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Integrating Antimicrobial Resistance Mitigation into Beekeeping Practices in Eastern Africa

Nairobi, Kenya

2 - 4 September 2026



Ministry of Agriculture &
Livestock Development



The
Fleming Fund



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EFFECTS OF CLIMATE CHANGE ON BEE HEALTH AND BIODIVERSITY

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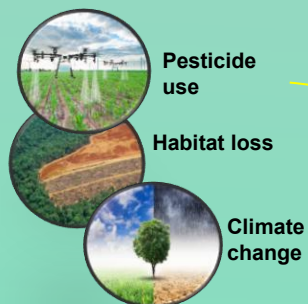


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INTRODUCTION



Bees pollinate 75% of 115 major global food crops

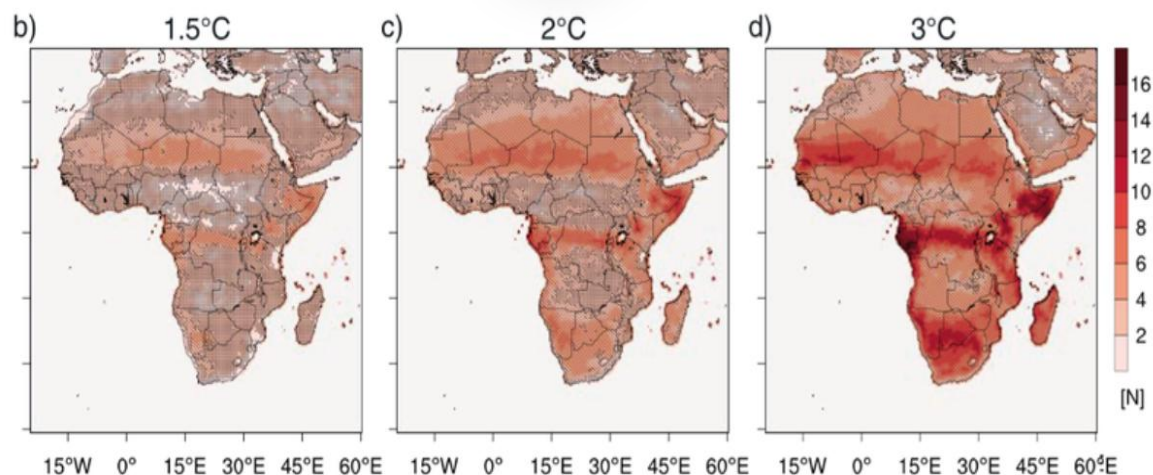


Dicks et al., (2021) *Nature Ecology and Evolution*

The combined impacts of habitat loss and climate change underscore the urgent need for strategies to enhance forage availability within honey bee landscapes to sustain their health and ecosystem services. (Nganso et al., 2025)



- ❖ In 2019, when East Africa experienced rainfall records and floods in many parts of the region, tomato prices skyrocketed in Kenya, Uganda, and Tanzania.
- ❖ Climate Change is expected to bring more frequent extremes and more intense rainfall.
- ❖ Technological change remains key to reducing the extremely high vulnerability of East African farmers to climate change.



- ❖ Projected changes in the number of **heatwave days** per year across the African continent in 2050 under warming scenarios of 1.5°C (left), 2°C (middle), and 3°C (right).
- ❖ Pink shows a small increase in the number of days while dark red shows a large increase in the number of days. Source: Carbon Brief / Weber et al. (2018)



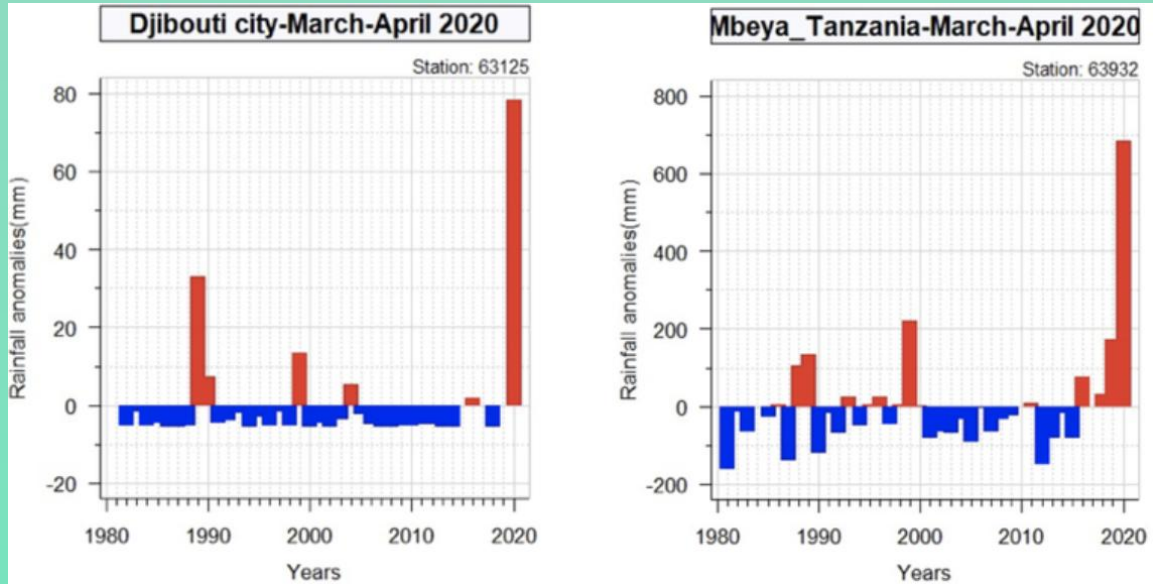
- ❖ In 2020, **6 million people** were affected by floods in East Africa.
- ❖ It was one of the wettest years on record. The short rains of 2019 were also wetter than usual.
- ❖ Severe flooding affected an estimated 800,000 people across **South Sudan** in October 2020, inundating homes and leaving people without adequate food, water, or shelter. Source: MSF



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INTRODUCTION

More extremes and higher climate variability



All models agree that the number of warmer days and intense rainfall is increasing. Monthly rainfall could also become more variable.

More frequent extremes and higher climate variability are leaving little time for communities to recover between shocks.

- ❖ Climate change, climate phenomena like extreme positive IODs and El Niño–Southern Oscillation (ENSO) are expected to intensify
- ❖ The socioeconomic impacts of these events are well known to East African countries.
- ❖ Between 1997 and 2000, floods and droughts associated with [El Niño — La Niña](#) reduced Kenya's gross domestic product (GDP) by 14%.

Source: ICPAC

Source: [Future Climate Projections in Africa: Where Are We Headed?](#)



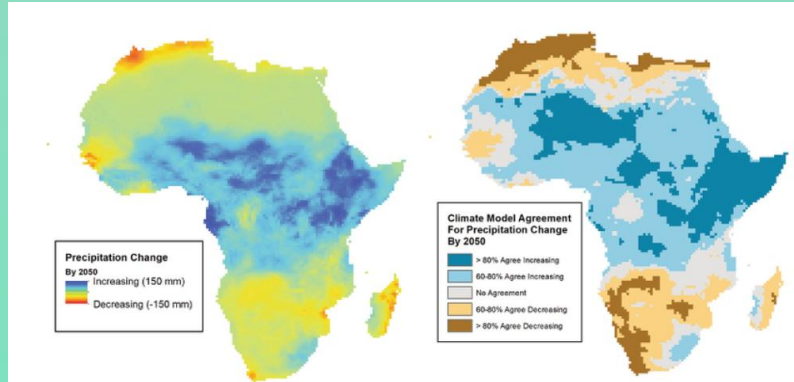
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INTRODUCTION

Major consequences of climate change



- ❖ Extreme weather
- ❖ Rising sea levels
- ❖ Food & agriculture crisis
- ❖ Mass climate migration
- ❖ Economic crisis

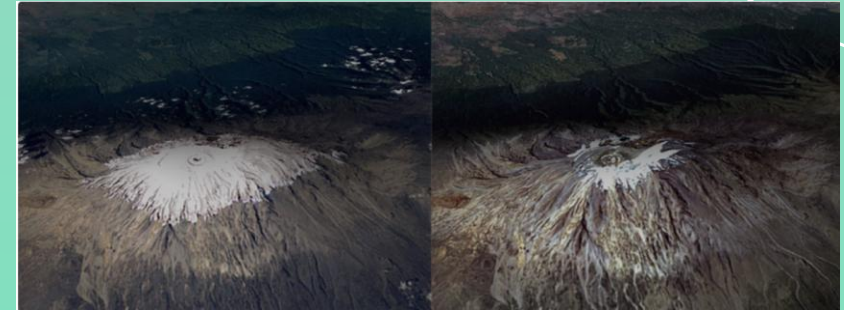


Projected changes in total annual precipitation by **2050** (top left), climate model agreement (top right),

Source: [Future Climate Projections in Africa: Where Are We Headed?](#)



Camp manager James Owuor, holds a photo showing a structure before it was submerged under **rising water** due to months of unusually heavy rains, in Lake Baringo, Kenya. Source: BAZ RATNER /Reuters (Telegraph 2020)



Snow and Ice on Mount Kilimanjaro: Left: February 17, 1993. Right: February 21, 2000. Source: [NASA Earth Observatory](#)

- ❖ **Vanishing glaciers:** Iconic African glaciers, including those on Mt. Kilimanjaro and Mt. Kenya, are rapidly melting and disappearing

<https://www.icpac.net/news/10-climate-change-impacts-in-east-africa-you-didnt-know-about/>



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EFFECTS OF CLIMATE CHANGE ON POLLINATOR HEALTH AND DIVERSITY

Major drivers of pollinator loss in Africa

Pesticide use



Habitat loss



Climate change



Impact of climate change on bees

- ❖ **Starvation/flooding:** Long droughts dry up flowers and cut off nectar supplies thus reduce floral resource availability, and impair bee colony development while heavy rains and floods destroy hives and nesting sites
- ❖ **Phenological mismatches/ Change in floral calendars:** Climate-driven changes in flowering seasons can cause mismatches between bees' active periods and floral resource availability, reducing pollination efficiency and food supply
- ❖ **Heat stress:** High temperatures dry out hives and kill bee larvae this weakens the bee immune systems, exposing the bees to diseases and pests
- ❖ **Disease spread:** High temperatures increases the spread of pests and viral diseases among colonies
- ❖ **Foraging disruption:** Unpredictable rains trick bees into waking up or flying at the wrong times. This leads to loss of workers bee populations during foraging, resulting to reduction in colony sizes
- ❖ **Habitat loss and fragmentation:** Changes in temperature and rainfall patterns affect the distribution of flowering plants and nesting sites, leading to habitat loss and fragmentation that threaten bee populations



EFFECTS OF CLIMATE CHANGE ON POLLINATOR HEALTH AND DIVERSITY

Major drivers of pollinator loss in Africa

Pesticide use



Habitat loss



Climate change



Impact of climate change on bee pests and diseases

- ❖ **Range expansion of pests:** Warmer temperatures increase the pupal survival and reproductive success of threats like the small hive beetle (*Aethina tumida*) and *Varroa* mites
- ❖ **Prolonged brood cycles:** Milder extreme cold weather prevent proper clustered resting phases, keeping brood present longer and allowing viruses to persist
- ❖ **Nutritional stress and immunity:** Droughts and extreme heat reduce floral nectar and pollen flows, weakening bee immune systems and making hives more susceptible to pathogens like *Nosema* and foulbrood
- ❖ **Altered behavior:** Scarcity of resources triggers robbing behaviors between colonies, accelerating the transmission of viruses and parasites



EFFECTS OF CLIMATE CHANGE ON POLLINATOR HEALTH AND DIVERSITY

Impact of climate change on biodiversity

Pesticide use



Habitat loss



Climate change



- ❖ **Plant loss:** Loss of honey bees due to climate change, which plays a critical role as pollinators, means reduction in reproduction by the wild plants thus loss of plants in the wild ecosystem thus biodiversity loss
- ❖ **Phenological mismatches:** Plants flower earlier or shift schedules, creating a dangerous time gap where bees emerge before or after food is ready
- ❖ **Ecosystem shift:** Entire food webs break down when native plants and animals lose their pollinators
- ❖ **Crop decline:** Farms lose vital pollination support, leading to lower food production and less variety in local diets. This is especially true for plants that rely entirely on bees as pollinators
- ❖ **Sensory disruption:** Air pollution and heat alter floral scents, making it difficult for bees to locate food
- ❖ **Ecosystem collapse:** Fewer active bees mean poor pollination of wild flora. This leads to lower seed production, reduced plant diversity, and failing food webs for other animals



EVIDENCE OF CLIMATE CHANGE IN AFRICA



Tulu et al 2026- Ethiopia

- ❖ Global climate change threatens honeybee survival, health, and pollination services essential for agriculture and biodiversity
- ❖ Future projections showing a 46.2% decline in highly suitable habitats by the 2070s
- ❖ Increasing landscape fragmentation
- ❖ Promoting drought-tolerant species like *Vachellia abyssinica*, and adopting adaptive apiculture practices.



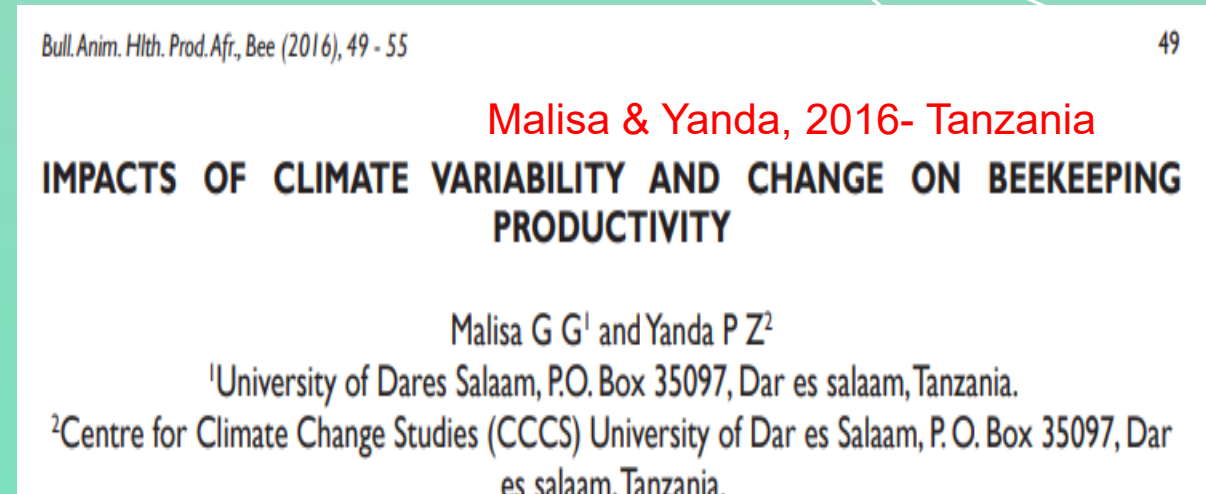
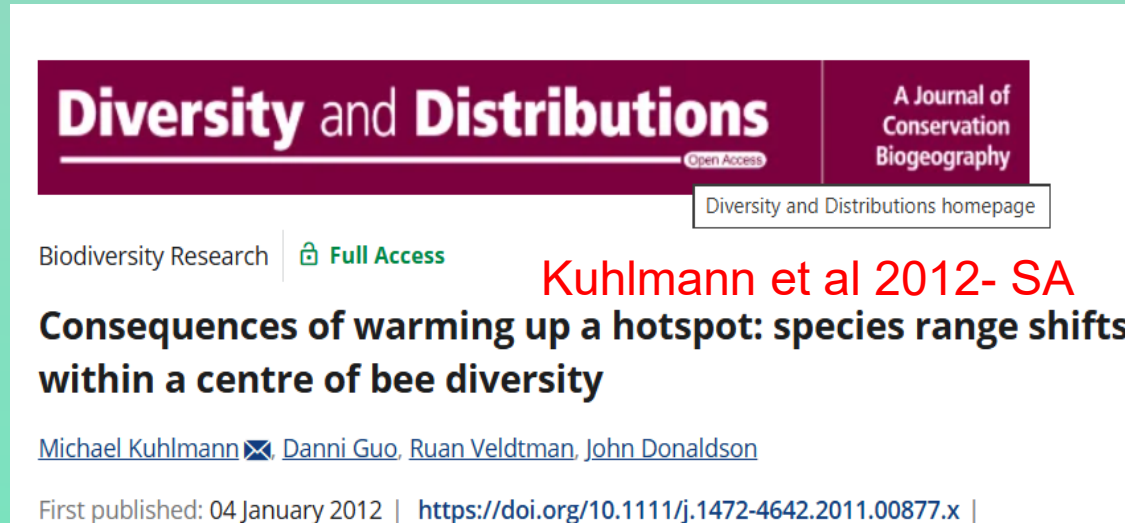
Nganso et al 2025- African countries

- ❖ An interactive web-based dashboard
- ❖ 1,572,790 occurrence records of these species from open-access - iNaturalist and GBIF-1248 forage plants identified (91 families)
- ❖ data-rich Southern and Eastern African regions
- ❖ significant data gaps in Western, Central, and Northern Africa
- ❖ plant-pollinator interactions –need for further research



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EVIDENCE OF CLIMATE CHANGE IN AFRICA



- ❖ The bee fauna of the Cape Floristic Region (CFR) is highly vulnerable to climate change due to its high endemism, small range sizes, and the isolated, island-like nature of this Mediterranean-type climate region at Africa's southwest tip.
- ❖ Potential climate change effects on bee life history traits, such as phenology, sociality, and synchronization with host plants, are recognized but require further research

- ❖ Climate change negatively affects honeybee productivity by;
altering plant flowering times, increasing water stress (especially during droughts), reducing pollen and nectar availability, impairing bee movement and communication, damaging hives, causing colony starvation, and hindering foraging activities.



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EVIDENCE OF CLIMATE CHANGE IN AFRICA

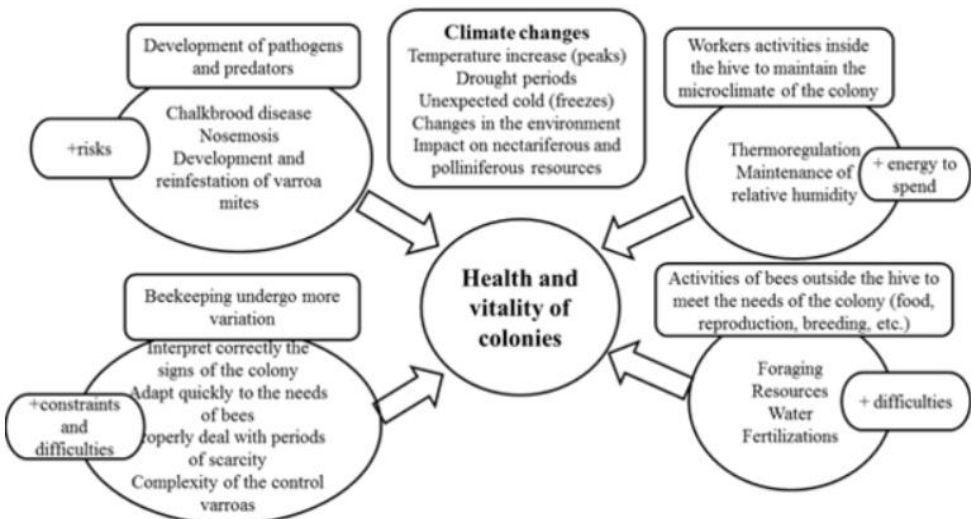
Climate Change Impact on Honeybees (*Apis* spp.) and Their Pollination Services: Climate Change and Honeybees Services

Okunin et al 2023 Morocco

Mohamed Ouknin (Moulay Ismail University, Morocco), Hassan Alahyane (Cadi Ayyad University, Morocco), Abdelaziz Mounir (Cadi Ayyad University, Morocco), and Lhou Majidi (Moulay Ismail University, Morocco)

Source Title: [Climate Change and the Economic Importance and Damages of](#)

Potential effects of climate change on health and vitality of honeybee colonies



Impact of climate change on biodiversity and food security: a global perspective—a review article

Review | [Open access](#) | Published: 06 September 2021

Melese 2021-Global study

Volume 10, article number 36 (2021) [Cite this article](#)

- ❖ Accordingly, agricultural yields in Africa alone could be decline by more than 30% in 2050
- ❖ Degraded land restoration, land use changes, use of bio-energy, sustainable forest management, and community based biodiversity conservation are recommended to mitigate climate change impacts.

Bee conservation in Sub-Saharan Africa and Madagascar: diversity, status and threats

Connal D. Eardley¹, Mary Gikungu² and Michael P. Schwarz³

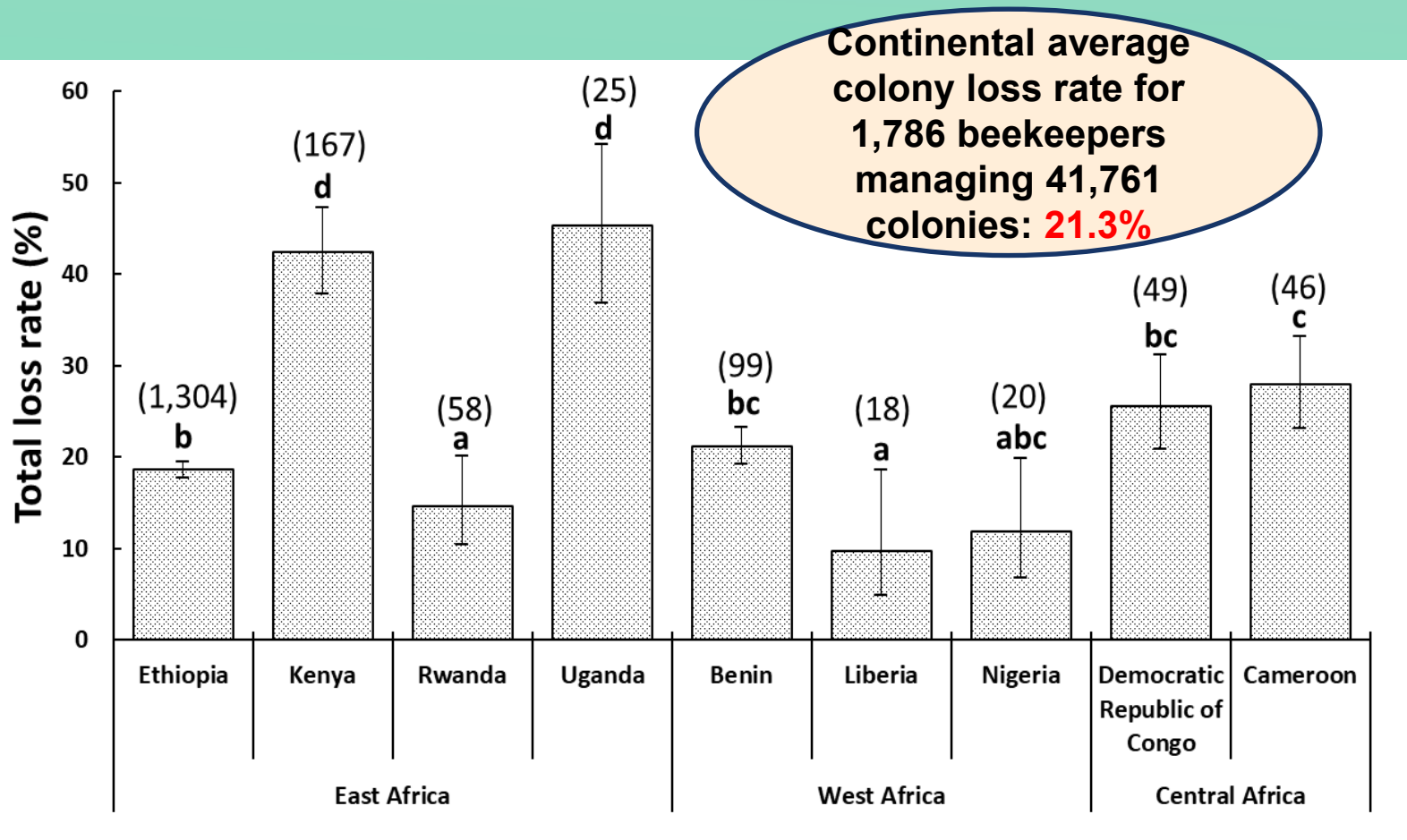
Eardley 2009-Africa

- ❖ Reliance on conserved areas such as National Parks will not be sufficient to preserve bee diversity in Africa and Madagascar;
- ❖ Changes to land use practices and development of industries that facilitate conservation, such as ecotourism, will be essential.

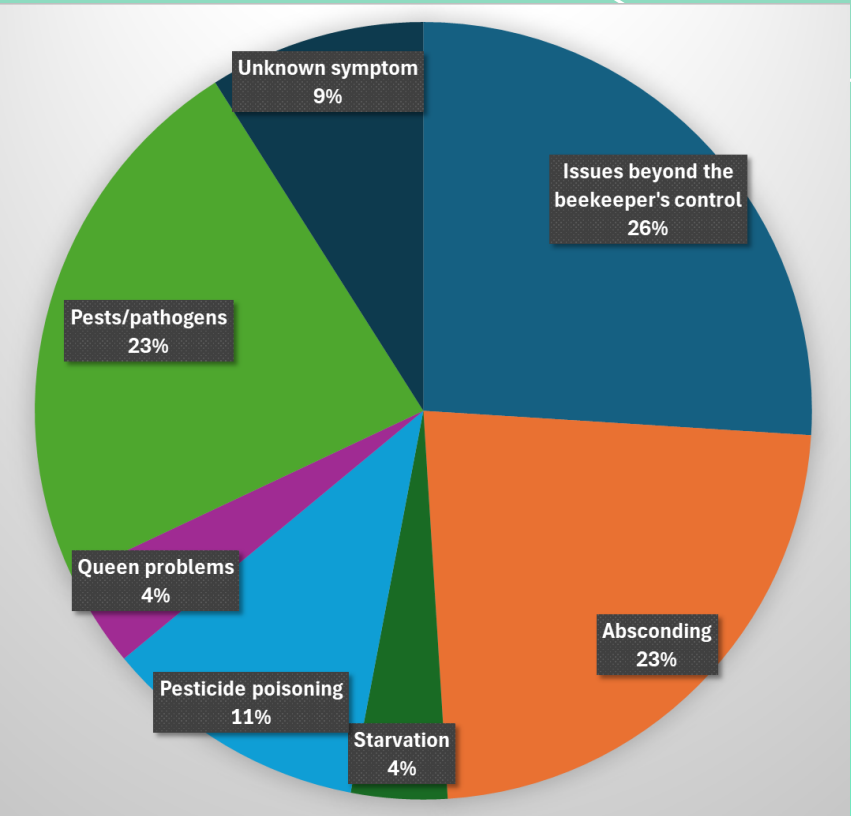


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EFFECTS CLIMATE CHANGE ON HONEY BEES: EVIDENCE FROM THE SURVEY 2022/2023



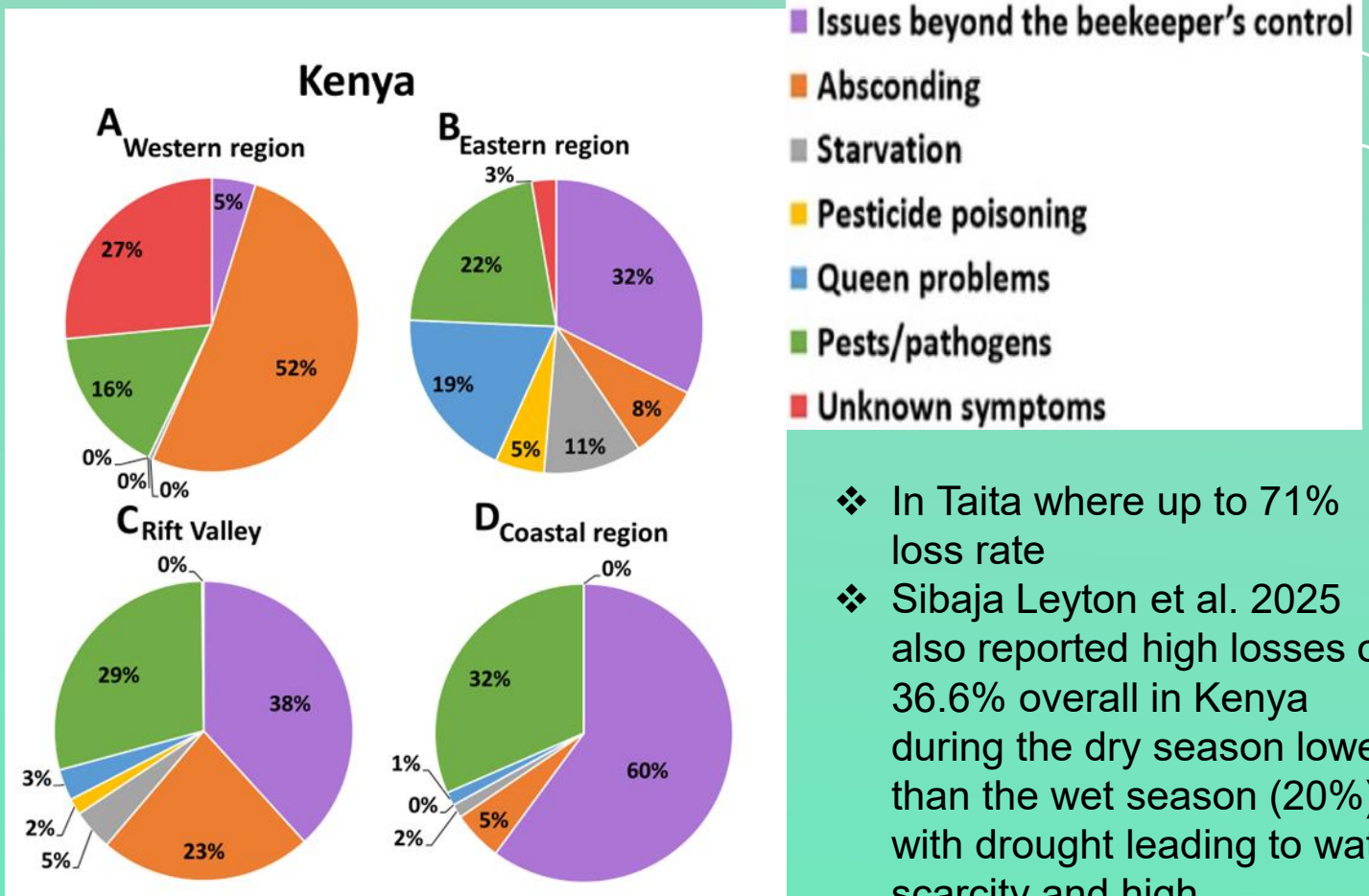
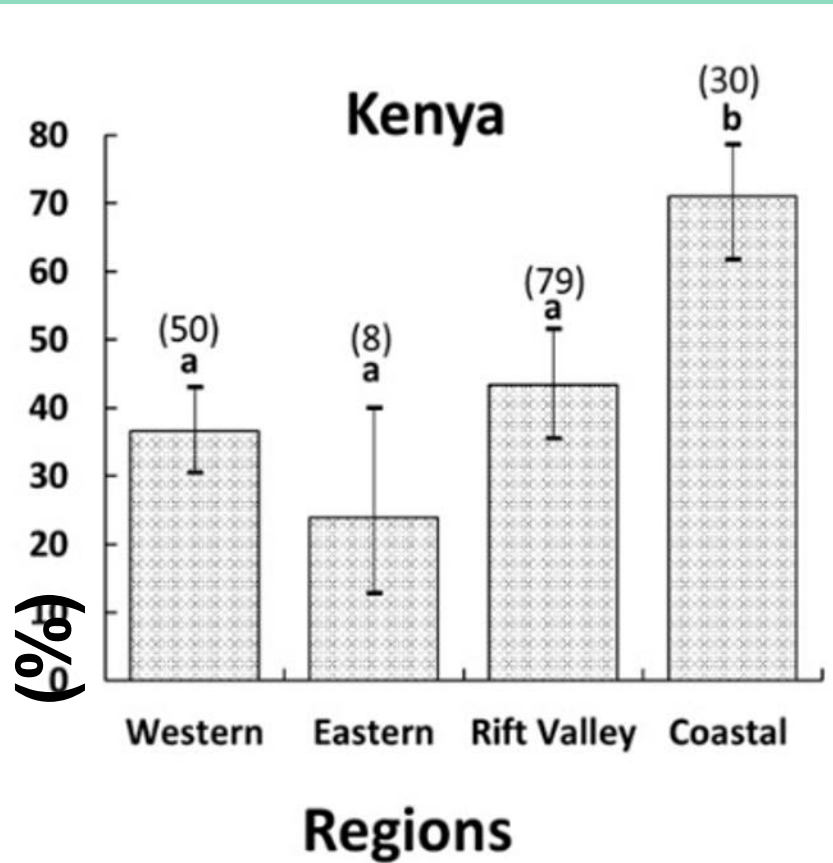
Farmers' perceived causes of losses



Nganso et al. (2025) **PLoS ONE**

EFFECTS CLIMATE CHANGE ON HONEY BEES: EVIDENCE FROM THE SURVEY 2022/2023 (cont..)

Total loss rate



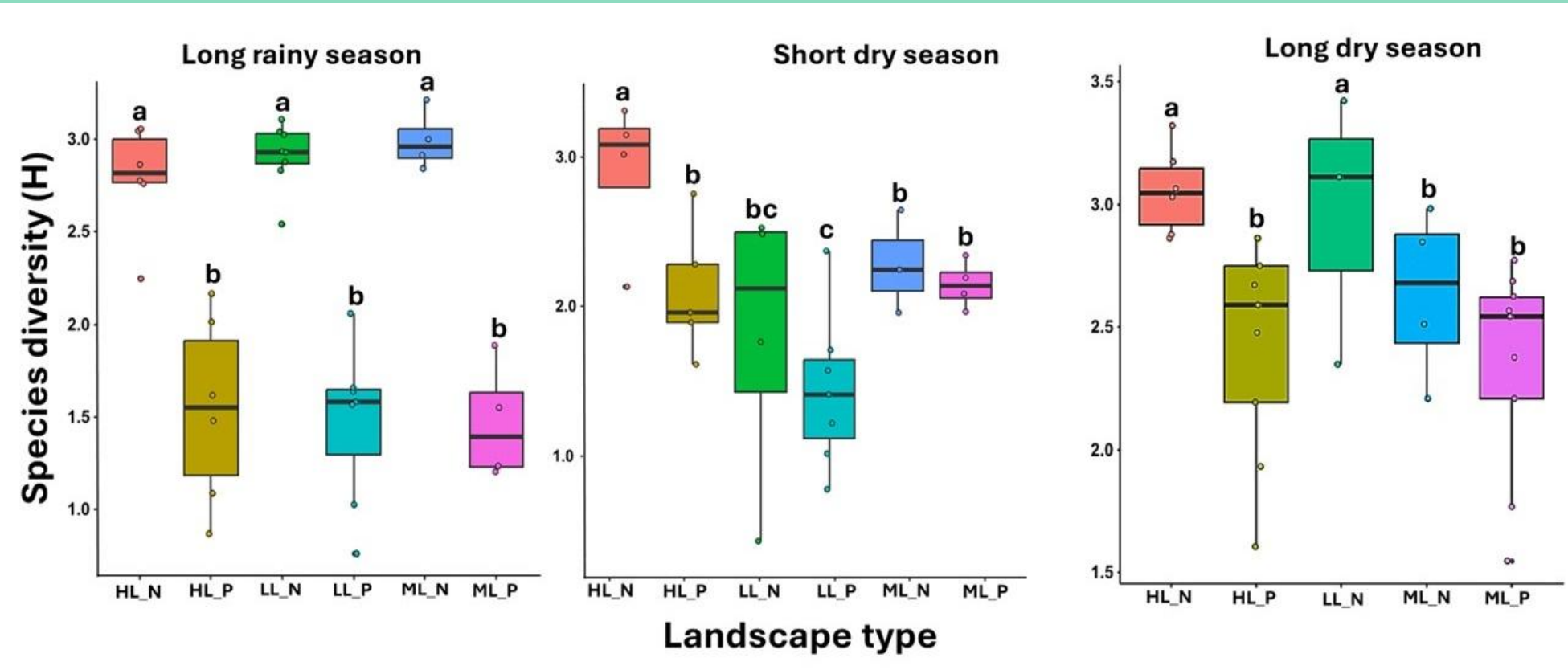
- ❖ In Taita where up to 71% loss rate
- ❖ Sibaja Leyton et al. 2025 also reported high losses of 36.6% overall in Kenya during the dry season lower than the wet season (20%) with drought leading to water scarcity and high absconding rate

Nganso et al. (2025) **PLoS ONE**



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CLIMATE CHANGE EFFECTS BEE FORAGE AVAILABILITY: EVIDENCE FROM TAITA TAVETA



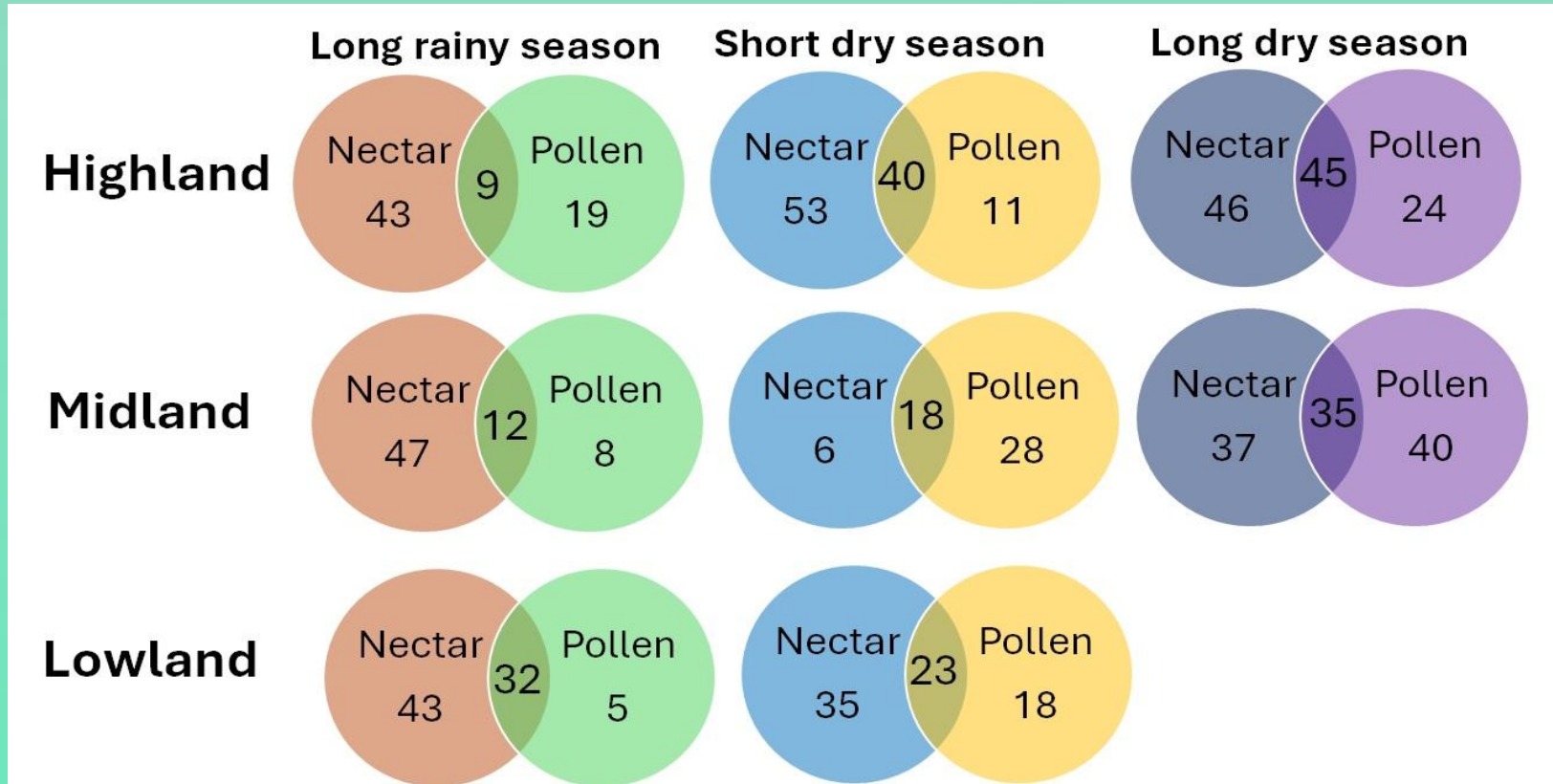
During the short dry season, lowland pollen was less diverse than highland pollen and midland pollen

Chege et al. (2025) Ecology and Evolution



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EFFECTS OF CLIMATE CHANGE ON BEE FORAGE AVAILABILITY: EVIDENCE FROM TAITA TAVETA (cont..)



During the long dry season, we found no food resources inside the hives for the colonies in the lowland due to drought

Chege et al. (2025) Ecology and Evolution



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CLIMATE CHANGE VULNERABILITY IN AFRICA



<https://www.grida.no/resources/7721>



<https://www.gettyimages.com/photos/kenya-drought-famine>



- ❖ This graphic shows which of the regions of Africa (North Africa, West Africa, Central Africa, East Africa, Southern Africa and the Western Indian Ocean Islands) are most vulnerable to specific impacts of climate change.
- ❖ These impacts include desertification, sea level rise, reduced freshwater availability, cyclones, coastal erosion, deforestation, loss of forest quality, woodland degradation, coral bleaching, the spread of bee diseases and impacts on food security.



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EFFECTS OF CLIMATE CHANGE ON BEE DIVERSITY: EVIDENCE FROM TAITA TAVETA

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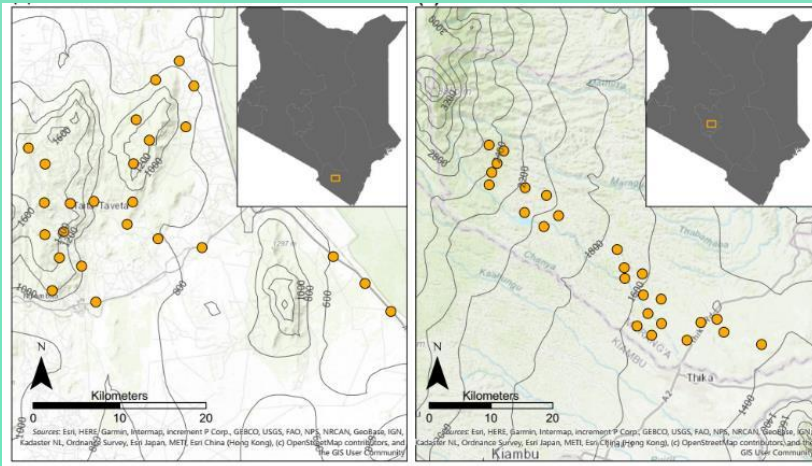
ARTICLE

Macrosystems Ecology

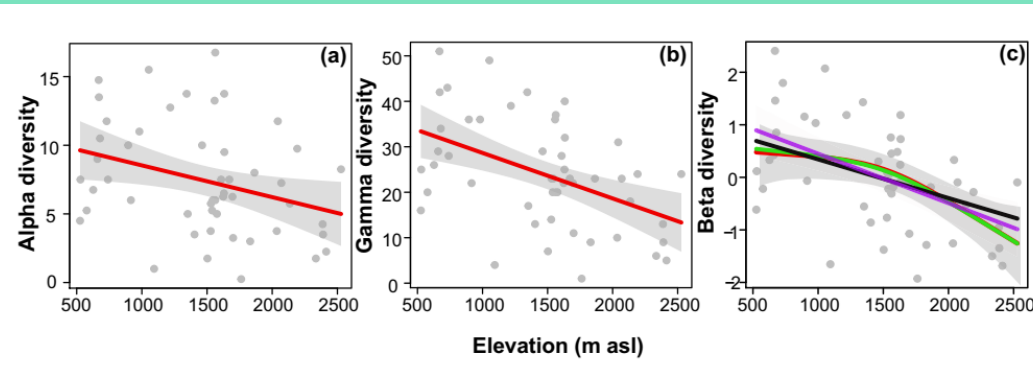
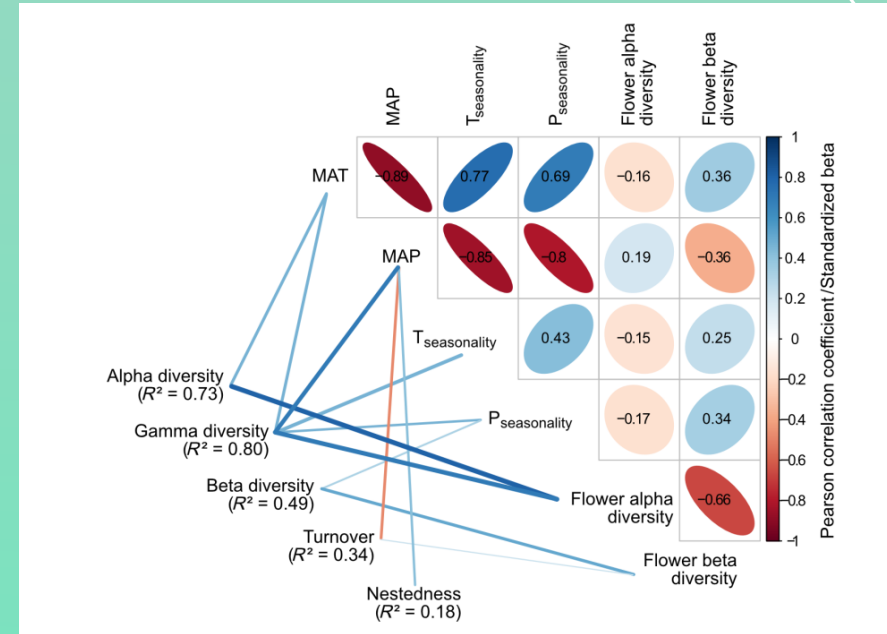
ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

Floral turnover and climate drive seasonal bee diversity along a tropical elevation gradient

Fairo F. Dzekashu^{1,2} | Abdullahi A. Yusuf² | Christian W. W. Pirk² |
Ingolf Steffan-Dewenter³ | H. Michael G. Lattorff¹ | Marcell K. Peters³



Dzekashu et al 2022

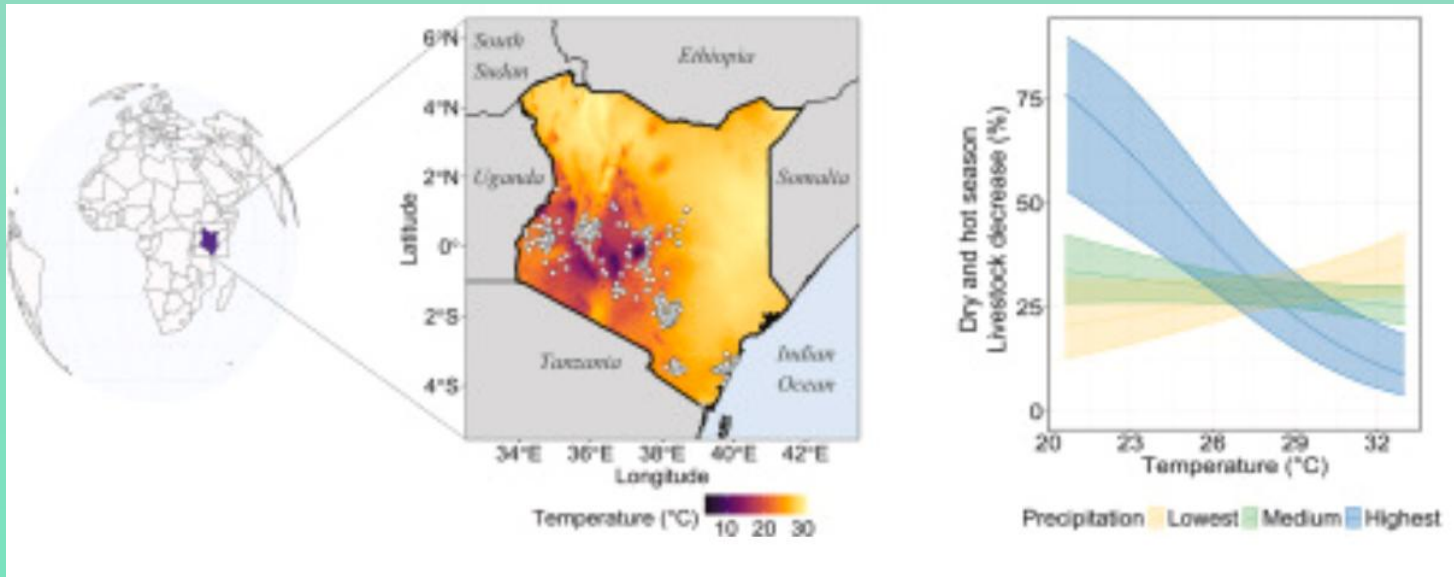


Both α - and γ -diversity decreased with elevation.



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Climate effects on honey bees can be mitigated by beekeeping management in Kenya



- ❖ Kenyan beekeepers lost on average 36.6% of their honey bee colonies in 2021–2022
- ❖ Livestock decreases were higher during the dry and hot than the wet and cold season.
- ❖ Precipitation mitigates temperature-induced livestock decrease within the Kenyan climate.
- ❖ Water supplementation can help reduce livestock decrease during dry and hot season
- ❖ Livestock decreases are expected to persist in Kenya based on climate change projections.

Period of colony loss	Current (2021–2022)	Horizon 2050	Horizon 2100
Dry and hot season (n=569)	31.9% (25–39.5%)	26.4% (23–30.1%)	25.4% (21.7–29.5%)
Wet and cold season (n=511)	20.2% (14.2–28%)	21% (17.7–24.6%)	21.7% (18–25.9%)
Annual (n=495)	36.6% (29.5–44.6%)	38.3% (34.1–42.7%)	38.3% (33.6–43.3%)

Predicted annual and seasonal livestock decrease related with climate change projections for horizon 2050 and horizon 2100 and compared with the current livestock decrease estimates. Estimates and confidence intervals are based on the outputs of the previously used models by using the projected temperature and precipitation data as input

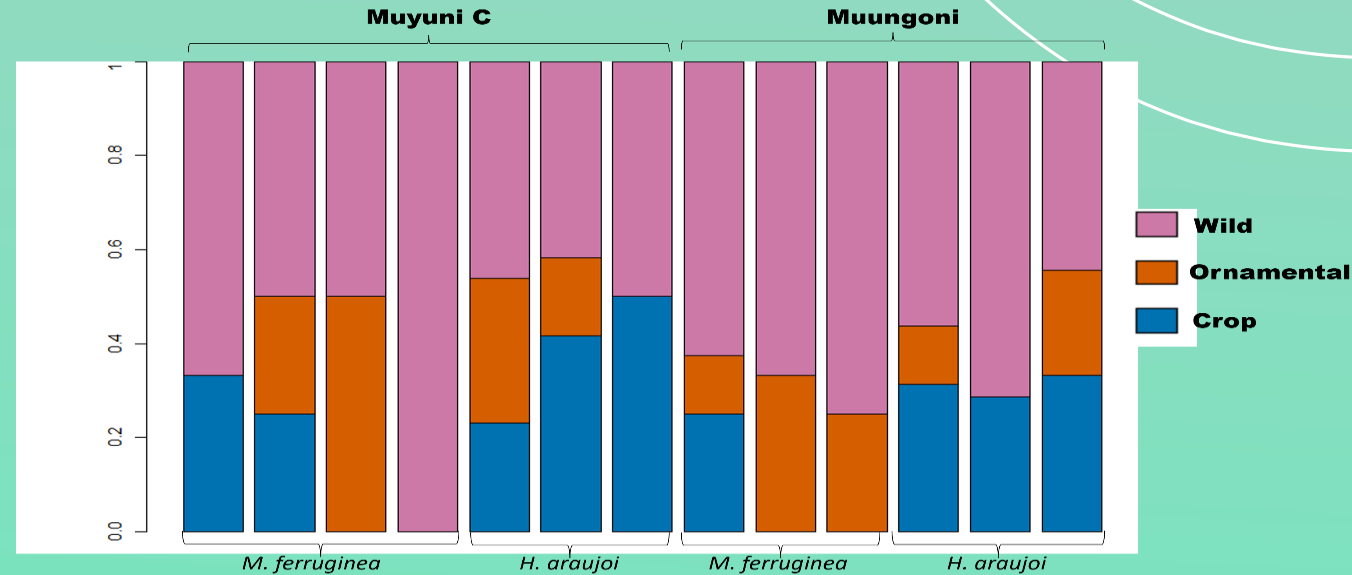
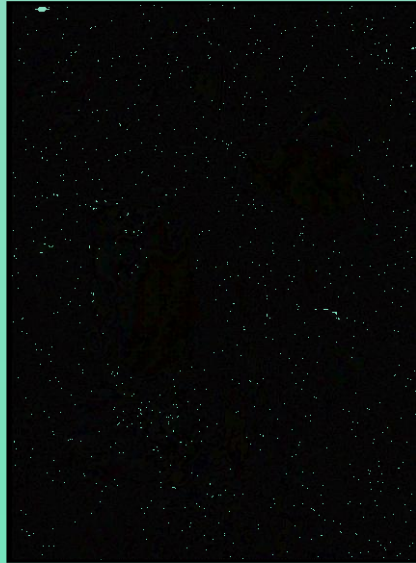
Sibaja et al 2025

EFFECTS OF CLIMATE CHANGE ON POLLINATOR HEALTH AND DIVERSITY

African stingless bees



- Medicinal honey/ propolis
- Effective pollinators
- Good for pollination in Green houses
- Surrogates for honey bees



Bar plot showing the proportions of wild, ornamental and cultivated plants in each pollen samples grouped according to the site and the stingless bee species

Kiatoko et al 2014

Ndungu et al 2024, African Journal of Ecology



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EFFECTS OF CLIMATE CHANGE ON POLLINATOR HEALTH AND DIVERSITY

Effects of climate change on stingless bees

Modeling the potential range expansion of *Hypotrigona gribodoi* (stingless bees) in Africa: assessing climate change impacts and habitat suitability using Maxent and GIS

Original Research Article | Published: 07 July 2025

Nassor et al 2025

Volume 45, pages 1771–1781 (2025) [Cite this article](#)

While significant changes in the habitat of *H. gribodoi* are not expected due to future climate conditions, one scenario for 2070 suggested a potential loss of much of its suitable habitat across the continent.

Research Article

The use of multisource spatial data for determining the proliferation of stingless bees in Kenya

David Masereti Makori , Elfatih M. Abdel-Rahman, Nelly Ndungu, John Odindi, Onesimo Mutanga, Tobias Landman

[...show all](#)

Pages 648-669 | Received 29 Sep 2021, Accepted 25 Feb 2022, Published online: 21 Mar 2022

 Cite this article  <https://doi.org/10.1080/15481603.2022.2049536>



Makori et al 2021

On the other hand, high seasonality in precipitation and temperature indicated high stingless niche variability in the future (i.e. 2055).



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WOAH contribution in Climate change effect on beekeeping and biodiversity conservation

- Disease tracking:** Monitors how global warming shifts the geographic limits and seasonal activity of disease vectors
- One Health Approach:** Collaborates globally to link environmental shifts, animal health including Bee Health, and human safety.



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Conclusion

- ❖ Climate change poses significant threats to bee health and biodiversity, particularly in vulnerable regions like Africa, where rising temperatures, extreme weather events, and habitat loss disrupt bee populations and their critical pollination services
- ❖ Key impacts include thermal stress leading to hive abandonment, reduced floral resources due to drought and altered flowering times, increased disease spread, and habitat fragmentation
- ❖ These changes not only weaken bee colonies but also cause cascading effects on plant reproduction, ecosystem stability, and agricultural productivity
- ❖ Addressing these challenges requires integrated strategies to enhance forage availability, monitor disease dynamics, and conserve native flora
- ❖ Global initiatives such as WOA's disease tracking and One Health approach play vital roles in managing these risks
- ❖ Sustaining bee populations amid climate change is essential for preserving biodiversity, food security, and ecosystem resilience
- ❖ Gap-More research on effect of climate change on bee health needed in Africa



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Thank You

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