

Climate Vulnerability Assessment

Herding for Health Initiative

Restoring Landscapes and Livelihoods for Climate Resilience in Southern Africa's Rangelands



By Dr Stephen Holness and Deidre de Vos
March 2020, Johannesburg





Overview

Key Concepts and Assessment Approach



Project objective

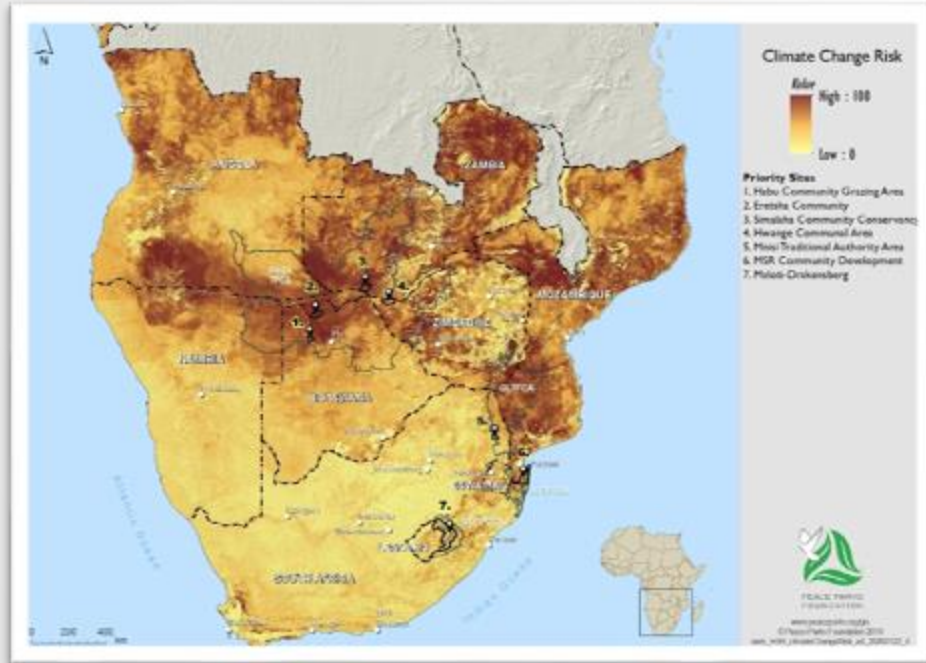


HERDING FOR HEALTH:

**Restoring Landscapes And Livelihoods
For Climate Resilience In
Southern Africa's Rangelands**

The project undertook a rapid spatial climate risk analysis using a framework compatible with IPCC concepts/standards, with a strong focus on the linkage between rural people and their environment across Southern Africa.

Assessment Approach



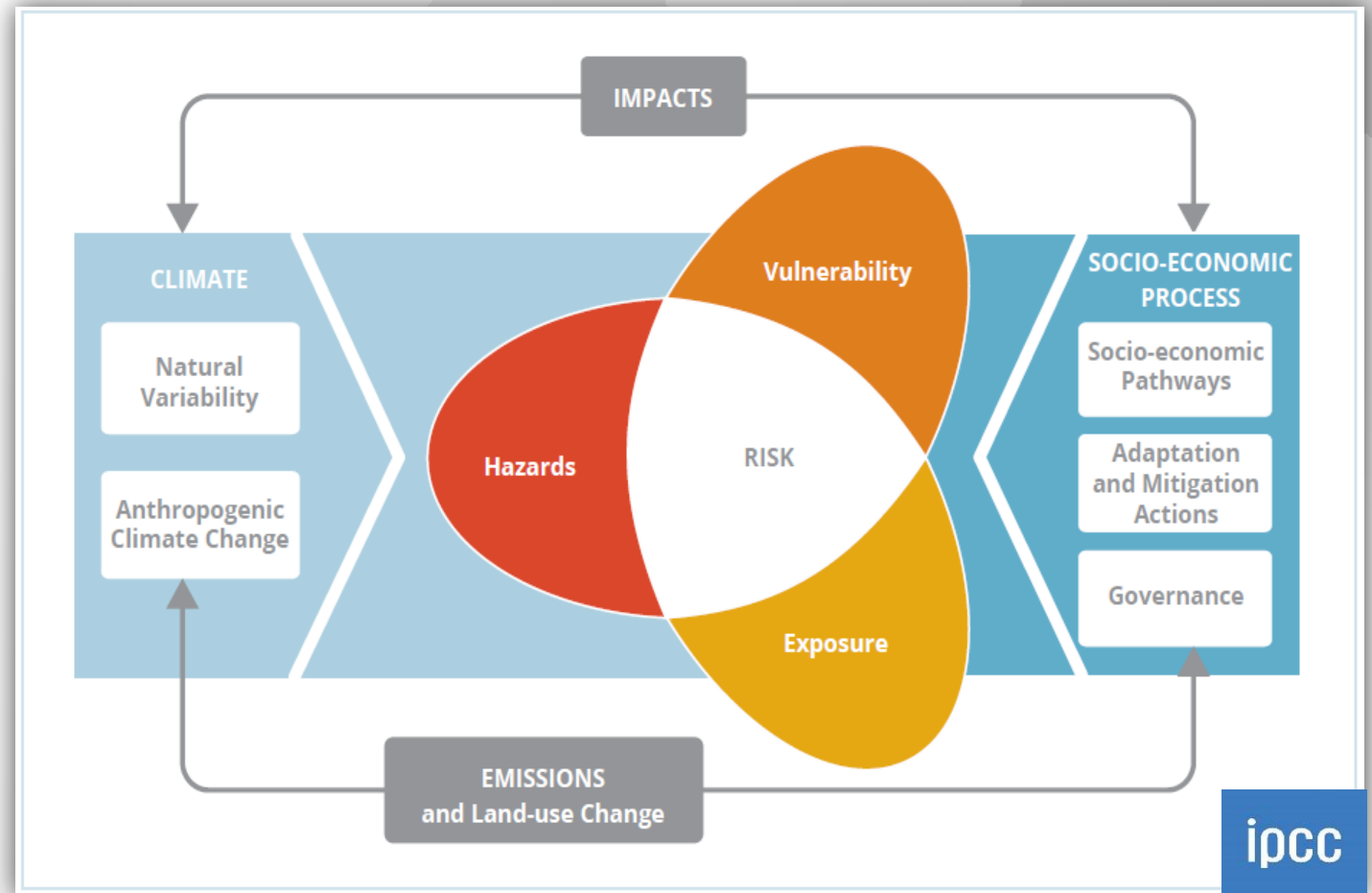
Spatial Risk Assessment



Community Workshops

Spatial Assessment

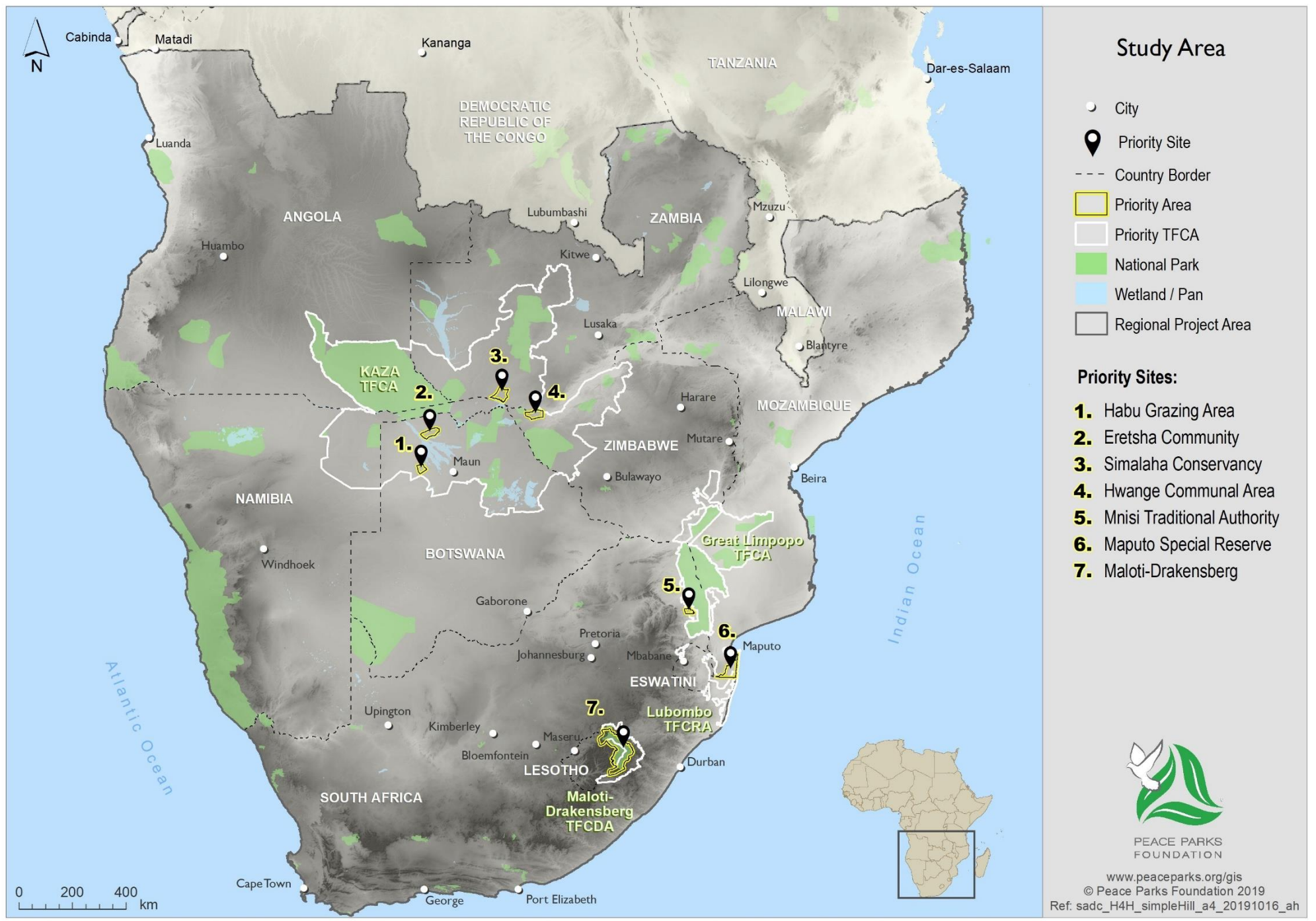
To evaluate climate risk the project followed the IPCC framework for climate Vulnerability Assessments, where **risk** is calculated from the interaction of climate-related **hazards** with the **vulnerability** and **exposure** of human and natural systems.



Note: The assessment takes an **Ecosystem-based Adaptation view of the response to climate risk.

Domain:

1. Angola
2. Zambia
3. Mozambique
4. Zimbabwe
5. Botswana
6. Namibia
7. South Africa
8. Lesotho
9. Eswatini



Spatial Assessment

SPATIAL LAYERS

Climate Change

- Observed climate change (1901 – 2012)
- Projected change (2070)
- **Temperature**
- **Precipitation**
- **Extreme Events**

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Climate Hazard

- Aridification
- Droughts
- Heat Waves
- Wildfire Risk
- Floods
- Deforestation
- Land degradation
- Reduced ability to grow crops

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Vulnerability

- Lack of access (markets, services, human and animal health services etc.)
- Lack of availability of alternative arable agriculture livelihoods
- Increasing population pressure
- Dependency ratio
- Gender imbalance issue in rural areas
- Human Development Vulnerability Index

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Exposure

- Rural population density in rangelands
- Priority conservation landscapes
- Intact rangelands

RISK Priority Areas

Spatial Assessment: Data Sources

SPATIAL LAYERS

Climate Hazard

- Precipitation and temperature data from Worldclim 2 (Fick and Hijmans, 2017).
- Spatial Planning for Protected Areas in Response to Climate Change (SPARC) (Roehrdanz, P., 2019)
- Aqueduct 3.0 project (Hofste et al., 2019)
- Global heat waves study (Dosio et al., 2018)
- NASA FIRMS (Fire Information for Resource Management System)
- Fire density UNEP/GRID-Europe

- World Atlas of Desertification (Cherlet et al., 2018) World Atlas of Desertification (Cherlet et al., 2018)
- High-Resolution Global Maps of 21st-Century Forest Cover Change (Hansen et al., 2013)
- Degradation assessment (Campbell et al., 2008; Field et al., 2008)
- The GLocal Assessment of SOil Degradation (GLASOD) project
- "Global Modelling of Agricultural Frontiers under Climate Change" (Roehrdanz, 2015)

Climate Change

- CRUTS 3.23 (Climatic Research Unit time series version 3)

Vulnerability

- "A global strategy for road building" (Laurance et al., 2014)
- "A new map of global urban extent from MODIS satellite data" (Schneider et al., 2009), World Urban Areas, LandScan (Kelso and Patterson, 2012) and the Global Human Built-up And Settlement Extent (HBASE) dataset and the Global Man-made Impervious Surface (GMIS) Dataset (De Colstoun et al., 2017).
- Malaria Atlas Project, global map of accessibility to cities for the year 2015 (Weiss et al., 2018).
- "Global Modelling of Agricultural Frontiers under Climate Change" (Roehrdanz, 2015)
- Gridded Population of the World, Version 4 (GPWv4)
- Subnational Human Development Index (HDI) data from the Global Data Lab (GDL) of the Radboud University in the Netherlands (Permanyer and Smits, 2019; Smits and Permanyer, 2019).

Exposure

- Global Food Security-support Analysis Data (GFSAD) Cropland Extent 2015 Africa 30 m V001
- European Space Agency Climate Change Initiative (ESA-CCI) project Land Cover CCI
- Conservation International. Version 2016.1. 25 April 2016. Original reference: (Myers et al., 2000)
- Olson and Dinerstein, 2002)
- The World Database on Protected Areas (WDPA)

RISK Priority Areas



Community Workshops



Community Workshops

1. Weather and climate
 - Number and intensity of hot days
 - Number and intensity of cold days
 - Average temperatures during day
 - Average annual rainfall
 - Cold spells
 - Dry spells
 - Drought
 - Natural bush fires
2. Crops and livestock
3. Planting and fruiting (all crops)
4. Livestock condition
5. Livestock movement patterns
6. Rivers and wildlife
 - Floods/ inundation
 - Wildlife conflict
7. Grazing land
8. Available grassland
9. Habitat change

“For a comprehensive understanding of community vulnerability, it is necessary to link specific hazards and the exposure of the impacts of these hazards to community livelihoods.” - Mutenje, et al., (2018).



COMMUNITY WORKSHOPS

Examples of the type of information extracted during workshops

Climate change related issue	Eretsha	Habu	MSR	Simalaha	Hwange
Increased overall temperature	●	●	●	●	●
Increased heat with less associated rain	●	●			●
Heat waves or extreme heat events		●			
Increased day and night temperatures		●			●
Increased winter temperatures		●			●
Decreased cold days in winter					●
Human deaths due to heatstroke		●		●	
Reduced rainfall reliability (increased variability both seasonally and spatially)	●	●		●	●
Annual rainfall variability (still some good years)		●			
Shortened and delayed rainy season	●	●		●	●
Decreased annual rainfall	●	●	●	●	●
Occurrence of extreme events		●		●	●
Increased flooding					●
Decreased flooding events	●	●			
Rivers have dried up		●		●	●
Reduced full river state (less flood)	●	●	●	●	●
Channels and dams frequently dry up	●	●	●	●	●
Increased drought	●	●		●	●
Increased wind				●	●

Climate change related issue	Eretsha	Habu	MSR	Simalaha	Hwange
Decreased available rangeland	●	●	●	●	
Deforestation	●			●	
Bushfires	●	●	●	●	●
Decrease in natural (non-invasive) biodiversity				●	●
Bush encroachment		●	●	●	
Too many cattle for land capacity		●		●	
Water runs off overgrazed/bare land		●		●	
Erosion				●	●
Overall reduced grazing capacity	●	●	●	●	●
Reduced ability to grow crops (decreased yield)	●	●		●	●
Extreme rainfall events have destroyed crops		●		●	●
Change in planting seasons (e.g. reduced second planting)	●	●			●
Reduced ability to live off crops		●			●
Less access to wetland grazing	●				
Lack of water for livestock	●	●	●	●	
Reduced grazing quality	●	●	●	●	●
Change in livestock movement patterns to find water and graze land	●			●	●
Livestock die from lack of enough water and food or drought	●	●			
Increased disease			●	●	
Livestock in poor condition	●	●	●	●	●
Grazing competition	●				
Increase predation and predators	●			●	
Stray cattle mixing with wildlife – lack of control	●	●	●	●	
Conflict between wildlife and livestock due to lack of water in the rivers	●	●		●	●
Cattle grazing in reserve			●		
Lack of access to Veterinary medicine (animal health support)	●		●		
Lack of access to market	●		●		

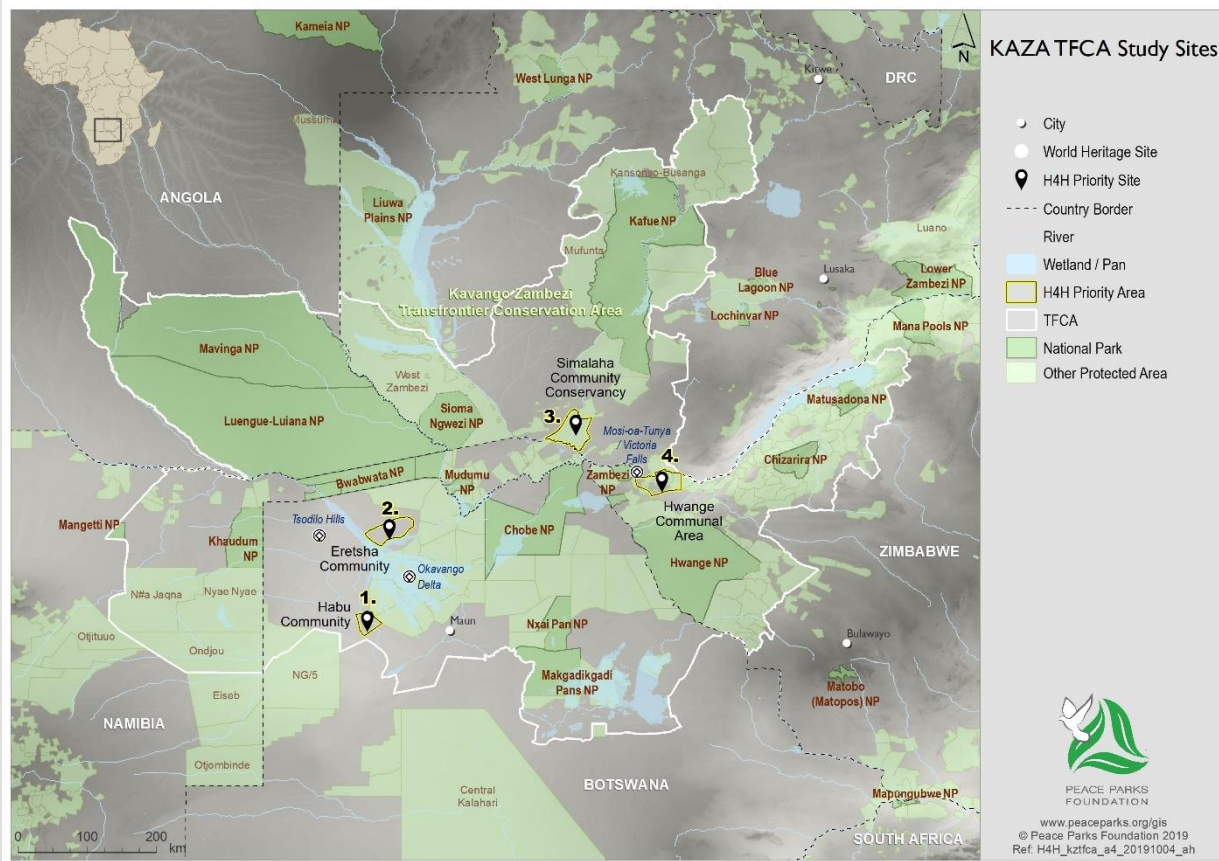


Climate Change

Observed and Projected Changes across the region

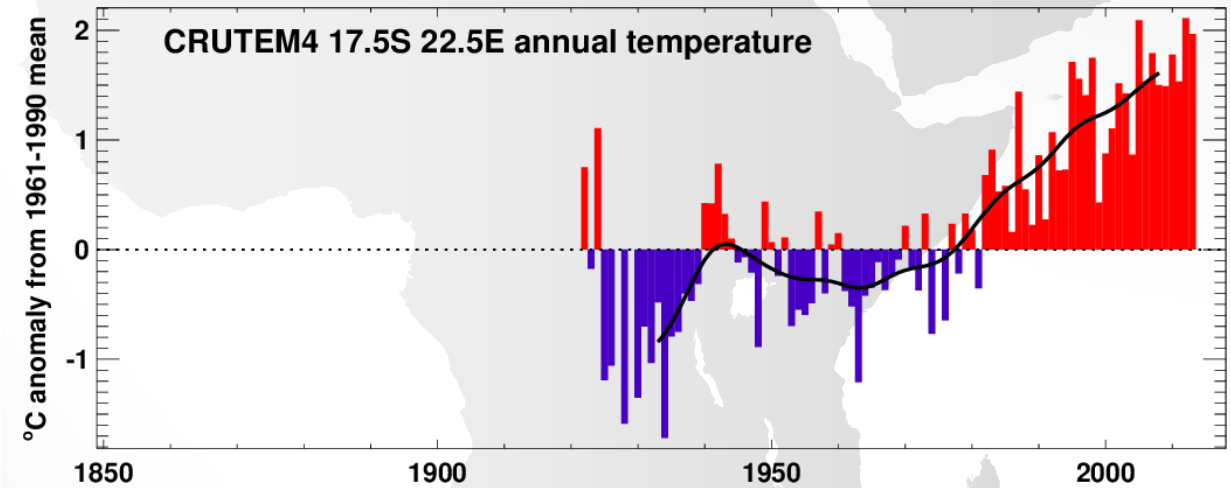


Observed trends:



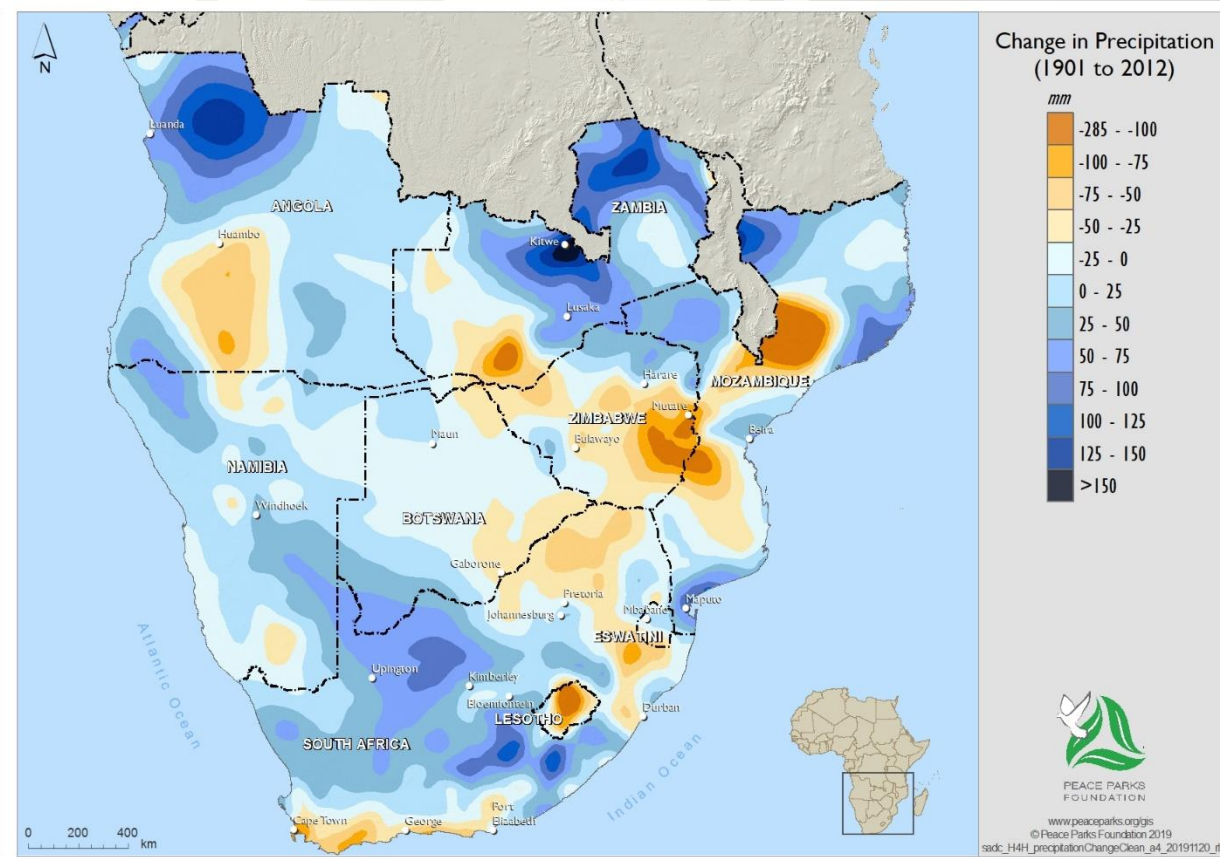
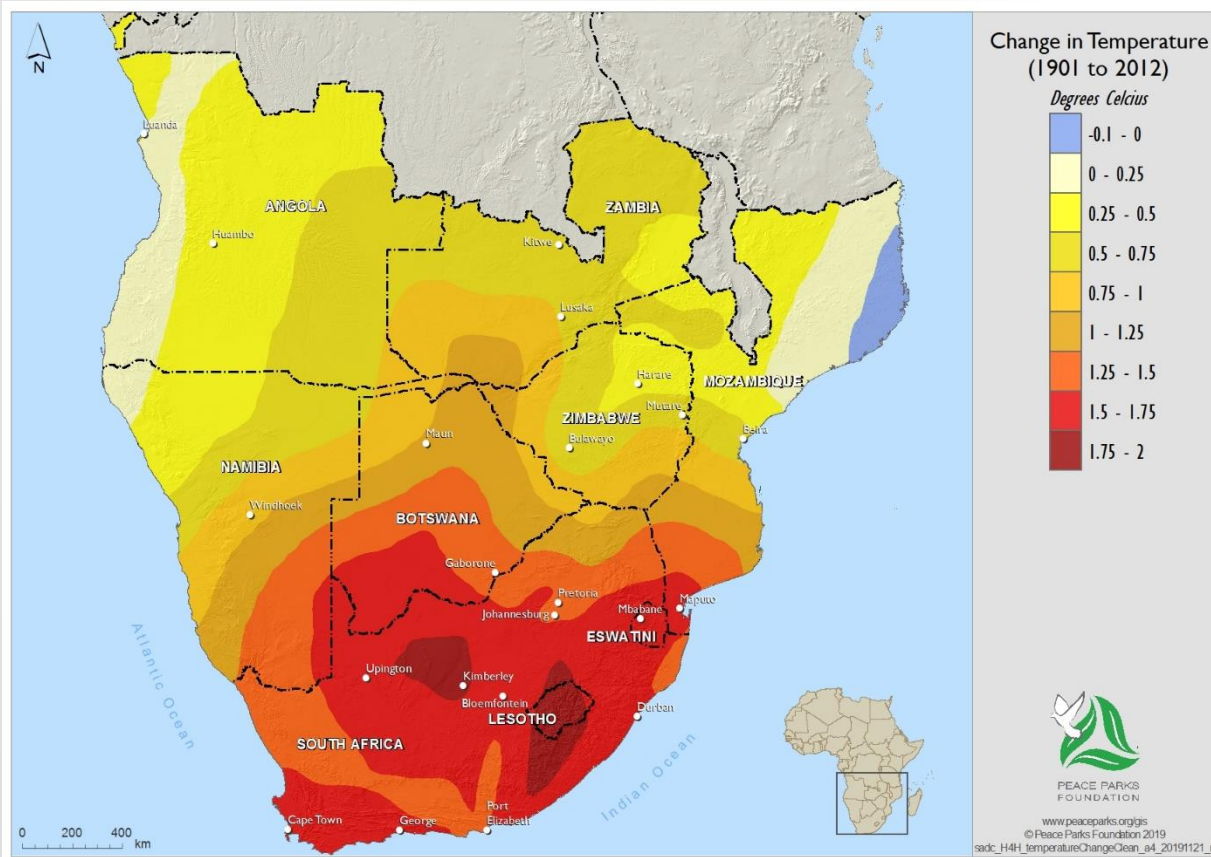
Time scale: 1901 – 2012
Data source: CRU TS 3.23 (Climatic Research Unit time series version 3)

Temperature over the KAZA TFCA



Observed trends:

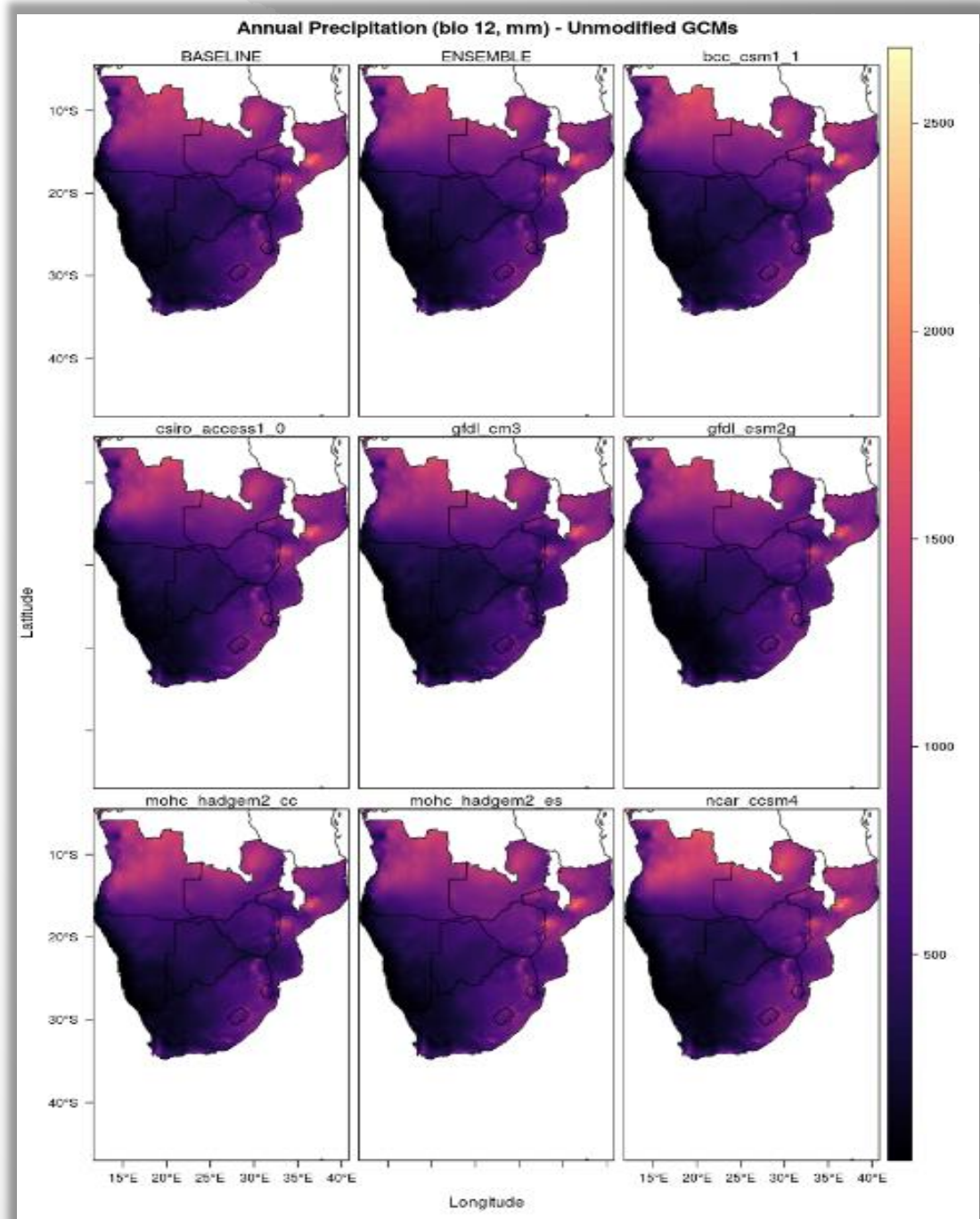
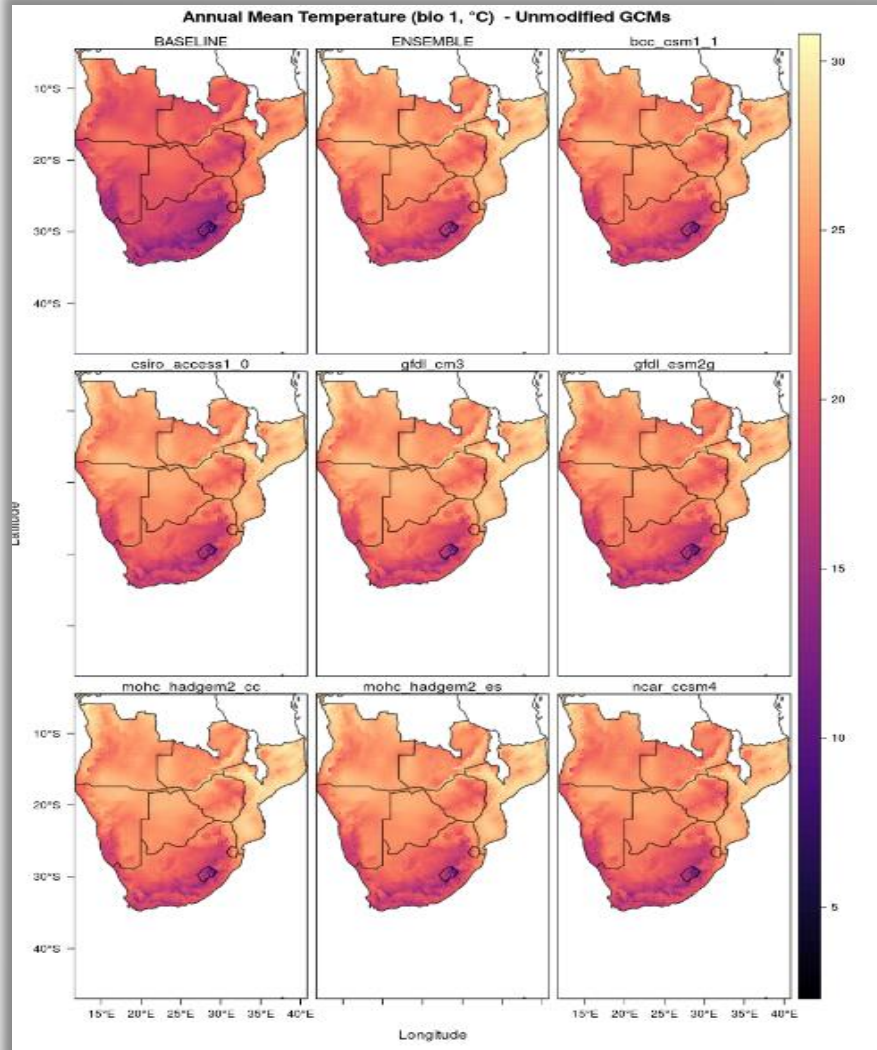
Temperature and Precipitation for the region



Time scale: 1901 – 2012
Data source: CRU TS 3.23 (Climatic Research Unit time series version 3)

Projected change for the region:

Temperature and Precipitation

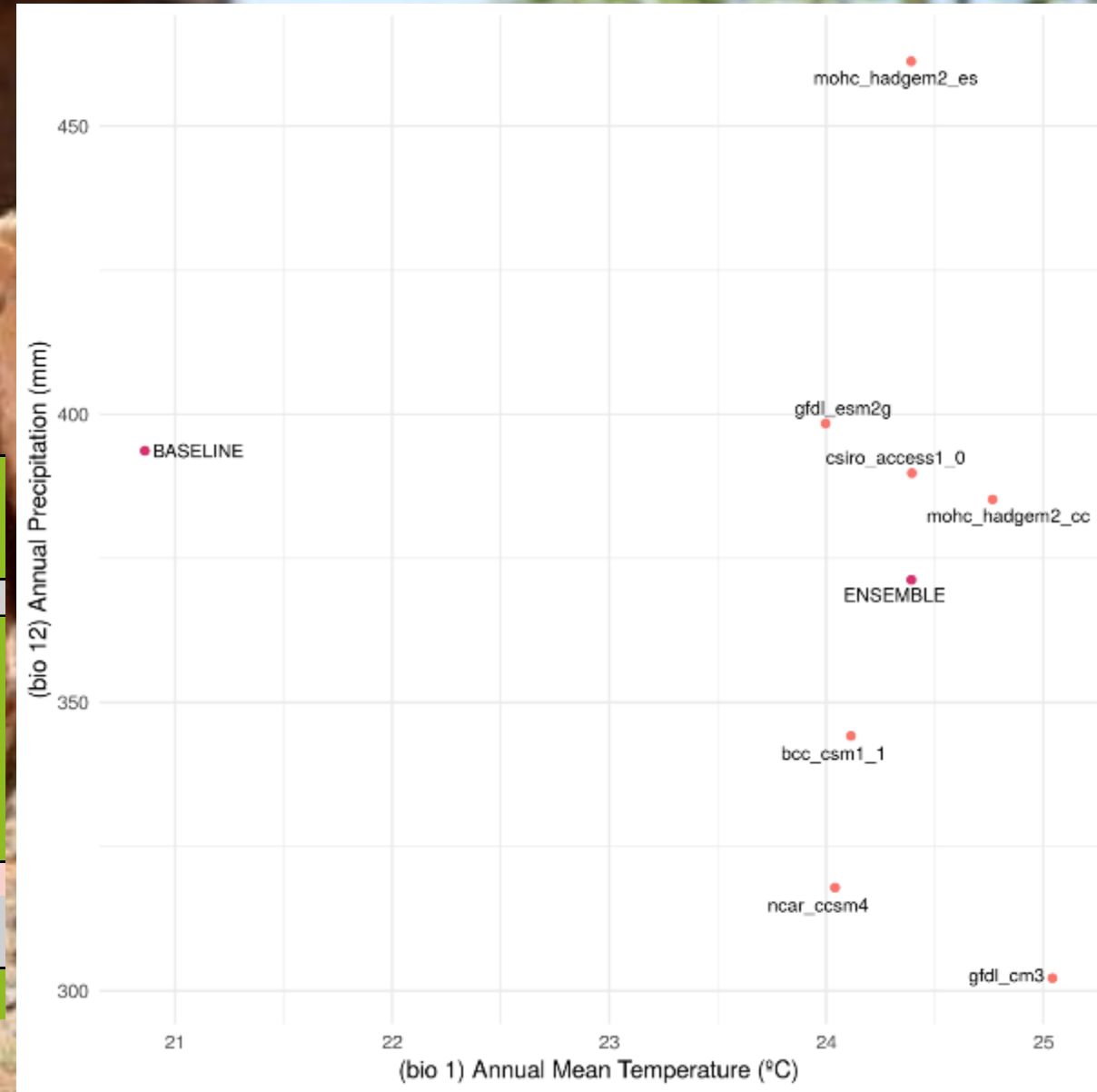


Projected timeframe: 2070 (RCP85)
Data source: 7 Global change models (GCM's)

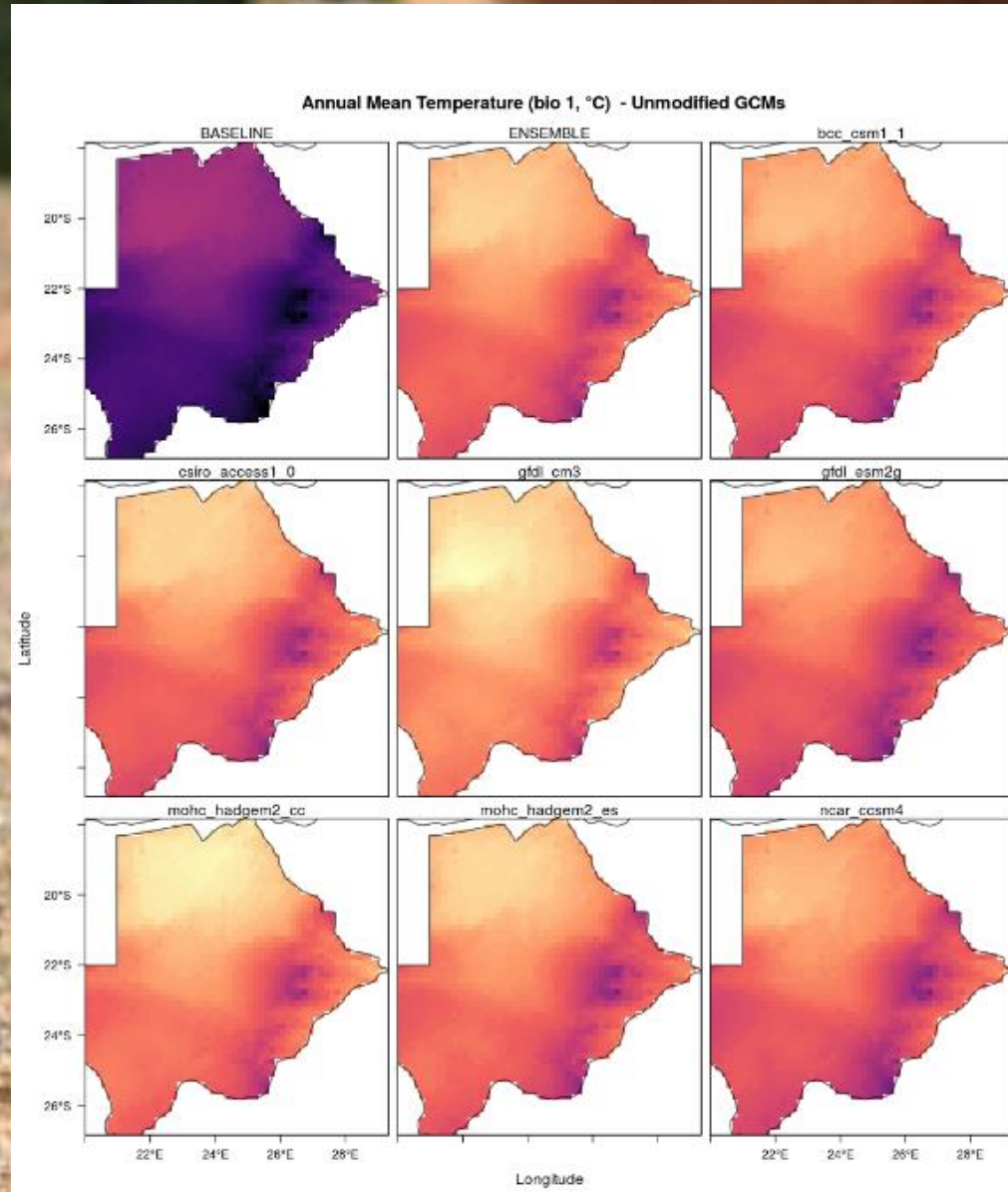
Projected change per country

Example of projected change of temperature and precipitation for **Botswana**.

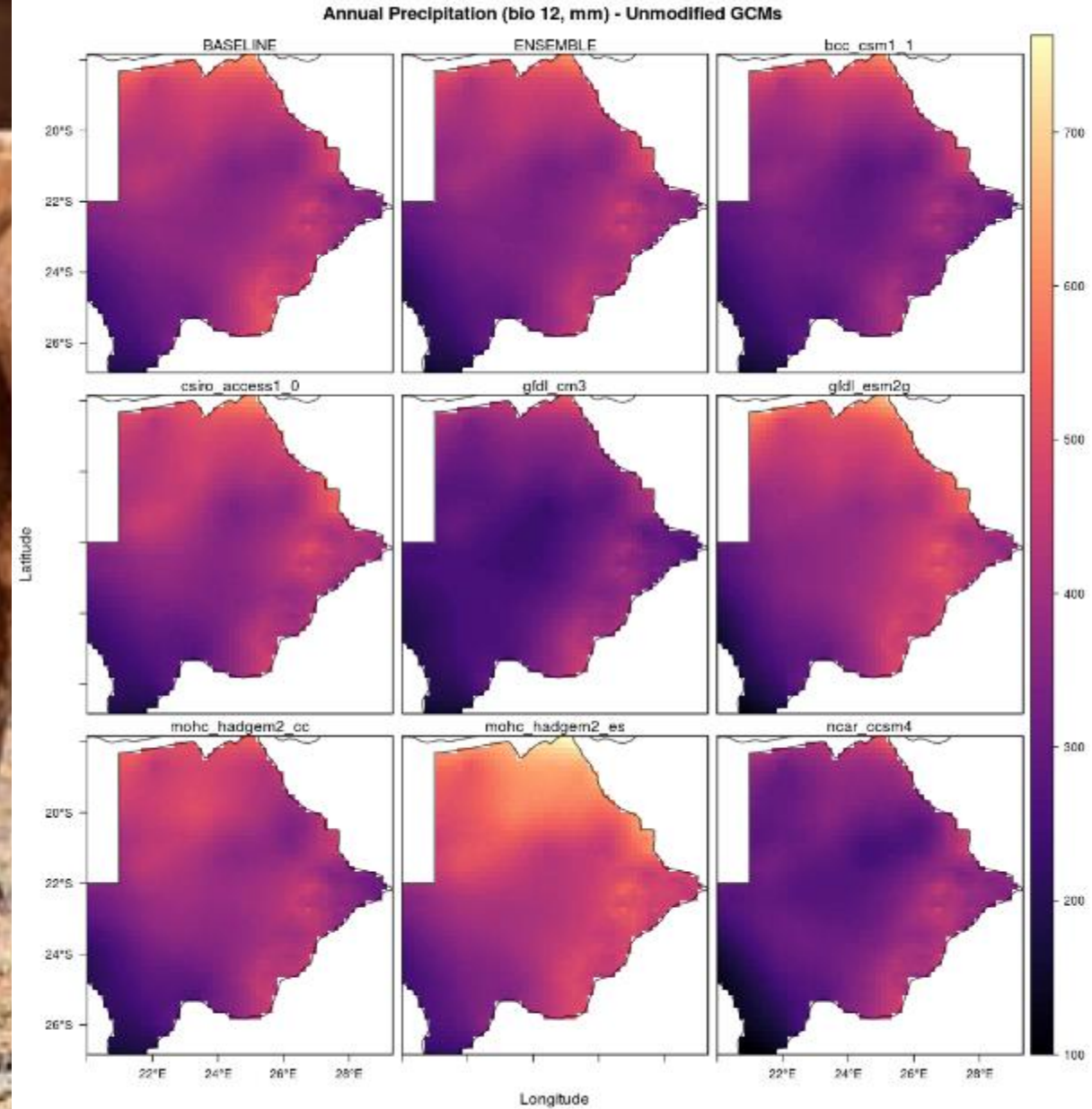
	Model	Annual Temperature °C	Change in Temperature °C	Annual Precipitation (mm)	Change in Annual Precipitation (mm)
Current	Baseline	20,9	0	393,6	0
Individual GCMs	bcc_csm1_1	24,1	3,3	344,2	-49,5
	csiro_access1_0	24,4	3,5	389,8	-3,9
	gfdl_cm3	25,0	4,2	302,2	-91,5
	gfdl_esm2g	24,0	3,1	398,4	4,7
	mohc_hadgem2_cc	24,8	3,9	385,2	-8,4
	mohc_hadgem2_es	24,4	3,5	461,2	67,6
	ncar_ccsm4	24,0	3,2	317,9	-75,8
Summary	Ensemble	24,4	3,5	371,3	-22,4
	Smallest Change	24,0	3,1	461,2	Plus 4,7
	Biggest Change	25,0	4,2	302,2	-91,5



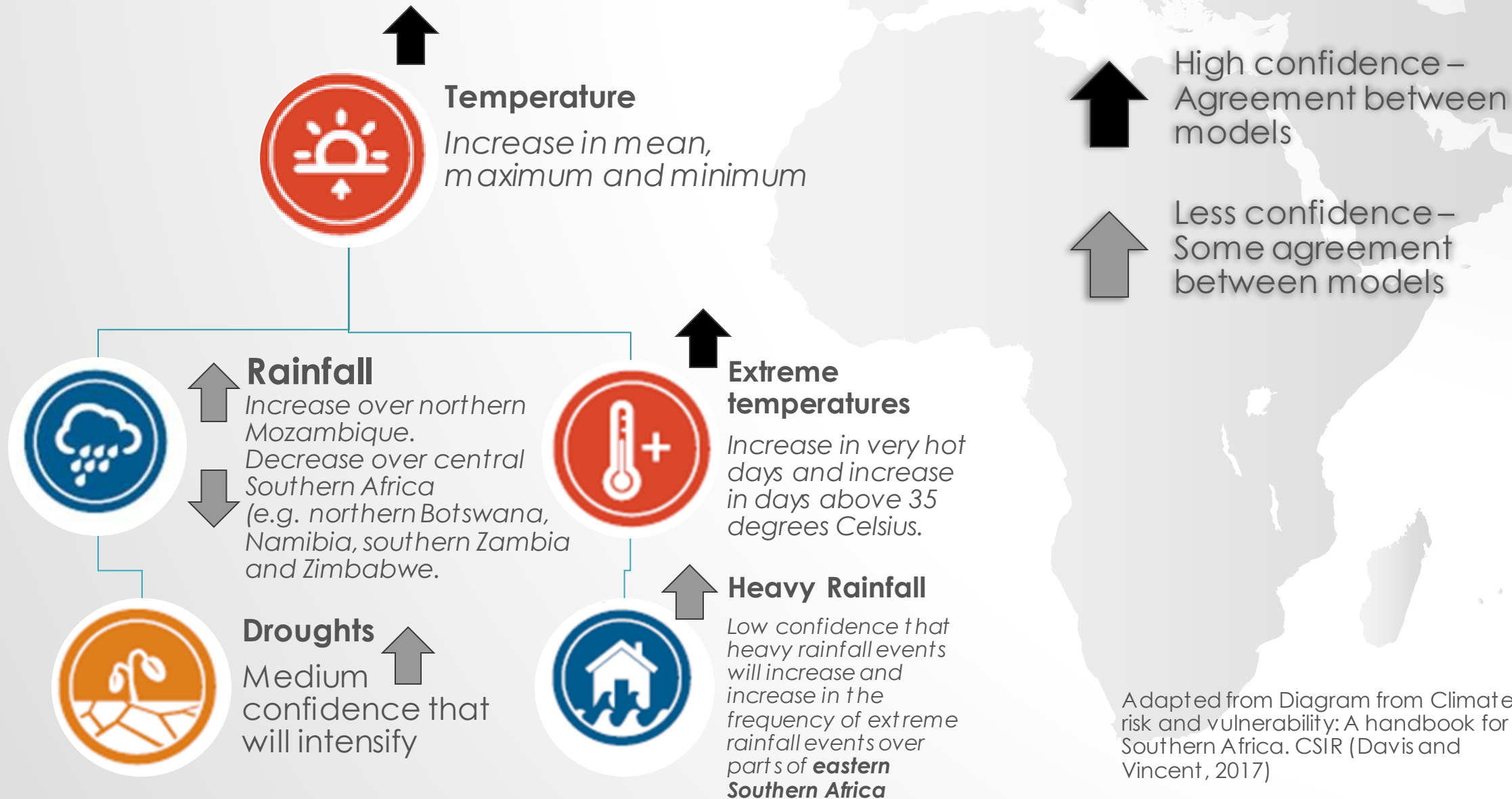
Projected change per country



Example of projected change of temperature and precipitation for Botswana



Summary of climate projections for the region:



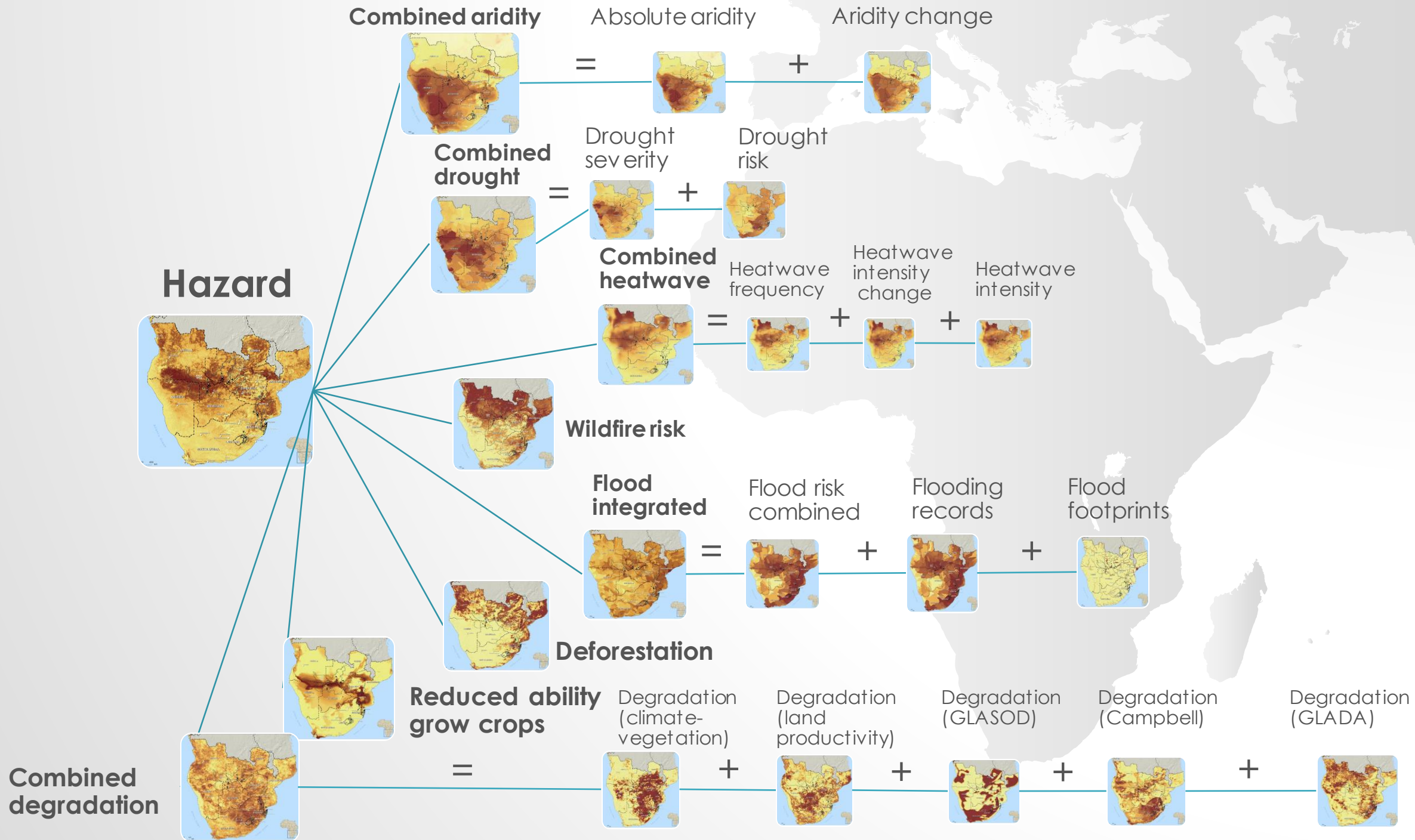
Adapted from Diagram from Climate risk and vulnerability: A handbook for Southern Africa. CSIR (Davis and Vincent, 2017)



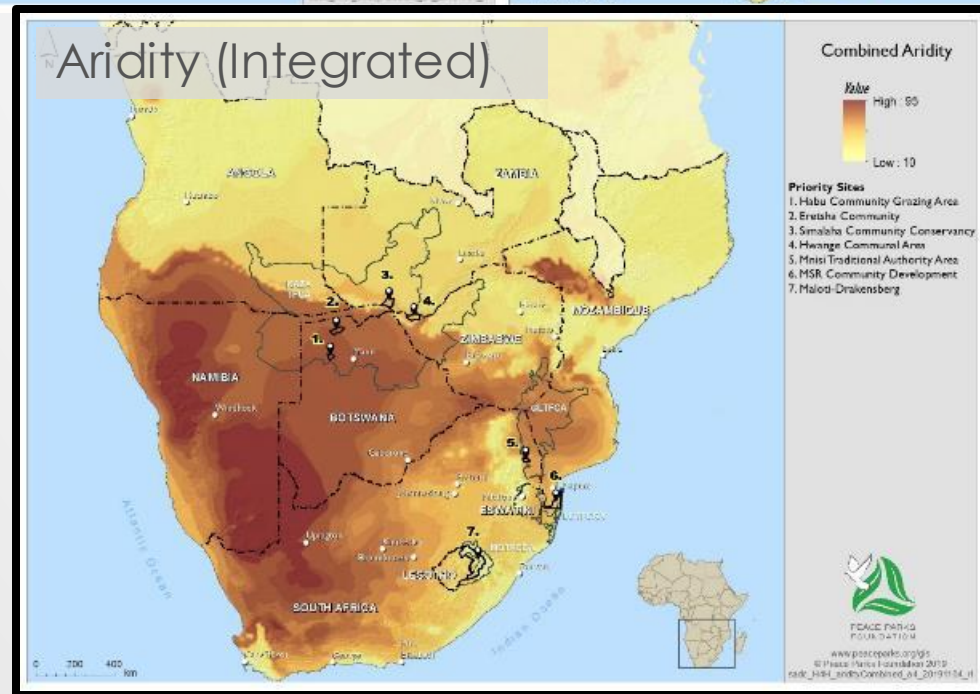
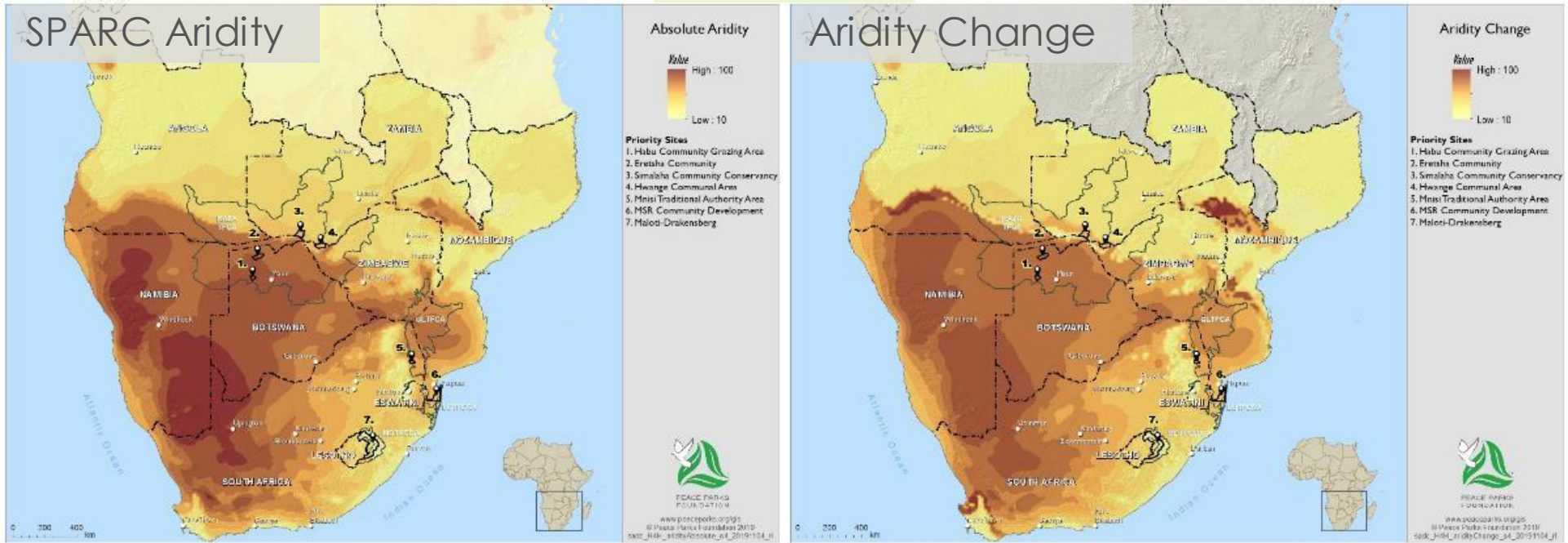
Hazards

“The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.” – IPCC (2014)

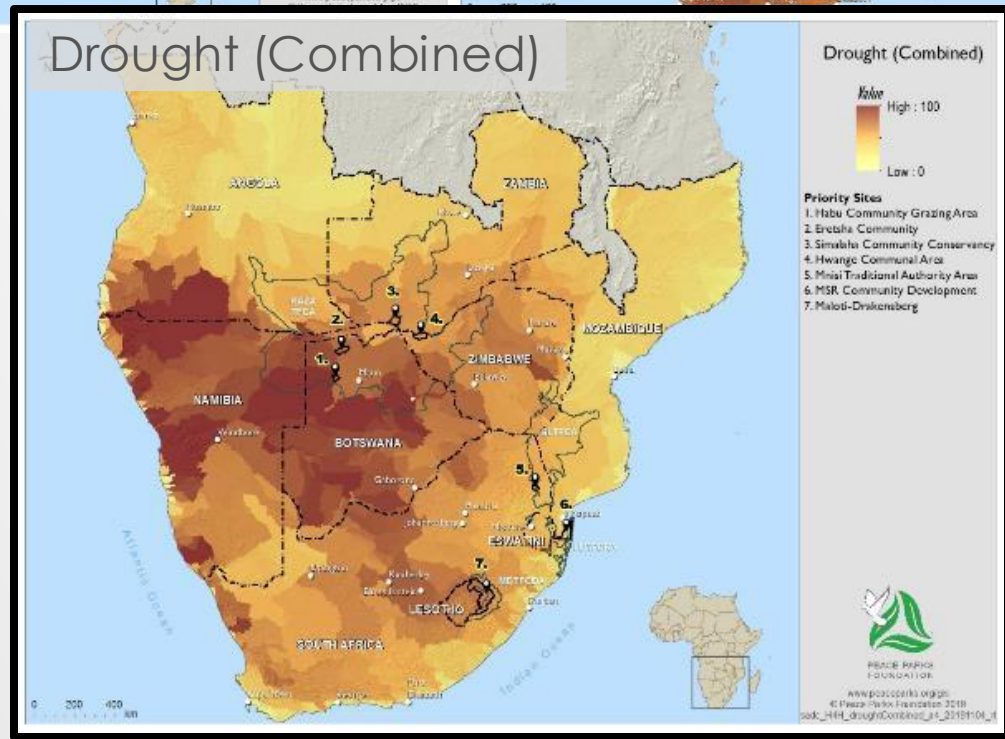
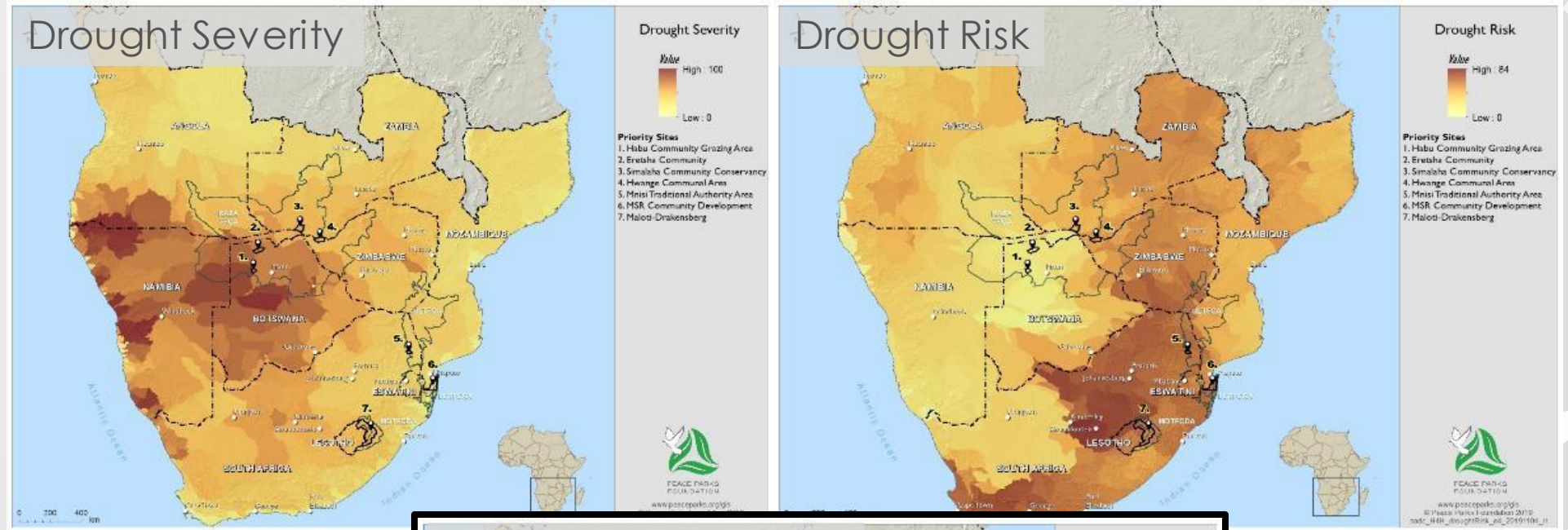




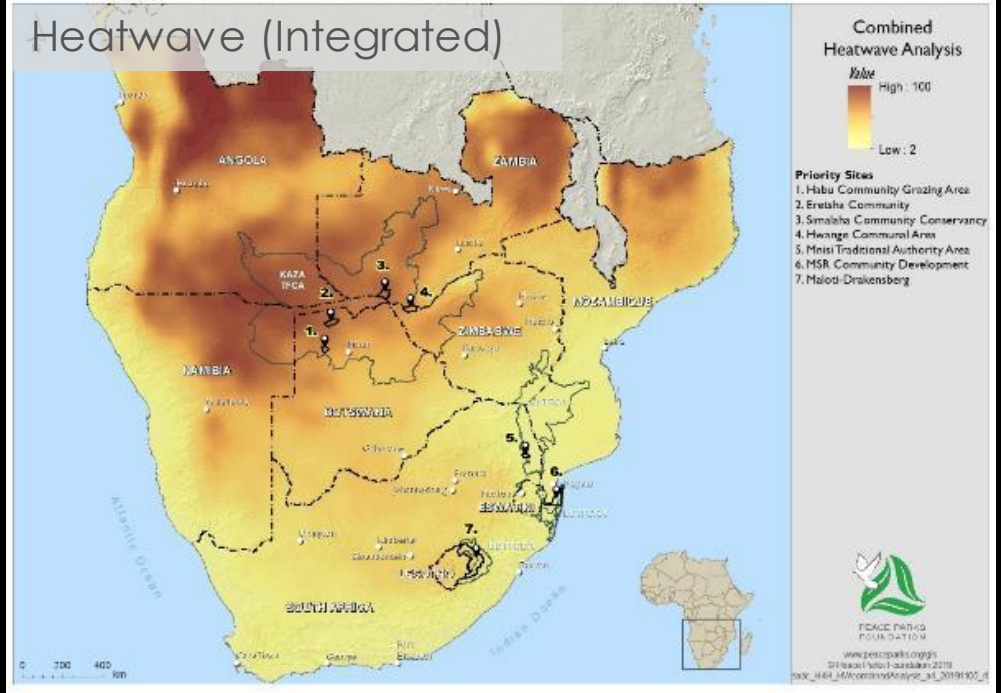
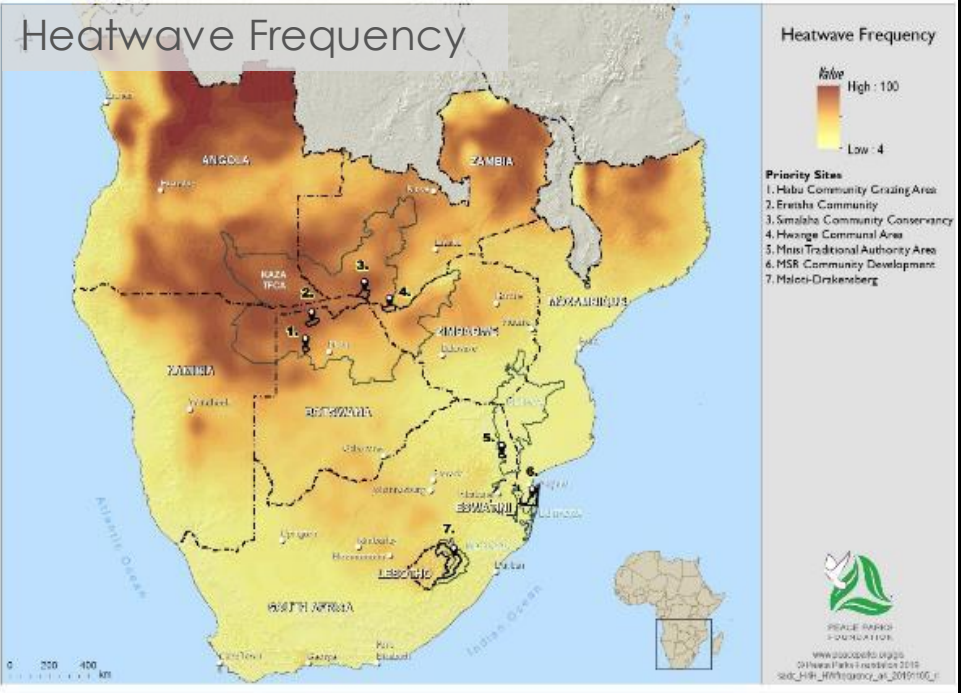
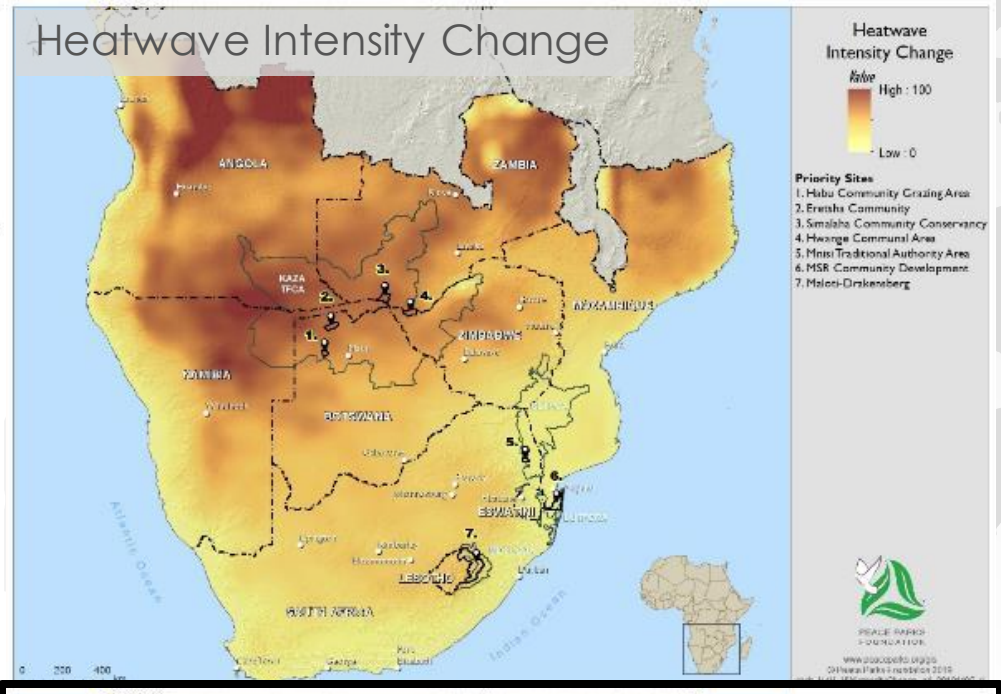
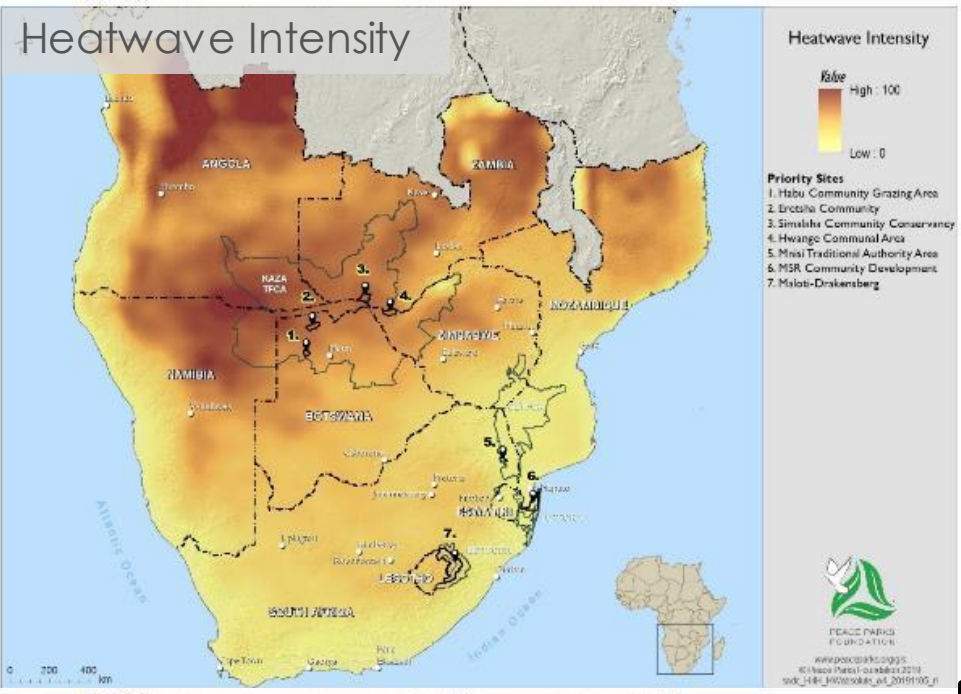
Aridification



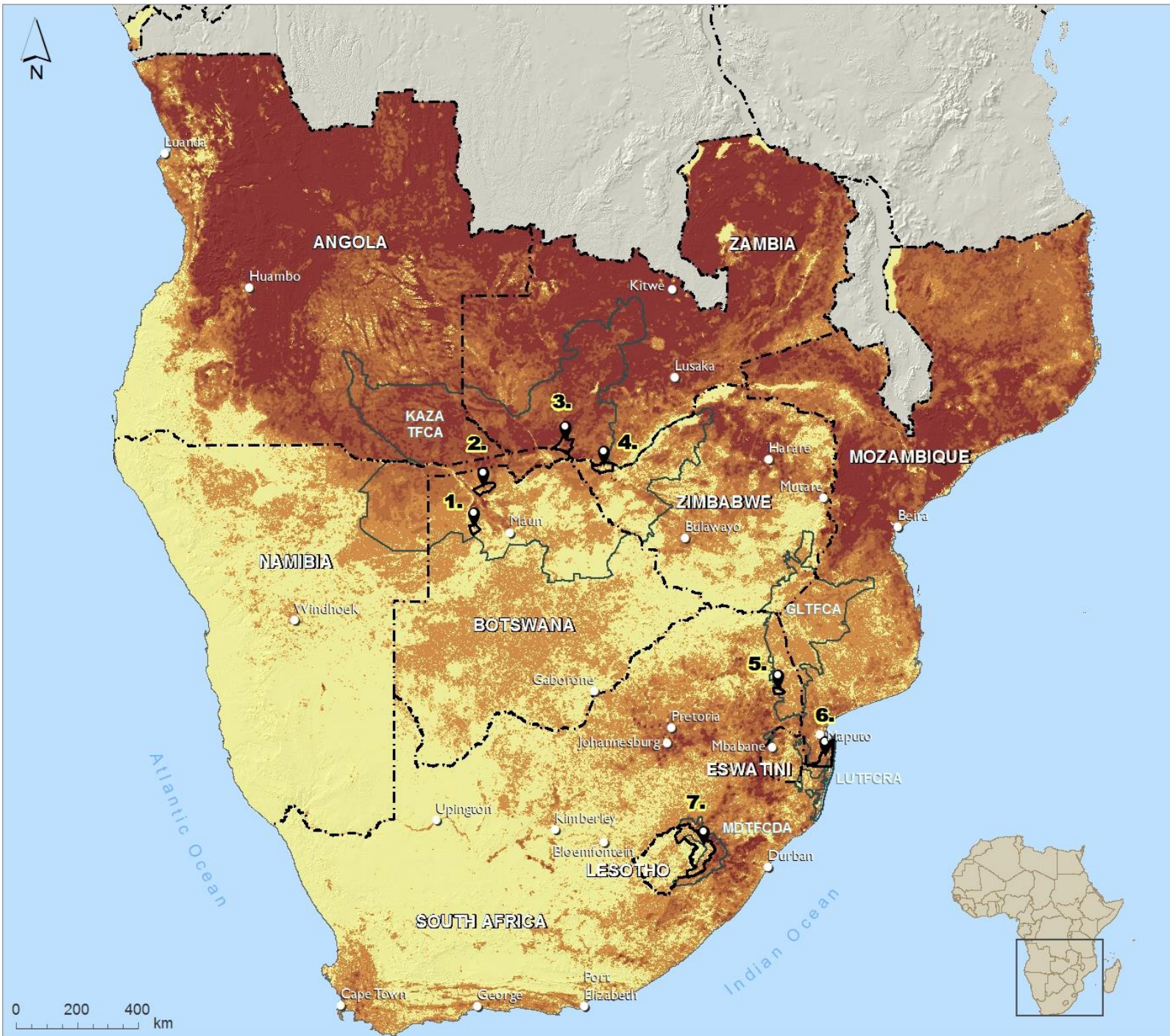
Drought



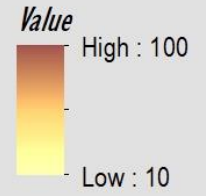
Heatwave



Wildfire



Fire Risk



Priority Sites

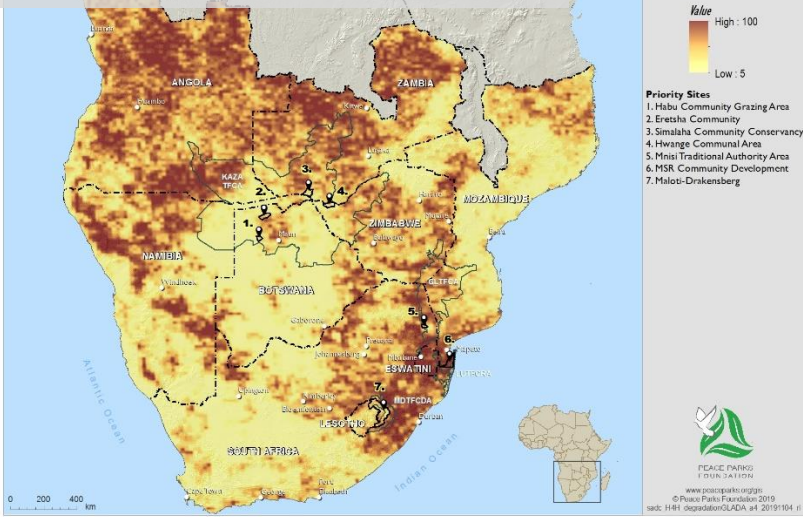
- 1. Habu Community Grazing Area
- 2. Eretsha Community
- 3. Simalaha Community Conservancy
- 4. Hwange Communal Area
- 5. Mnisi Traditional Authority Area
- 6. MSR Community Development
- 7. Maloti-Drakensberg



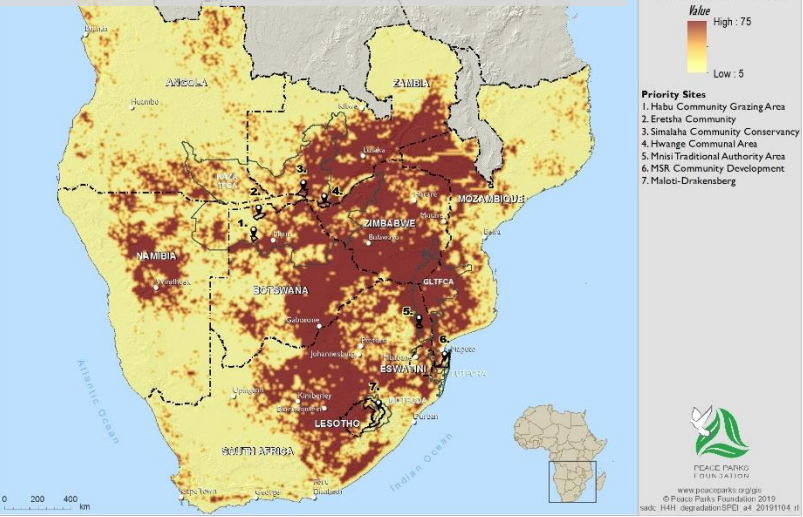
PEACE PARKS
FOUNDATION

Land degradation

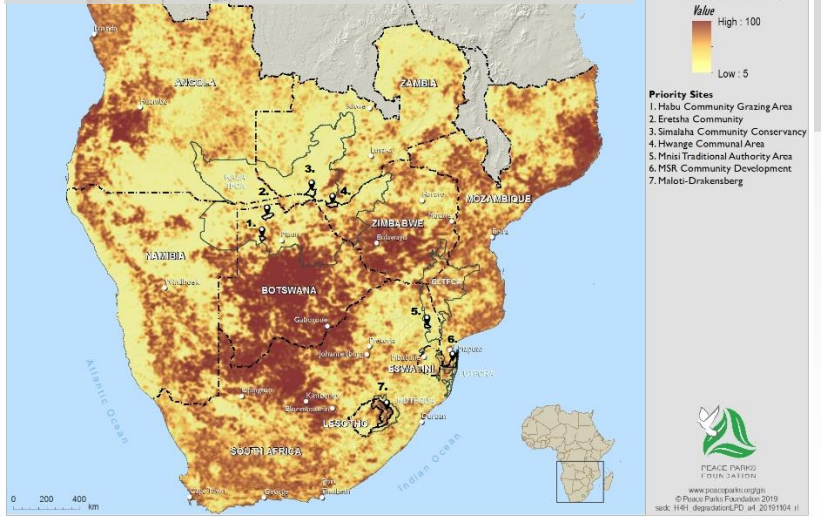
Degradation (GLADA)



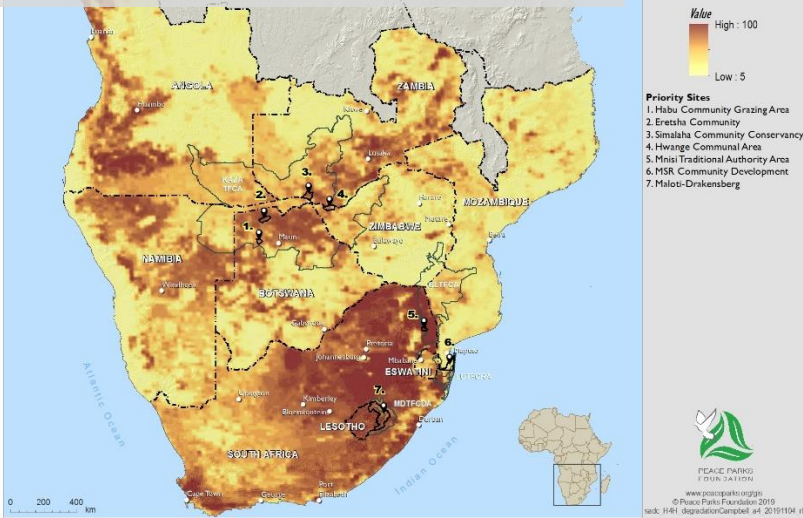
Degradation (Climate-vegetation)



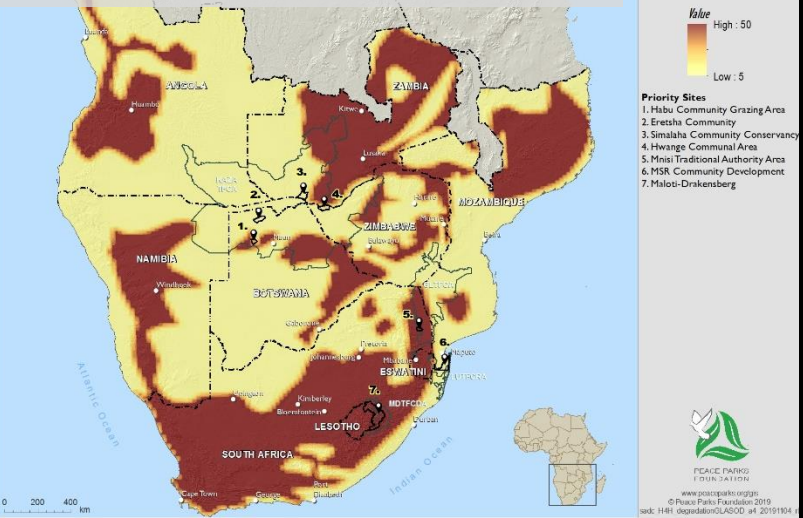
Degradation (Land Productivity)



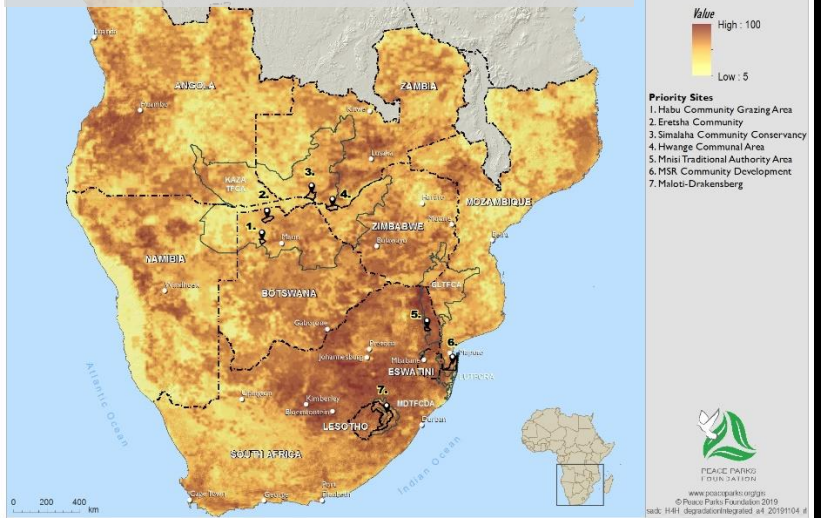
Degradation (Campbell)



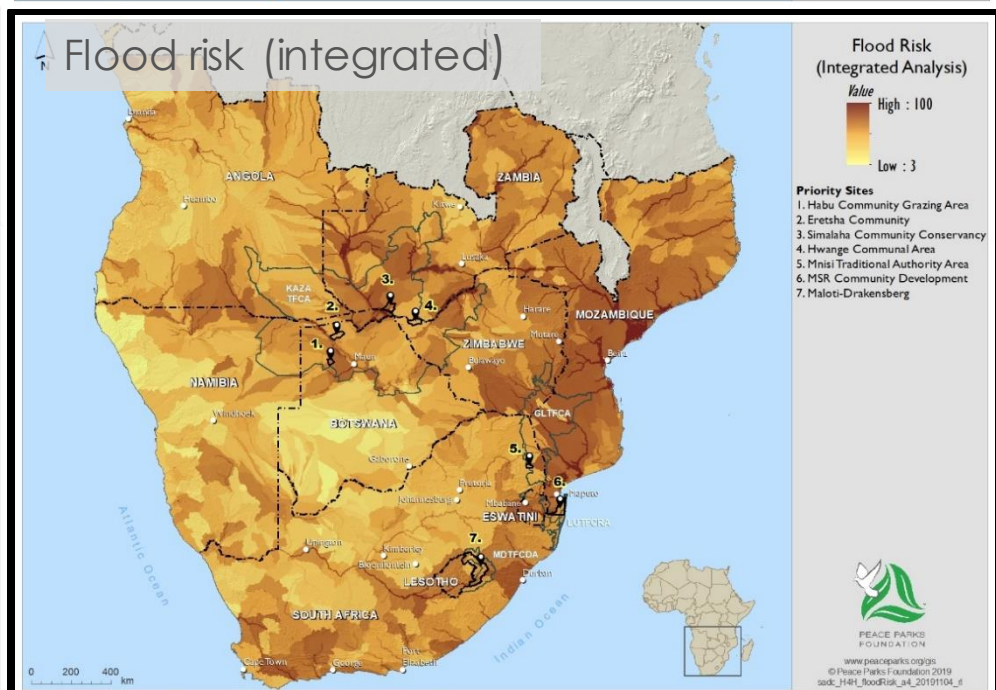
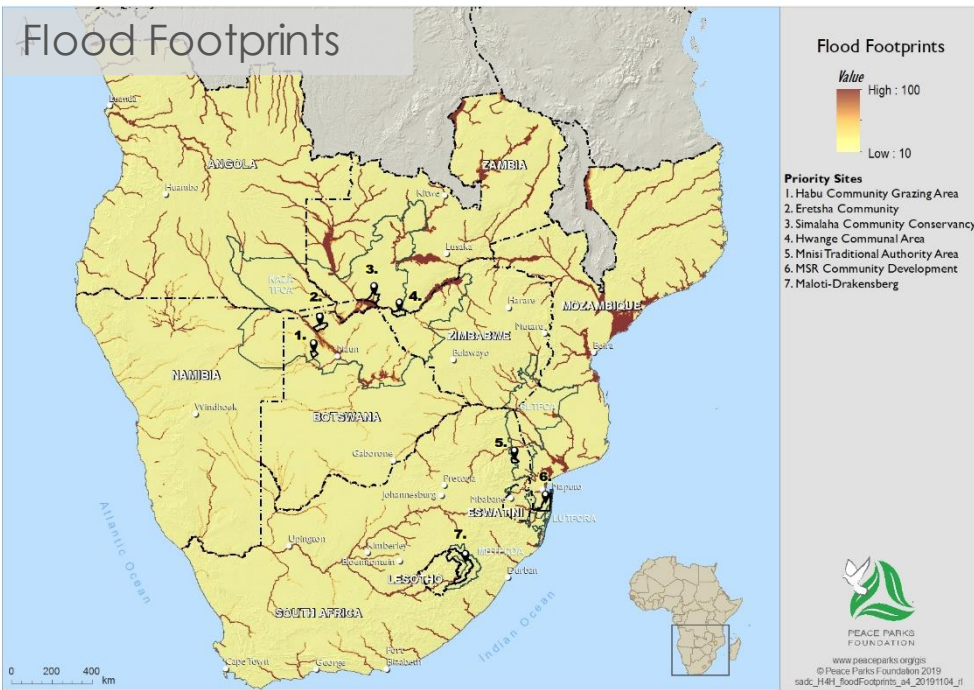
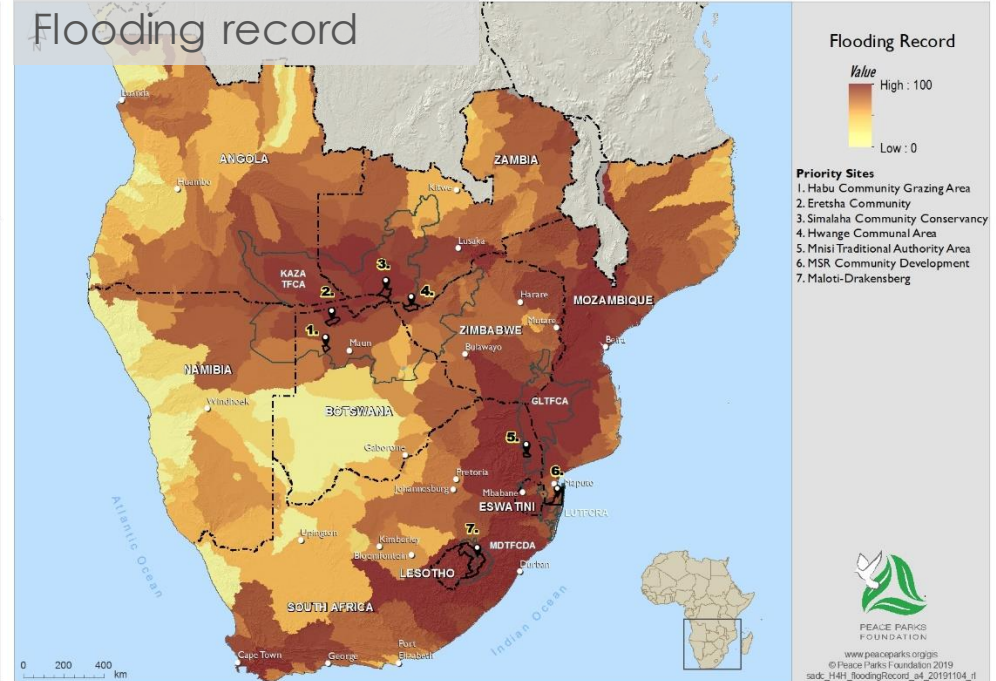
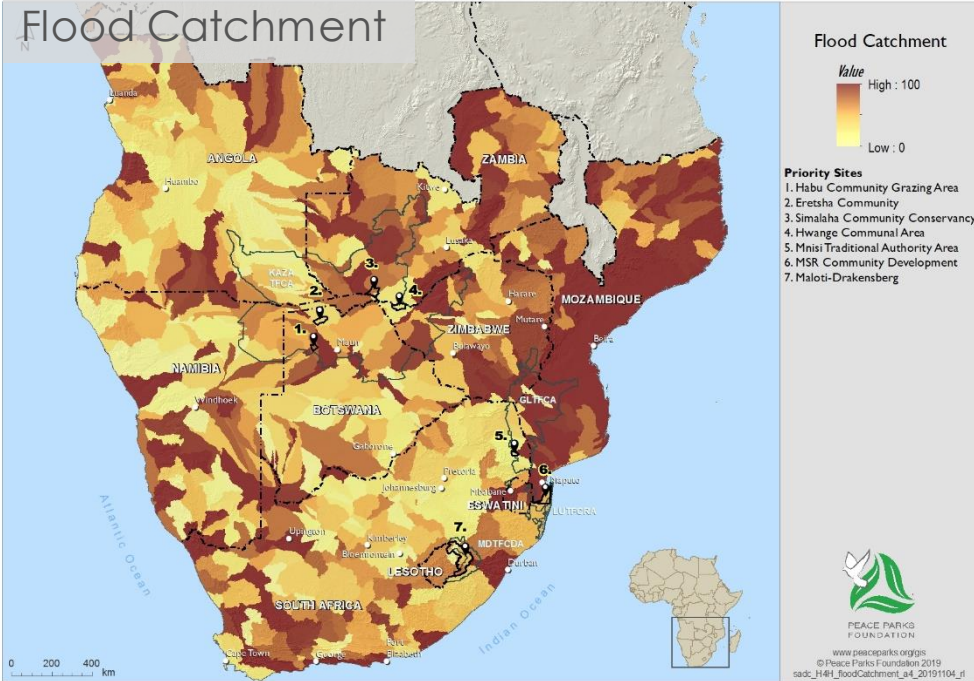
Degradation (GLASOD)



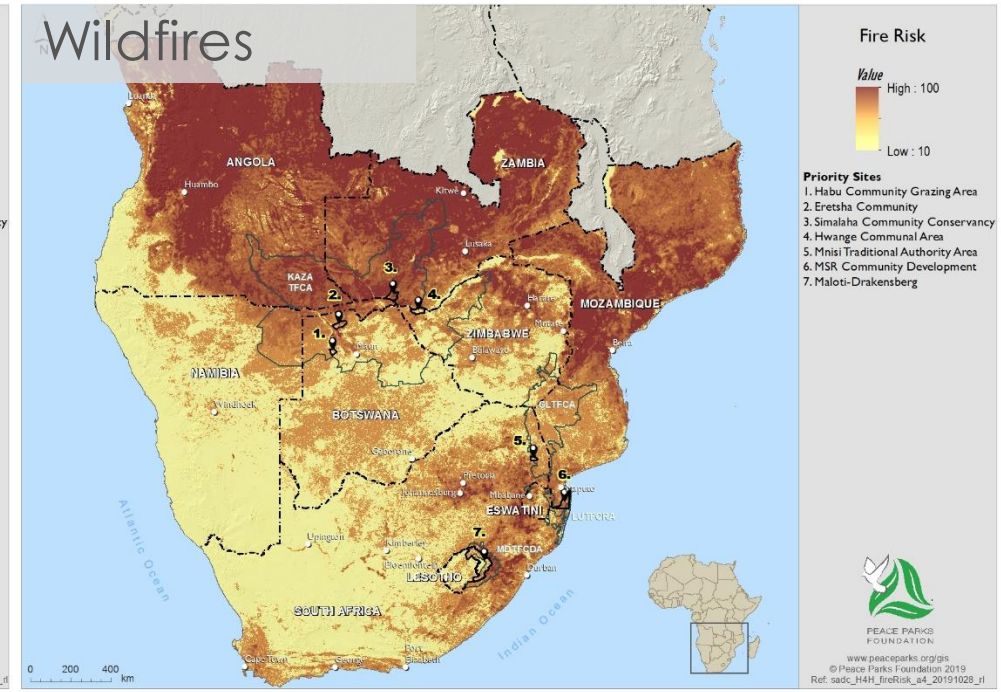
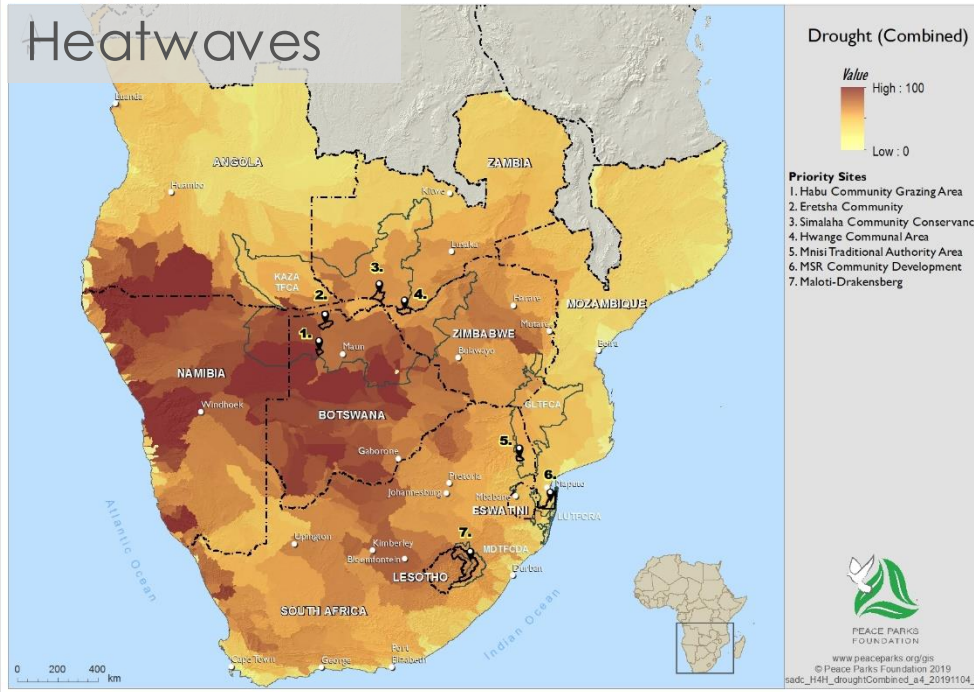
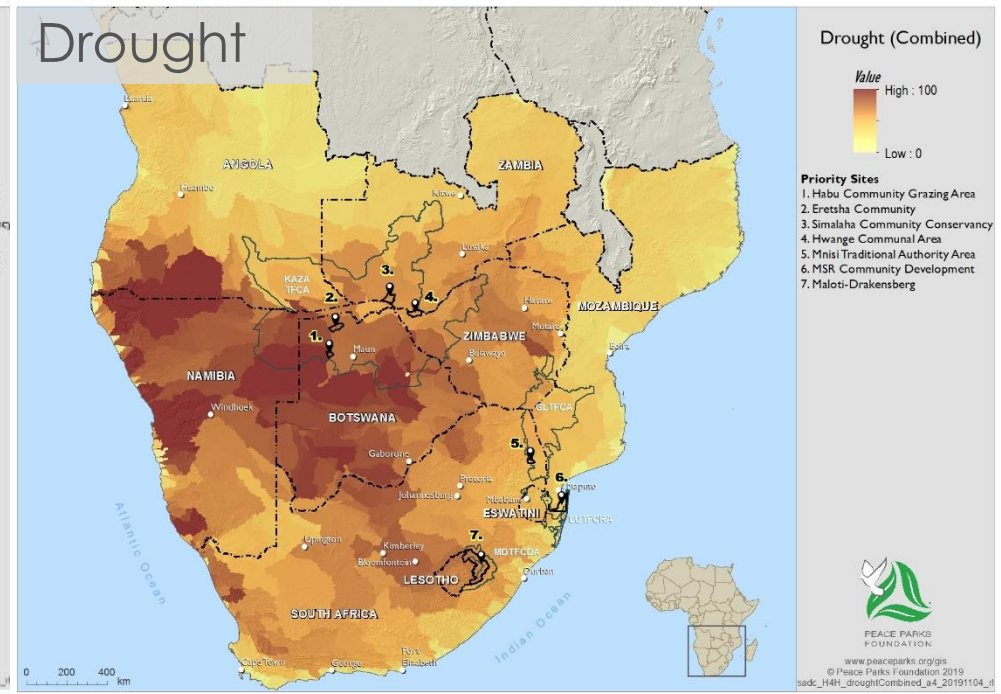
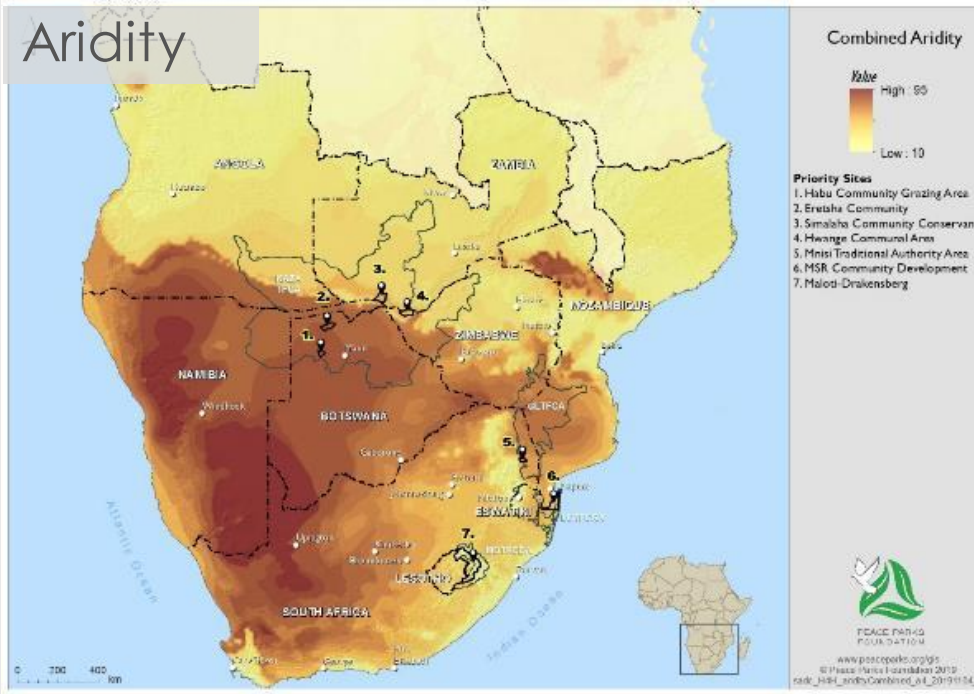
Degradation (Integrated)



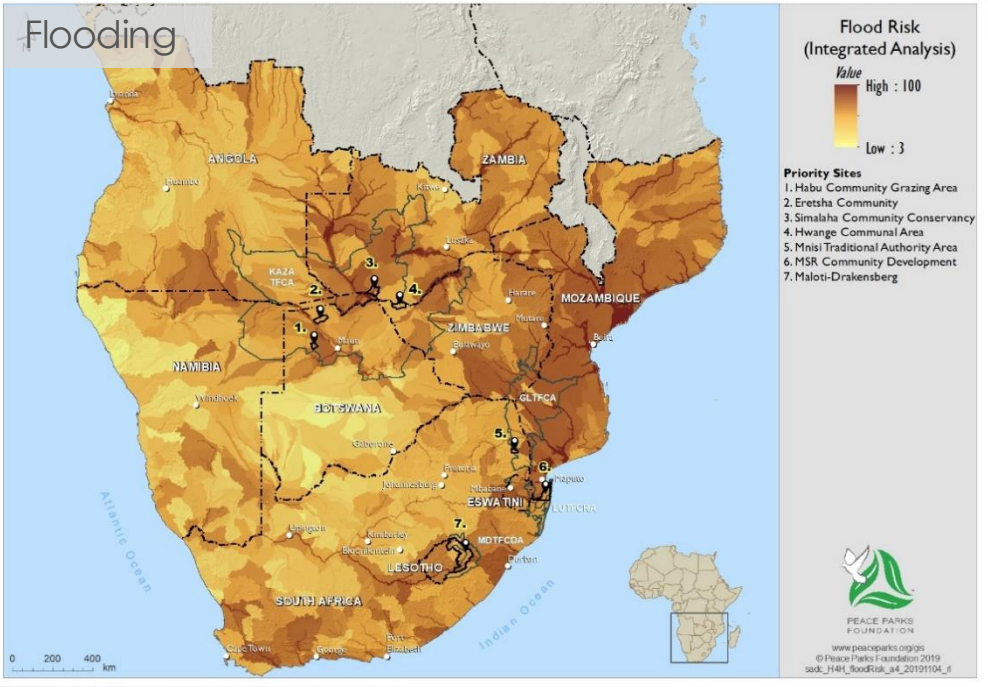
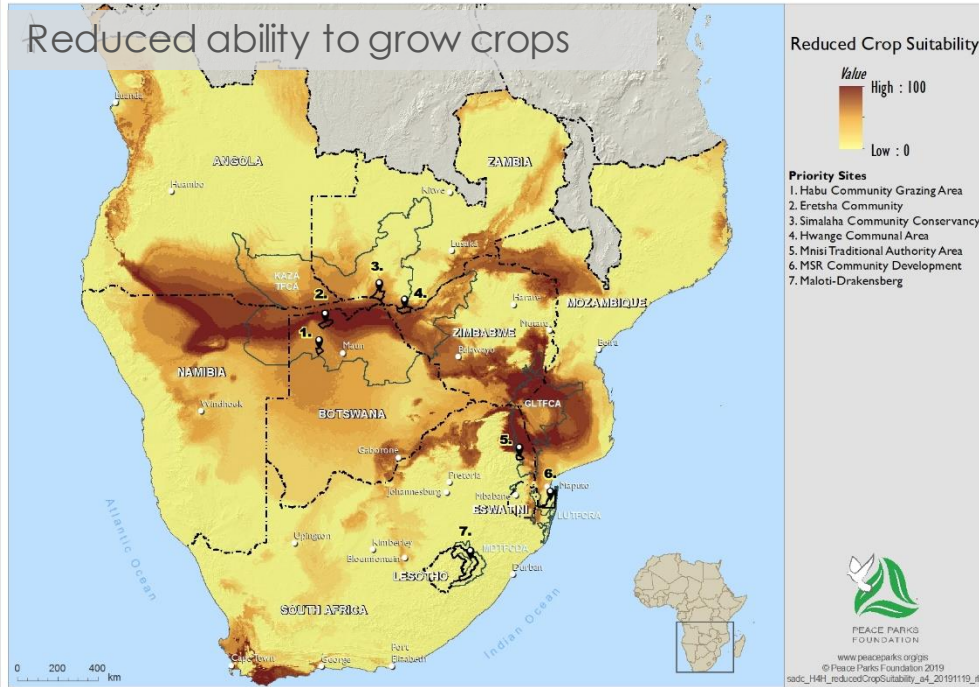
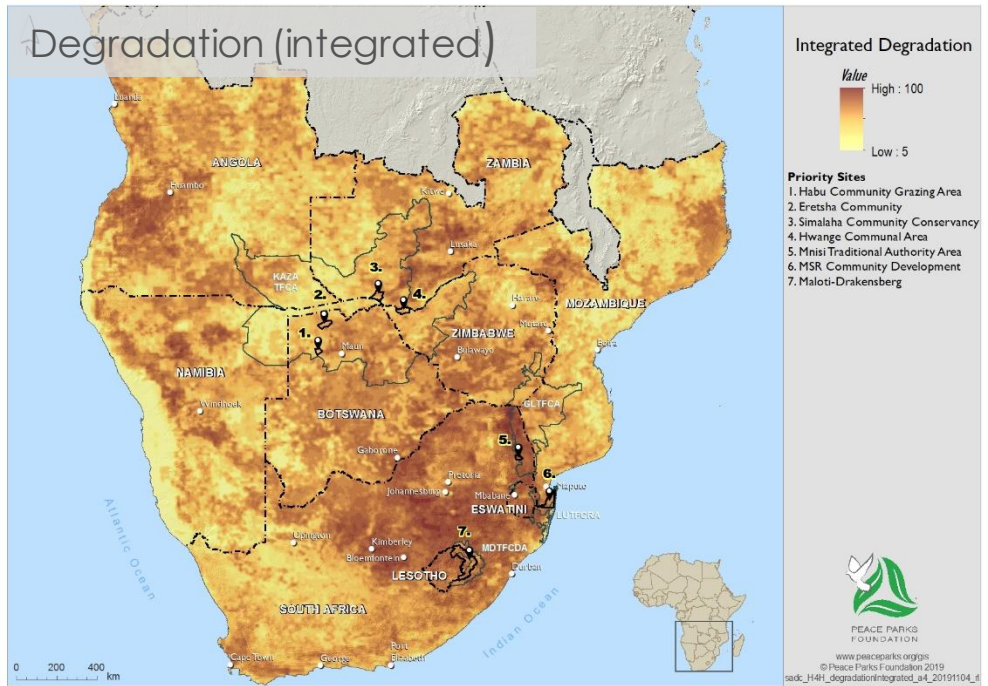
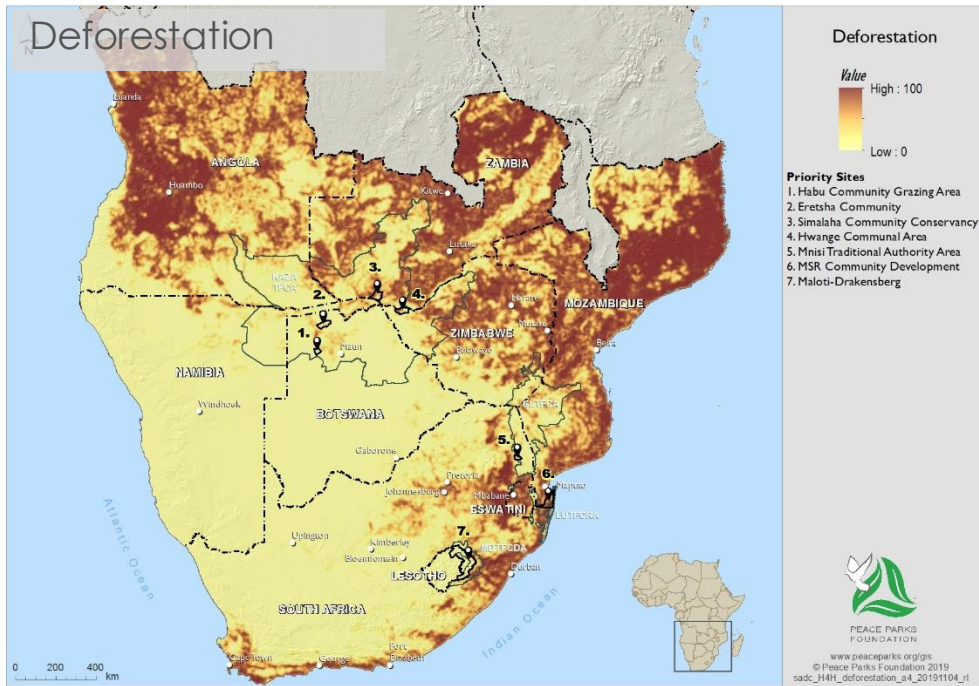
Flooding



Integrated maps

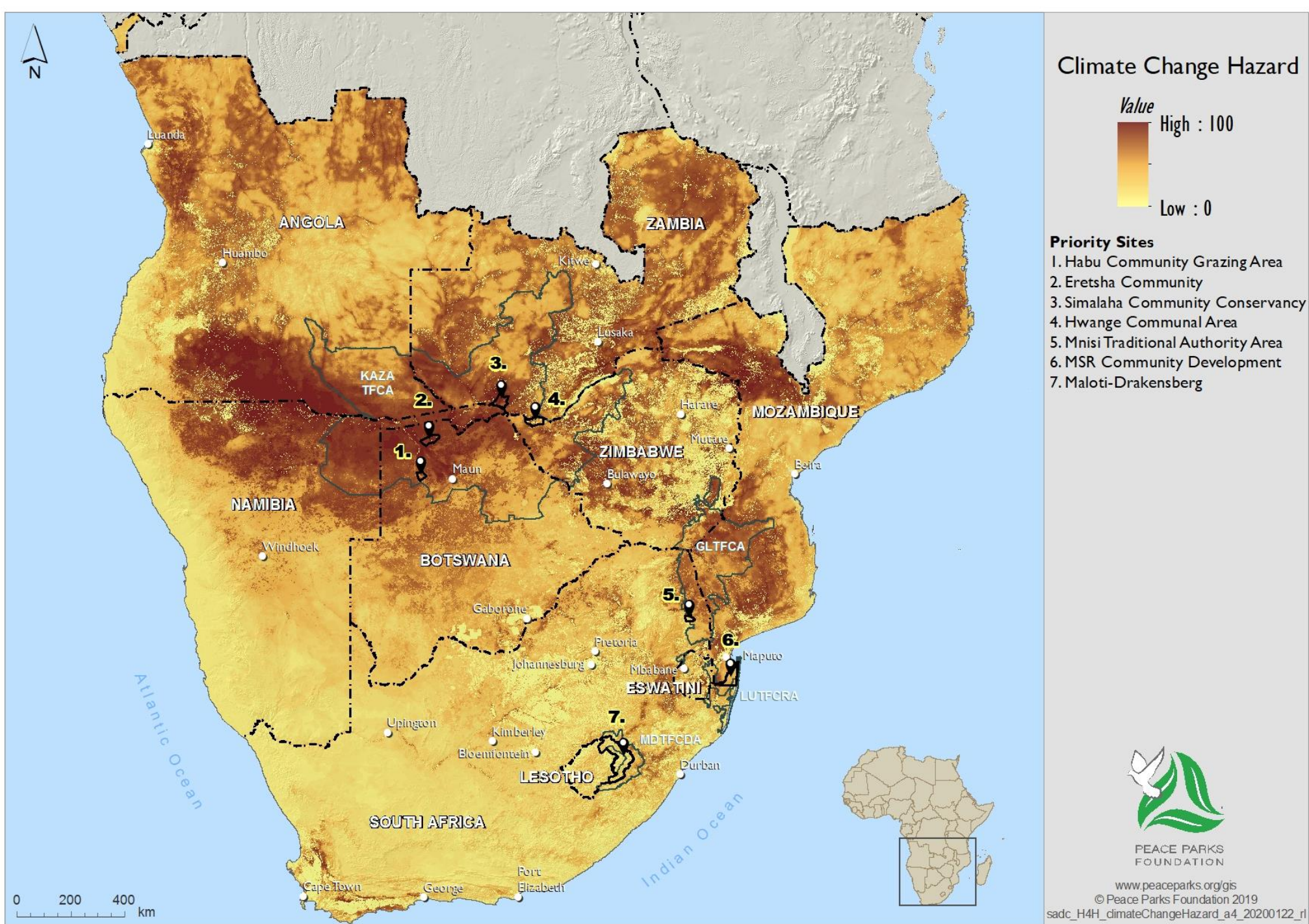


Integrated maps



Hazard:

1. Aridification
2. Droughts
3. Heat Waves
4. Wildfire Risk
5. Floods
6. Deforestation
7. Land degradation
8. Reduced ability to grow crops



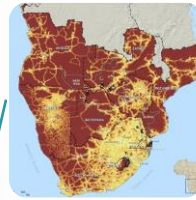
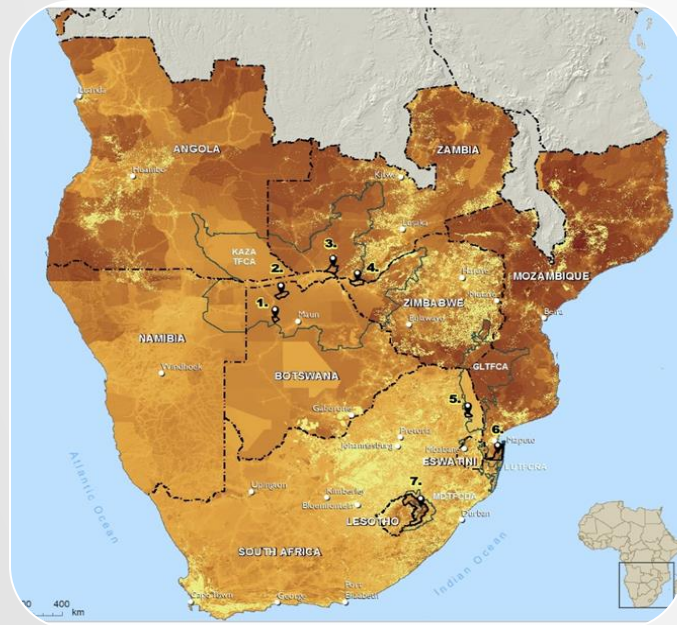


Vulnerability

“The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt”. – IPCC (2014)



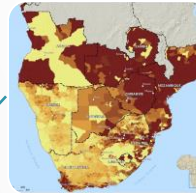
Vulnerability



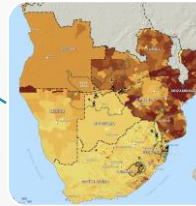
Lack of access



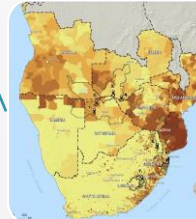
Lack of alternative livelihood options



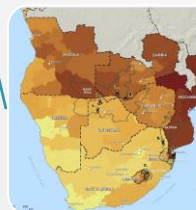
Increasing population pressure in rural areas



Dependency ratio

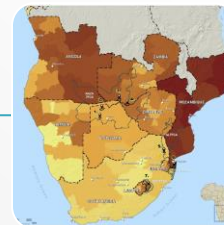


Gender Imbalance Issues in rural areas

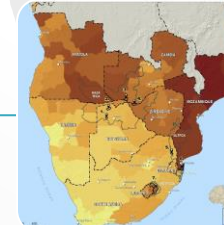


Human Development

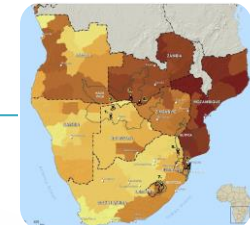
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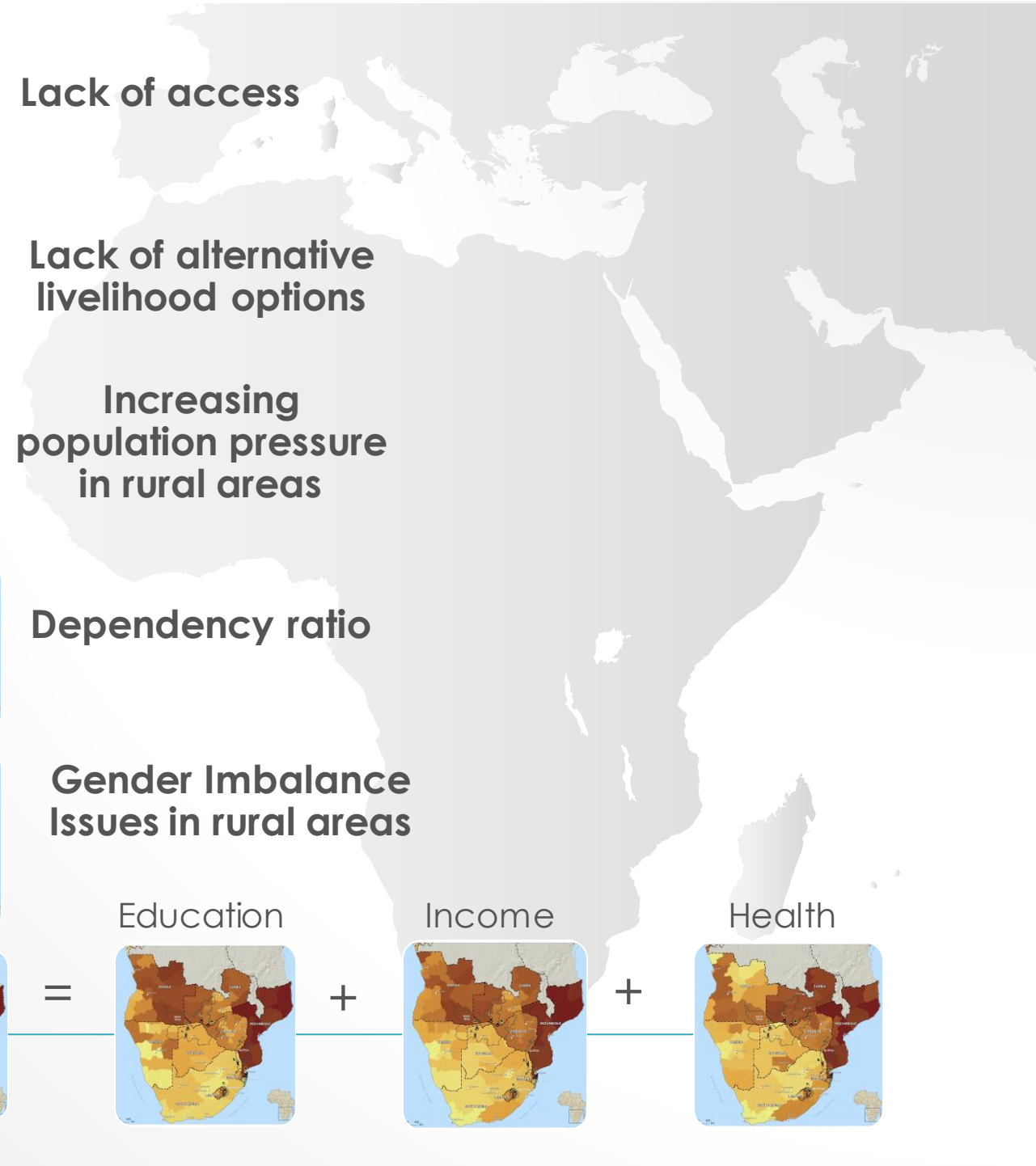
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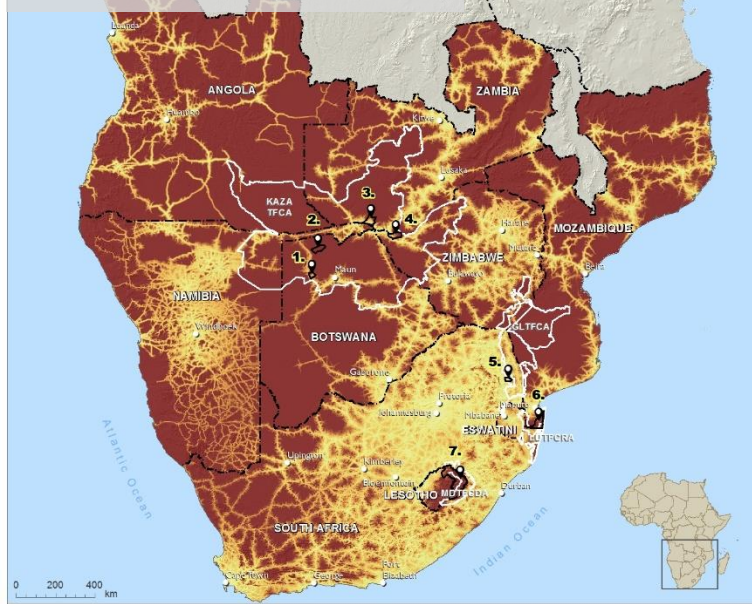
Education

Income

Health



Lack of access



Lack of Access

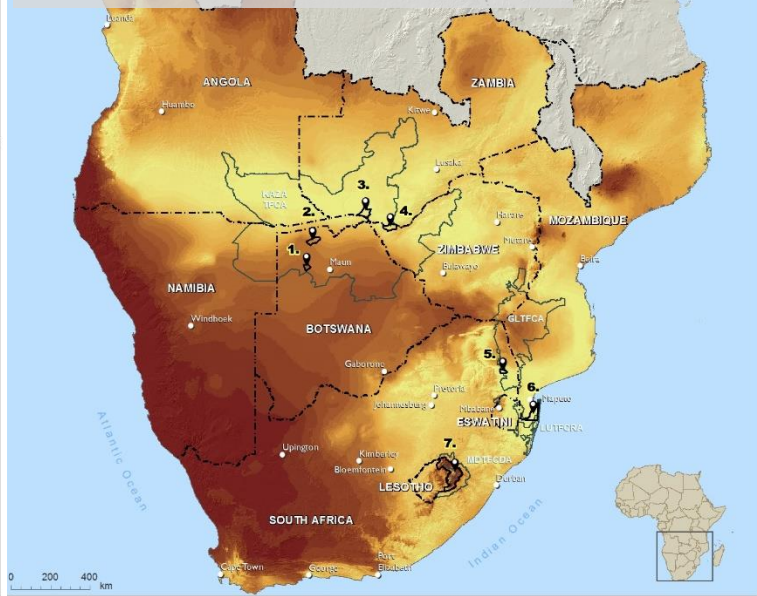


- Priority Sites**
1. Habu Community Grazing Area
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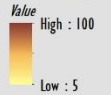


www.peaceparks.org/ris
 © Peace Parks Foundation 2019
 Ref: sadc_H4I1_access_a4_20191016_01

Low crop suitability



Low Crop Suitability

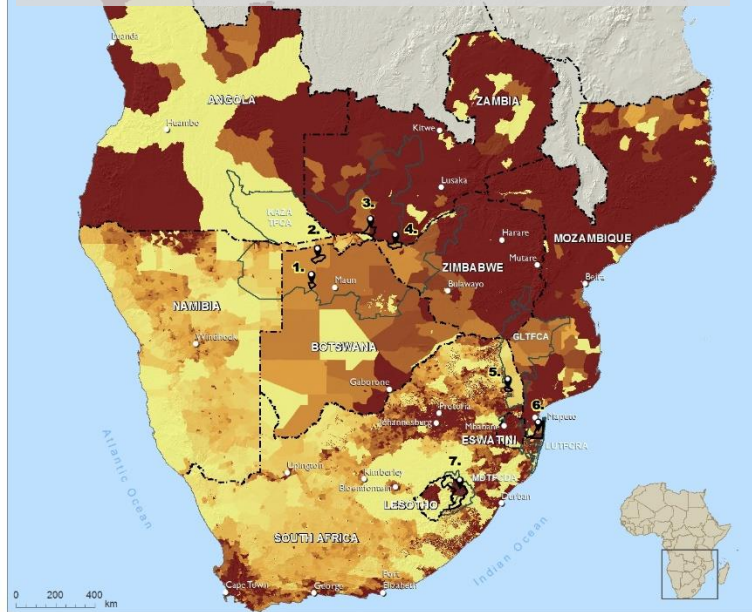


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 7. Maloti-Drakensberg

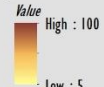


www.peaceparks.org/ris
 © Peace Parks Foundation 2019
 Ref: sadc_H4I1_lowCropSuitability_a4_20191119_01

Increasing population pressure



Increase in Population Density

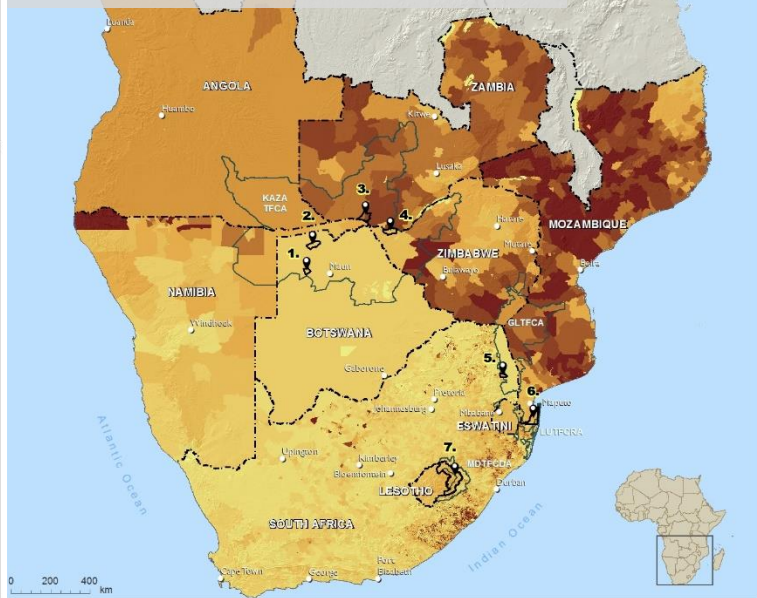


- Priority Sites**
1. Habu Community Grazing Area
 2. Eretsha Community
 3. Simalaha Community Conservancy
 4. Hwange Communal Area
 5. Mnsi Traditional Authority Area
 6. MSR Community Development
 7. Maloti-Drakensberg

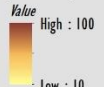


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 © Peace Parks Foundation 2019
 Ref: sadc_H4I1_popDensityIncrease_a4_20191121_01

Dependency ratio



Population Dependency Ratio

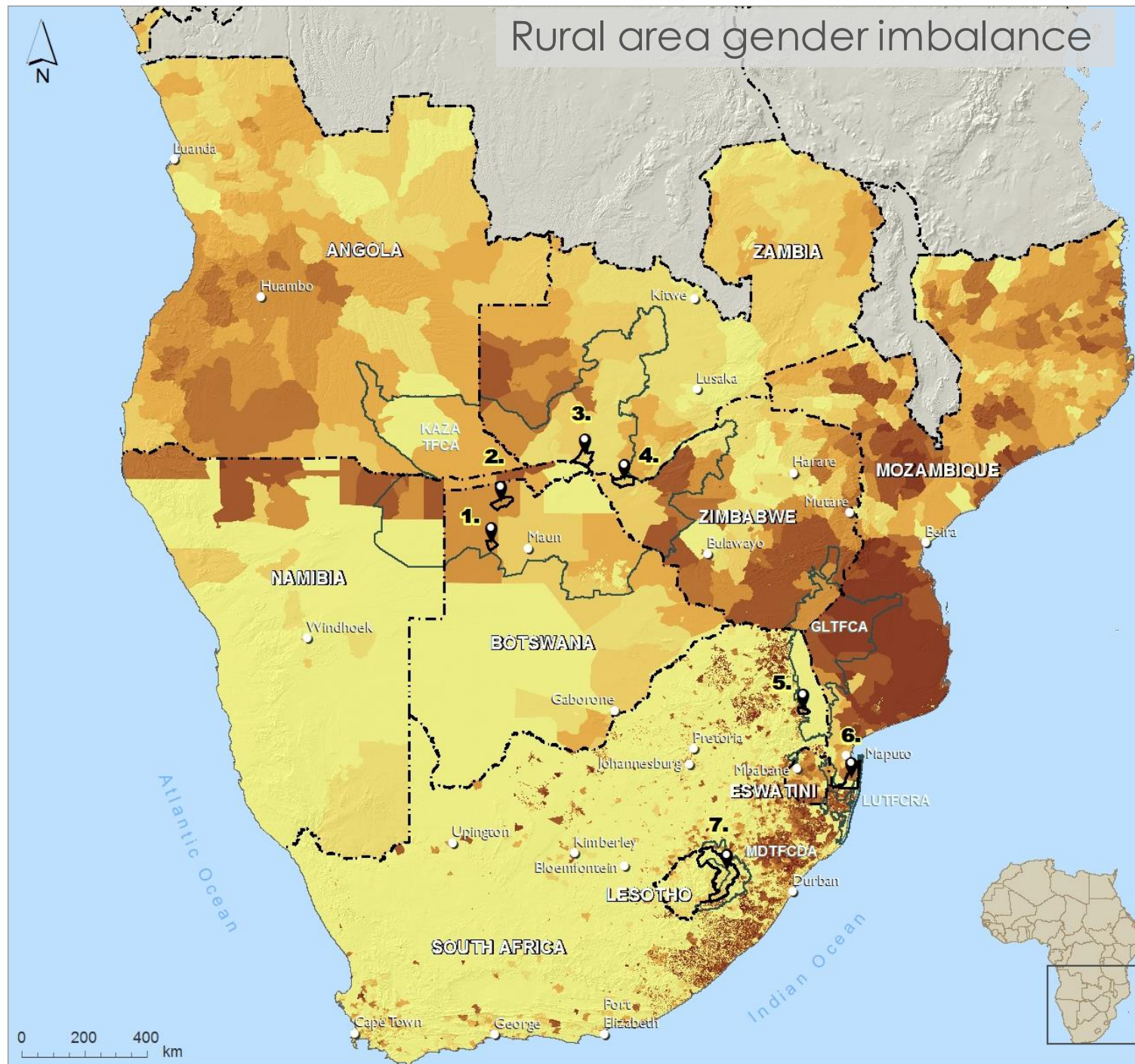


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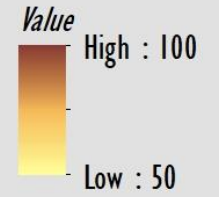


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 © Peace Parks Foundation 2019
 Ref: sadc_H4I1_popDependency_a4_20191121_01

Rural area gender imbalance



Gender Imbalance



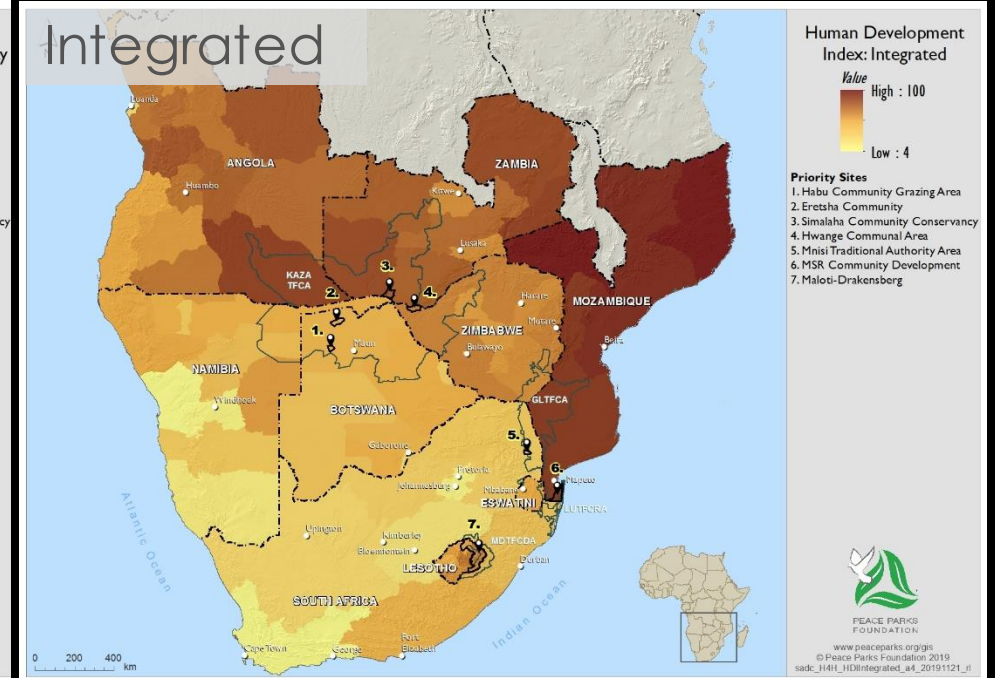
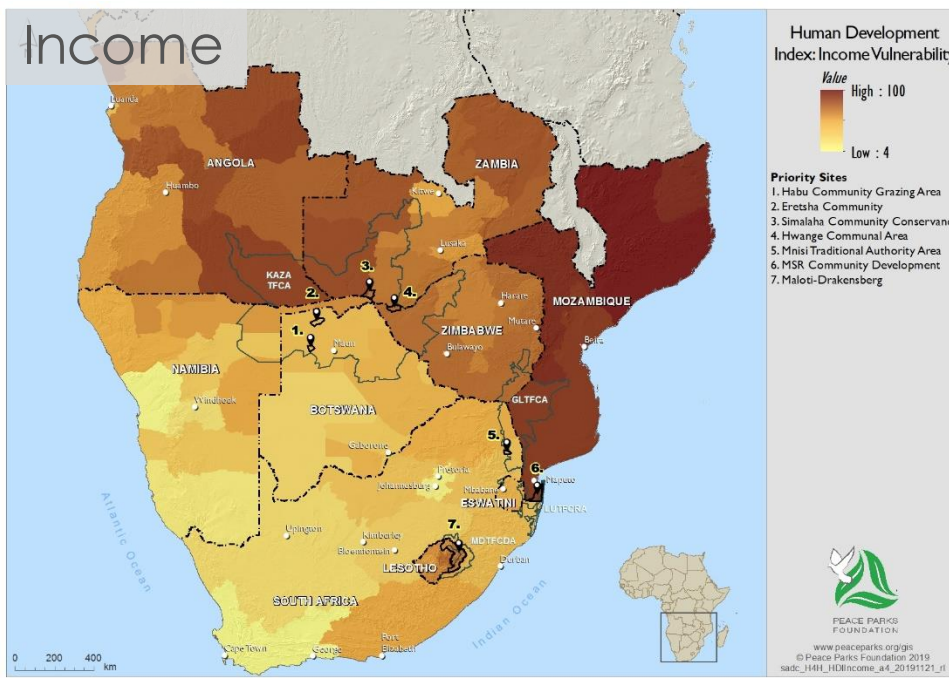
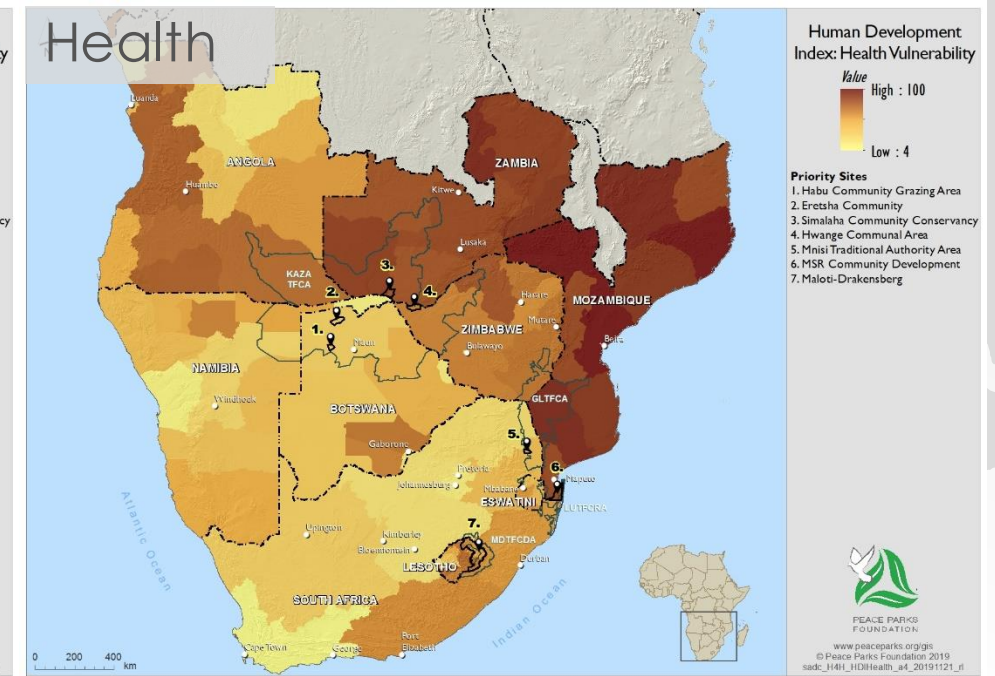
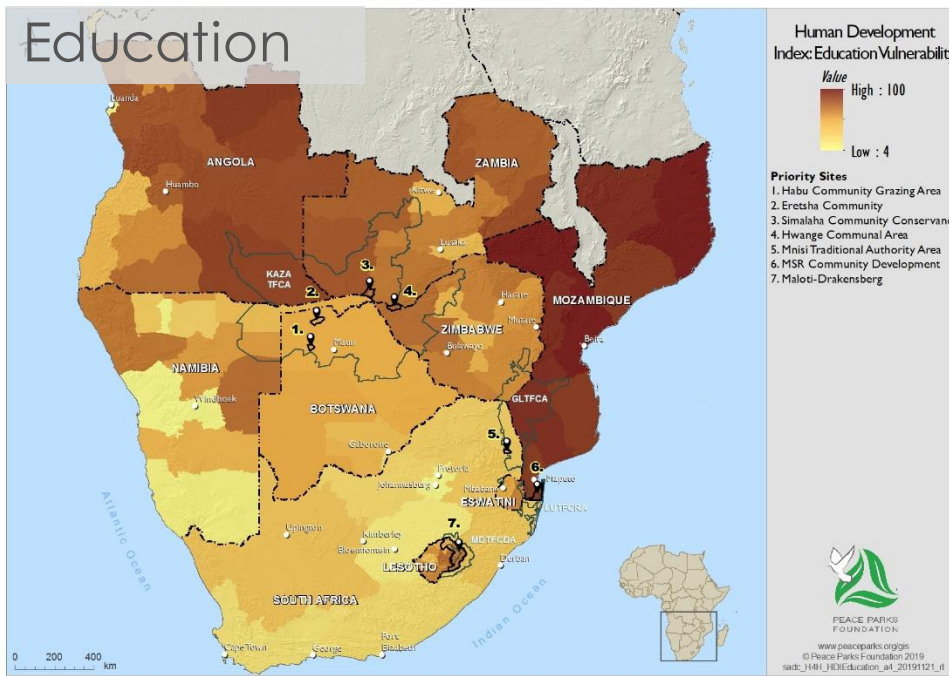
Priority Sites

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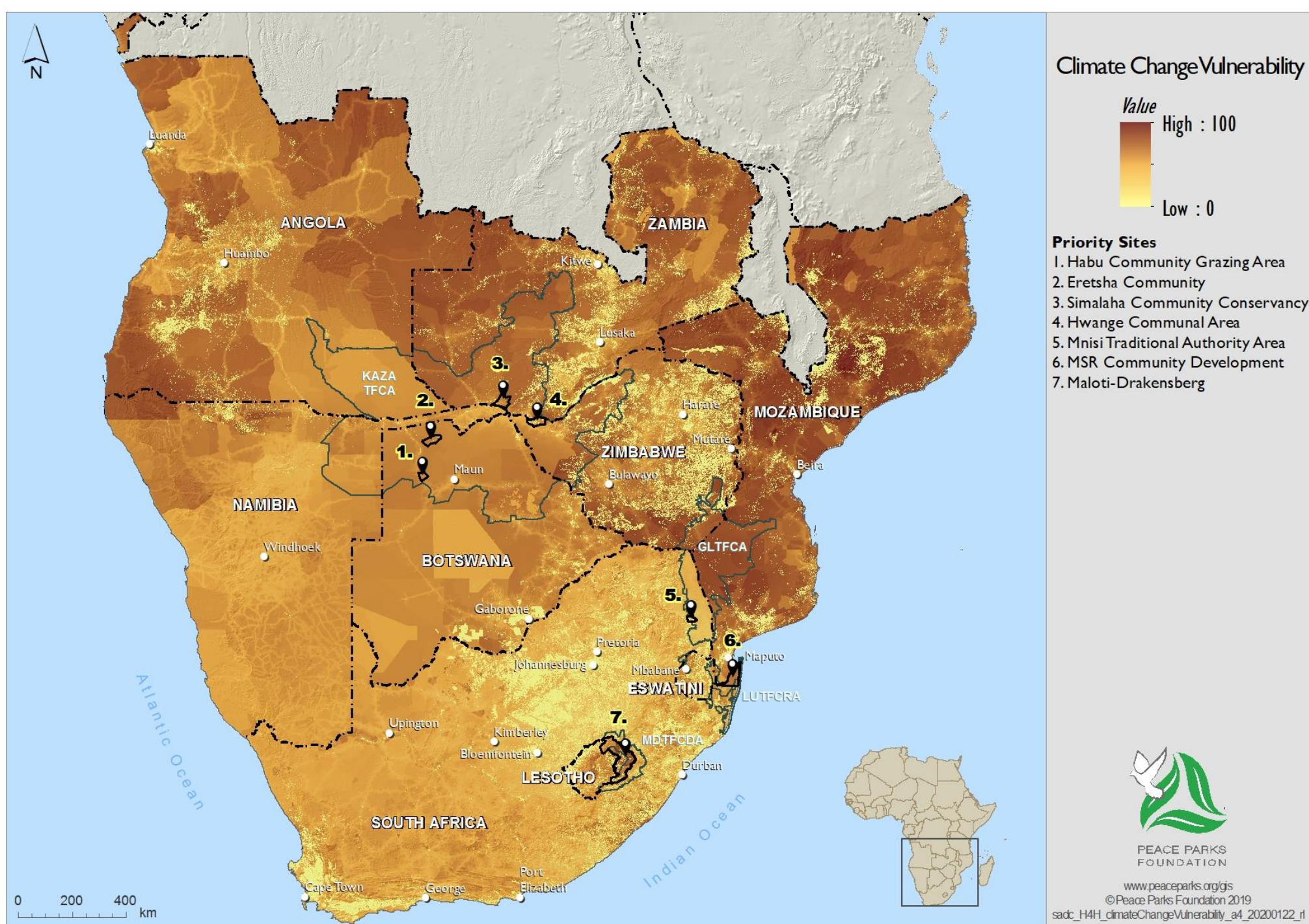
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Human Development Vulnerability Index



Vulnerability:

1. Lack of access (markets, services, human and animal health services etc.)
2. Lack of availability of alternative arable agriculture livelihoods
3. Increasing population pressure
4. Dependency ratio
5. Gender imbalance issue in rural areas
6. Human Development Vulnerability Index



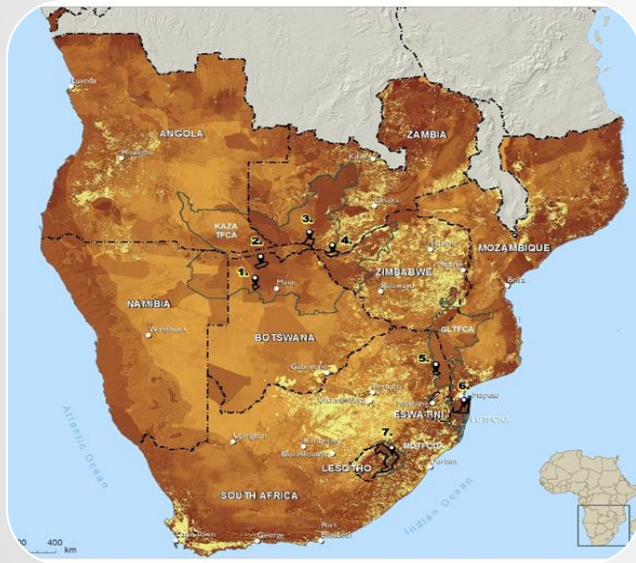


Exposure

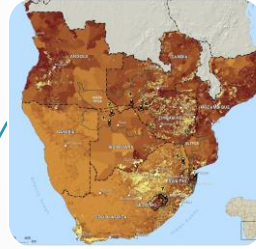
“The presence of people, livelihoods, species or ecosystems, environmental functions, service, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.” – IPCC (2014)



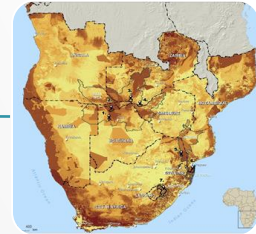
Exposure



Rural Rangeland Exposure



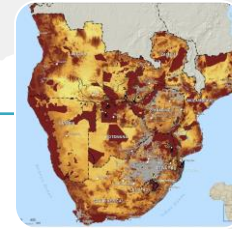
Priority Conservation Landscapes



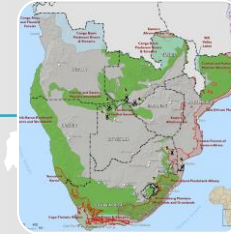
SPARC Conservation Priorities

Biodiversity hotspots and ecoregions

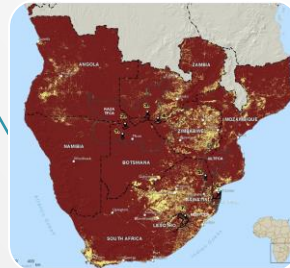
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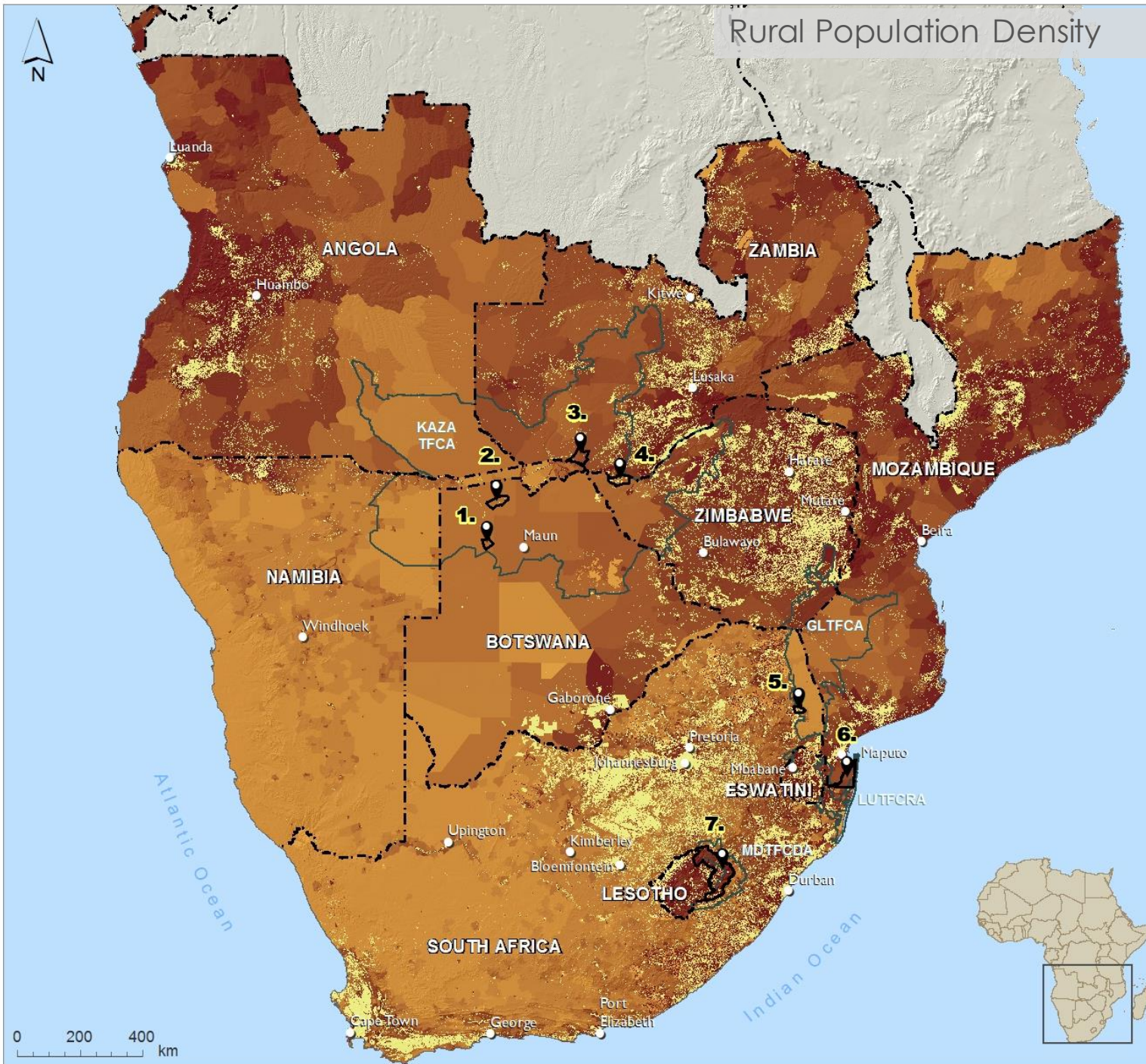


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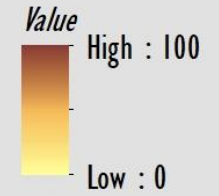
Intact Rangelands





Rural Population Density

Rural Rangeland Exposure

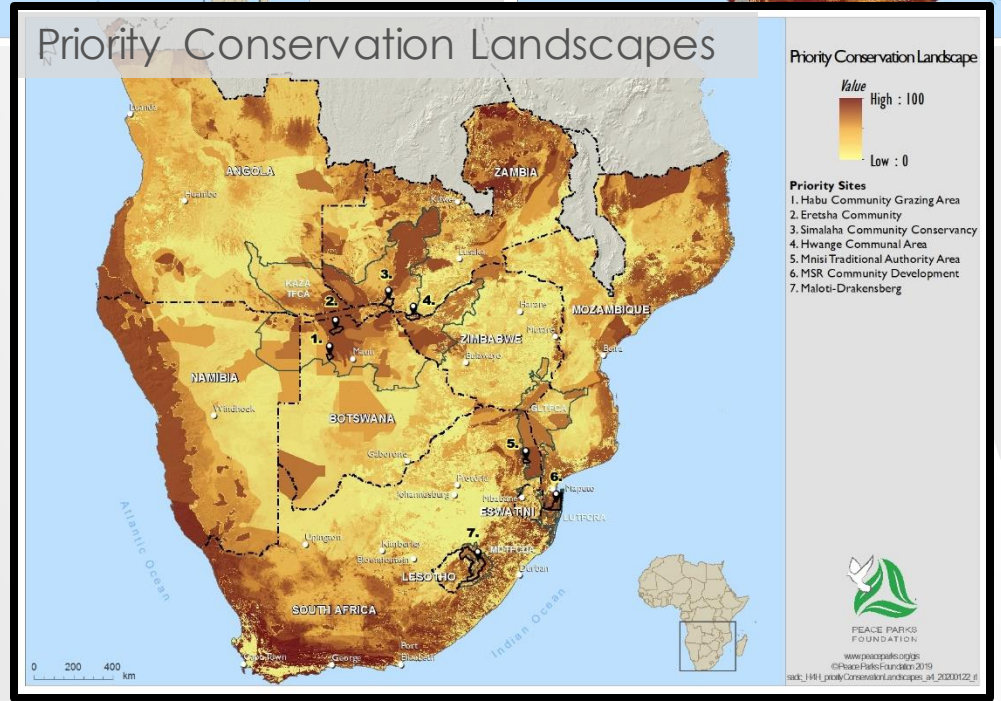
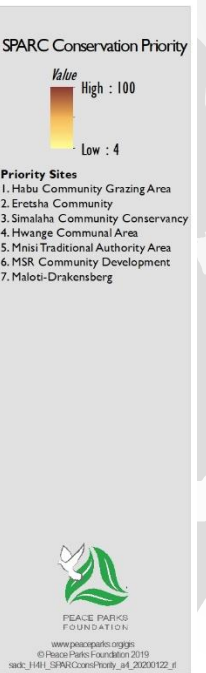
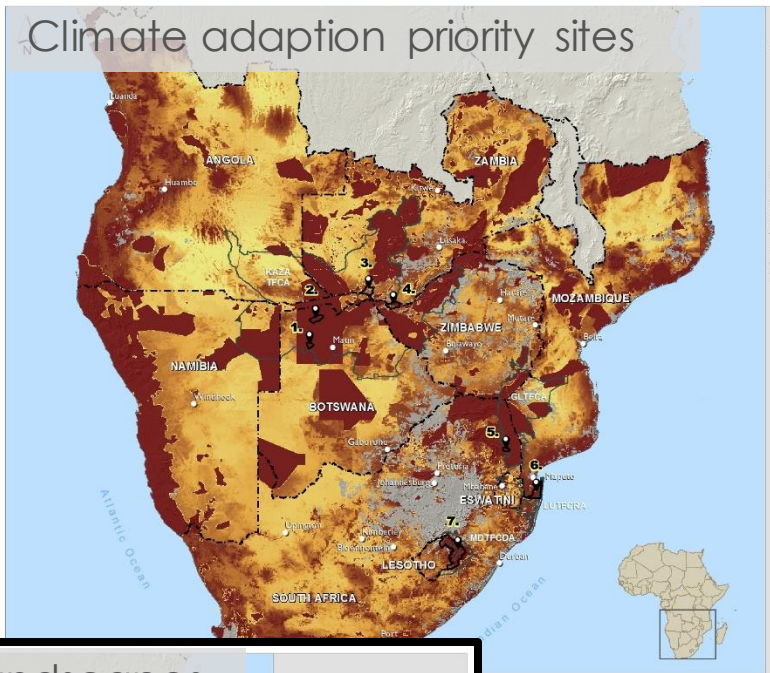
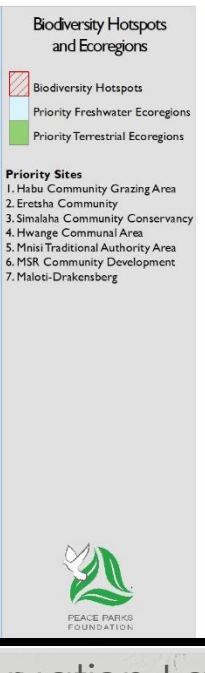
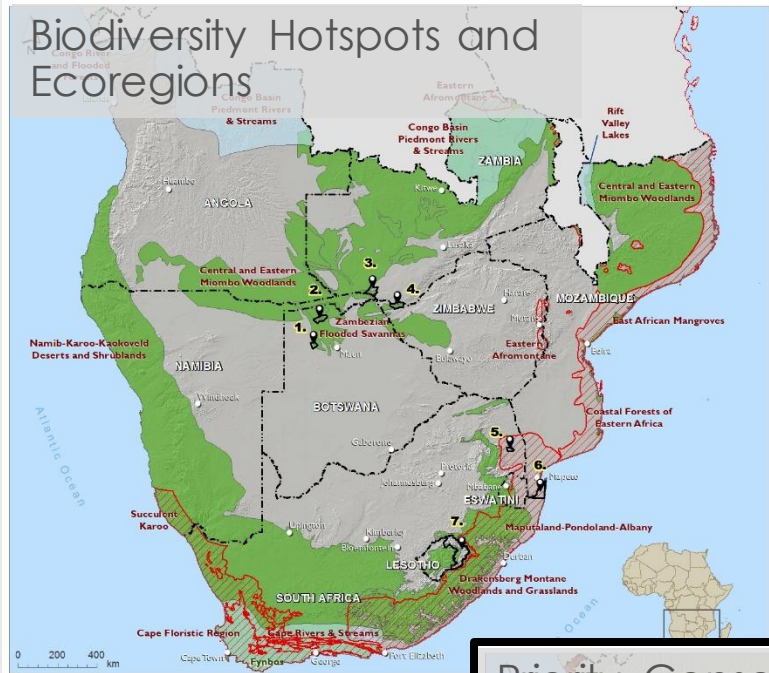


- Priority Sites**
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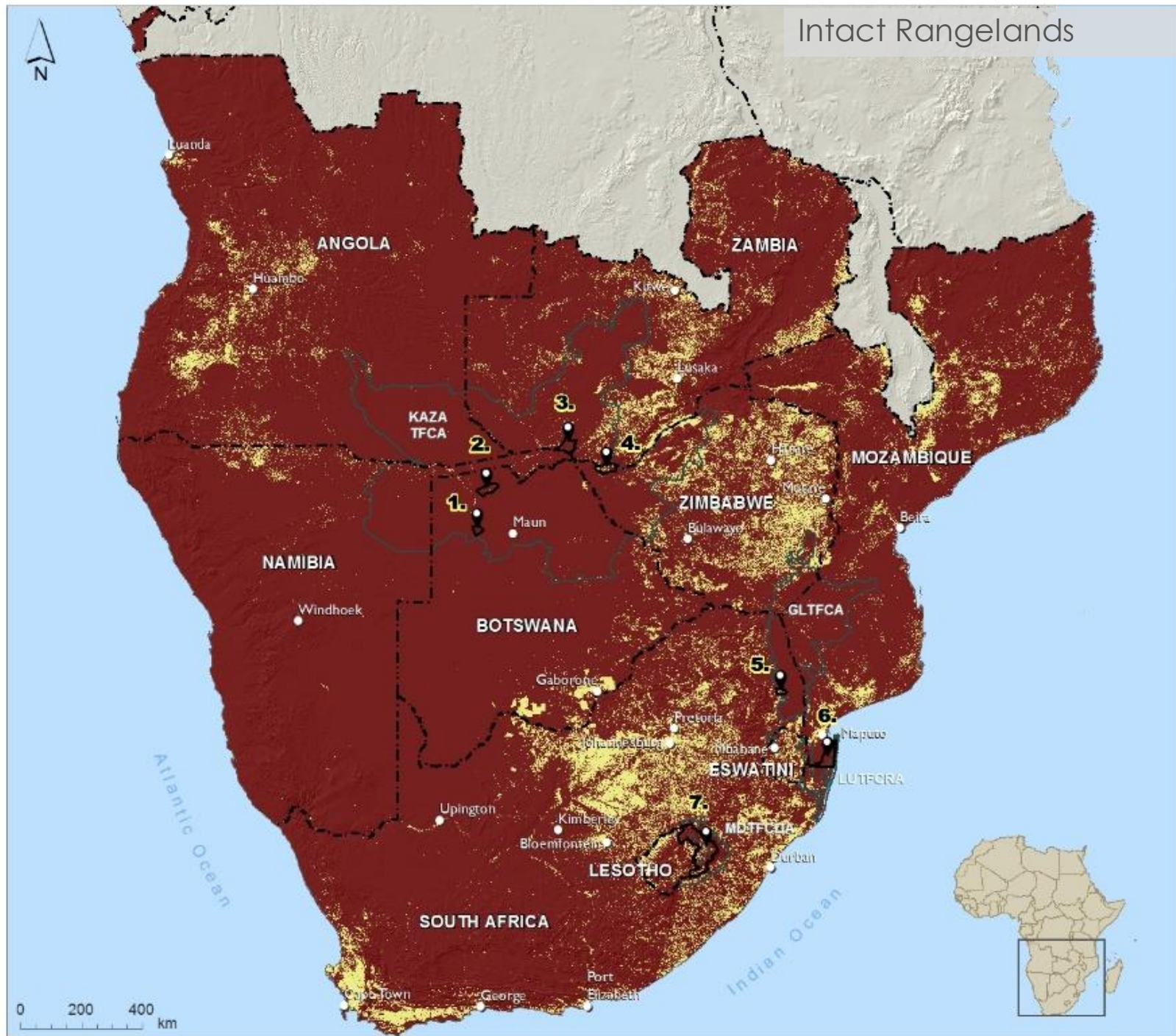


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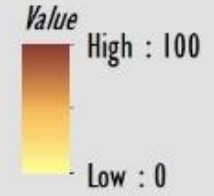
Conservation Landscapes



Intact Rangelands



Intact Rangelands



Priority Sites

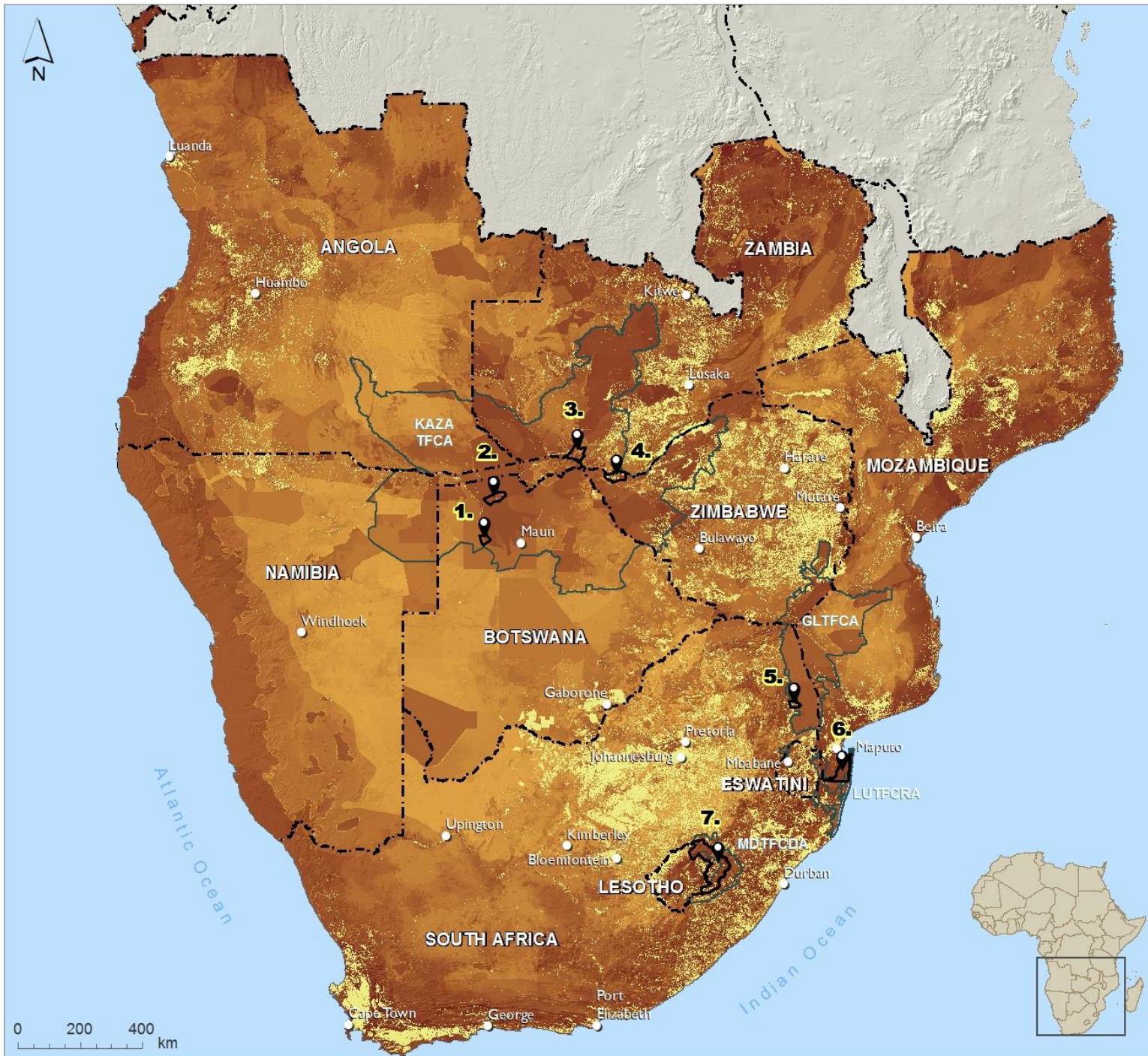
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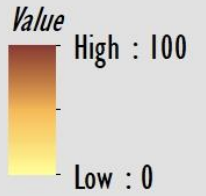
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Exposure:

1. Rural population density in rangelands
2. Priority conservation landscapes
3. Intact rangelands



Climate Change Exposure



- Priority Sites**
1. Habu Community Grazing Area
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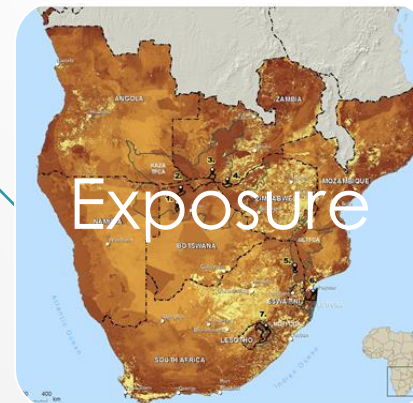
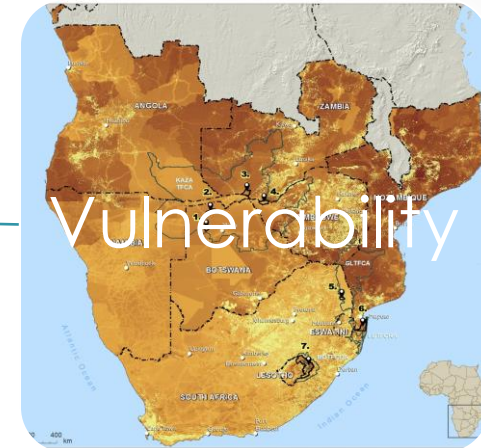
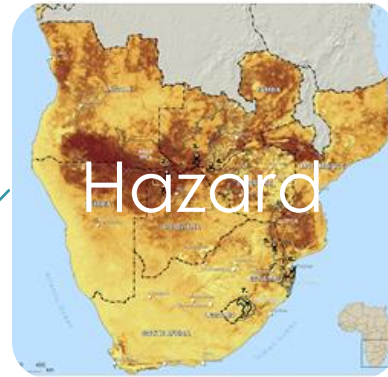
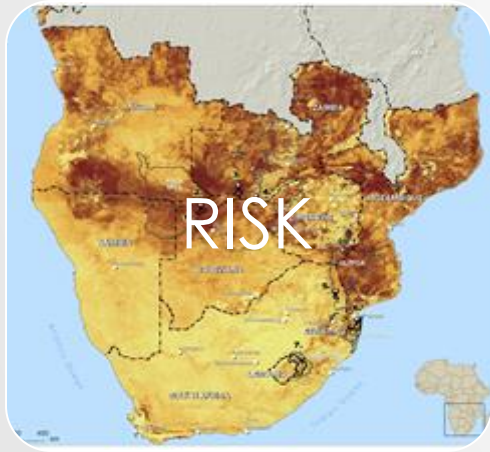
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Risk

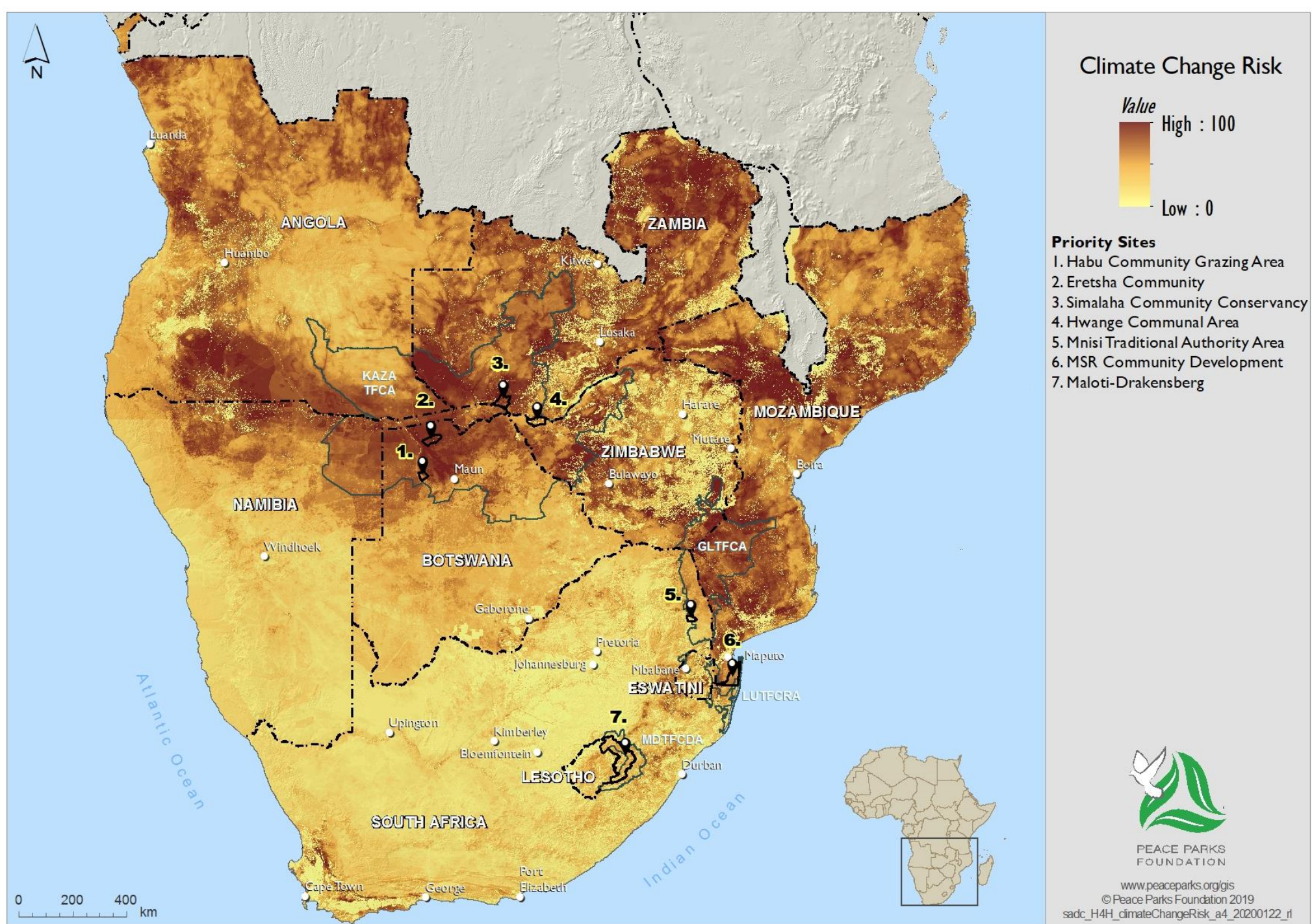
Hazard + Vulnerability + Exposure





Risk:

1. Hazard
2. Vulnerability
3. Exposure





Thank you.

