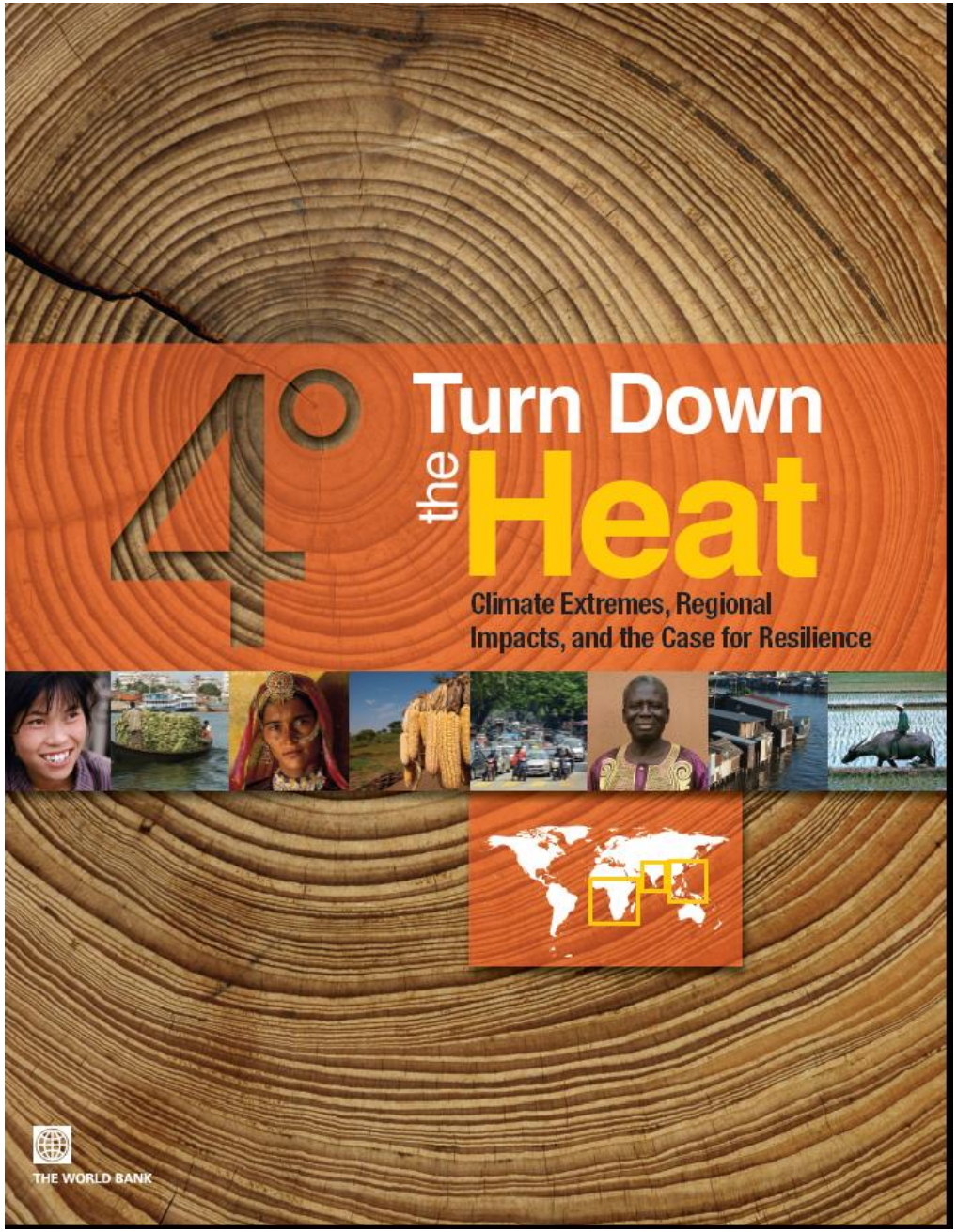
PRISE
Pathways to resilience in semi-arid economies

Projected climate change in Kenya ASALs

Mohammed Y Said[1,2], Joseph Muhwanga[1], Claire Bedelian[3], Liz Carabine[4], Simon Nderitu[5], Stephen Moiko[1], Joanes Atela[6] and Robina Abuya[1]

[1]Kenya Market Trust (KMT)
[2]REAM Consultant
[3]University College of London,
[4]Overseas Development Institute
[5]Strathmore University
[6]ACTs

PRISE County Workshops
16th February 2018, Nanyuki, Kenya



The Climate Agenda

Droughts in Kenya

What are the big issues in ASALs?

- Population increases – exponentially – 12.6 million 2009 and by 2030 will be almost doubled to 22.2 million people (based on national population growth rate of 2.7%).
- Projected changes – increase in temperature, more variability in rainfall and extreme events (droughts and flood)
- A 3°C global warming savannas are projected to decrease to approximately one-seventh of total current land area - reducing the availability of forage for grazing animals (World Bank 2013).
- Changes in livestock – herd structure, composition, breeds, …… (PRISE Project 3)
- Poor livestock marketing ….. (PRISE Project 3, 4 and 5)
- Poverty – lack of infrastructure (fodder, water, ..) PRISE Project 3, 5

Historical Climate Changes - ASALs

Rainfall

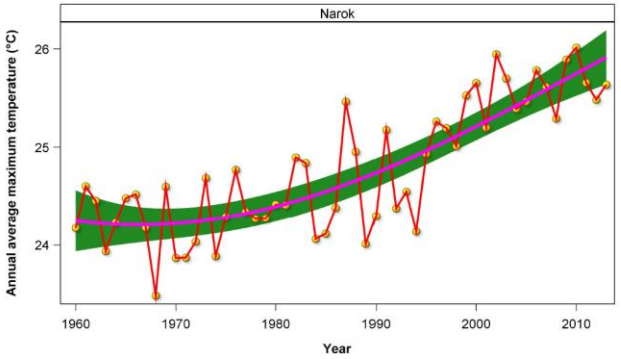
✓General decline in rainfall in 15 out of 21 ASALs counties except for Narok, Baringo, Laikipia, Turkana, West Pokot and Elgeyo Marakwet – rainfall declined then increase in in the last few years.

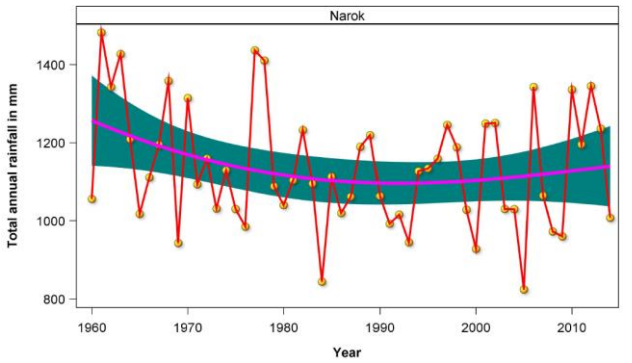
Temperature

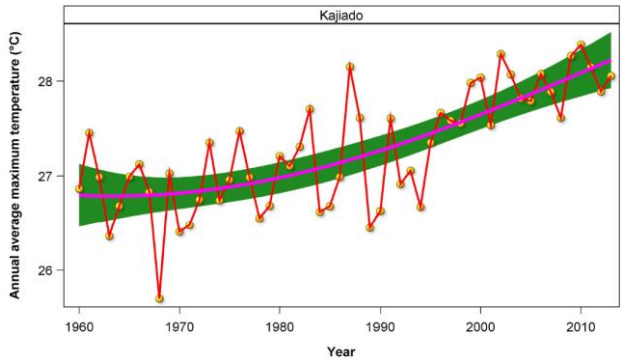
All 21 ASALs counties showed increase in temperature in the last 50 years

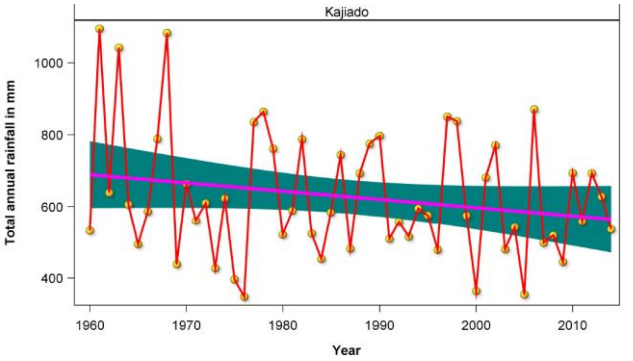
✓5 Counties surpassing the 1.5^{o}C increase are Turkana (1.8^{o}C), West Pokot, Elgeyo Marakwet (1.91^{o}C), Baringo (1.8^{o}C), Laikipia (1.59^{o}C) and Narok (1.75^{o}C).

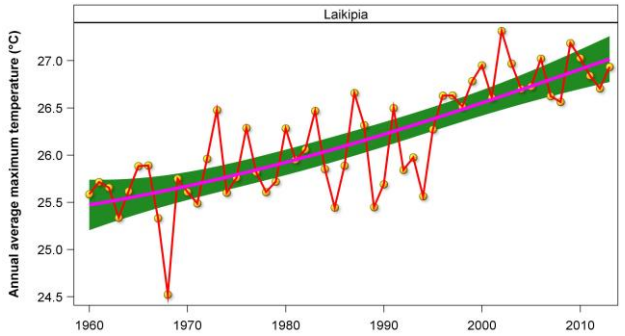
Rainfall and Temperature changes 1960-2013

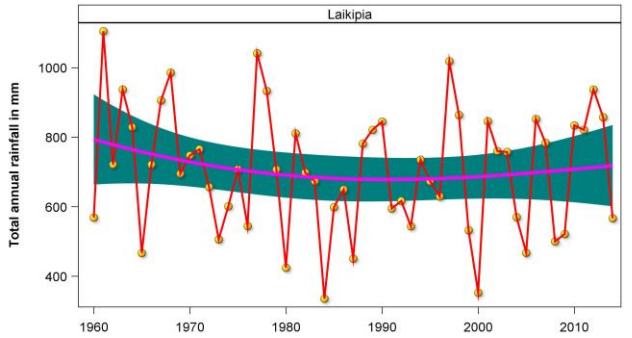


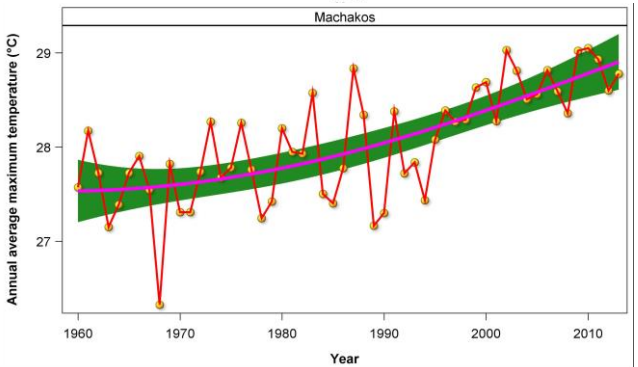


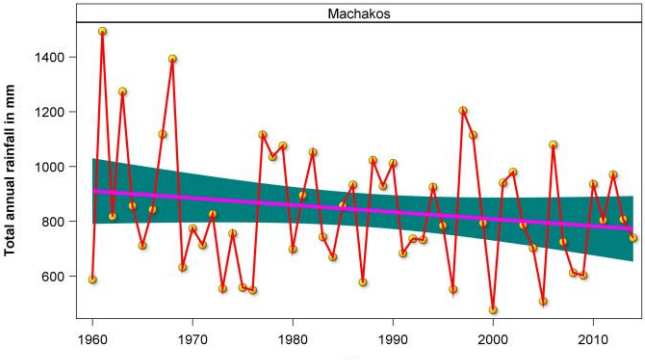








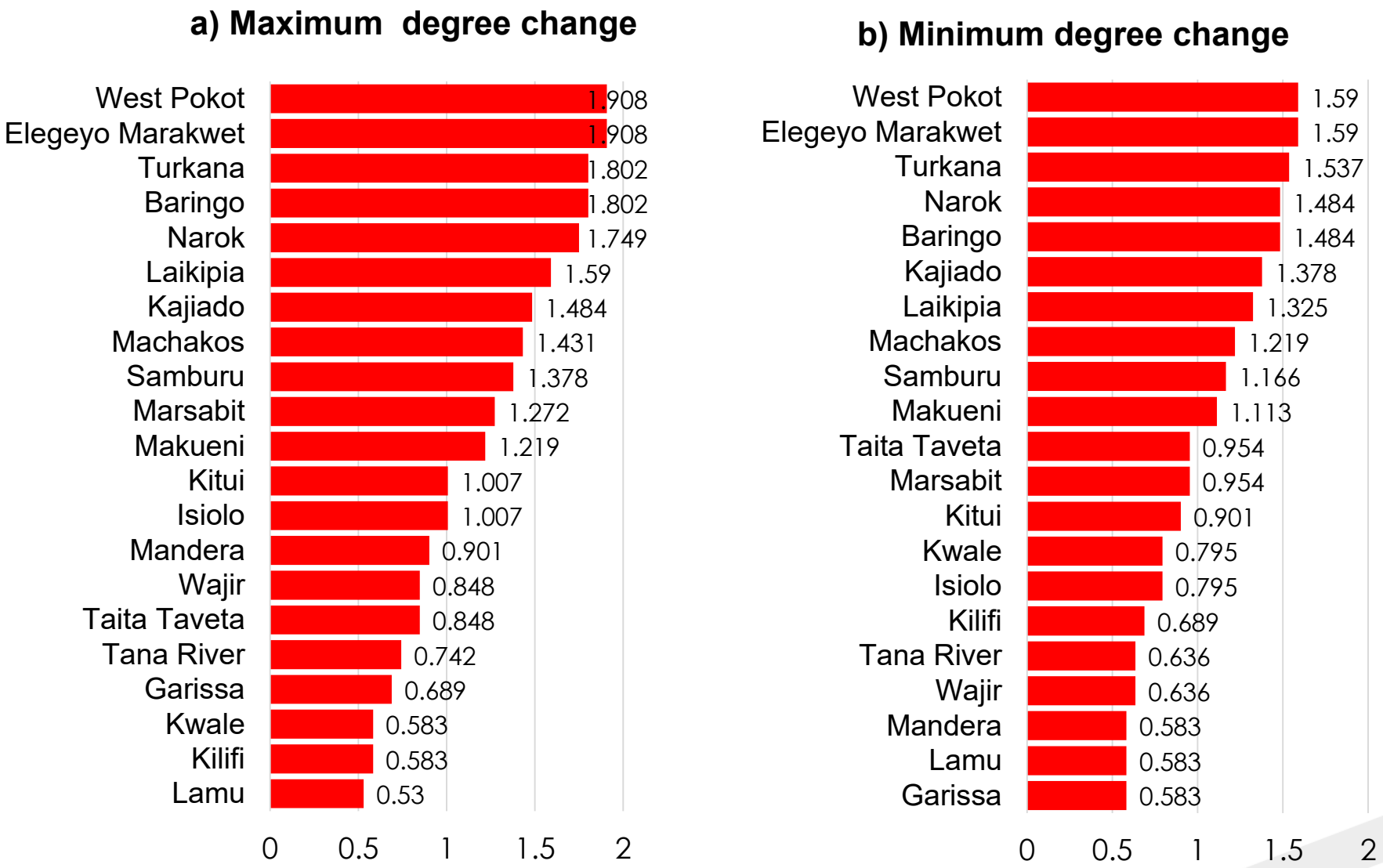




Source: Ogutu et al., 2016

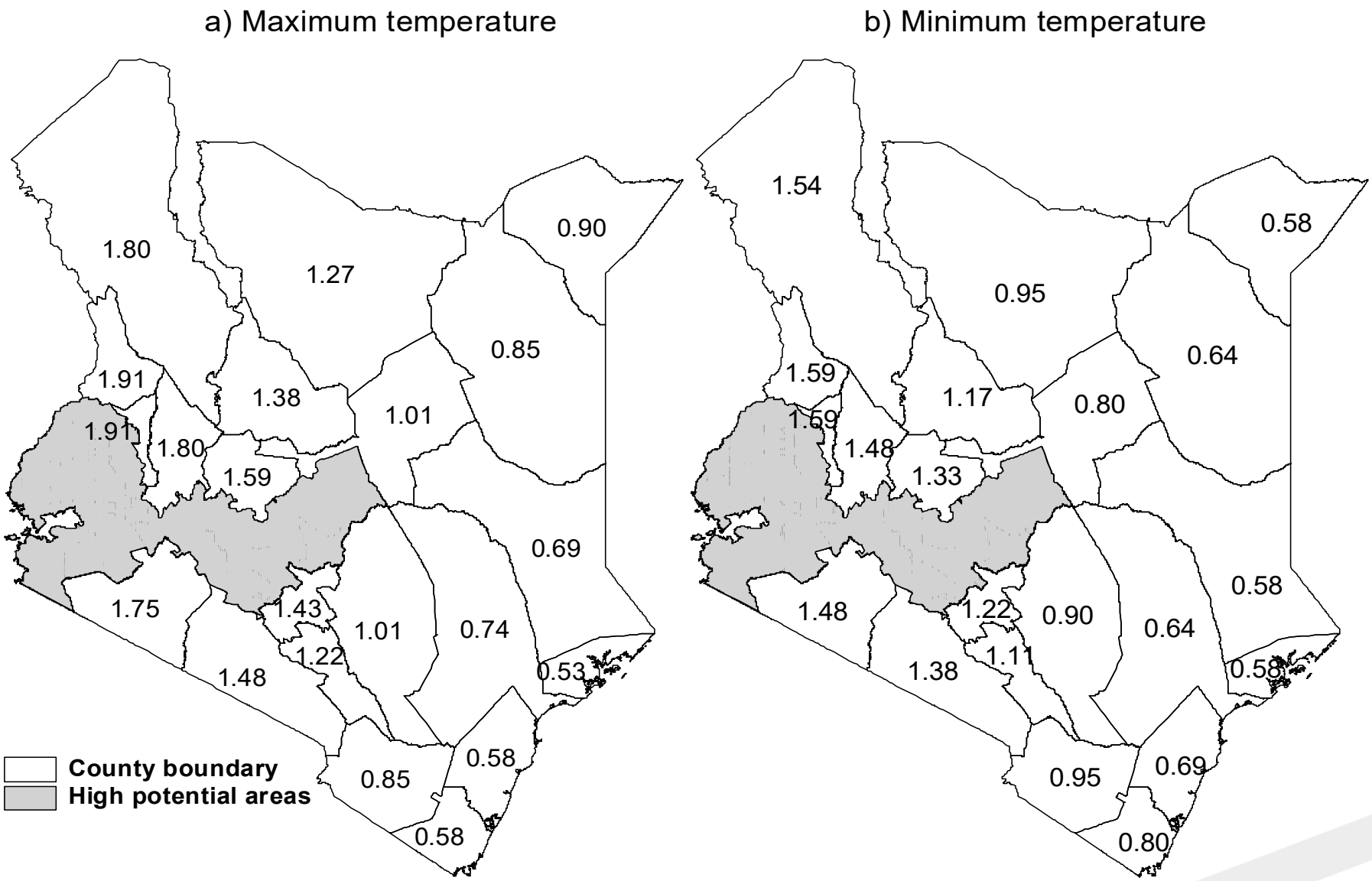
Temperature Changes in the ASAL

PRISE
Pathways to resilience in semi-arid economies



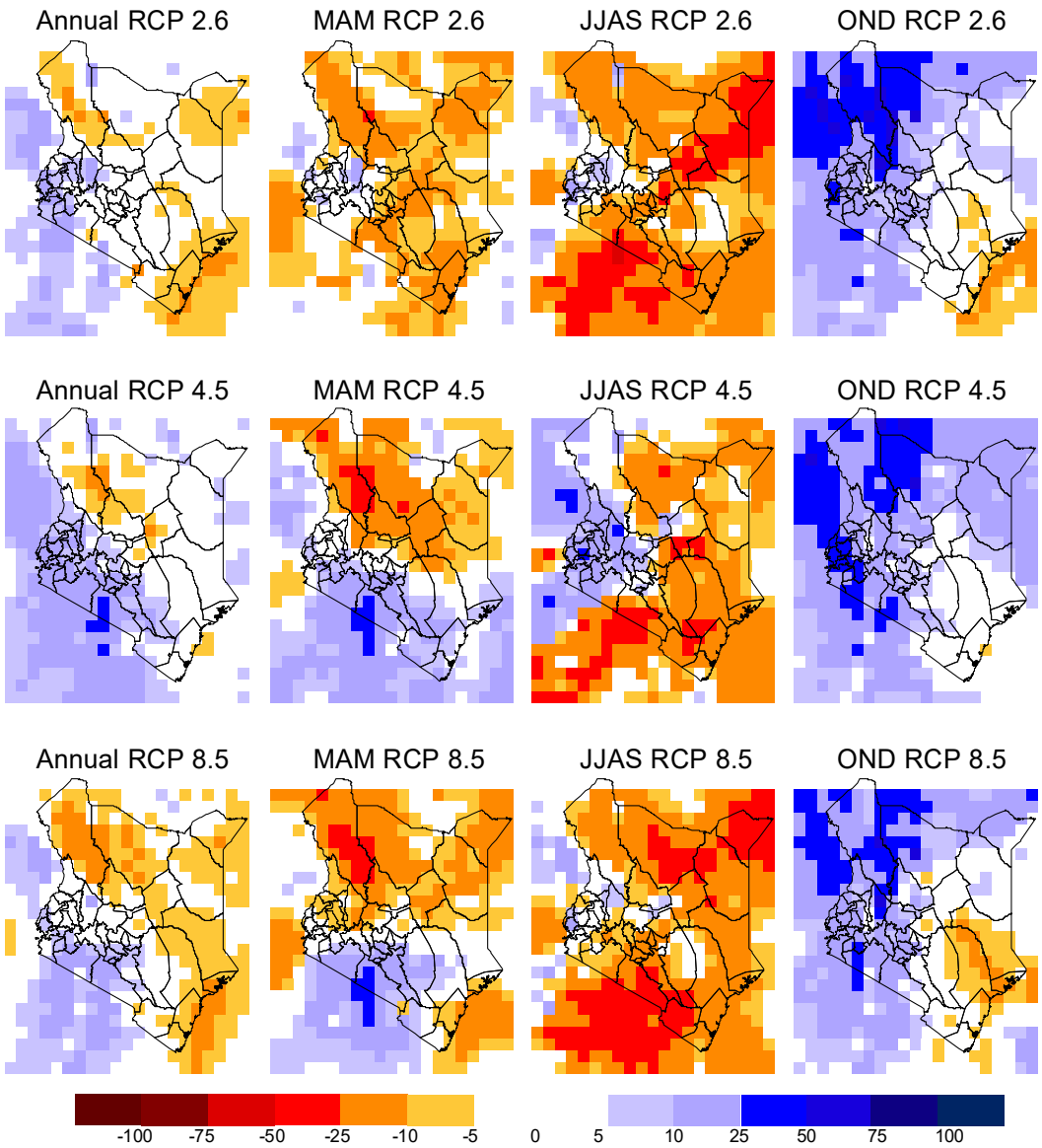
Said et al., 2017 PRISE report

Temperatures changes in the Kenya arid and semi-arid lands between 1960 and 2013



Said et al., 2017 PRISE report

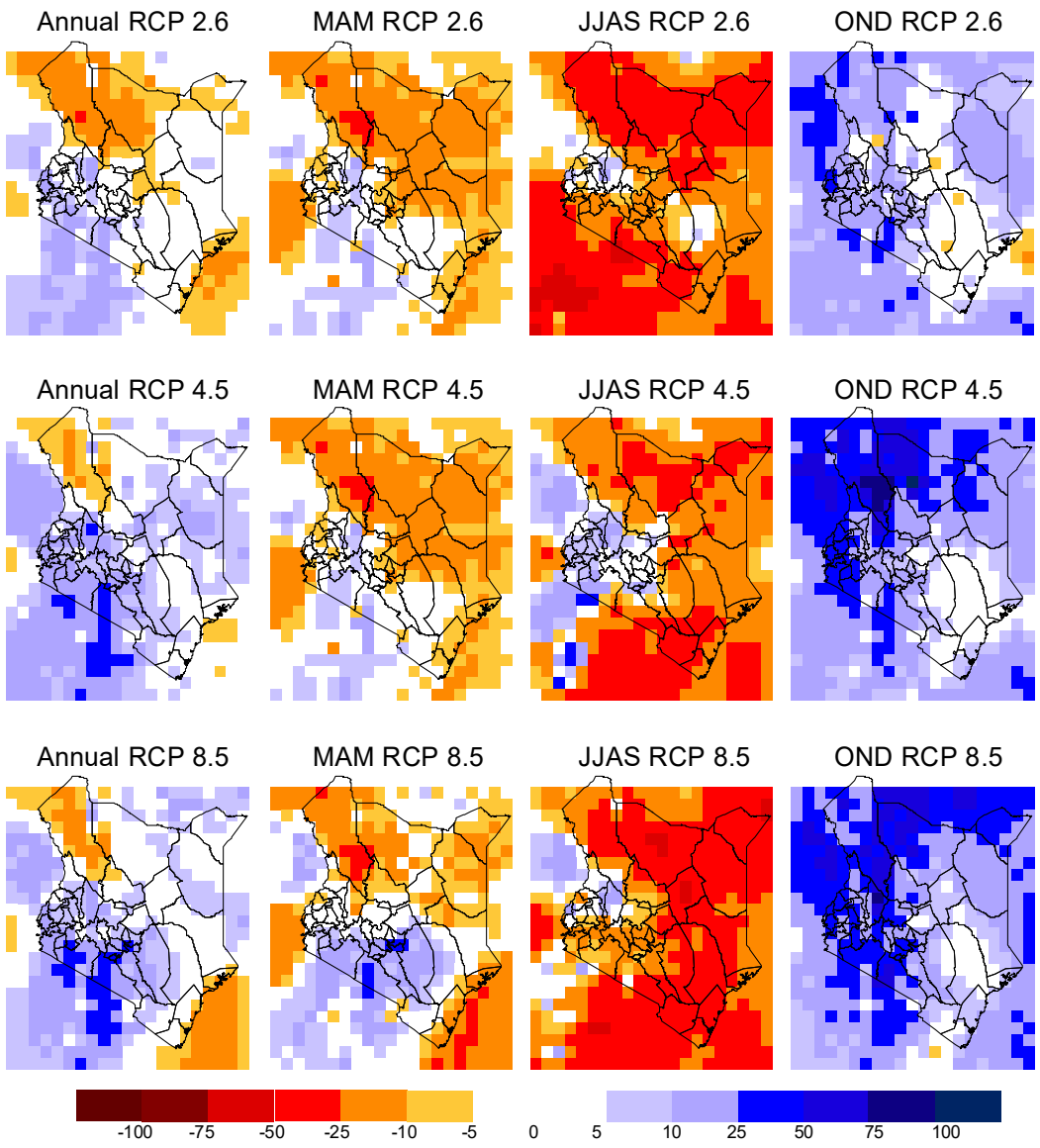
Projected rainfall and temperatures in Kenya ASALs



Projected rainfall changes in Kenya by 2030s for the 4 season – annual, MAM (March-April-May), JJAS (June-July-August-September), and OND (October-November-December).

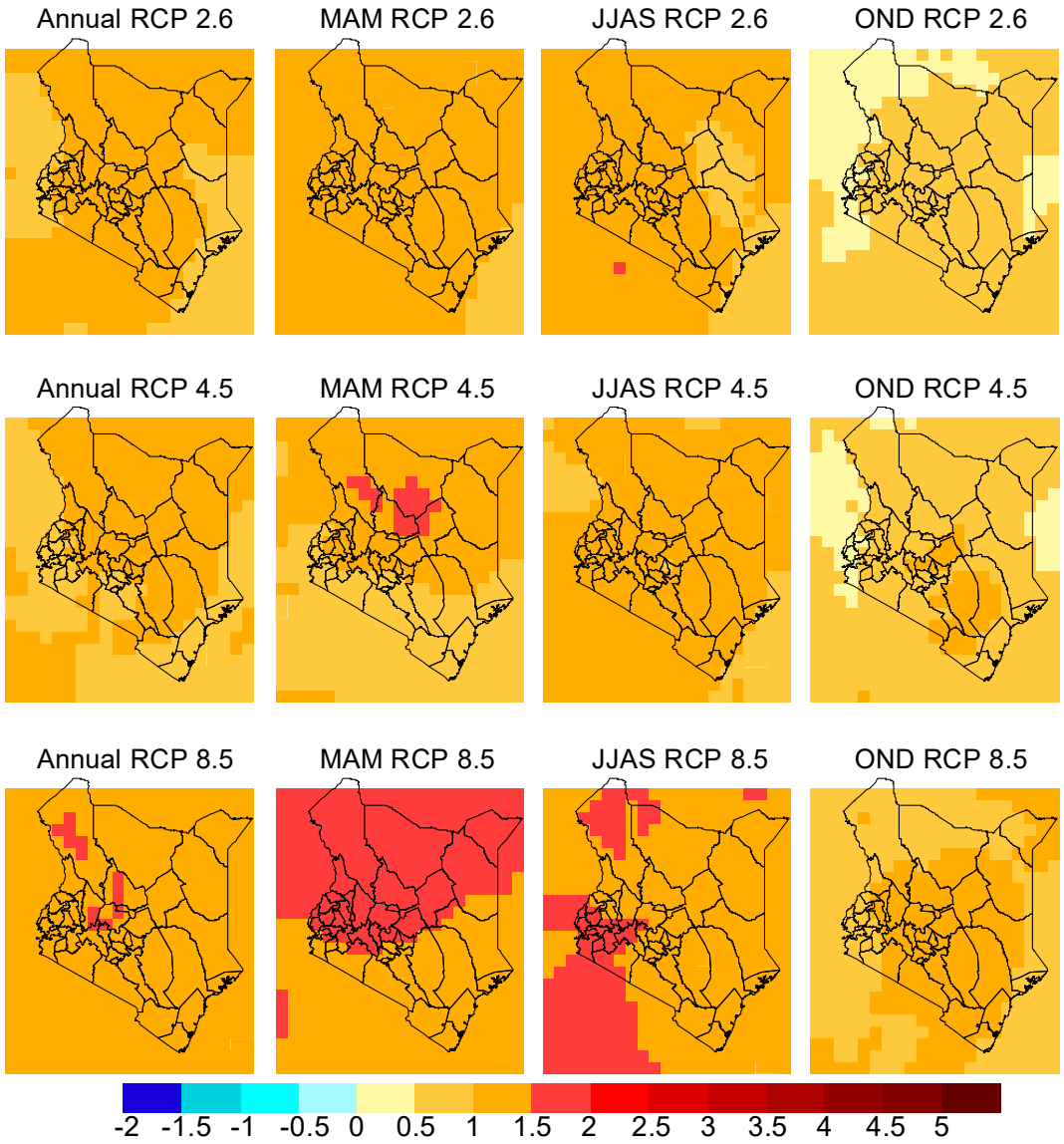
Source: Said et al., 2017 PRISE Report

PRISE
Pathways to resilience in semi-arid economies



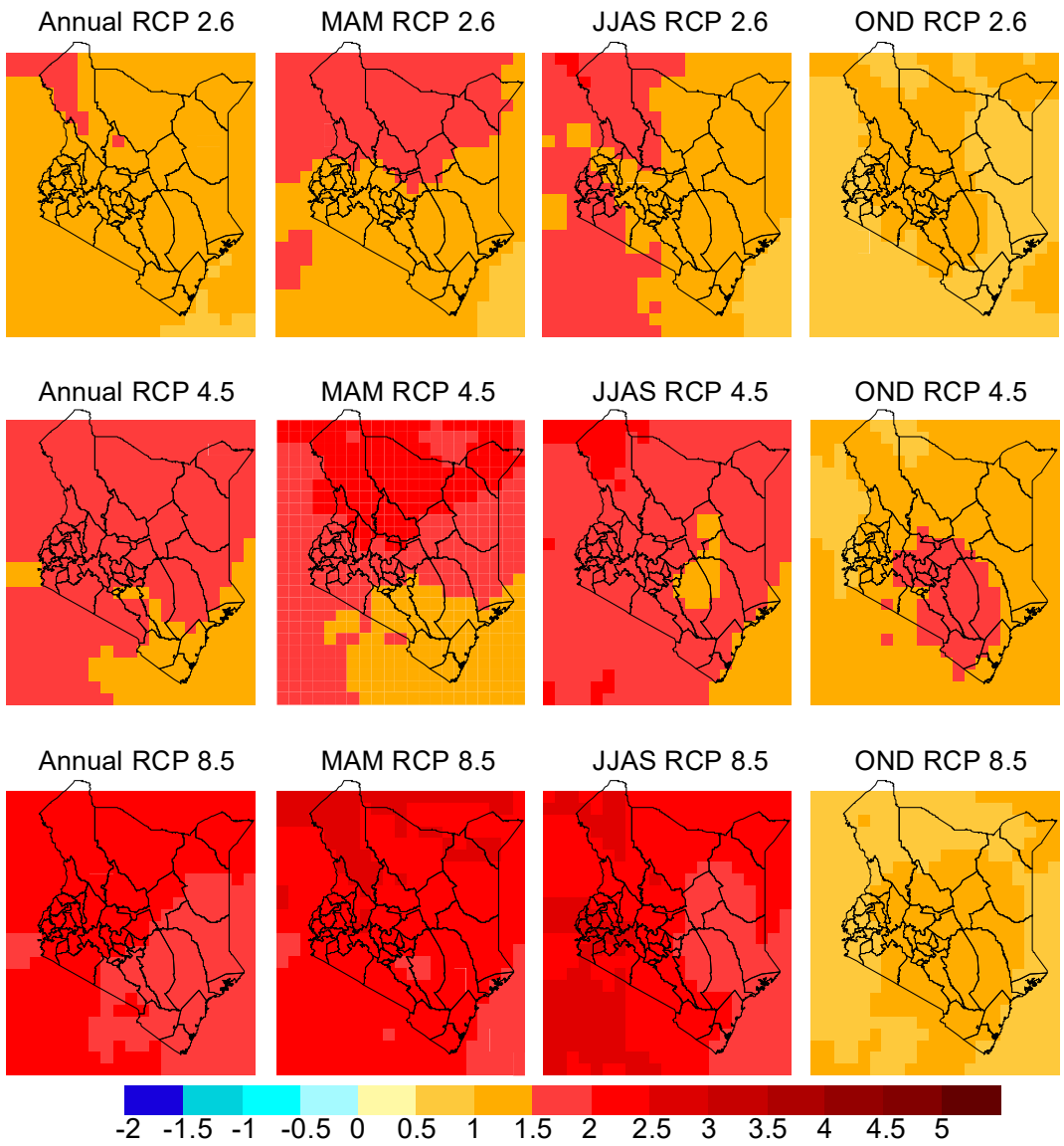
Projected rainfall changes in Kenya by 2050s for the 4 season – annual, MAM (March-April-May), JJAS (June-July-August-September), and OND (October-November-December).

Source: Said et al., 2017 PRISE Report



Projected maximum temperature changes in Kenya by 2030s for the 4 season – annual, MAM (March-April-May), JJAS (June-July-August-September), and OND (October- November-December). November-December).

Source: Said et al., 2017 PRISE Report



Projected maximum temperature changes in Kenya by 2050s for the 4 season – annual, MAM (March-April-May), JJAS (June-July-August-September), and OND (October- November-December). November-December).

Source: Said et al., 2017 PRISE Report

Potential climate impacts on Livestock

PLOS | ONE

RESEARCH ARTICLE

Extreme Wildlife Declines and Concurrent Increase in Livestock Numbers in Kenya: What Are the Causes?

Joseph O. Ogutu[1,2]*, Hans-Peter Piepho[1], Mohamed Y. Said[2,4,5], Gordon O. Ojwang[3], Lucy W. Njino[3], Shem C. Kifugo[2,6], Patrick W. Wargute[3]

1 University of Hohenheim, Institute for Crop Science-340, 70599, Stuttgart, Germany, **2** International Livestock Research Institute, P.O. Box 30709–00100, Nairobi, Kenya, **3** Directorate of Resource Surveys and Remote Sensing, P.O. Box 47146–00100, Nairobi, Kenya, **4** Kenya Market Trust, 14 Riverside, Cavendish Block 3rd Floor, Suite B, Riverside Drive P.O. Box 44817–00100, Nairobi, Kenya, **5** Center for Sustainable Drylands Ecosystems and Societies, University of Nairobi, P.O. Box 30197, 00100, Nairobi, Kenya, **6** Northern Rangelands Trust, Private Bag, Isiolo, 60300, Kenya

* jogutu2007@gmail.com

Citation: Ogutu JO, Piepho H-P, Said MY, Ojwang GO, Njino LW, Kifugo SC, et al. (2016) Extreme Wildlife Declines and Concurrent Increase in Livestock Numbers in Kenya: What Are the Causes? PLoS ONE 11(9): e0163249. doi:10.1371/journal.pone.0163249

Editor: Samuel Rezende Paiva, Embrapa, BRAZIL

Received: January 25, 2016

Accepted: September 5, 2016

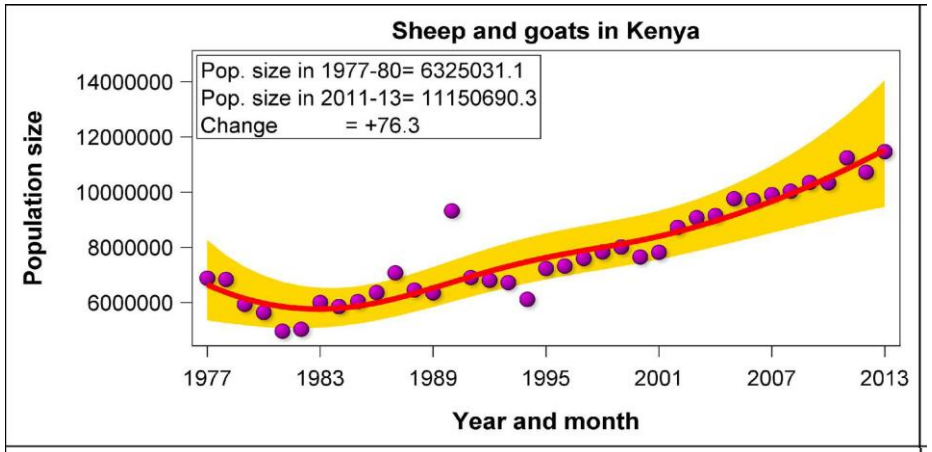
Published: September 27, 2016

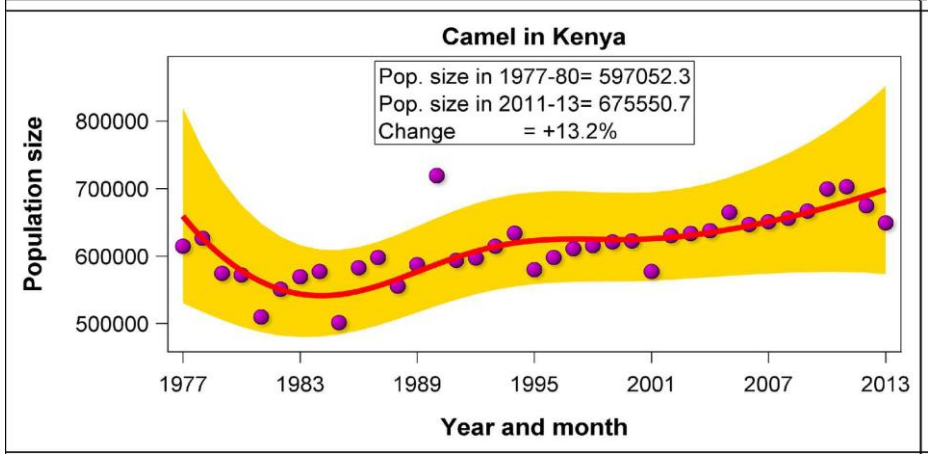
Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

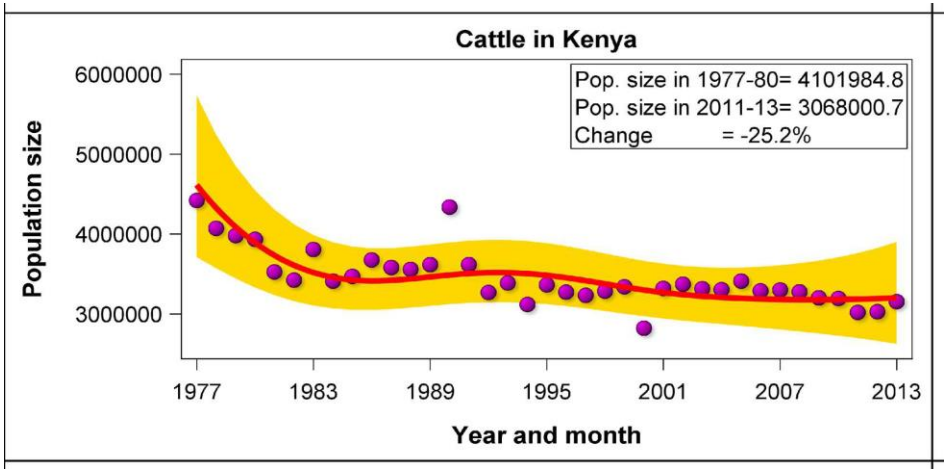
Funding: This work was supported by Deutsche Forschungsgemeinschaft grant to JOO (DFG, Grant # OG 83/1-1), and European Union's Horizon 2020 research and innovation programme, grant agreement No 641918 (JOO, HPP, MYS, GO, LN, PW). MYS was supported by the Pathways to

Abstract

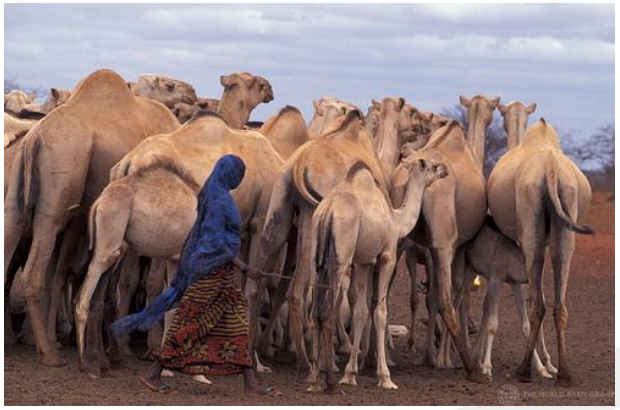
There is growing evidence of escalating wildlife losses worldwide. Extreme wildlife losses have recently been documented for large parts of Africa, including western, Central and Eastern Africa. Here, we report extreme declines in wildlife and contemporaneous increase in livestock numbers in Kenya rangelands between 1977 and 2016. Our analysis uses systematic aerial monitoring survey data collected in rangelands that collectively cover 88% of Kenya's land surface. Our results show that wildlife numbers declined on average by 68% between 1977 and 2016. The magnitude of decline varied among species but was most extreme (72–88%) and now severely threatens the population viability and persistence of warthog, lesser kudu, Thomson's gazelle, eland, oryx, topi, hartebeest, impala, Grevy's zebra and waterbuck in Kenya's rangelands. The declines were widespread and occurred in most of the 21 rangeland counties. Likewise to wildlife, cattle numbers decreased (25.2%) but numbers of sheep and goats (76.3%), camels (13.1%) and donkeys (6.7%) evidently increased in the same period. As a result, livestock biomass was 8.1 times greater than that of wildlife in 2011–2013 compared to 3.5 times in 1977–1980. Most of Kenya's wildlife (*ca.* 30%) occurred in Narok County alone. The proportion of the total "national" wildlife population found in each county increased between 1977 and 2016 substantially only in Taita Taveta and Laikipia but marginally in Garissa and Wajir counties, largely reflecting greater wildlife losses elsewhere. The declines raise very grave concerns about the future of wildlife, the effectiveness of wildlife conservation policies, strategies and practices in Kenya. Causes of the wildlife declines include exponential human population growth, increasing livestock numbers, declining rainfall and a striking rise in temperatures but the fundamental cause seems to be policy, institutional and market failures. Accord-



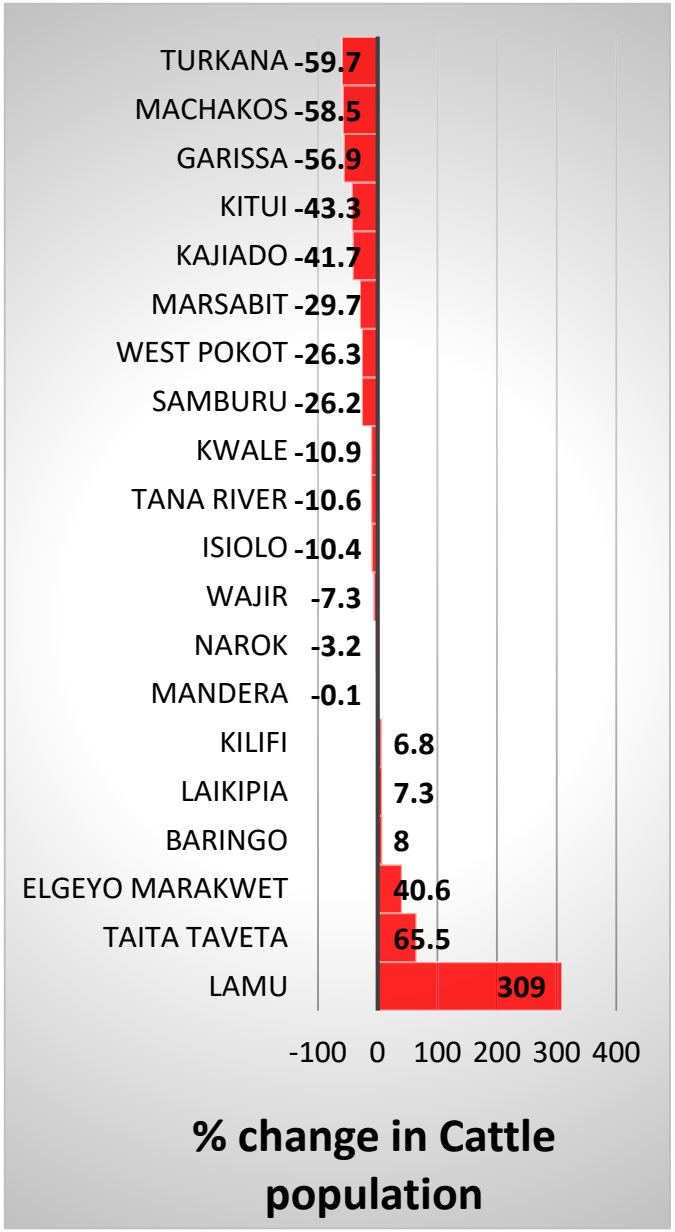


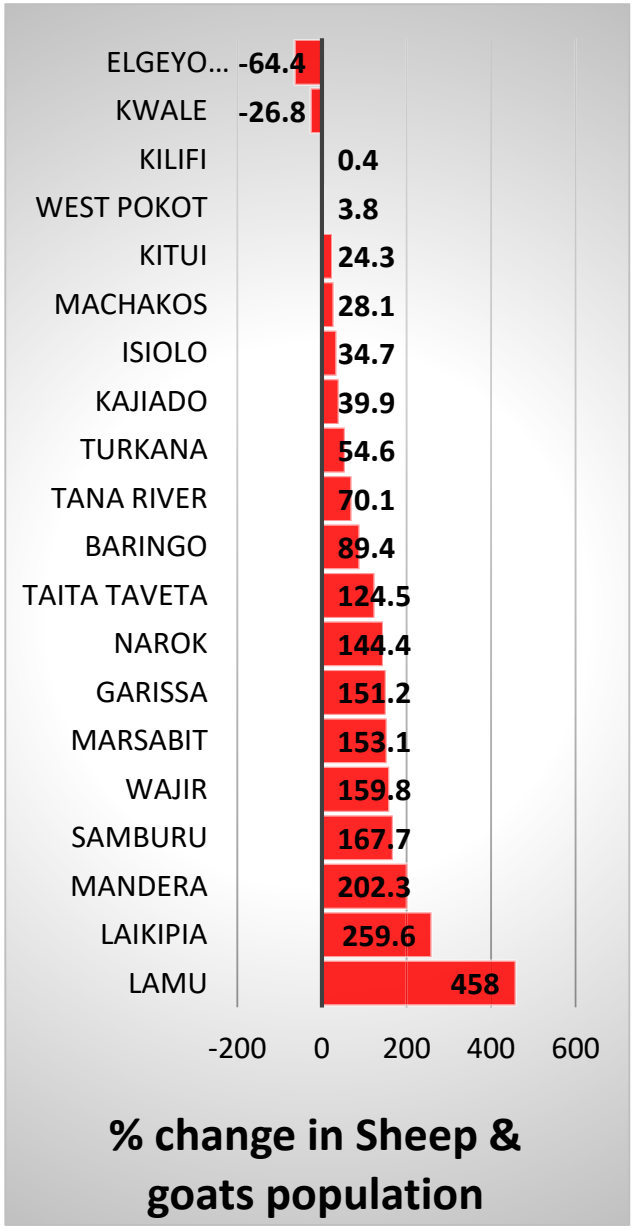


Large decline in cattle population and large increase in sheep and goat and camel population in the Kenya Rangelands



Ogutu et al, 2016

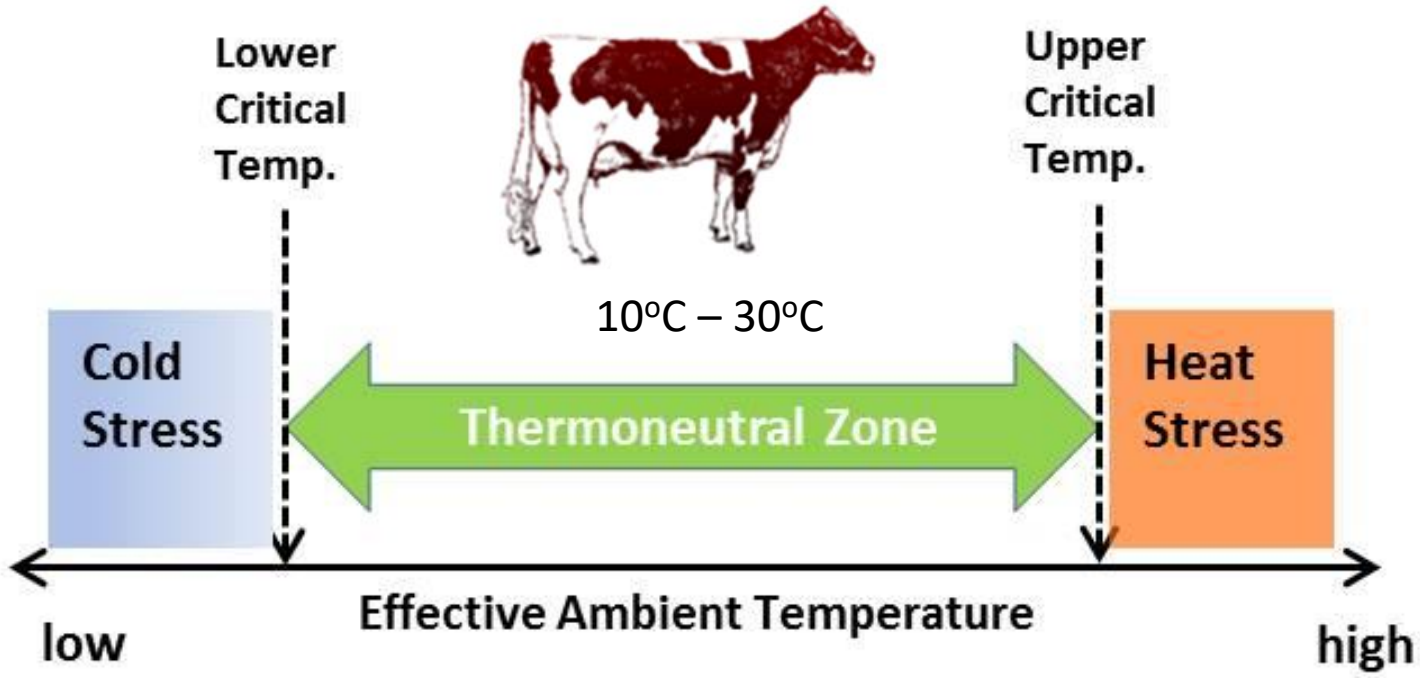




National trends on Cattle and Sheep and goats between 1977 and 2015 in the Kenya rangelands

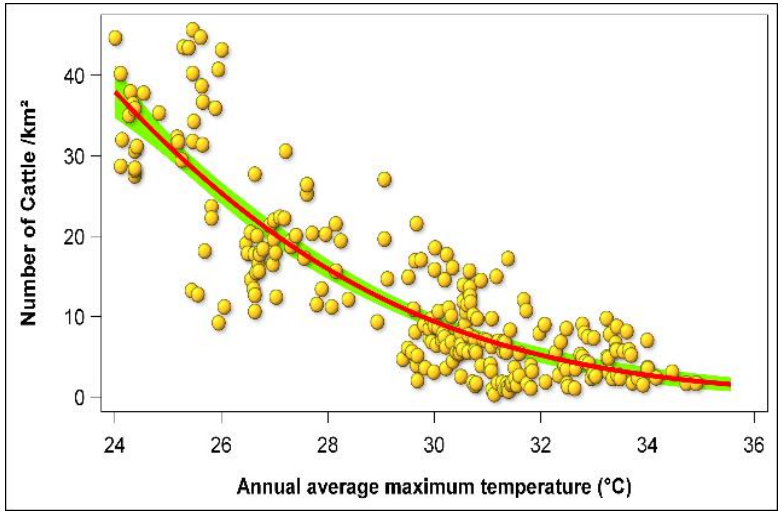
Said et al, PRISE Report 2017

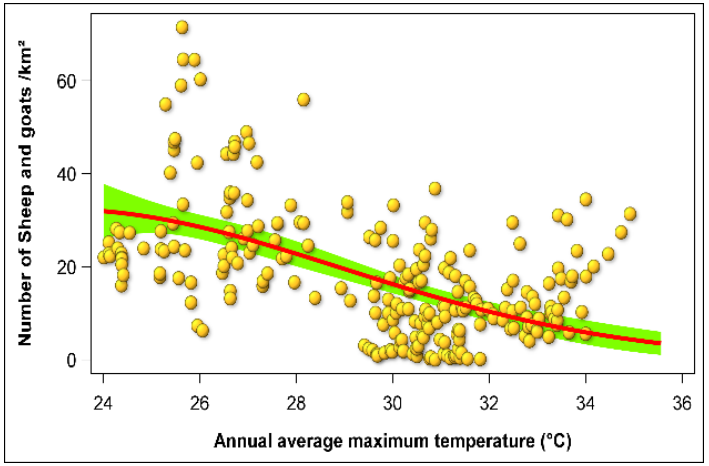
Figure 1. Schematic of Relationships of Temperature and Thermal Zones[1]

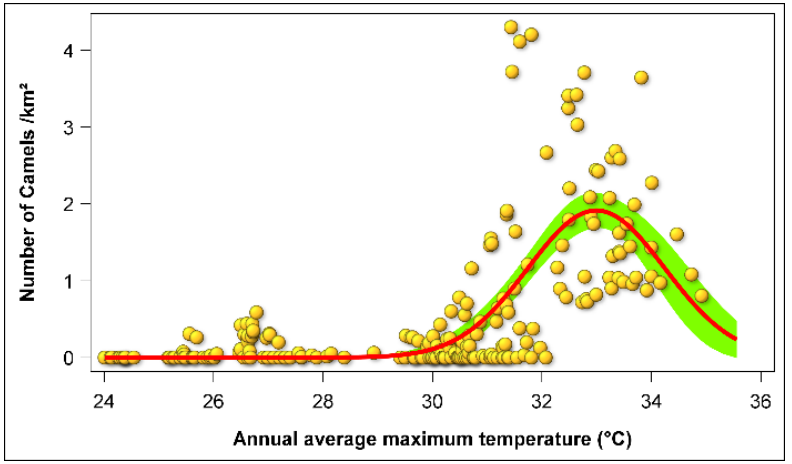


[1]Adapted from: NRC, 1981, Effect of Environment on Nutrient Requirements of Domestic Animals

The relationship between cattle, Sheep and goats, and camel density (km^2) maximum temperatures (deg C)

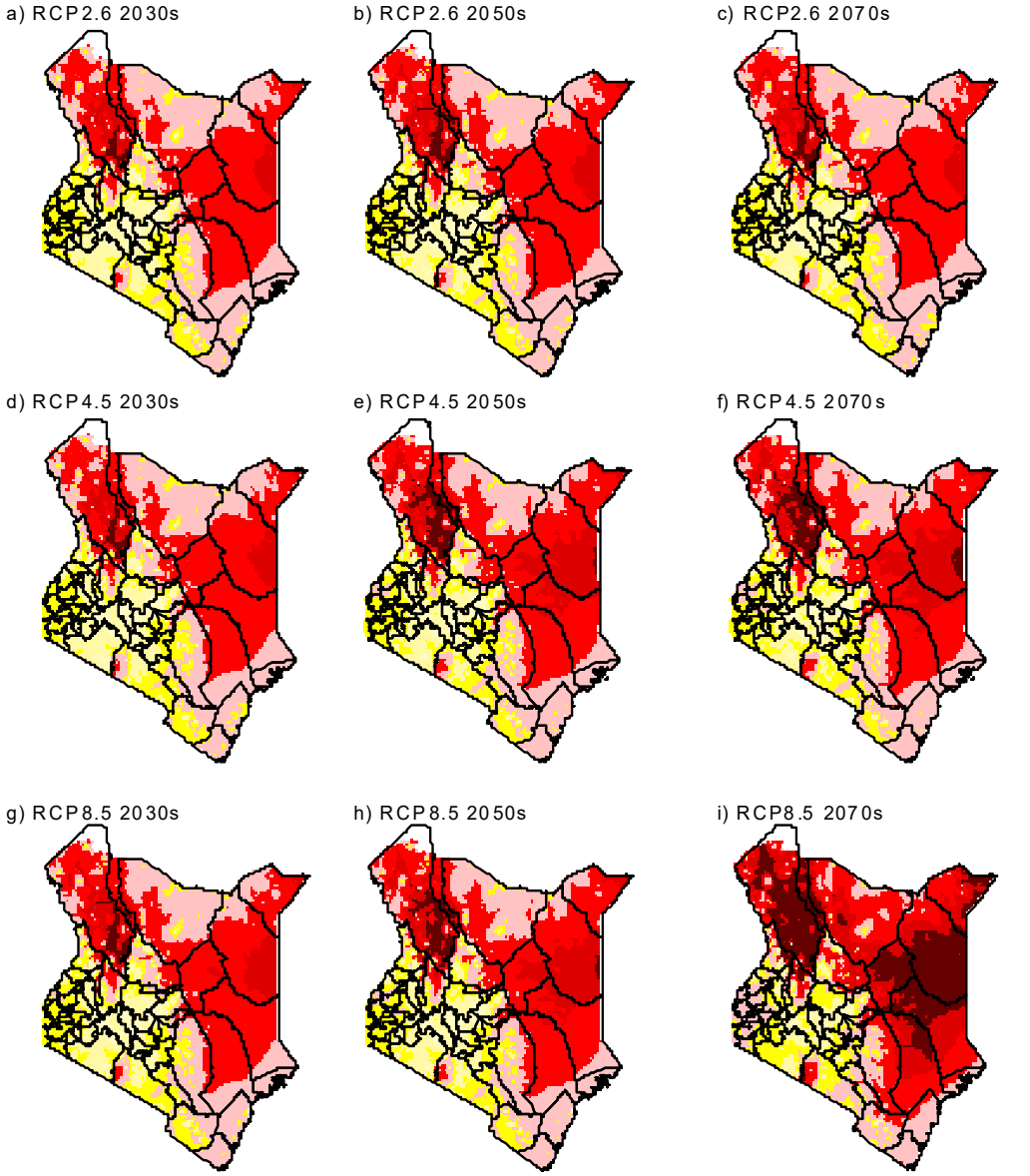


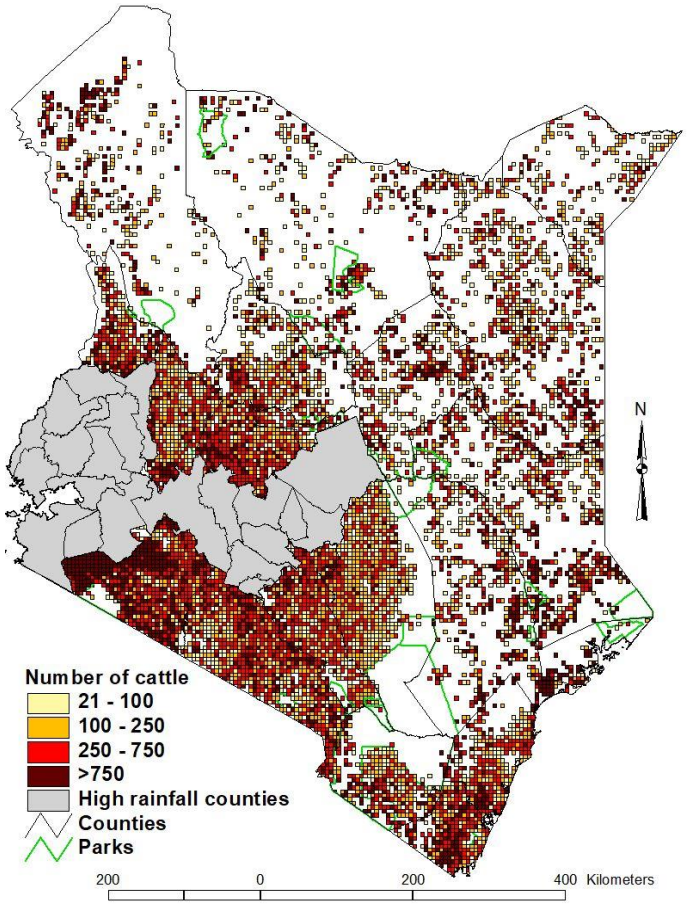




Source: Said et al, PRISE Report 2017, DRSRS

Temperature changes and cattle distribution





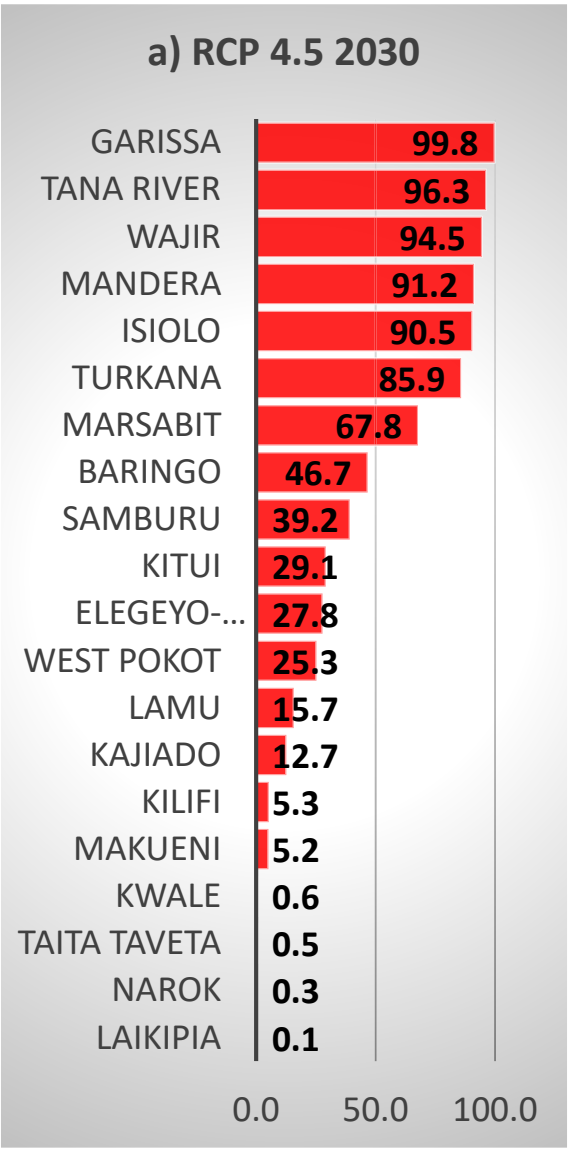
Source: Said et al, PRISE Report 2017, DRSRS

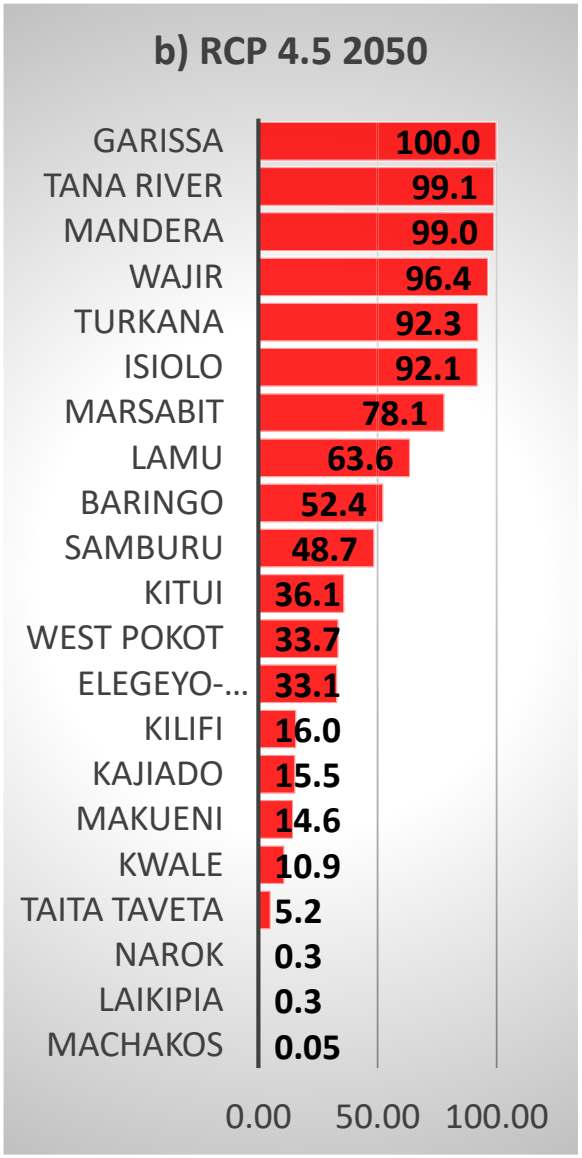
Projected RCP 2.6, 4.5 and 8.5 maximum temperature changes for 21 ASALs counties for the periods 2030s, 2050s and 2070s

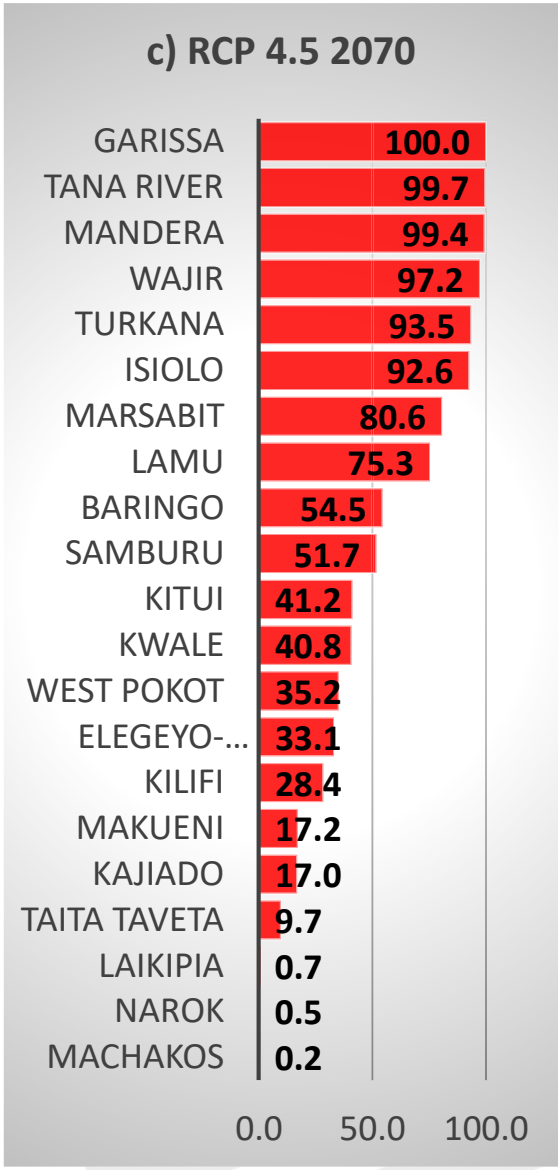
	RCP 2.6			RCP 4.5			RCP 8.5		
Counties	2030s	2050s	2070s	2030s	2050s	2070s	2030s	2050s	2070s
Baringo	1.08	1.39	1.30	1.13	1.79	2.02	1.49	2.28	3.43
Elegeyo-Marakwet	1.09	1.41	1.31	1.16	1.82	2.04	1.49	2.28	3.42
Garissa	0.98	1.15	0.90	1.05	1.56	1.69	1.26	1.90	2.85
Isiolo	1.04	1.24	1.06	1.18	1.64	1.84	1.36	2.05	3.08
Kajiado	1.16	1.26	1.10	1.00	1.55	1.83	1.35	1.99	3.09
Kilifi	0.96	1.06	0.88	0.93	1.44	1.64	1.22	1.84	2.69
Kitui	1.09	1.21	1.00	1.06	1.53	1.78	1.30	1.88	2.95
Kwale	0.94	1.03	0.89	0.90	1.39	1.59	1.18	1.84	2.64
Laikipia	1.08	1.38	1.28	1.14	1.78	1.99	1.51	2.25	3.36
Lamu	0.86	1.04	0.82	0.91	1.43	1.59	1.11	1.75	2.62
Machakos	1.12	1.29	1.10	1.00	1.52	1.82	1.35	1.94	3.08
Makueni	1.14	1.25	1.06	1.00	1.50	1.79	1.32	1.90	3.00
Mandera	1.10	1.30	1.16	1.12	1.73	1.89	1.38	2.11	3.12
Marsabit	1.06	1.36	1.22	1.16	1.72	1.94	1.42	2.12	3.19
Narok	1.10	1.29	1.17	0.97	1.58	1.85	1.37	2.09	3.25
Samburu	1.12	1.43	1.30	1.22	1.84	2.03	1.48	2.24	3.35
Taita Taveta	1.10	1.14	0.94	0.97	1.46	1.70	1.28	1.93	2.86
Tana River	1.04	1.15	0.92	1.07	1.55	1.71	1.28	1.89	2.84
Turkana	1.10	1.50	1.37	1.14	1.83	2.07	1.48	2.27	3.37
Wajir	1.03	1.20	1.00	1.07	1.61	1.77	1.32	1.99	2.96
West Pokot	1.04	1.43	1.30	1.04	1.75	1.97	1.43	2.20	3.34

Range size

Potential impacts of temperature on cattle range in Kenya arid and semi-arid lands based on RCP 4.5





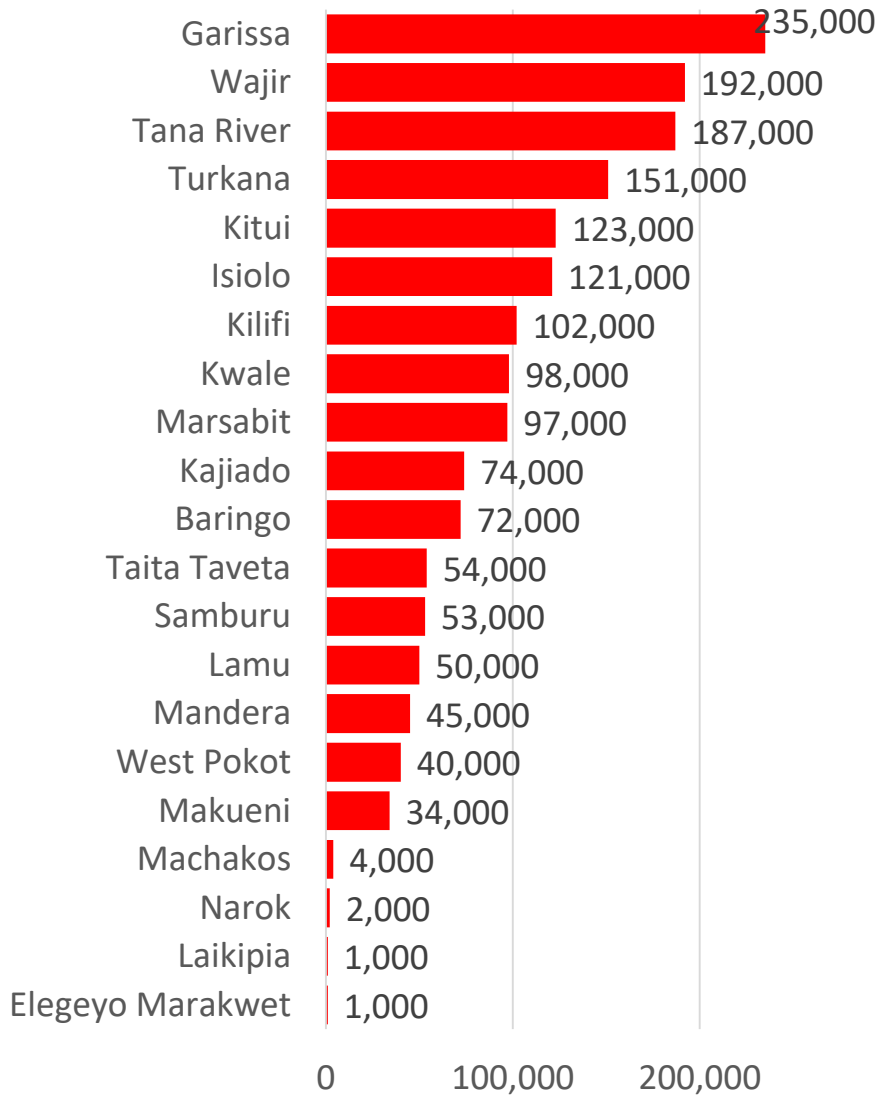


Said et al, PRISE Report 2017

Social and economic impacts

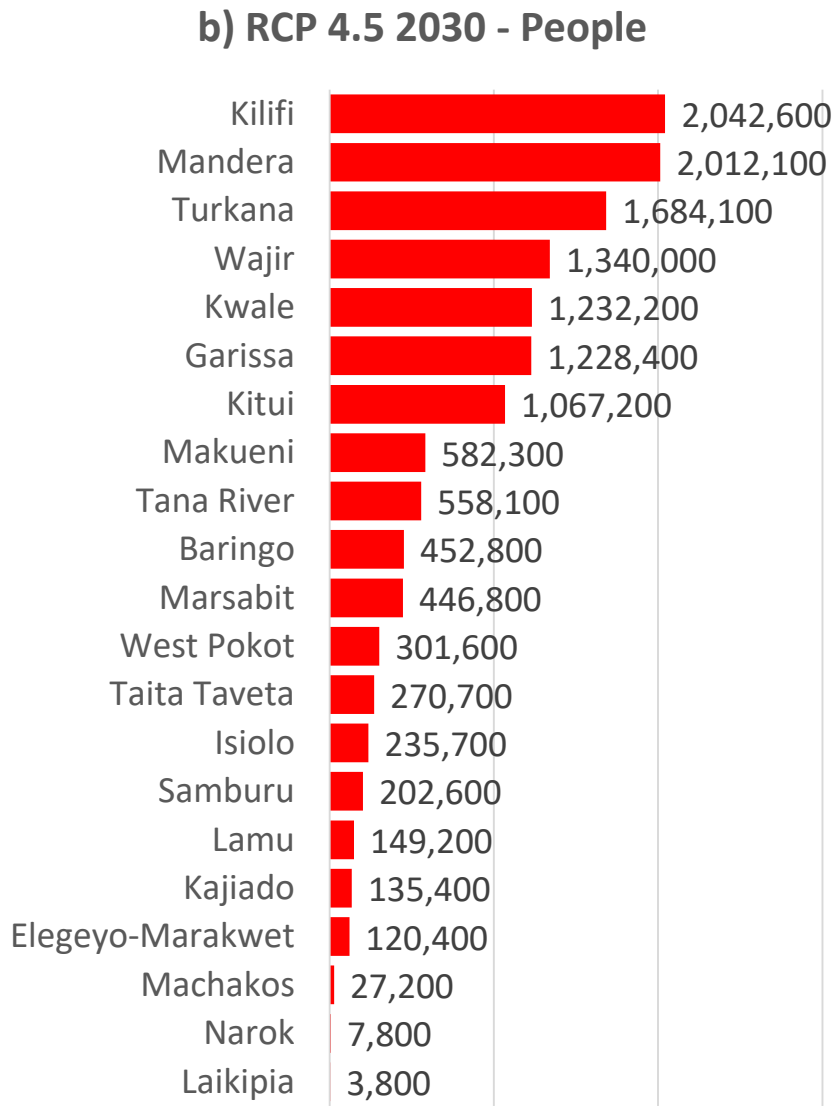
Potential Impacts of the number of livestock per county

a) RCP 4.5 2030 - Cattle Population



Said et al, PRISE Report 2017

Projected potential impacts of the number of people per county

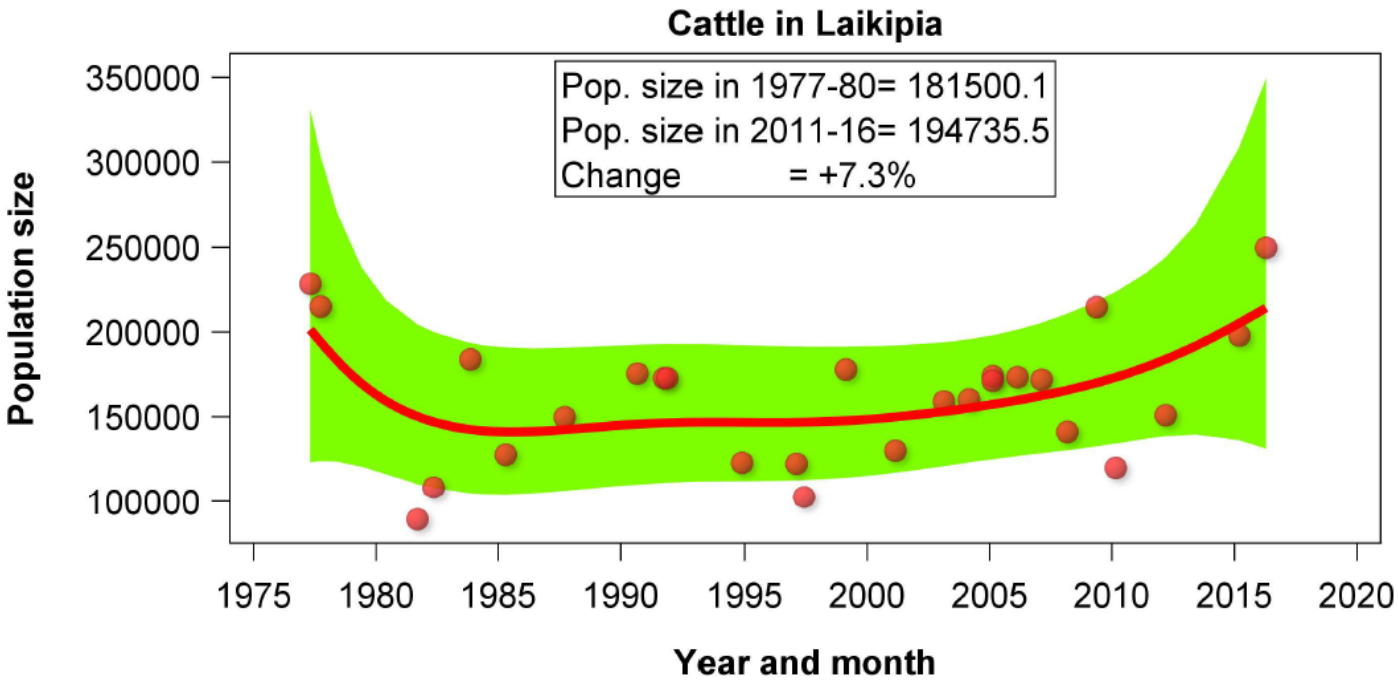


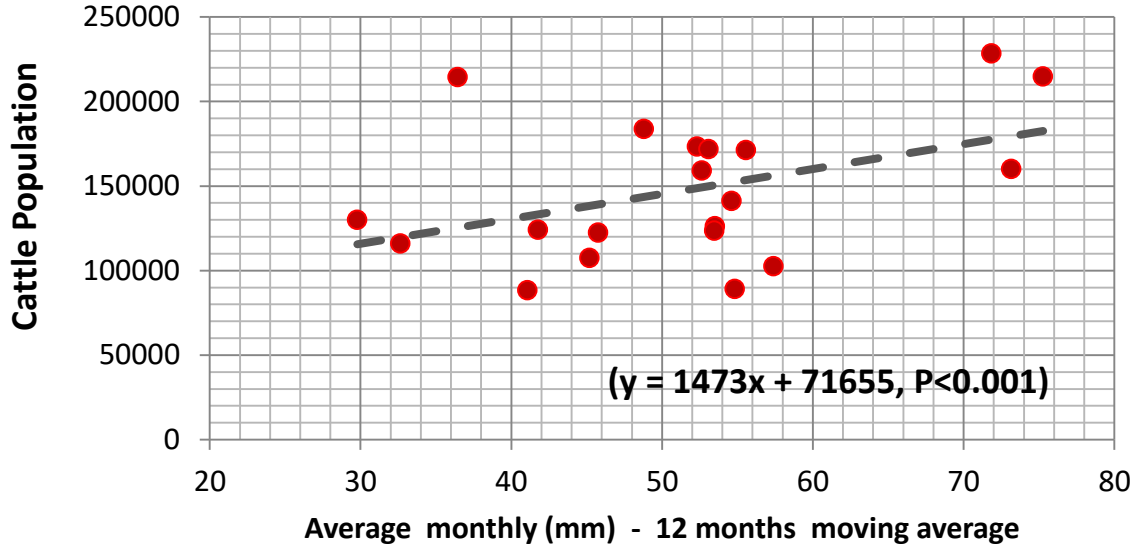
Women and children

School dropouts

Said et al, PRISE Report 2017

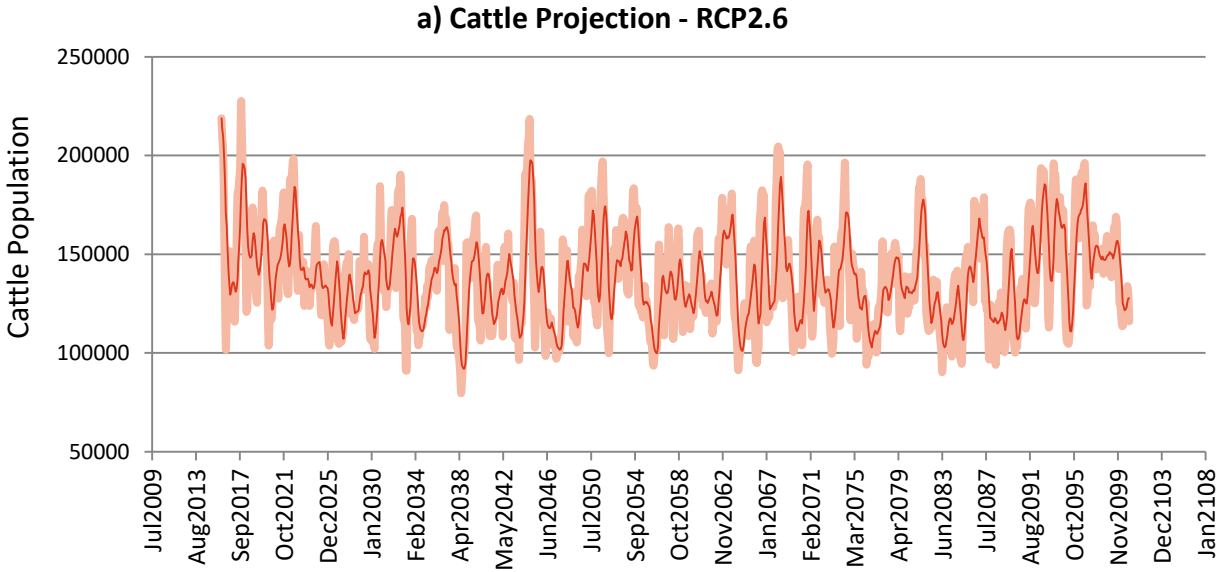
Cattle Projections In Laikpia

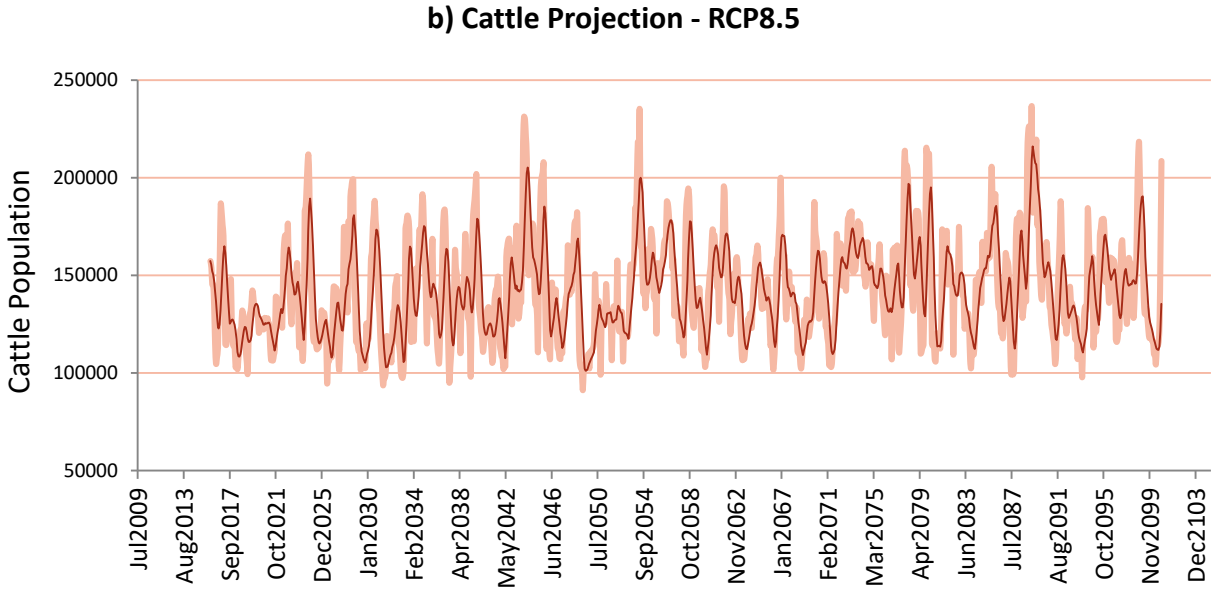




Said et al, PRISE Report 2016, Ogutu et al, 2016

Projected cattle population for Laikipia 2016 – 2100 for RCP 2.6 and RCP 8.5





Source: Said 2016 KMT report

Summary of the Findings

National Summary

PRISE
Pathways to resilience in semi-arid economies

CARIAA
Collaborative Adaptation Research Initiative in Africa and Asia

Decrease in rainfall (15 out 21 counties) and increase in temperature all ASAL counties

Temperature increases between 0.5 °C and 1.9 °C between 1960-2014

Livestock trends 1977 – 2014

27% decline in cattle, 76% increase in sheep & goats 13% increase in camel

Projected maximum temperature between the period 2006 – 2100 will increase between 0.88 °C and 3.43 °C

Between 53% (131,000 km^2) and 59% (151,000 km^2) of ASALs be highly unproductive (>30°C) for cattle grazing

Impacts on cattle production at extreme temperature stress

1.7 million cattle or (52%) of total ASALs cattle population (34 - 68 billion shillings)

People that might be affected by extreme temperature changes

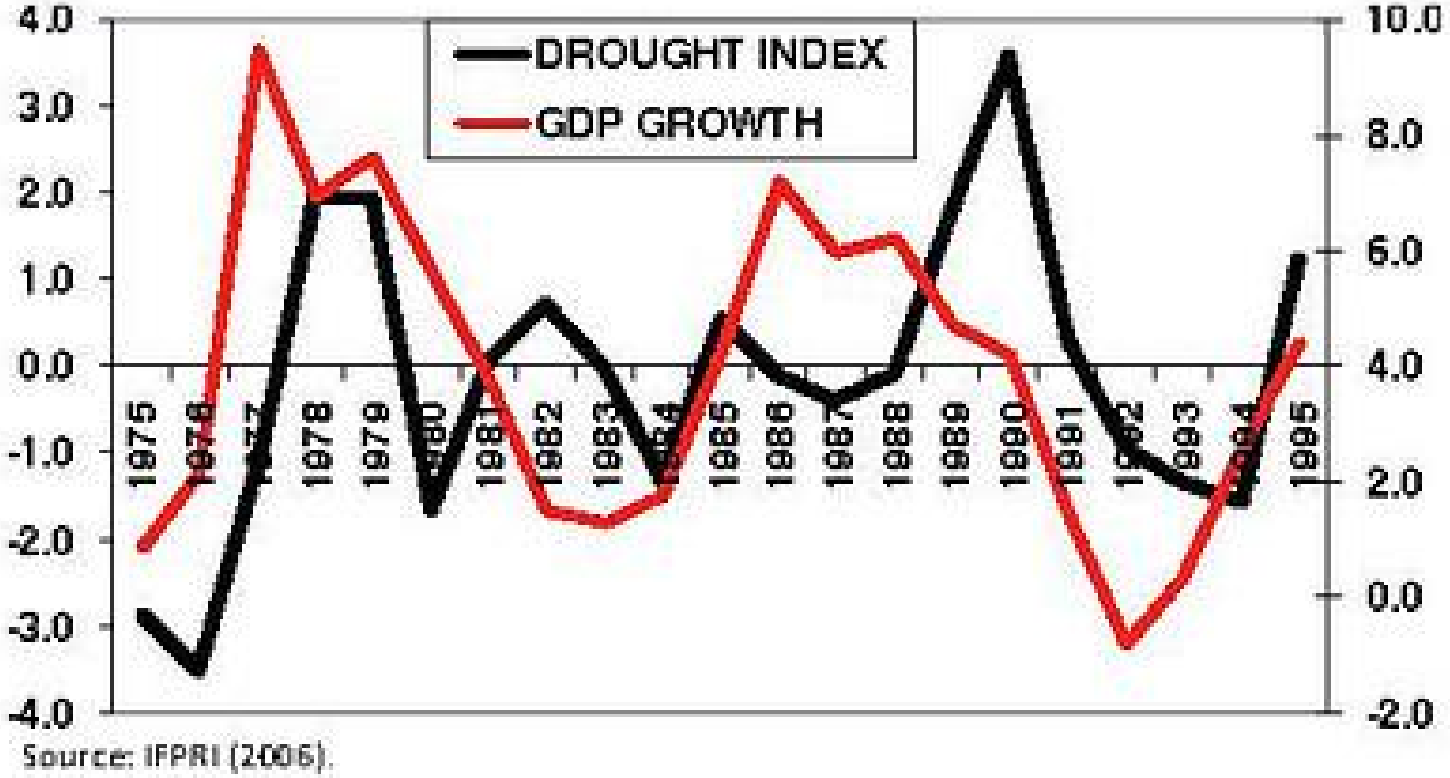
8.2 million people in 2016 and 14.1 million people by 2030

Historical Past (1960 -2014)

Projected Situation 2030s

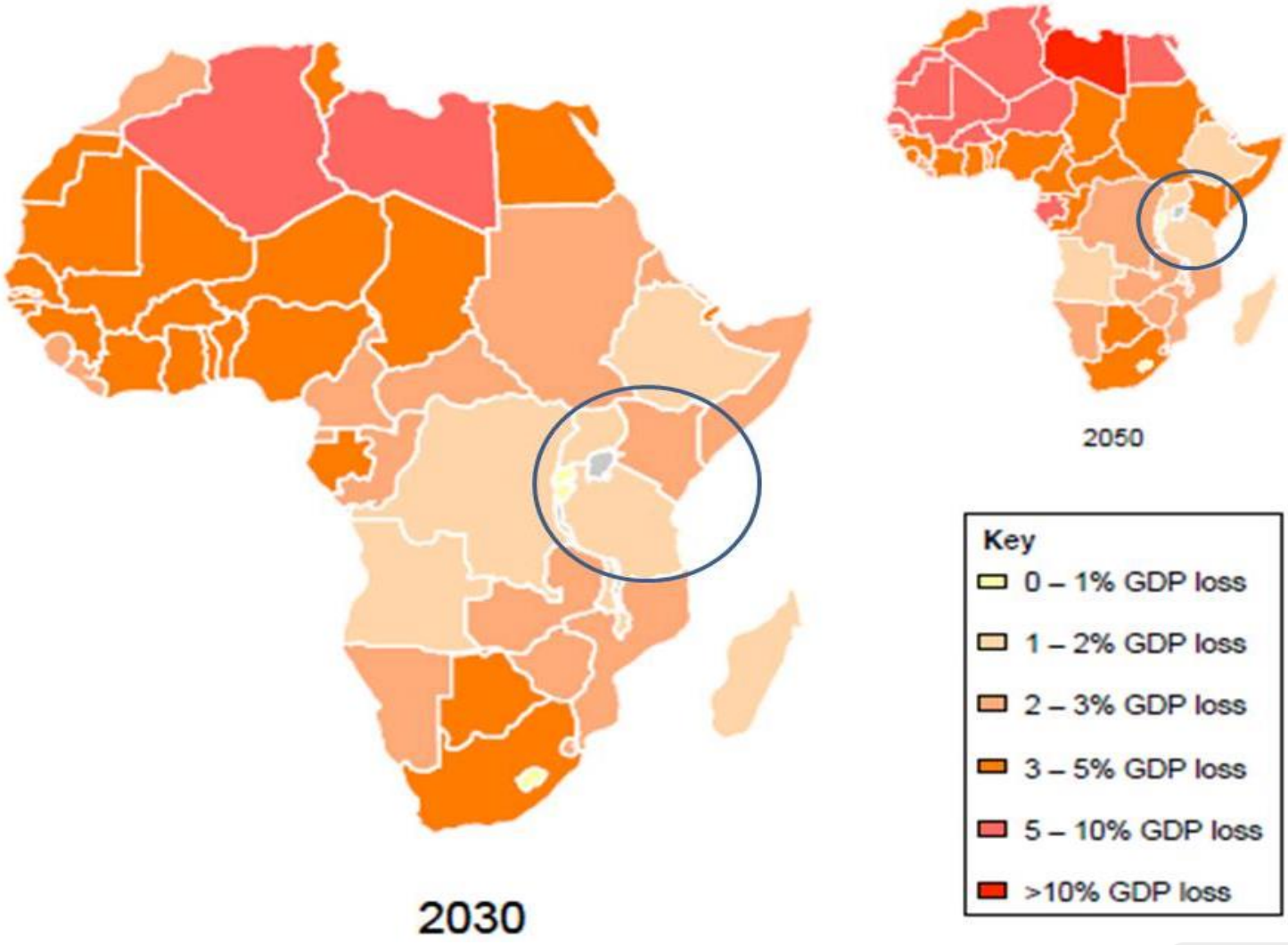
Said et al., 2017 PRISE report

Linkages between Palmer Drought Index and GDP in Kenya 1975 - 1995



Source: IFPRI (2006).

Projected impacts of climate change on regional economies in Africa



World Bank Report

What needs to be done

- Current population of 49.6 million people will nearly double the population by 2050 to 95.5 million;

- Climate change pressure (increase in temperature) will increase the vulnerability especially of the ASALs who depend mostly on livestock production;

- Need to re-assess livestock and agriculture potentials and projections based on climate change to include economic analysis The national and country strategies (CIDP and spatial plans) needs to include climate change in its plans;

- INVESTMENTS - Need to diversify the economy to reduce pressure in the ASALs – example exportation of livestock (urban centers and abroad) and marketing livestock products; milk and meat productions at the County levels

- Promote export-led industrialization with a focus on light manufacturing; increase SME to increase the contribution of entrepreneurs to the country's industrialization vision.

County Projects – addressing droughts and livelihood

MAKUENI COUNTY TO RECEIVE SH50M TO MITIGATE CLIMATE CHANGE

Mary Lole Environment, Governance, Makueni

Makueni County Government is set to benefit from Sh50 million for climate change adaptation after the county government became the first local government in the Africa to pass the County Climate Change Fund Regulation (CCCF) 2015.

The CCCF which was passed by the County Assembly in September is the first of its kind in the entire continent and will provide a mechanism through which the county can access and use financial resources to build resilience to the changing climate.

The Sh50 million kitty is part of seed money provided by the Department for International Development (DFID)-UK through the Adaptation Consortium which consists of Christian Aid, Anglican Development Services (ADS-Eastern) a local organisation working in Kitui and Makueni counties and the National Drought Management Authority (NDMA) among other implementing partners and will be used to mitigate environmental degradation and desertification through rehabilitation of water catchment areas and forests.

Speaking in Wote during a climate change forum Nicholas Abuya from Christian Aid said the initiative is a pilot project and will be replicated in other four counties which include Isiolo, Garissa, Wajir and Kitui

Poultry farming in Makueni

PRISE

Pathways to resilience
in semi-arid economies

PRISE
Overseas Development Institute
203 Blackfriars Road
London SE1 8NJ
United Kingdom

www.prise.odi.org
@PRISEclimate

www.kenyamarkets.org

CARIAA
Collaborative Adaptation Research Initiative in Africa and Asia

This work was carried out under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) with financial support from the UK Government's Department for International Development and the International Development Research Centre, Ottawa, Canada. The views expressed in this work are those of the creators and do not necessarily represent those of the UK Government's Department for International Development, the International Development Research Centre, Canada or its Board of Governors.