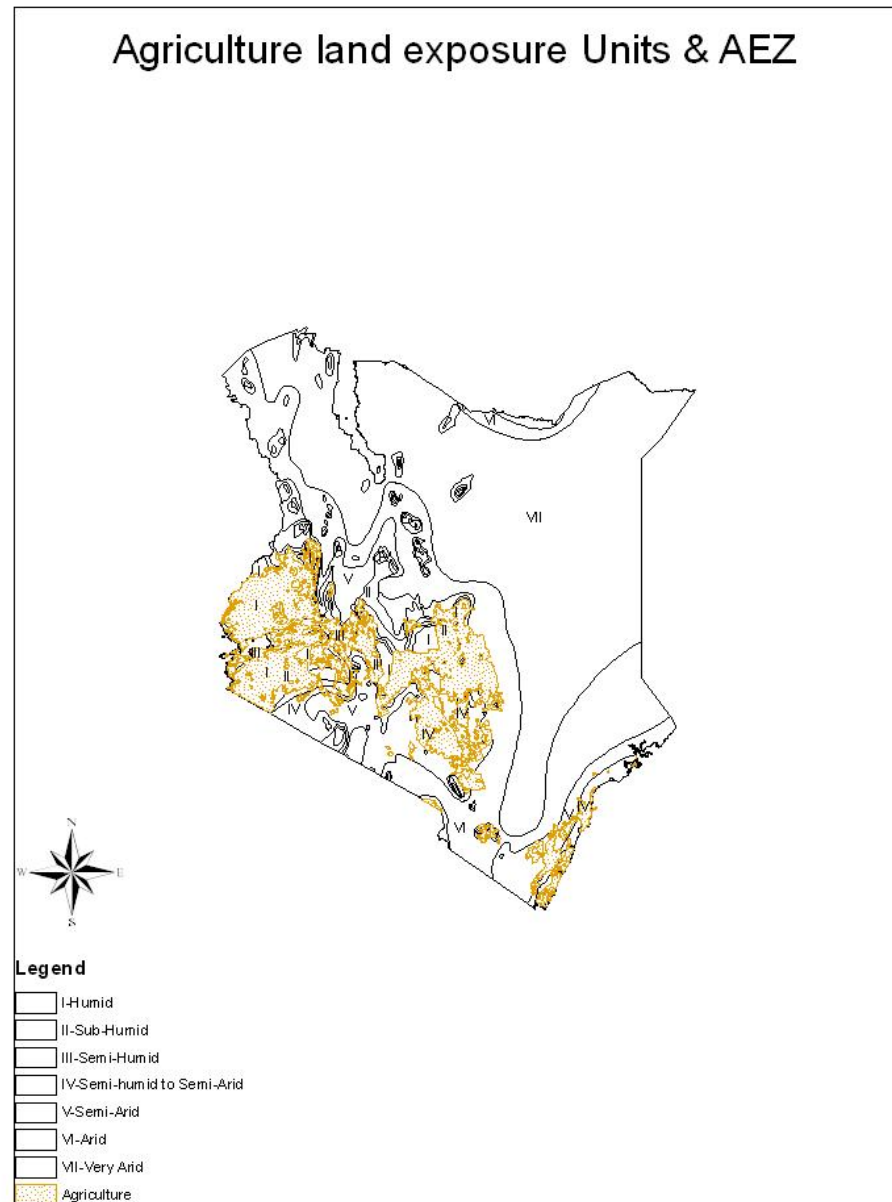


- **Forest areas becoming warmer and drier**
 - Reduction of species diversity and distribution
 - Deforestation
 - Loss of forest products and biodiversity
 - Enhanced land degradation



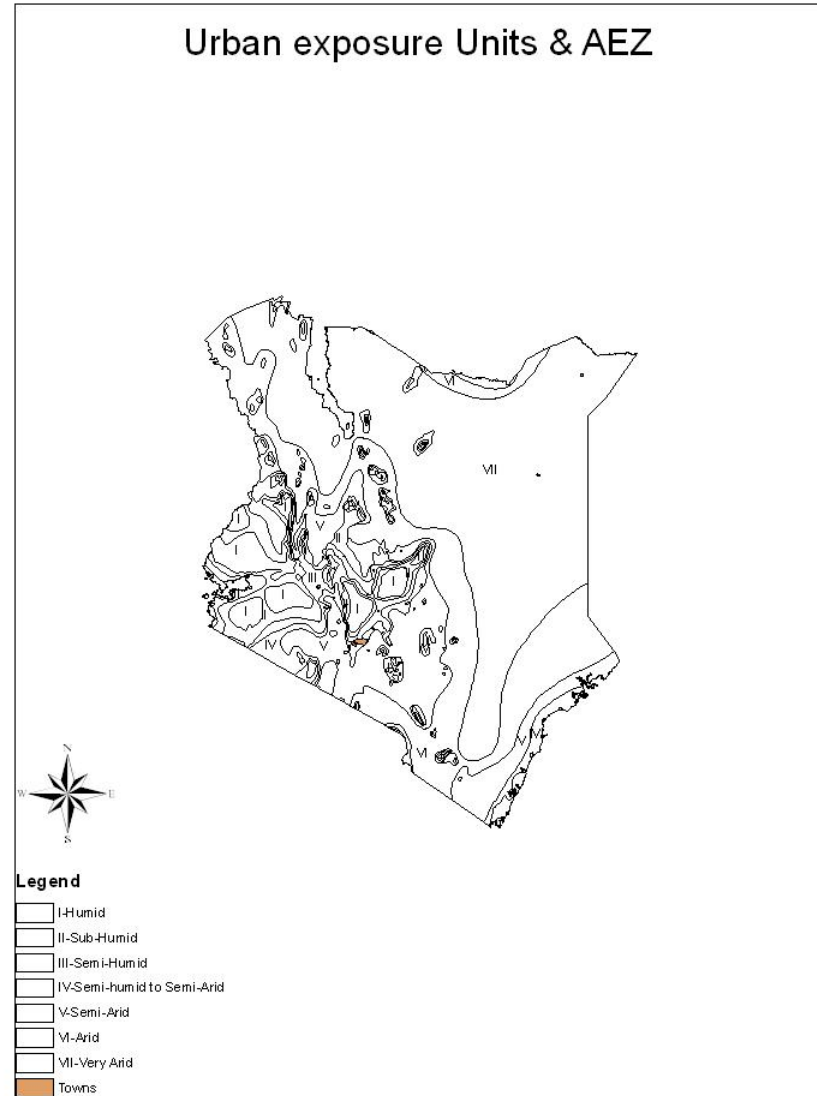
- **Agricultural areas**

- Altered seasonality for cropping and related activities
- Poor performance and failure of some crops
- Surface water evaporates faster
- Livestock feeds becoming scarcer
- New challenges of human and livestock diseases
- Water sources become scarcer for humans and livestock



- **Areas of high urban becoming warmer and drier**

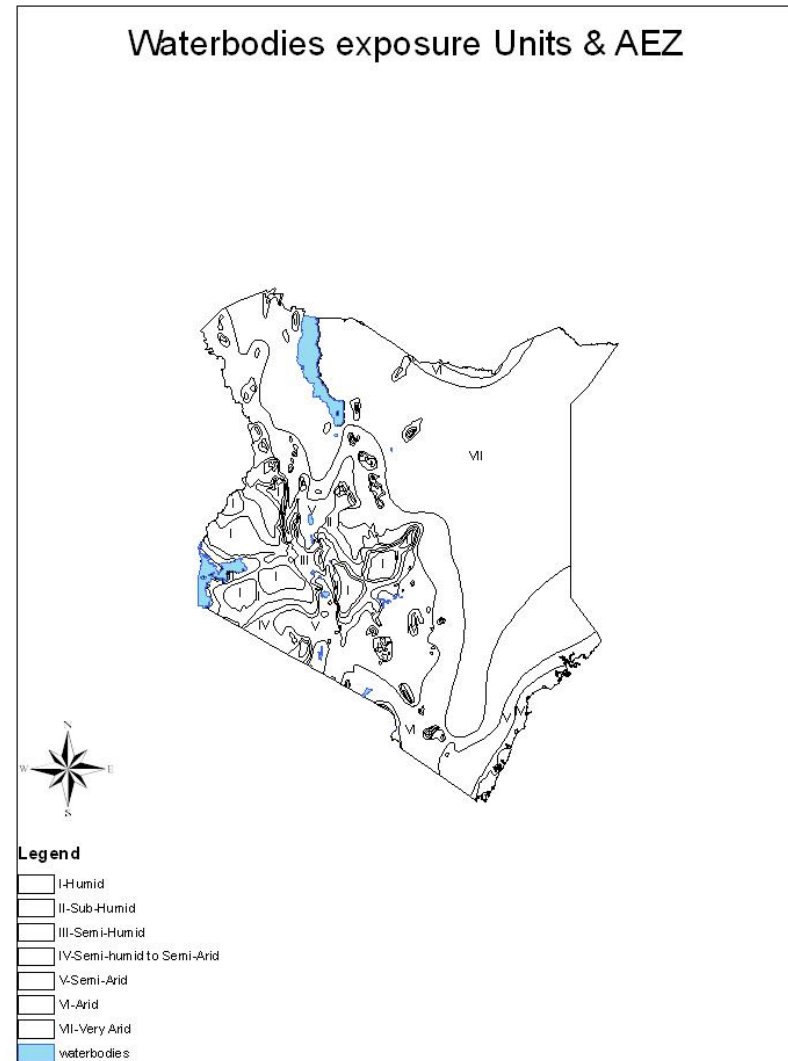
- Environmentally induced diseases
- Problems with municipal water supplies
- Problems associated with hotter temperatures at homes and offices
- Air pollution (factory wastes, aerosols)



•**Lake shores, river line and riparian areas getting warmer and drier**

•Water for irrigation dry up or not available when needed

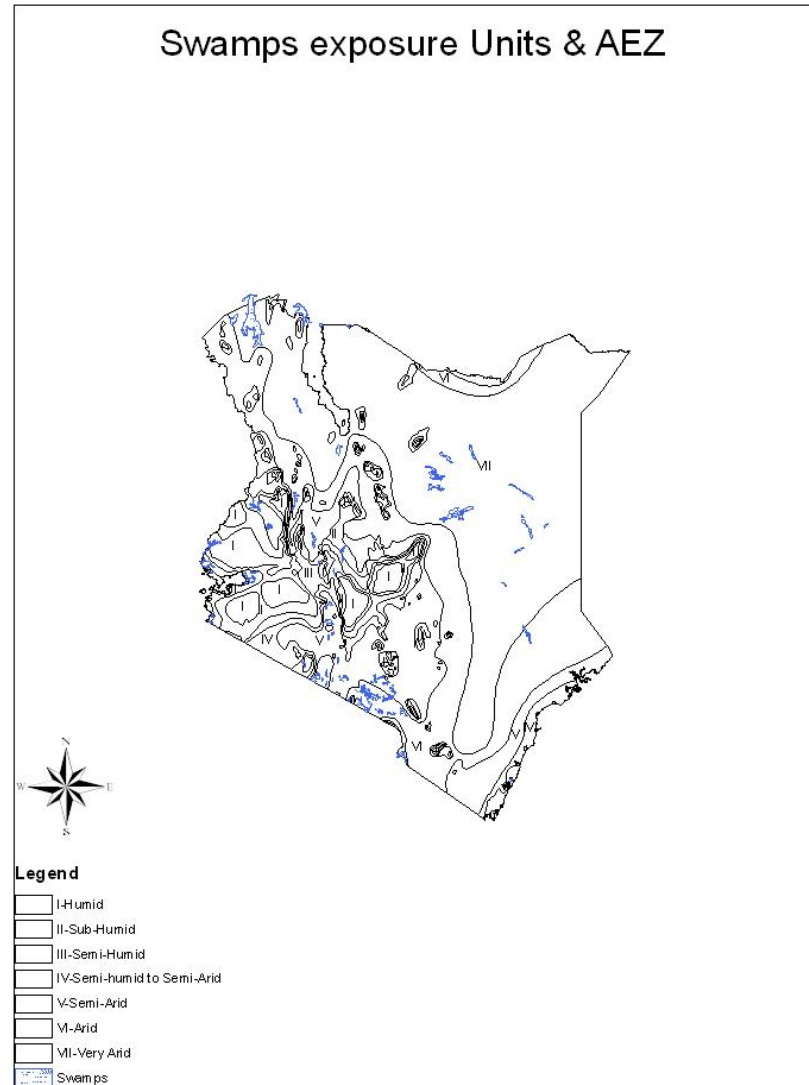
•Aquatic animals and plants not available



Wetlands and flood plains getting warmer and drier

Water not available for agriculture

Some disease vectors disappear



Impacts triggering human responses

Impacts of primary causal effects on humans – triggers of human responses

- Agricultural areas
 - Lack of water for irrigation and domestic use
 - Crops grown not doing well drying up or not producing
 - Rains not coming on time
 - Rain ends too soon
 - Length of growing season too short
 - Less food available – hunger
 - Less livestock feeds (Grass, Stover, Browses)

- Forests areas becoming warmer and drier
 - Reduced biodiversity (plants and animals)
 - Less supply of timber and wood products
 - Less supply forest food products

- Bushland & grasslands
 - No pastures for livestock
 - No water for livestock and human
 - Loss of livestock to wildlife
 - Livestock deaths
 - Less food available

- Areas of high urban habitation becoming warmer and drier
 - Increased incidence of certain diseases
 - Lack of water
 - Excessive heat

- Lake shores, riverine and riparian areas
 - Reduced dry season farming areas
 - Destruction of landing bays
 - Dry rivers and lakes
- Wetlands and flood plains
 - Dry swamps
 - Loss of wetland biodiversity
 - Lack of dry season grazing and cultivation areas

Primary Human Responses

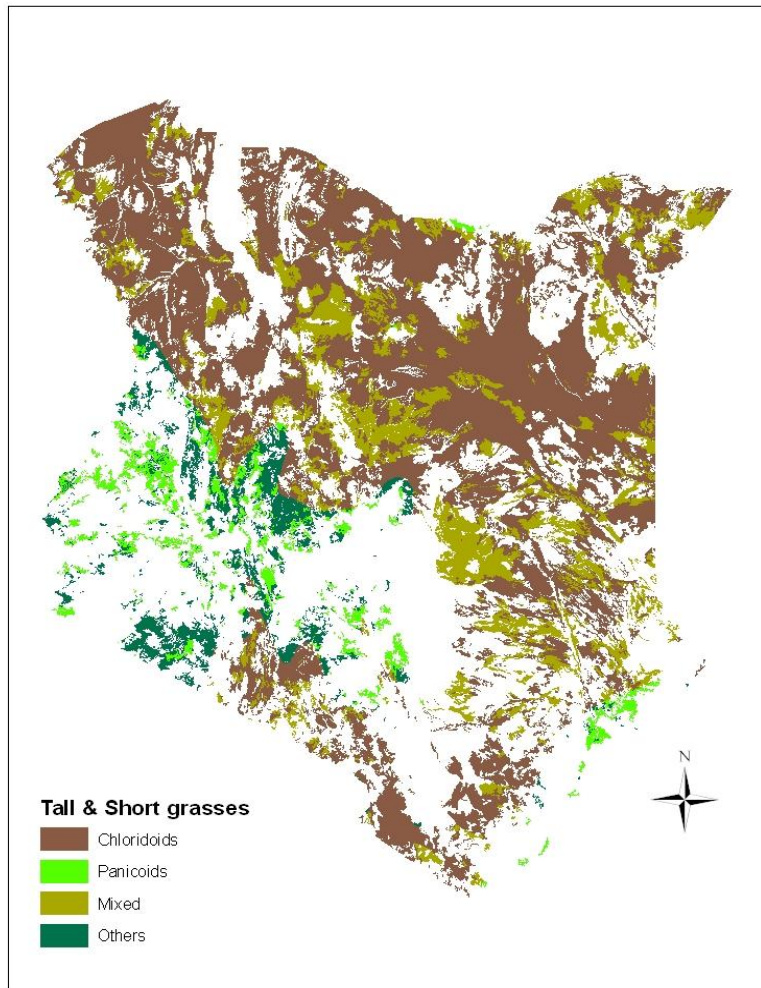
Human responses impacts in Agricultural areas

- Human responses
 - Changes in crop types, and cropping patterns
 - Shifts between crops and livestock
 - Adoption of new technologies in cropping
 - New livestock feeding practices
 - Change to new livestock breeds
 - More diversification of livelihood strategies

Bushland/grasslands

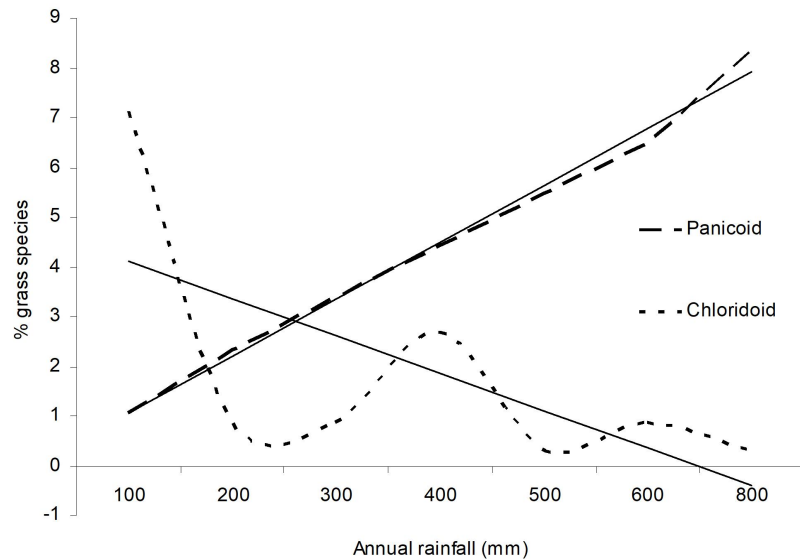
- Conditions becoming warmer and drier
 - Due reduced vegetation cover and pastures
 - Adopt winter seasonal migrations
 - Migrations to urban areas
 - Changes in livestock herds composition
 - Reductions in livestock numbers
 - Start to cultivate in specific areas
 - Increased dependence on natural resources (wild food plants, charcoal, wildlife etc.)
 - Adoption of alternative livelihood

Spatial distribution of Chloridoid and Panicoid grass species



- Chloridoids dominate northern and north eastern Kenya
 - Typical habitat: Open grasslands high temperatures and low rainfall
- Panicoids dominate central and western highlands

Changes in abundance in relation to Rainfall variability



- As rainfall increases abundance of Chloridoids decreases as Panicoid increase
- Implications on grazers and browsers as it becomes bushier



General impact on cropping systems

- Rain is the major limiting factor for crops, yet plants will require more water with warmer temperatures.
- Warmer temperatures reduce growing season length. Grain yield highly sensitive to length of season.
- Crop pests and diseases will increase.
- Irrigation water availability may decline.



Impact on herding systems

- Warmer temperatures lead to vegetation drying faster and drinking water becoming scarce faster
- Livestock forage productivity and palatability may change as plant composition changes due to temperature and rainfall. Bush encroachment in Northeastern?
- Droughts more severe— with impacts on livestock, wildlife, and people.
- Livestock diseases more frequent with climatic extremes.
- Increased competition, insecurity?



Agronomic Implications

1. Warmer temperatures lead to accelerated phenology in nearly all cases, shortening the growing season and decreasing potential yield.
2. In some cases, the effects of warmer temperatures are offset by the impact of increasing precipitation. In other cases, there is insufficient additional precipitation to offset the higher temperatures.
3. Future impacts to highland agriculture may include shifts to maize at the expense of tea, coffee.
4. Simulated impacts illustrate need for development of maize varieties with longer thermal time requirements.
5. The range and variability of the outcomes suggests that future technologies need to be regionally specific

Rangeland implications

1. Warmer temperatures lead to accelerated phenology in nearly all cases, shortening the growing season.
2. In some cases, the effects of warmer temperatures are offset by the impact of increasing precipitation (e.g, NE Kenya). In these areas, vegetation amounts and surface water may increase, and species composition may change. There may be impacts on soil (erosion, weathering).
3. In other cases, there is insufficient additional precipitation to offset the higher temperatures. In these areas, vegetation production and surface water availability will decline. Species composition may change.
4. The distribution and intensity of pests and diseases will change.

Feedback: People respond to altered climate

Expert workshops indicate that people may:

- Switch crops, abandon cropping on some land
- Move to search for jobs and food in towns
- Increase conflict over water, grazing
- Develop irrigation where possible
- Turn to livestock, especially native breeds, maintained since lower risk.

Implications include altered farming systems, a retreat of cropping in some areas and expansion in others.

Responses differ by region, community, households, age and gender groups as climate change effects interact with other processes.



Thank You

