UNIVERSITY OF NAIROBI

CCDA-V

Africa, sustainable development and climate change

Prospects of Paris and beyond

ClimDev-Africa

A Regional Assessment of Agricultural Production, Climate Change, Agricultural Trade and Food Security

Nancy M. Laibuni,

A. Muluvi, E. Mukhala, J. Ngaina, N. Maingi, R. Mulwa, M. Omolo, C. Onyango, J. Nyangena, S. Githuku and J. Omiti

KIPPRA

The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

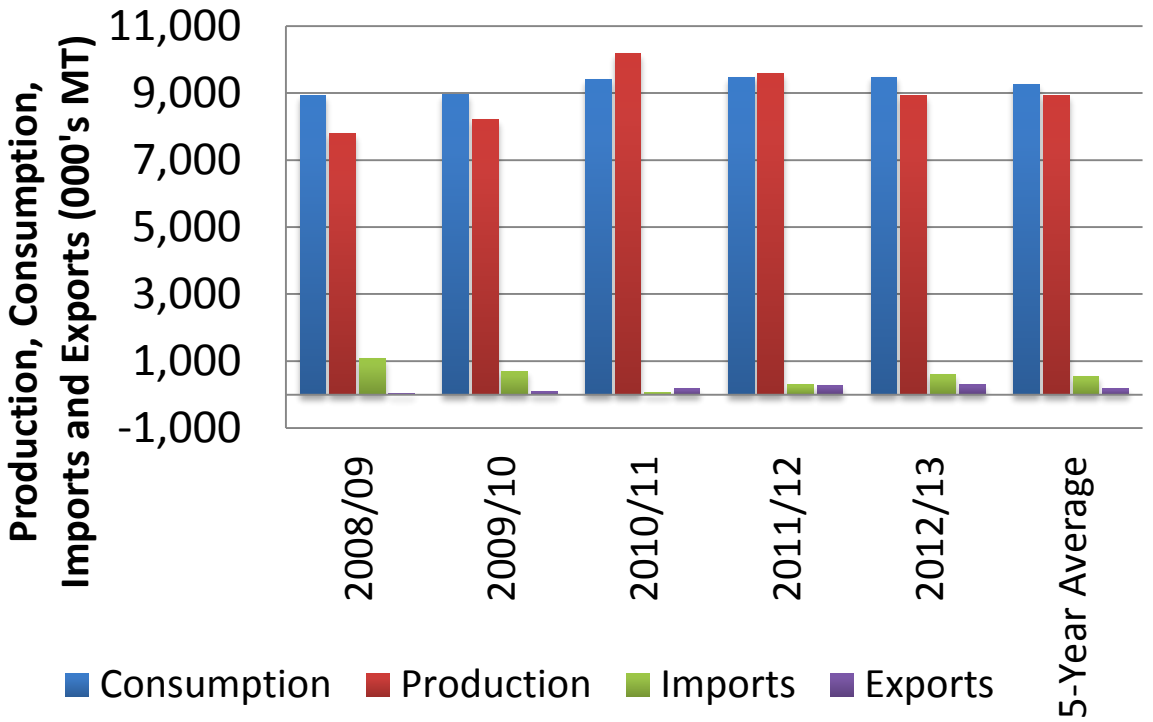
World Meteorological Organization

University of Nairobi

Agriculture in the EAC

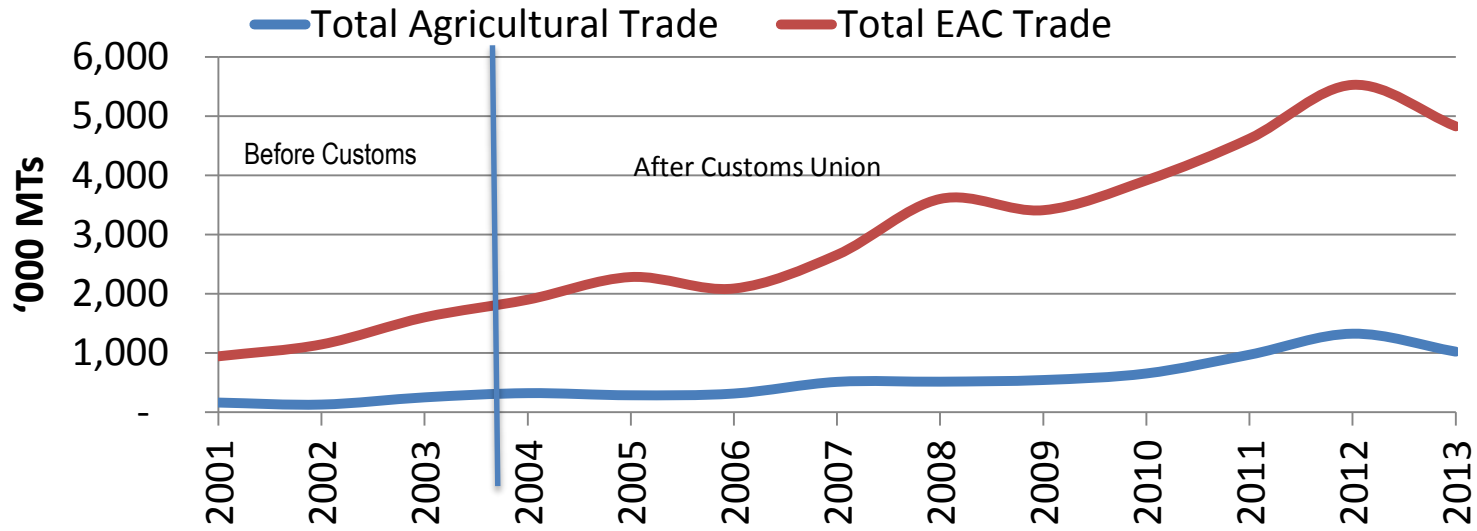
- Contributes over 30 % GDP
- 60 % of employment
- Foreign exchange earnings
- 80 % of the total population lives -rural areas
- 75 % involved in agriculture

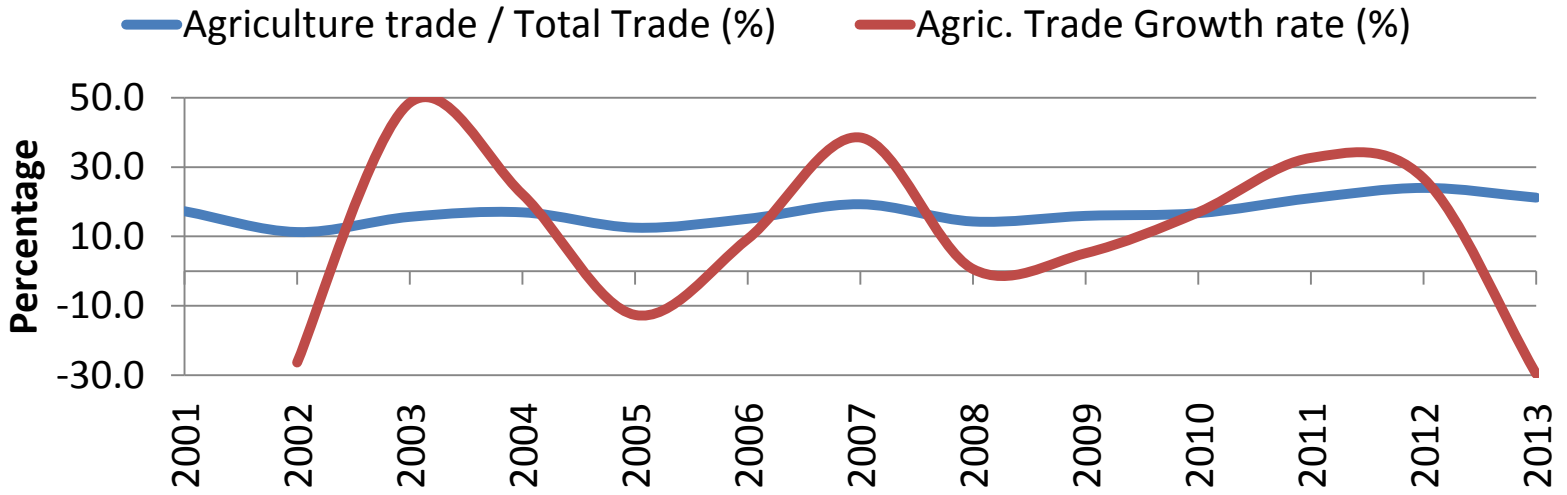
EAC maize production, imports, exports and consumption



- Yield gap
- Food and nutrition insecurity – hidden hunger
- Poverty
- Population

Agricultural Trade in the EAC





Objectives

1. Explore the spatial effects of climate change on agricultural production and food security in the East African Community region, examining current medium as well as long-term effects

2. Explore the Implications on regional agricultural policy across political boundaries, within and across national boundaries

3. Examine the potential trade effects of climate change on food security in the EAC region

Methods

1. Spatial and temporal effects of climate change

- Downscaled CORDEX models
- Historical-1971 to 2000, Scenarios 2016 to 2045 as mid century and 2071 to 2100 as end century
- Projections use Representative Concentration Pathways (RCPs) scenario 4.5wm^2 and 8.5wm^2

1.1 Spatial effects of climate change on agricultural production

APSIM Crop model in simulating crop production in EAC

Methods

2. Explore the Implications on regional agricultural policy across political boundaries, within and across national boundaries

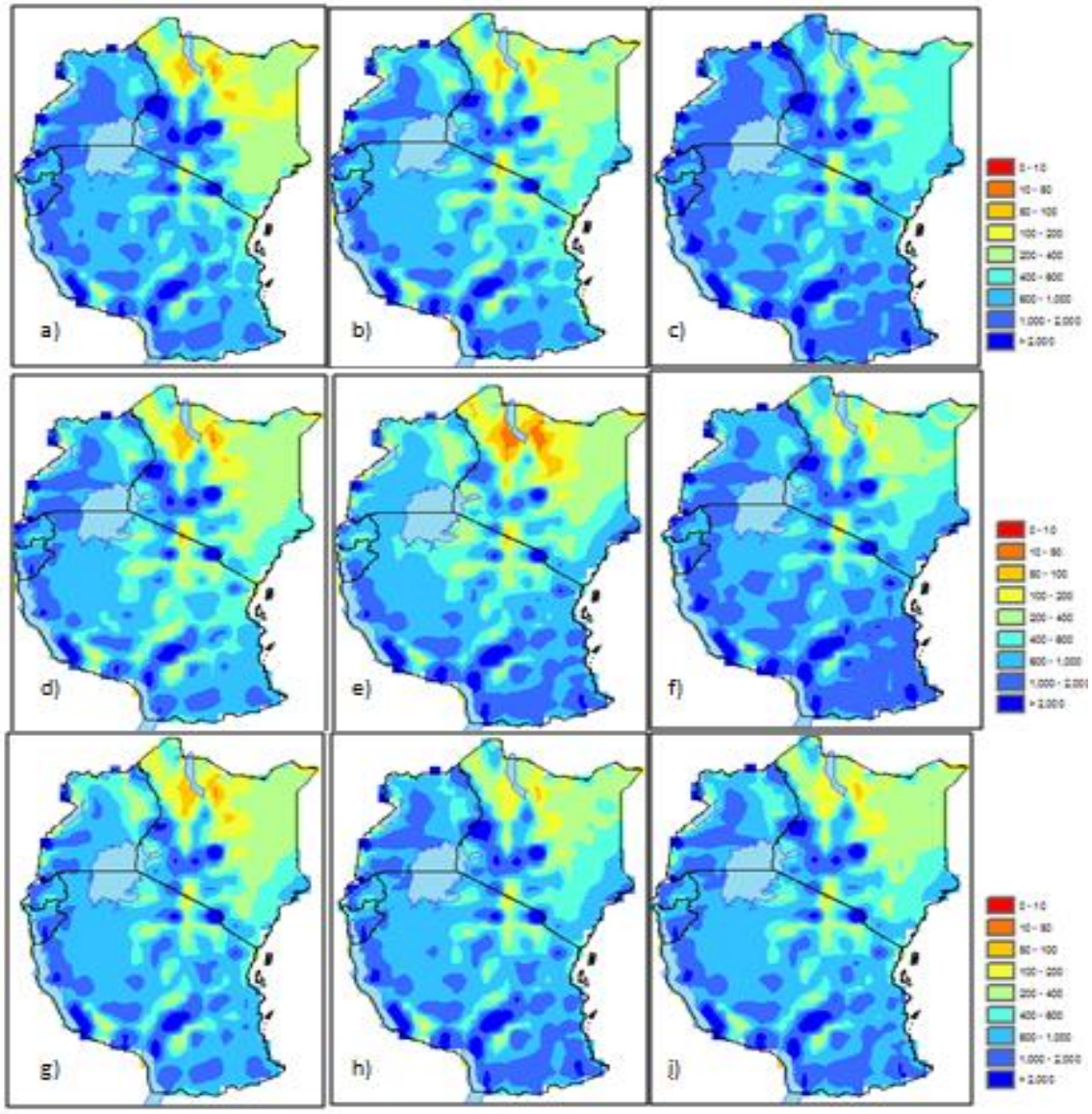
- Supply response models for different crops with and without CC
- Partial Equilibrium Model: Maximize Consumer and Producer Welfare
  - With CC
  - With CC and Policy change

3. Examine the potential trade effects of climate change on food security in the EAC region

CGE models

- The base scenario -no climate change
- Scenario 1: where there are productivity changes due to temperature changes accompanied by an intra EAC export/import ban.
- Scenario 2: where there are productivity changes due to rainfall changes accompanied by an intra EAC export/importban.

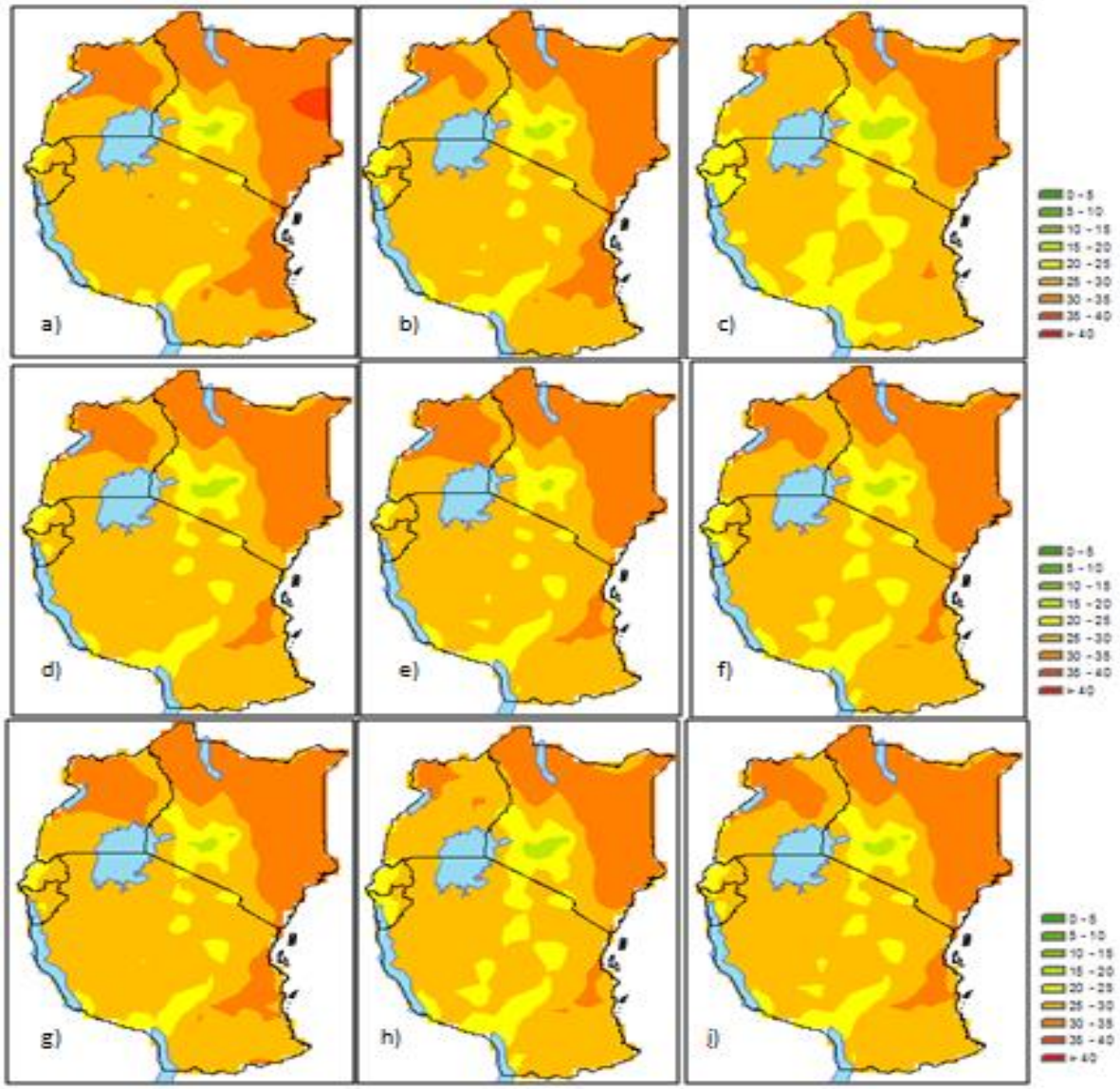
Spatial Analysis of Baseline Climate



Annual precipitation over EAC (1971 -2000)

a) CCCma
b) CNRM
c) ICHEC
d) MIROC
e) MOHC
f) MPI
g) NCC
h) NOAA
i) Ensemble CORDEX RCMs

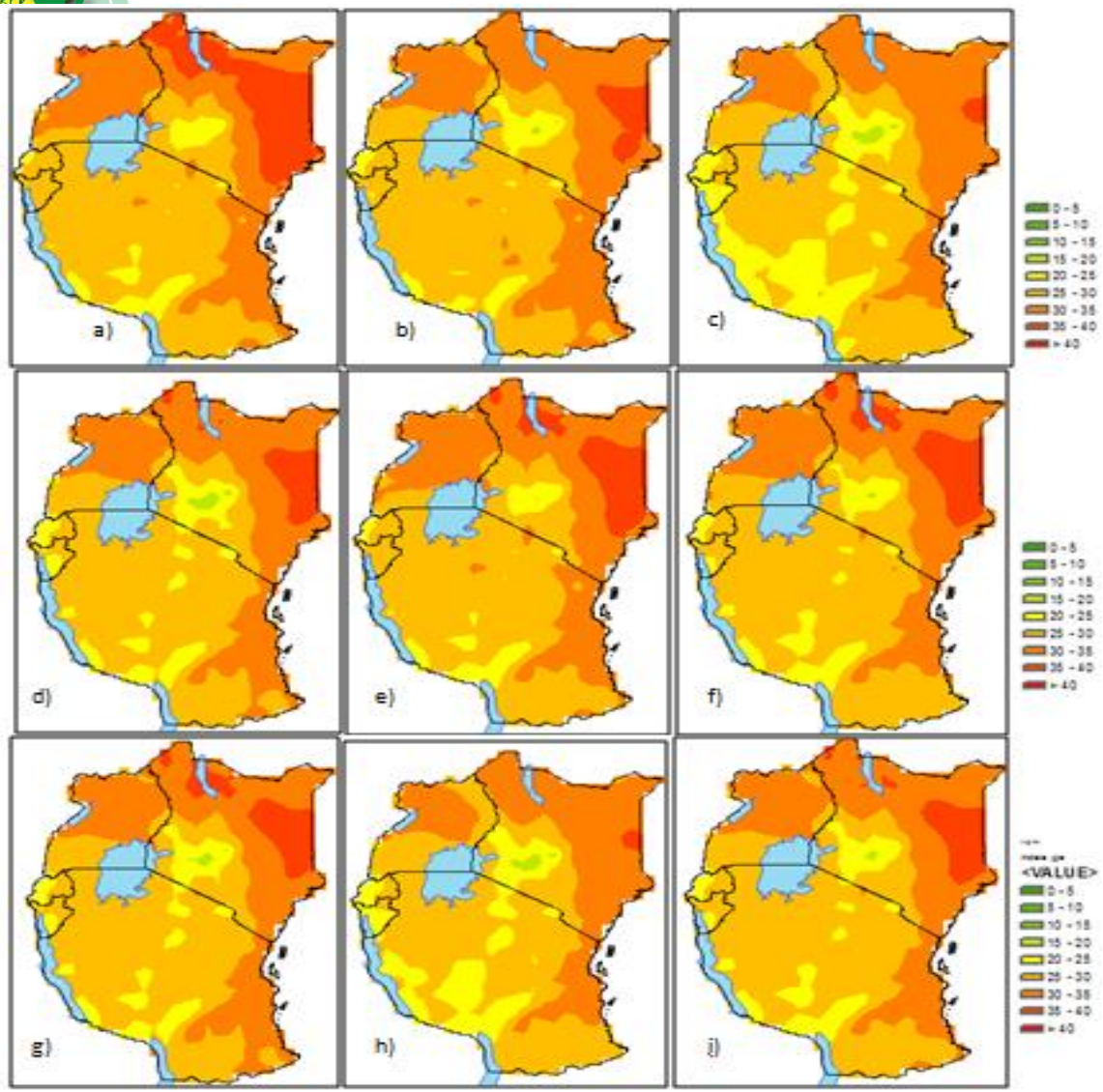
Spatial Analysis of Baseline Climate



Annual Maximum Temperature over EAC

a) CCCma
b) CNRM
c) ICHEC
d) MIROC
e) MOHC
f) MPI
g) NCC
h) NOAA
i) Ensemble CORDEX RCMs

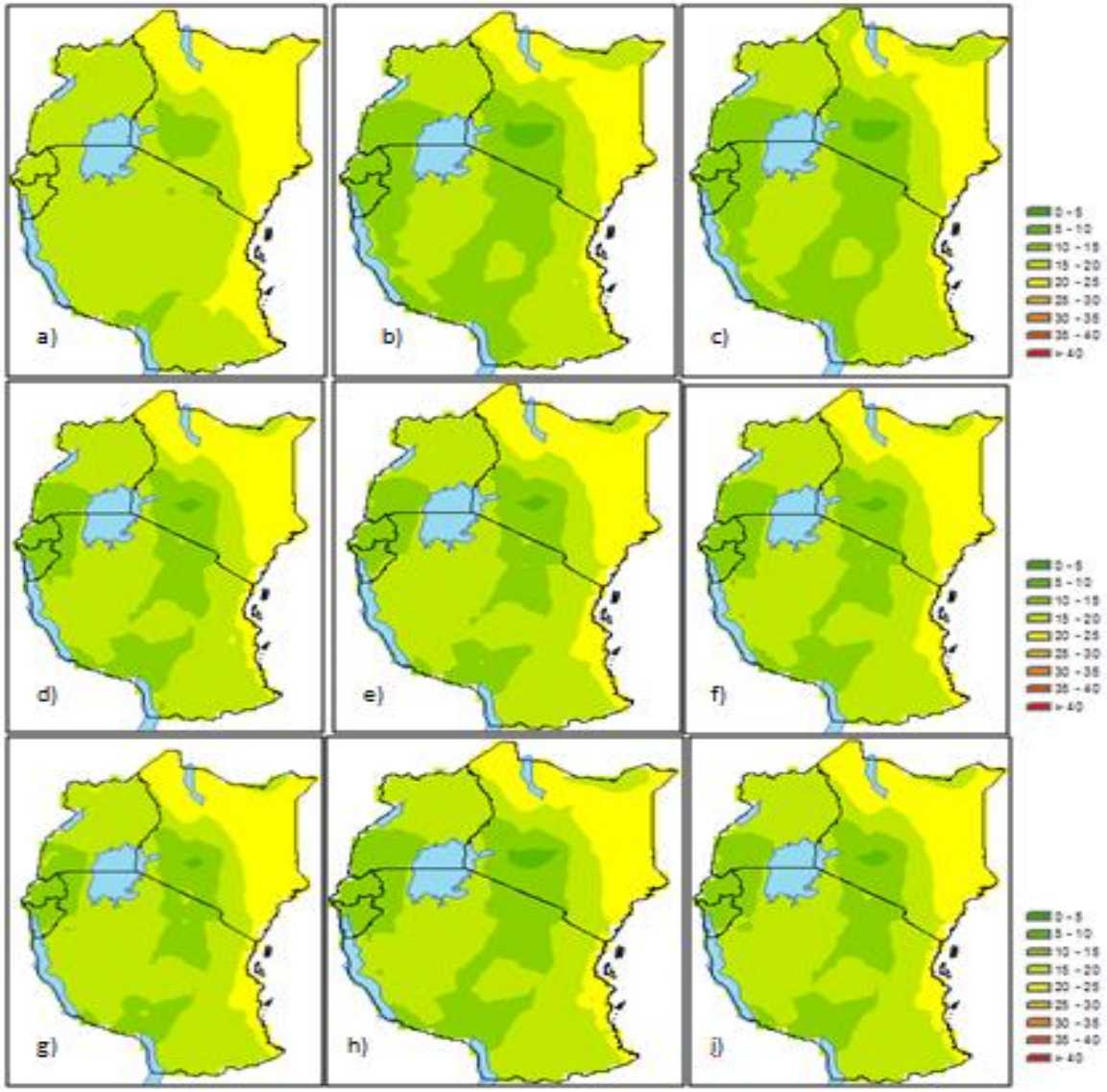
Spatial Analysis of Baseline Climate



DJF Maximum Temperature over EAC

a) CCCma
b) CNRM
c) ICHEC
d) MIROC
e) MOHC
f) MPI
g) NCC
h) NOAA
i) Ensemble CORDEX RCMs

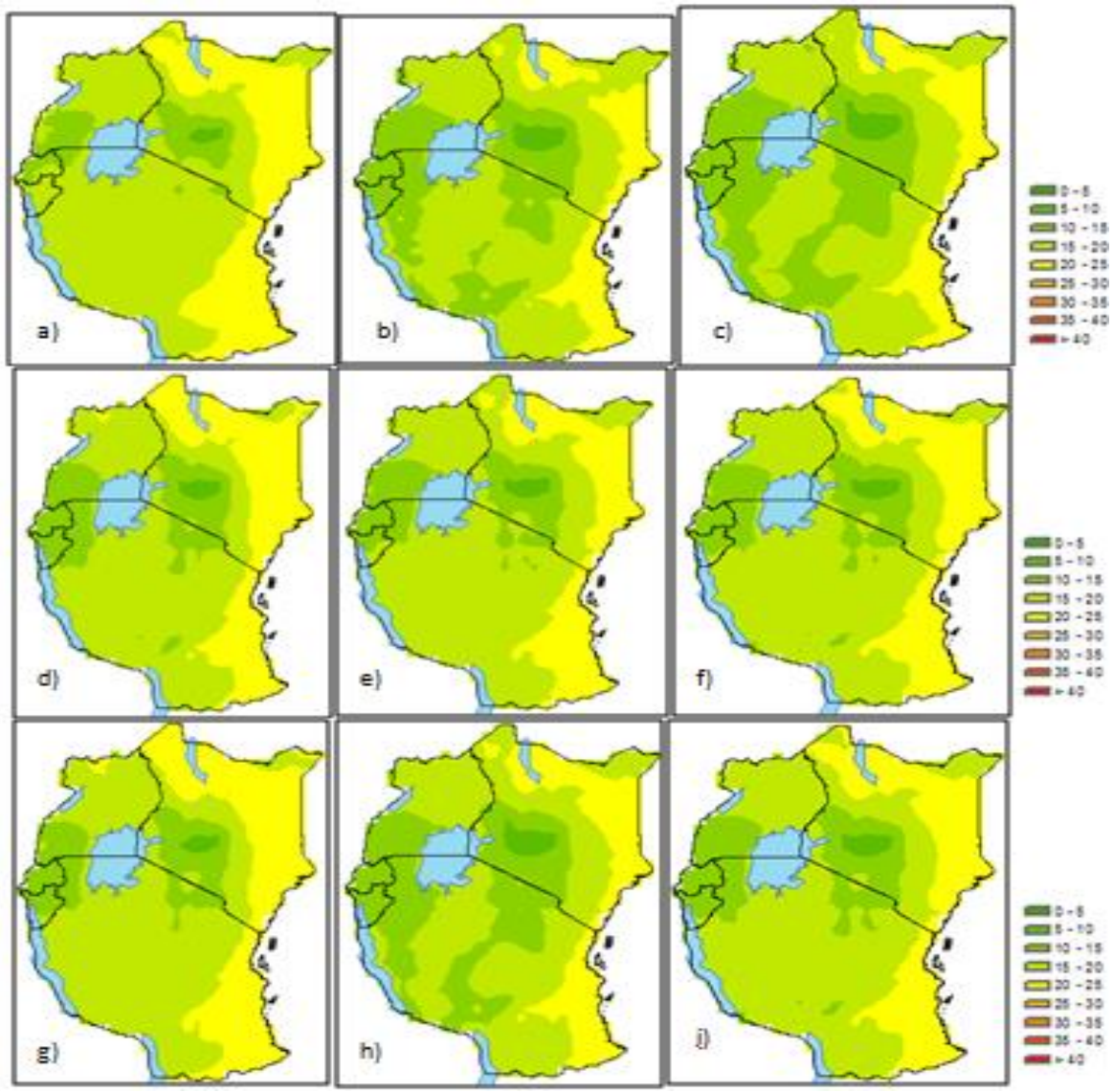
Spatial Analysis of Baseline Climate



Annual Minimum Temperature over EAC

a) CCCma
b) CNRM
c) ICHEC
d) MIROC
e) MOHC
f) MPI
g) NCC
h) NOAA
i) Ensemble CORDEX RCMs

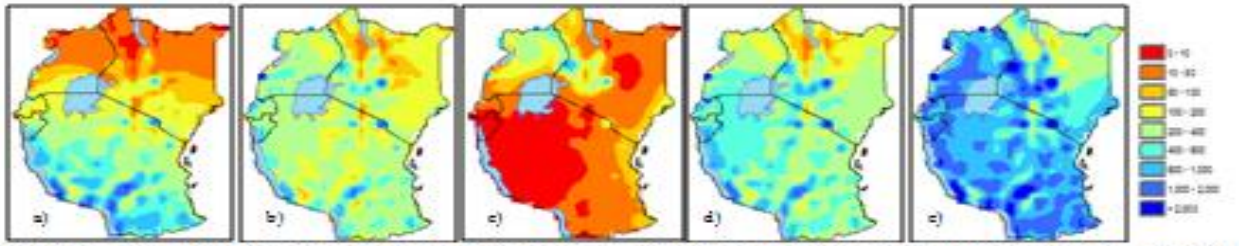
Spatial Analysis of Baseline Climate



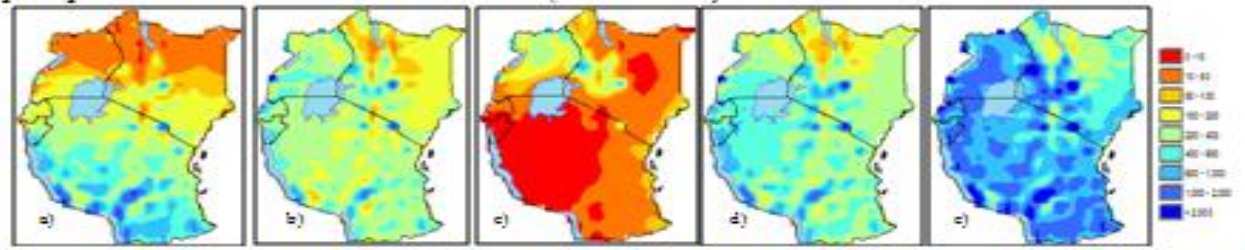
DJF Minimum Temperature over EAC

a) CCCma
b) CNRM
c) ICHEC
d) MIROC
e) MOHC
f) MPI
g) NCC
h) NOAA
i) Ensemble CORDEX RCMs

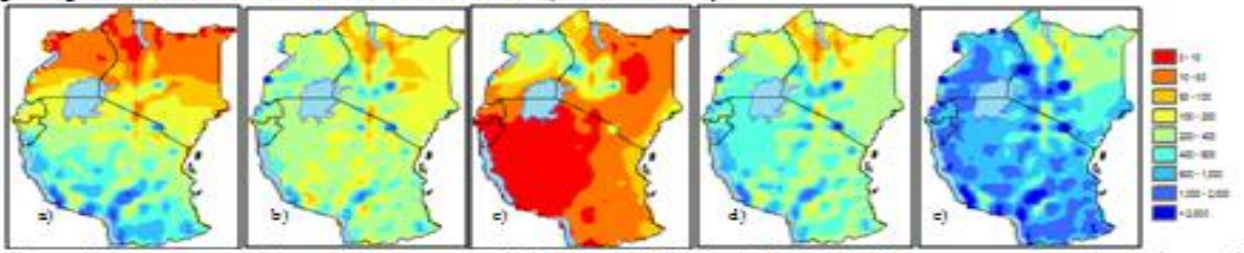
Spatial Analysis of Projected Precipitation



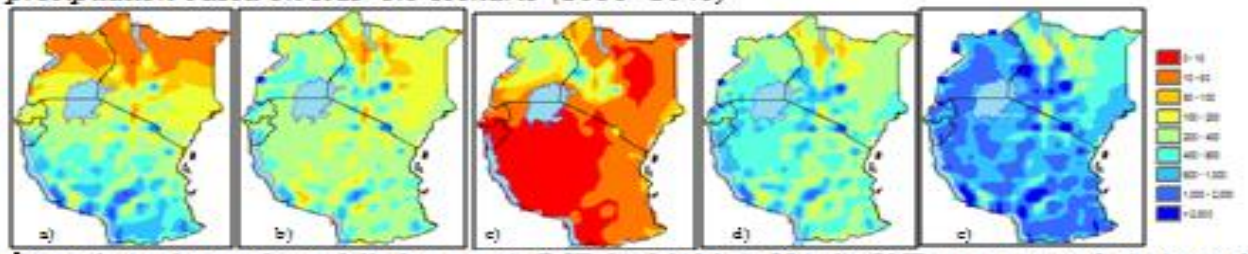
Spatial Analysis of rainfall during a) DJF b) MAM c) JJA d) OND seasons and e) Annual precipitation based on RCP 4.5 scenario (2016 -2045)



Spatial Analysis of rainfall during a) DJF b) MAM c) JJA d) OND seasons and e) annual precipitation based on RCP 4.5 scenario (2071 -2100)

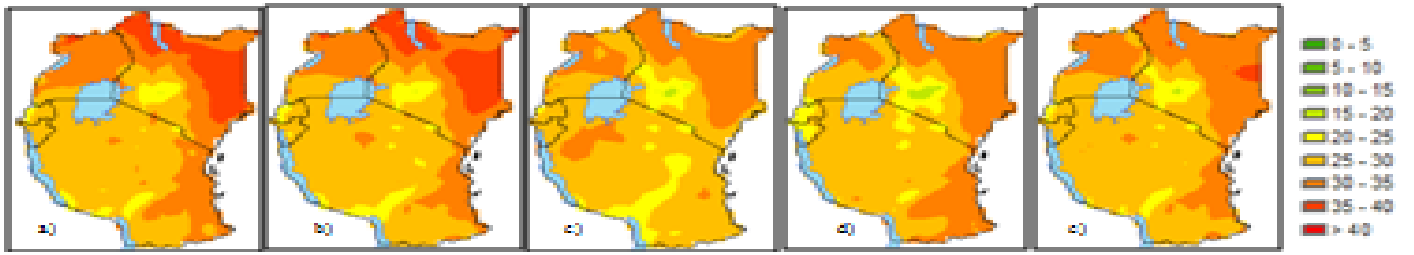


Spatial Analysis of rainfall during a) DJF b) MAM c) JJA d) OND seasons and e) Annual precipitation based on RCP 8.5 scenario (2016 -2045)

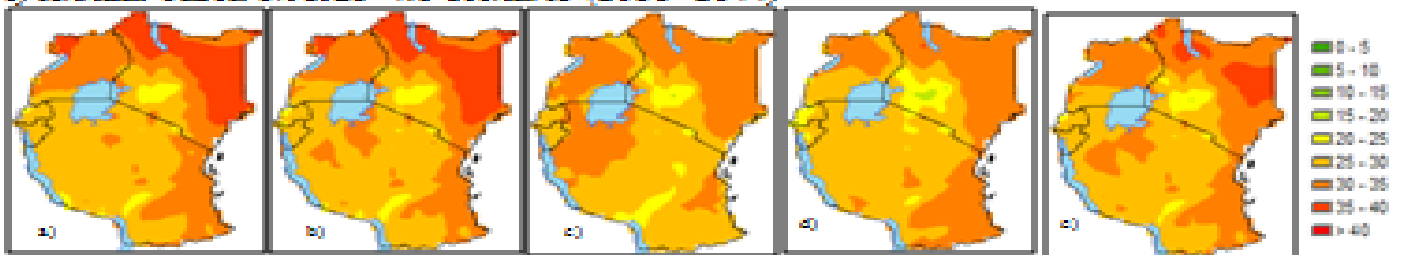


Spatial Analysis of rainfall during a) DJF b) MAM c) JJA d) OND seasons and e) Annual precipitation based on RCP 8.5 scenario (2071 -2100)

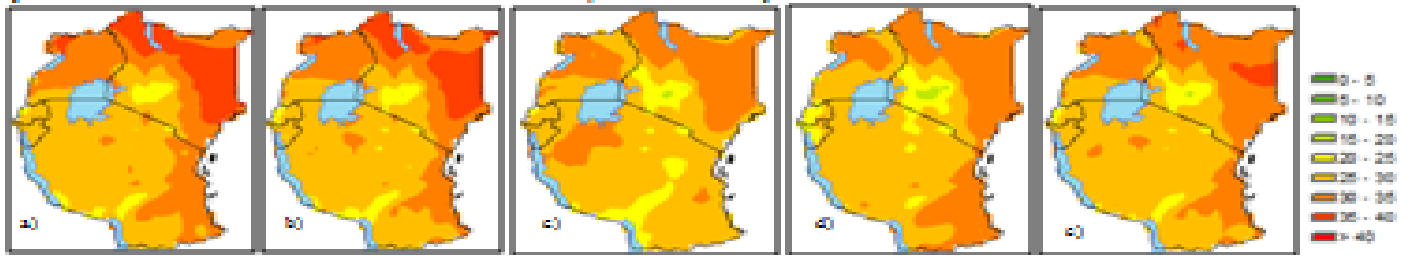
Spatial Analysis of Projected Max. Temperature



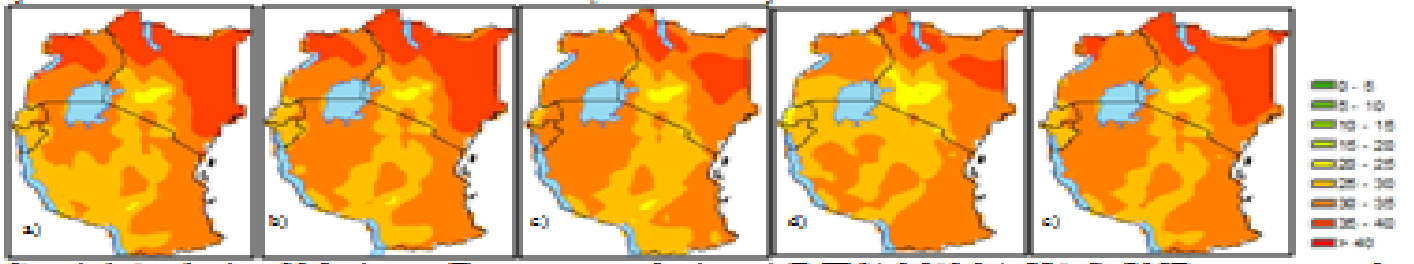
Spatial Analysis of Maximum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 4.5 scenario (2016 -2044)



Spatial Analysis of Maximum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 4.5 scenario (2071 -2100)

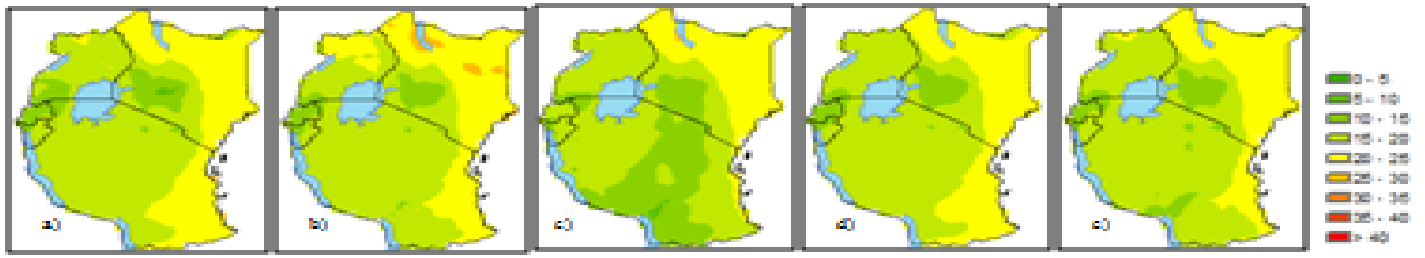


Spatial Analysis of Maximum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 8.5 scenario (2016 -2045)

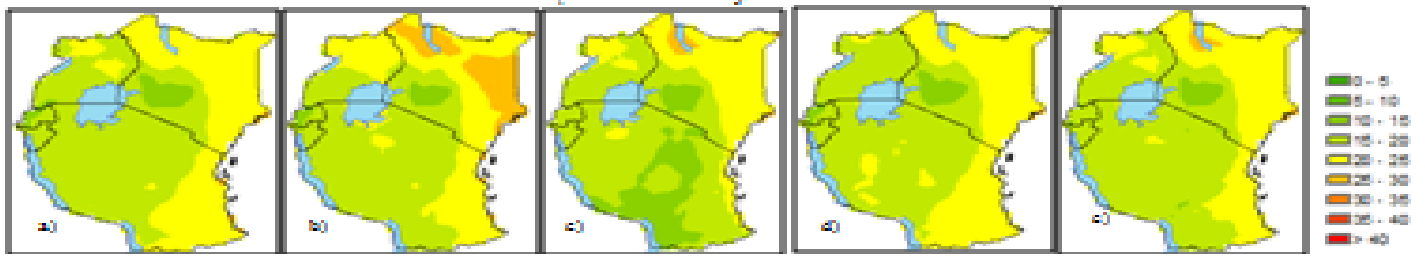


Spatial Analysis of Maximum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 8.5 scenario (2071 -2100)

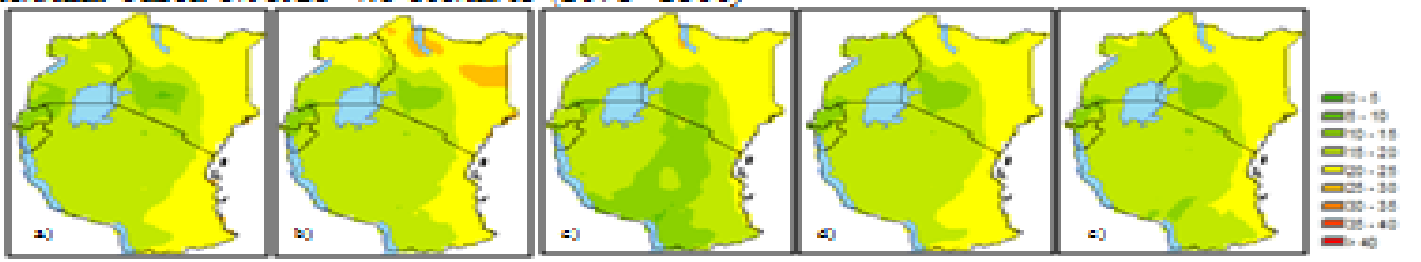
Spatial Analysis of Projected Min. Temperature



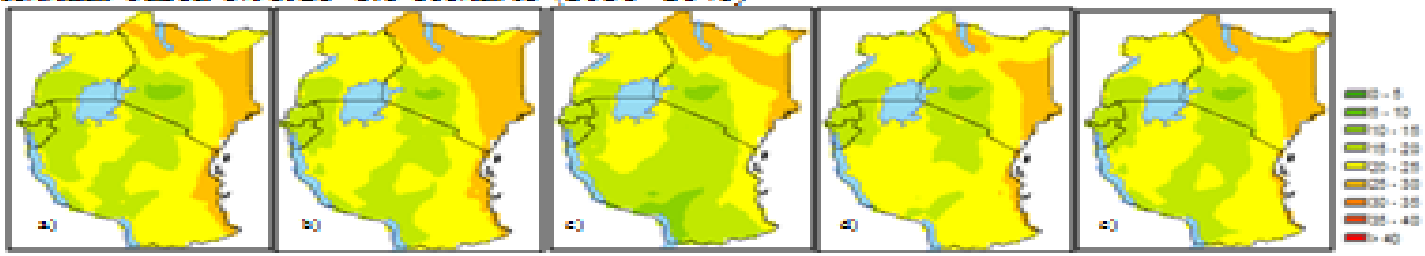
Spatial Analysis of Minimum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 4.5 scenario (2016 -2045)



Spatial Analysis of Minimum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 4.5 scenario (2071 -2100)



Spatial Analysis of Minimum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 8.5 scenario (2016 -2045)



Spatial Analysis of Minimum Temperature during a) DJF b) MAM c) JJA d) OND seasons and e) Annual based on RCP 4.5 scenario (2071 -2100)

Supply response elasticities for different crops in EAC

Crop	Country and Supply Response									
	Kenya		Rwanda		Burundi		Tanzania		**Uganda**	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	**LR**
Maize	0.54	0.73	0.061	1.97	0.16	0.25	0.25	1.96		**0.8**
Beans	0.20	0.81	0.16	0.63	0.19	0.25				
Rice	0.097	0.21	0.09	0.13	0.7	0.8				
Sorghum	0.68	1.04	0.13	0.34	0.11	0.32				
Millet	0.79	1.26	0.57	1.65	0.01	0.013				
Wheat	**0.197**	**0.21**	**0.59**	**2.31**	**0.81**	**1.10**				

NB:Due to lack of price data, the supply response estimates for Tanzania were estimated from literature.

Own Price elasticities of demand in EAC

Crop	EAC Partner States				
	Burundi	Kenya	Rwanda	Uganda	Tanzania
Sorghum	-0.29	-0.61	-0.41		
Wheat	-1.72	-0.10	-0.15		
Millet	-1.50	-1.19	-0.85		
Maize	-0.22	-0.18	-0.34		
Rice	-1.27	-0.04	-0.08		

Income elasticities of demand in EAC

Crop	EAC Partner States				
	Burundi	Kenya	Rwanda	Uganda	Tanzania
Sorghum	0.99	1.37	0.96		
Wheat	2.71	1.00	1.56		
Millet	0.03	0.11	0.61		
Maize	1.14	1.08	1.03		
Rice	1.71	0.76	1.11		

Policy Simulations

Expenditure and CV in EAC with price change (MT)

	EAC Partner States		
	Burundi	Kenya	Rwanda
Current Expenditure	3043.25	953.75	2312.88
Expenditure price increases	7212.49	2441.33	5435.27
Compensating Variation (CV)	4169.25	1287.57	3122.39

CCDA-V

ClimDev-Africa

Base and Future Production with climate change (MT)

Period	Crop	EAC Partner States		
		Burundi	Kenya	Rwanda
Base (2001-2010)	Maize	126,194	2,885,480	239,328
Future (2015-2045) without climate change		154,591	7,510,928	1,185,864
Future (2015-2045) with climate change		139,132	6,008,743	1,067,277

CCDA-V

ClimDev-Africa

Price change due to climate change

Variable	EAC Partner States		
	Burundi	Kenya	Rwanda
Base production	12,938	3,123,263	827,949
Future production with climate change	126,194	2,885,480	239,328
Producer price (US$/Ton)	0.1830	0.1562	0.2531
Supply Elasticity	0.25	0.73	1.97
Percent Price Change	7.50	23.16	44.45

Expenditure and CV in EAC with climate change

Crop	EAC Partner States		
	Burundi	Kenya	Rwanda
Current Expenditure (/MT)	3043.25	953.75	2312.88
Expenditure with climate change (/MT)	6208.22	2050.56	4926.43
Compensating variation	3164.97	1096.82	2613.55

Summary

- The rainfall pattern over eastern Africa is highly variable both in space and time
- Precipitation has decreased over EAC between March and May.
- Projected precipitation increased especially during OND and MAM seasons
- Temperature fields are well represented by the all the CORDEX RCMs and the ensemble.

Summary

Climate change: **Maize**

Kenya

- maize prices by 23%
- expenditure to increase to Ksh. 2051.
- Compesation Variation Ksh. 1097 -115%.

Burundi,

- the current expenditure is BFr. 3043 increase to BFr. 6208
- Compensating variation of 3165, increment of 104%

Rwanda,

- increase expenditure to RFr. 4926 from the current RFr. 2313.
- Compensating variation of RFr. 2614, an increase of 113%

Conclusions

- The yields gaps in the region are wide – room for productivity gains.
- Trade policies in the region should not impede smooth flow of imports and exports in the region.
- Agricultural policies in individual countries influence – the practice of agriculture and input use
- Climate change is a global phenomenon, potential effects are not expected to be uniform; they are unevenly distributed, both between and within countries.