LFPL's MyLibraryU Short Course
September 14, 2023

Land use, livelihoods, and environmental change for a transfrontier conservation landscape in southern Africa

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https://xkcd.com/

Interdisciplinary Madness!

I work in	but get paid by	My group is in
_____ (Lab)	_____ (Program)	_____ (Department)
...but my *real* group is in	Officially, I'm part of	...even though my office is in
_____ (another Department)	_____ (Research Center)	_____ (Basement of another building)
Most of my classes are on	yet technically, my degree is in	Basically, I belong
_____ (Stuff I haven't seen since High School)	_____ (Major other than my undergrad's)	_____ (Nowhere)

https://phdcomics.com/


Mozambique
Harare
Zimbabwe
Bulawayo
Namibia
Botswana
Gaborone
Pretoria
Maputo
Eswatini
Bloemfontein
Lesotho
Durban
South Africa
Cape Town
Gqeberha

An interdisciplinary project studying how communities and their households, land use, and climate interact to create or mitigate vulnerability in the Kavango-Zambezi Transfrontier Area of Southern Africa

KAZAVA

KAZA Vulnerability and Adaptation

Project Partners

KAZAVA
KAZA Vulnerability and Adaptation

https://kazava.weebly.com/

University of Louisville

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Weaver, A.*, Resener, L*, Quisenberry, N*

UNCW

Pricope, N., Woodward, K.*,
Bradshaw, A.*, Olsen, S*

University of Colorado Boulder

Hartter, J., Bailey, K, *Drake, M.

Colorado State University

Salerno, J., Hilton, T.

Okavango Research Institute, University of Botswana

Cassidy, L. (Botswana)

African collaborators

Mupeta-Muyamwa, P. (TNC)
Nyoni, M. (TNC)
Henry Maseka (DNPW)
University of Namibia
IRDNC

* Graduated









Rationale

- In many parts of Africa, already low levels of agricultural productivity and food security are increasingly threatened by climate change.
- For communities living near protected areas, these problems are exacerbated by wildlife crop depredation, particularly by elephants.
- While impacts may be unavoidable when human and wildlife land use overlap, scant large-scale human data exist quantifying the direct costs of wildlife to livelihoods.

Salerno et al., 2021, *Curr.Bio.,* Stevens et al., 2023*, J. Land Use Science*

ANGOLA

$3,432 per capita

856 kg/ha

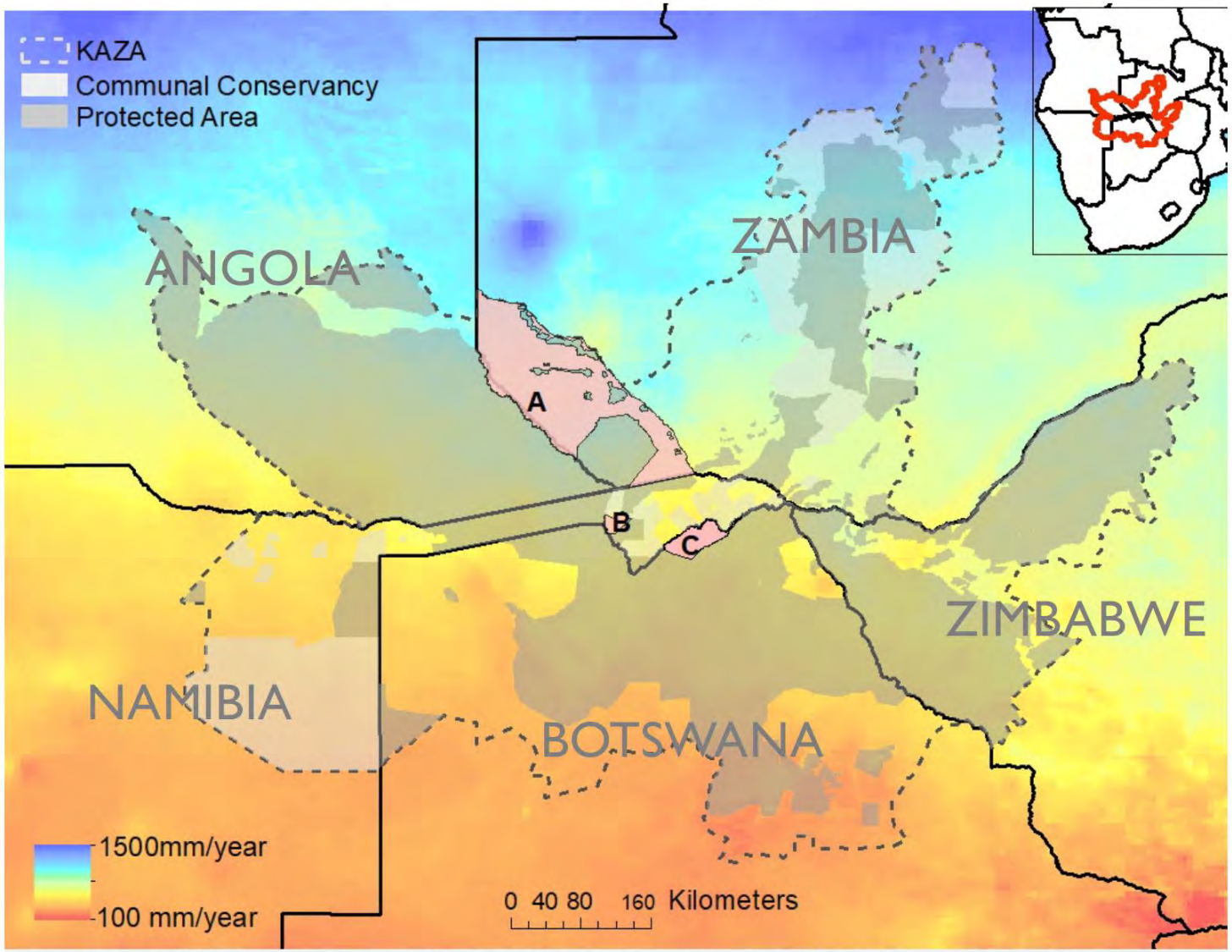
3,396

NAMIBIA

$5,932 per capita

2,353 kg/ha

22,754



A: West Zambezi Game Management Area | **B:** Mashi Conservancy | **C:** Chobe Enclave

ZAMBIA

$1,540 per capita

2,205 kg/ha

21,967

ZIMBABWE

$2,147 per capita

613 kg/ha

82,630

BOTSWANA

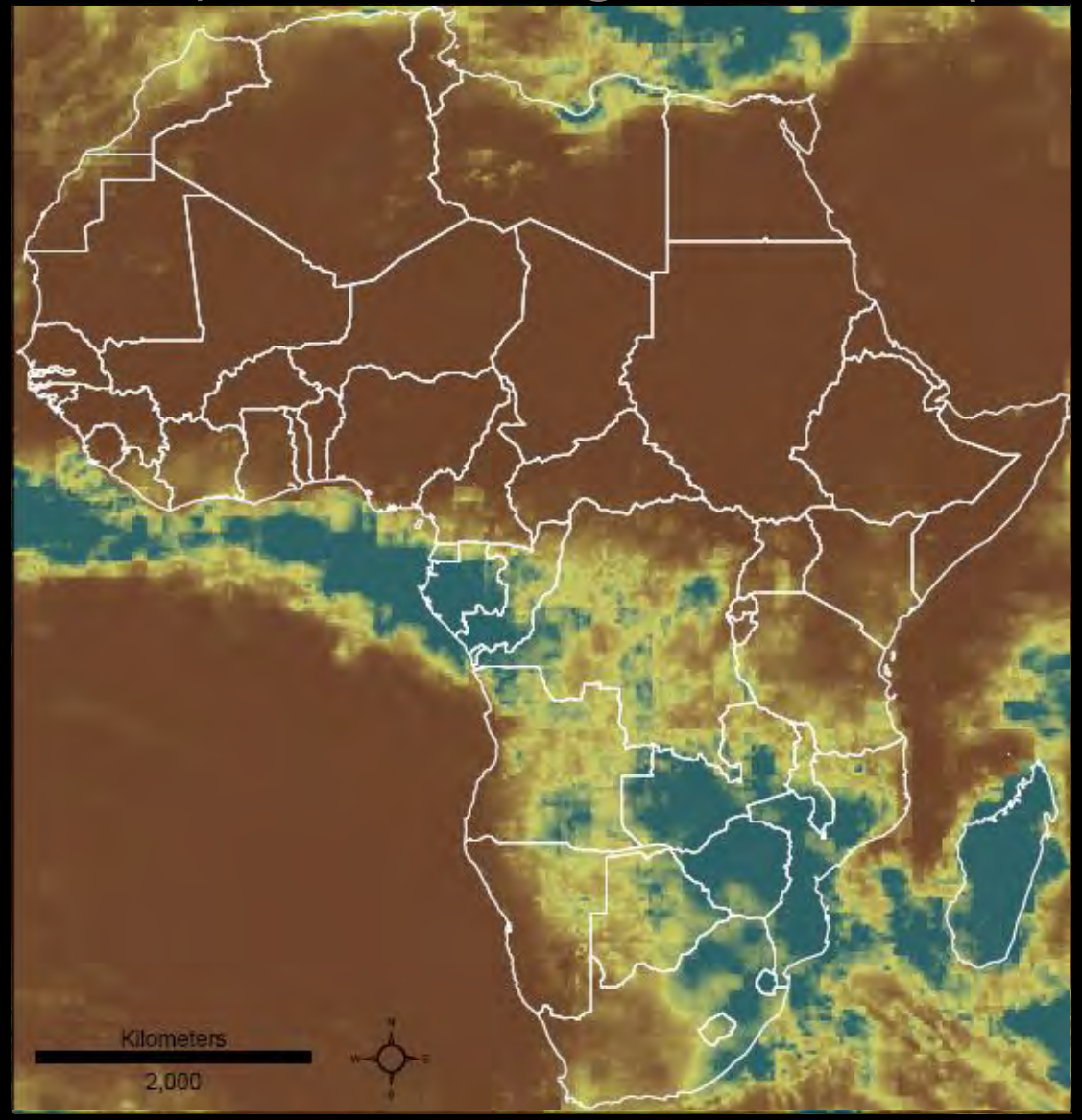
$8,259 per capita

211 kg/ha

131,626

Study Region

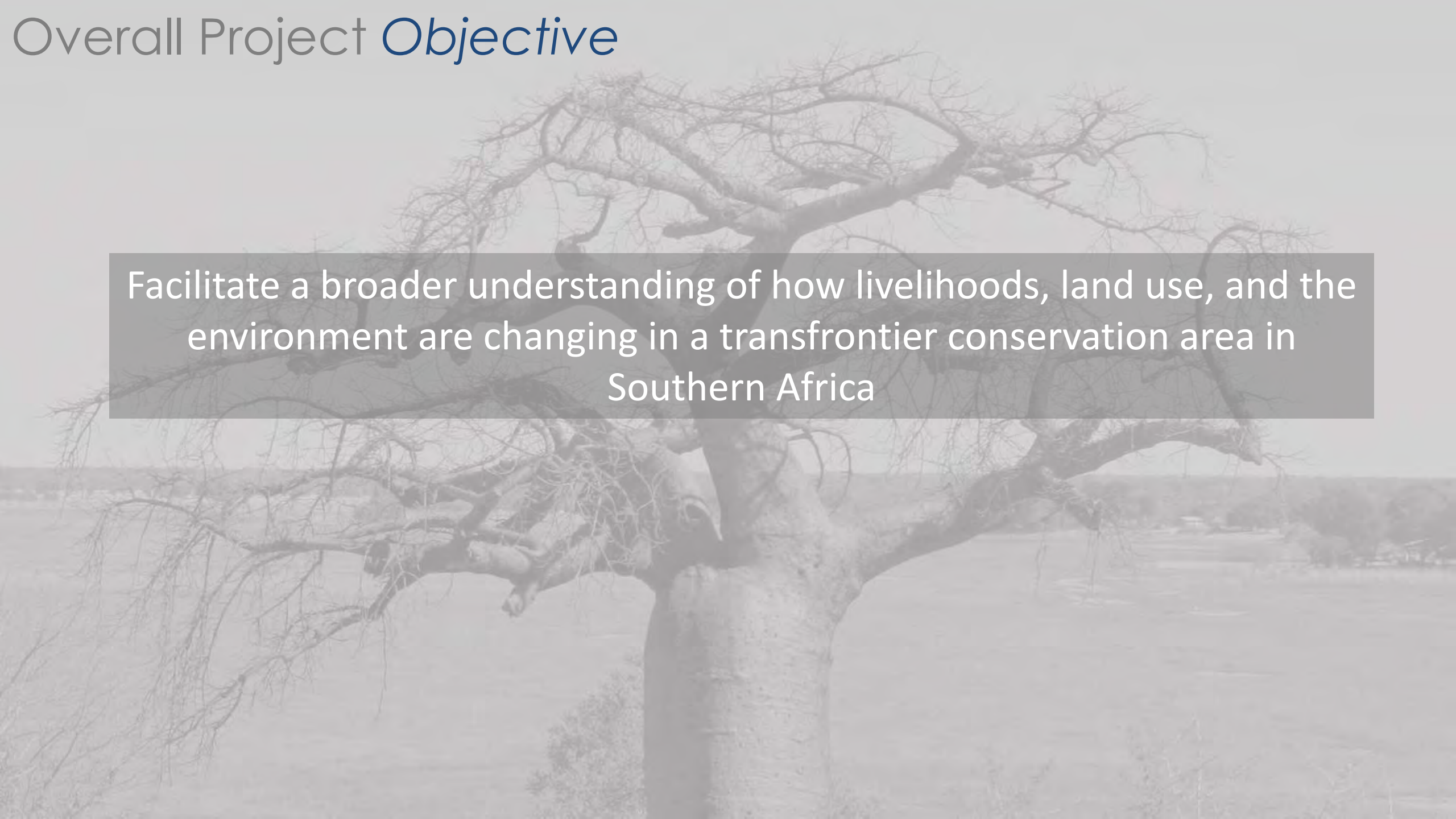
Inter-tropical Convergence Zone (ITCZ)



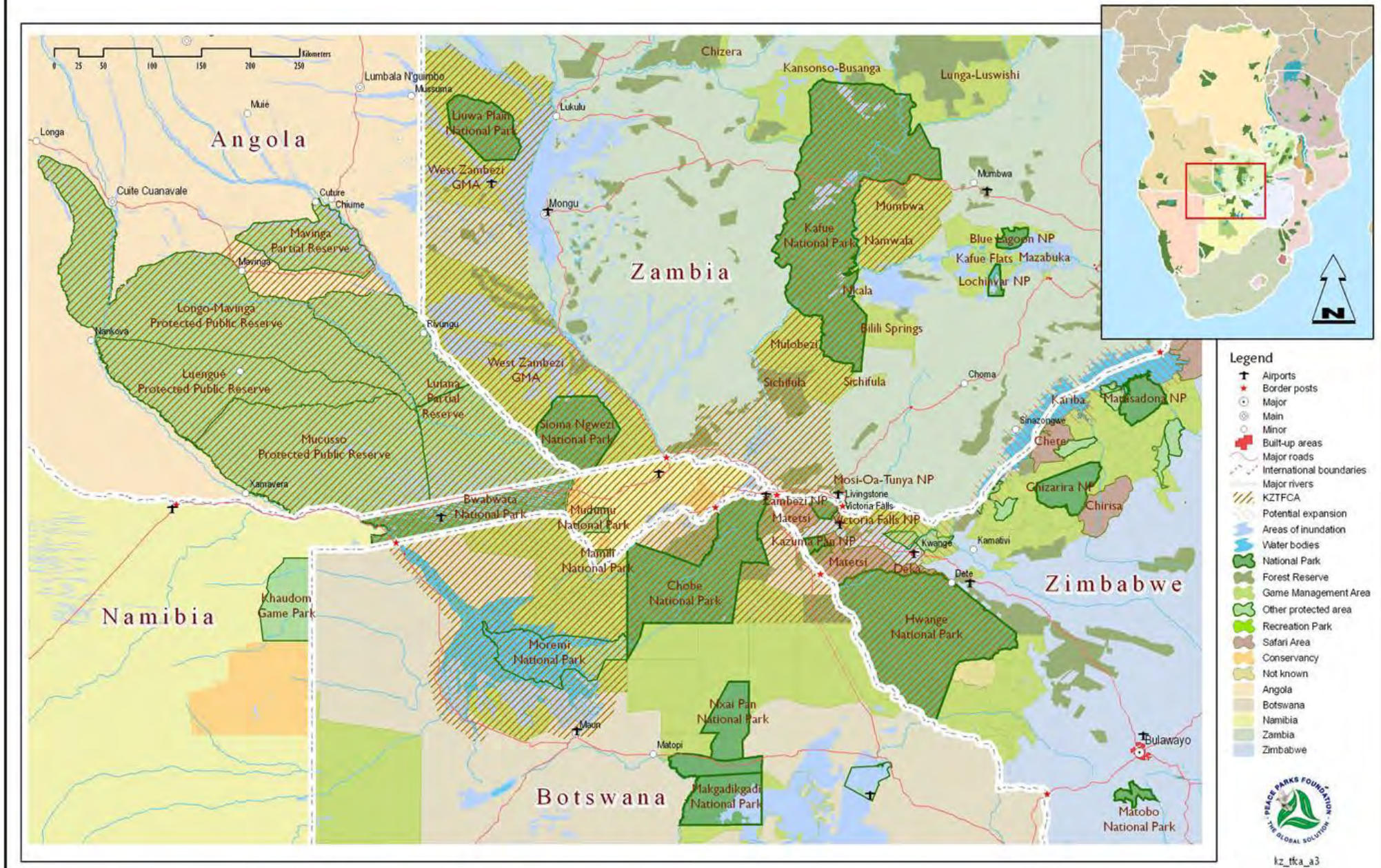
Background


Savanna Vegetation Type
Tree-grass ratio percent
Low
Rainfall
Rainfall (mm)
High
Rainfall

Overall Project *Objective*



Facilitate a broader understanding of how livelihoods, land use, and the environment are changing in a transfrontier conservation area in Southern Africa


Angola
Zambia
Namibia
Botswana
Zimbabwe
Kilometers
0 25 50 100 150 200 250
Lumbala N'guimbo
Mussuma
Muié
Longa
Cuite Cuanavale
Cuture
Chiume
Mavinga
Mavinga Partial Reserve
Longo-Mavinga Protected Public Reserve
Nankova
Luengue Protected Public Reserve
Mucusso Protected Public Reserve
Xamavera
Khaudom Game Park
Chizera
Kansonso-Busanga
Lunga-Luswishi
Luiwa Plain National Park
Lukulu
West Zambezi GMA
Mongu
Kafue National Park
Mumbwa
Namwala
Blue Lagoon NP
Kafue Flats
Mazabuka
Lochinvar NP
Mumbwa
Mkala
Bilili Springs
Mulobezi
Sichifula
Sichifula
Choma
Rivungu
West Zambezi GMA
Luiana Partial Reserve
Sioma Ngwezi National Park
Kariba
Matusadona NP
Sinazongwe
Chete
Mosi-Oa-Tunya NP
Livingstone
Victoria Falls
Zambezi NP
Victoria Falls NP
Matetsi
Kazuma Pan NP
Chizarira NP
Chirisa
Bwabwata National Park
Mudumu National Park
Mamili National Park
Kwange
Kamativi
Matetsi
Dete
Dete
Chobe National Park
Hwange National Park
Moremi National Park
Nxai Pan National Park
Maun
Matopi
Bulawayo
Makgadikgadi National Park
Matobo National Park
Legend
Airports
Border posts
Major
Main
Minor
Built-up areas
Major roads
International boundaries
Major rivers
KZTFCA
Potential expansion
Areas of inundation
Water bodies
National Park
Forest Reserve
Game Management Area
Other protected area
Recreation Park
Safari Area
Conservancy
Not known
Angola
Botswana
Namibia
Zambia
Zimbabwe
PEACE PARKS FOUNDATION
THE GLOBAL SOLUTION
kz_tfca_a3
21/03/2005
Angola
Botswana
Namibia
Zambia
Zimbabwe
Kavango - Zambezi TFCA

A model is…

A simplification of reality

On modelling…

"Essentially, all models are wrong, but some are useful."

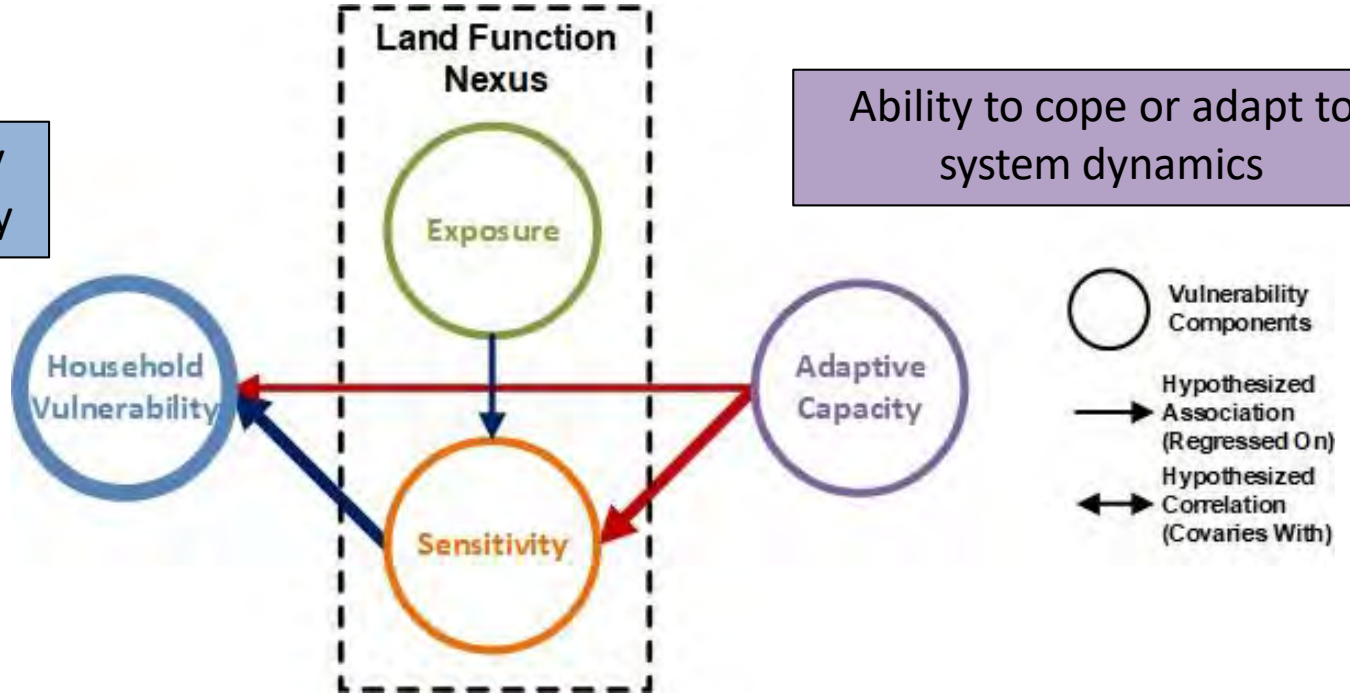
-George E. P. Box

Box, G. E. P., and Draper, N. R., (1987), *Empirical Model Building and Response Surfaces*, John Wiley & Sons, New York, NY.

Vulnerability Framework – Vulnerability to What?

Spatiotemporal nature of environmental characteristics and land uses (including climate)

Household-level Vulnerability With Respect to Food Security



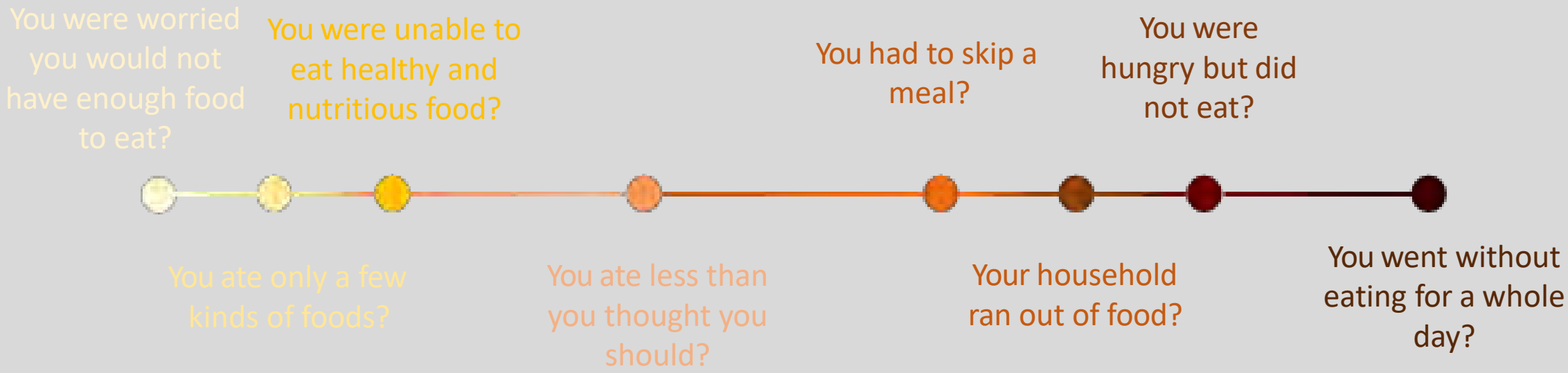
Ability to cope or adapt to system dynamics

Degree to which a household is impacted by and results from E, potentially mediated by AC

Turner et al., 2003, *PNAS*, Gaughan et al., 2019, *Land*

Approach to Food Insecurity

The Food Insecurity Experience Scale (FIES)



2 ZERO HUNGER

https://sdgs.un.org/goals

Source: FAO, http://www.fao.org/in-action/voices-of-the-hungry/en/

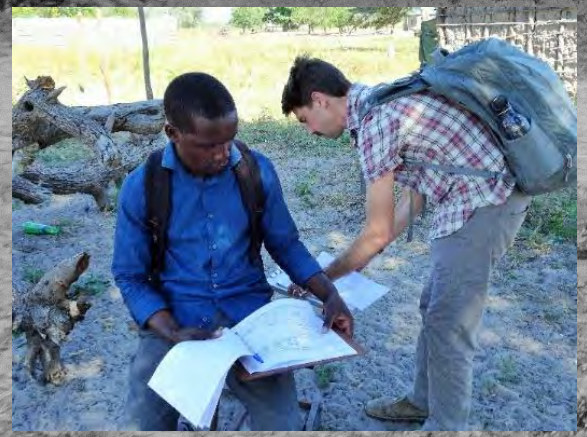
Sustainability

2030 Agenda for Sustainable Development

- Global convention noting resources limited
- Adopted by 193 countries of the United Nations
- SDGs are part of the 2030 Agenda
- 17 goals, 169 targets, 232 indicators

Resources: https://sdgs.un.org/goals, https://sdgstoday.org/

Interdisciplinary Approach

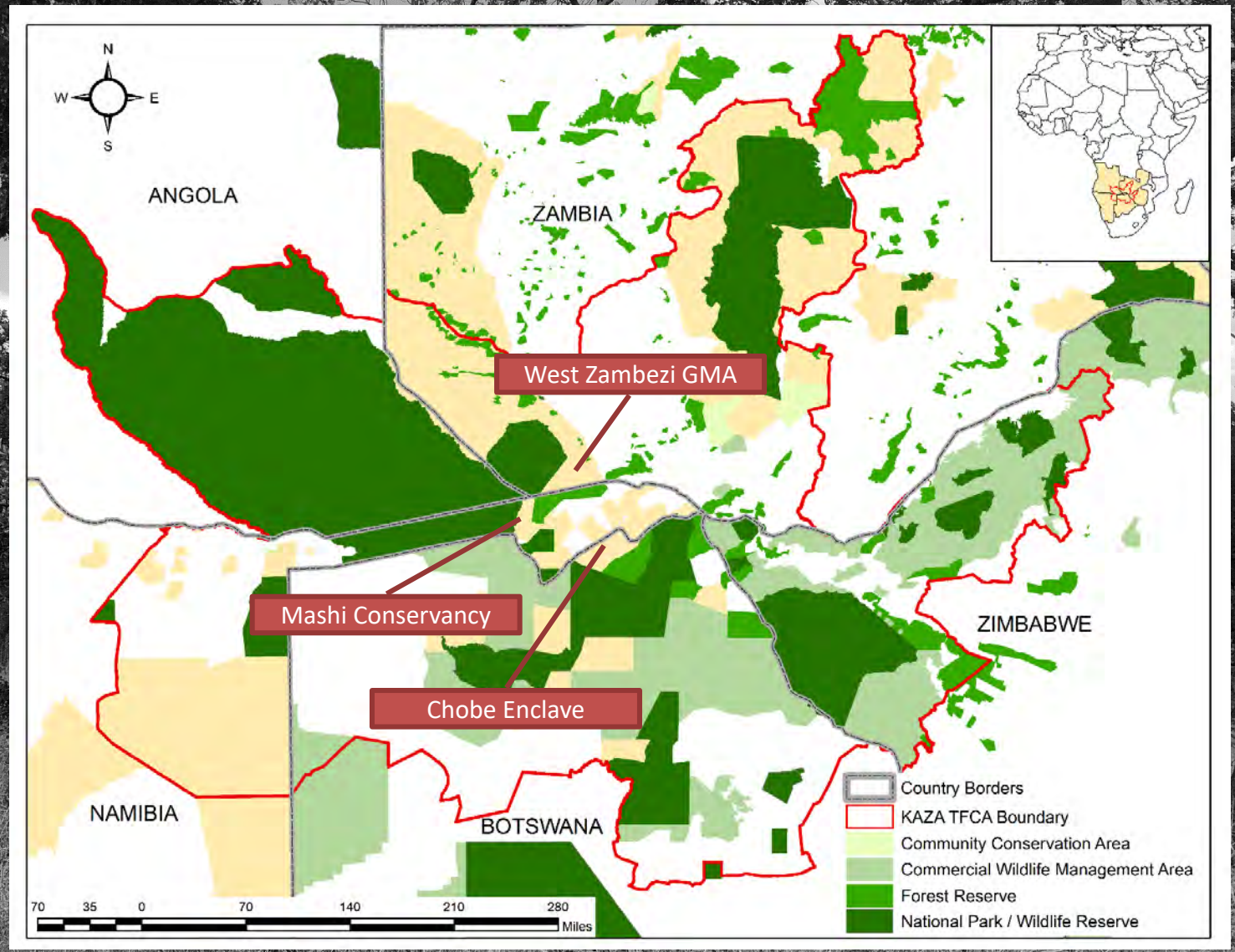


Pricope et al. 2020, *Soc. Nat. Res.*

Approach (1)

Household Sampling Protocol

- Household surveys in 5 communities in Botswana, Namibia and Zambia
- Surveys were designed to measure household livelihood capitals (economic, human, natural, physical, social)
- ~30-50 min/survey, n=240/country



Salerno et al., 2020, *Cons.Bio*

Household Survey Data

Table S3. Summary values from household survey data.

Variable	Botswana	Namibia	Zambia	Total sample
Food insecurity scores[a]	3.40	5.63	6.07	5.05
Farmed area (ha)[b]	4.31	2.27	2.04	2.54
Cash income ($USD)	2680	740	272	1220
Experienced crop depredation (%)[b]	65	60	55	58
Crop depredation (ha)	1.16	0.45	0.42	0.57
Elephants as reported primary spp. (%)[b,c]	67	83	55	67

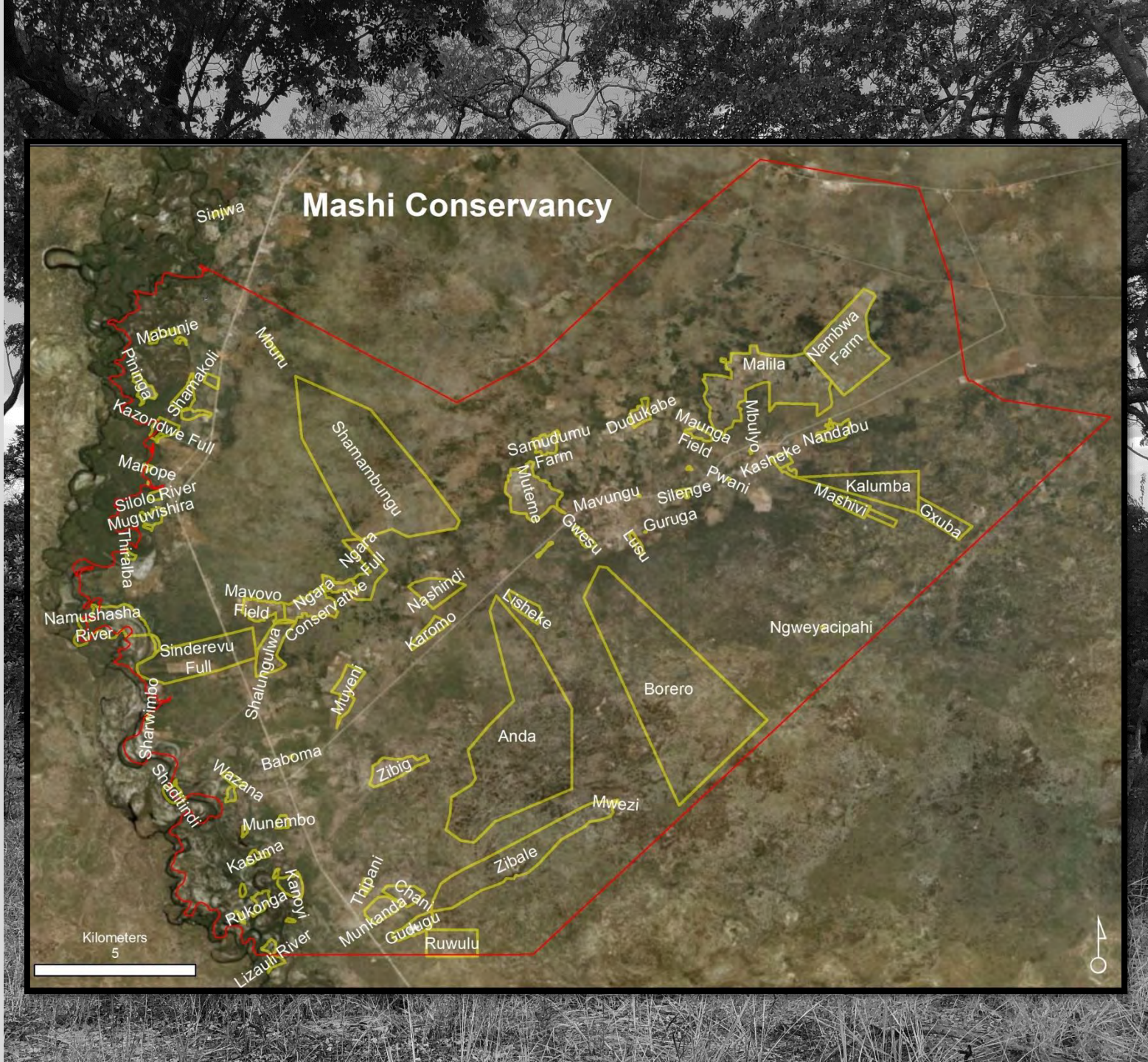
[a.] Reported means calculated from the FIES raw scores
[b.] Calculations based on only those households that reported farming in the previous season
[c.] Calculations based on only those households experiencing crop depredation

Salerno et al., 2021, *Curr.Bio*.

Approach (2)

Resource Mapping Protocol

- Resource location names from household surveys
- With enumerator, mapped GPS waypoints around resource area
- Polygons created in GIS to represent different resource areas
- Resource mapping completed in all three countries



Bailey et al., 2020, *App. Geog.*, Woodward et al., 2020, *RS*

Approach (3)

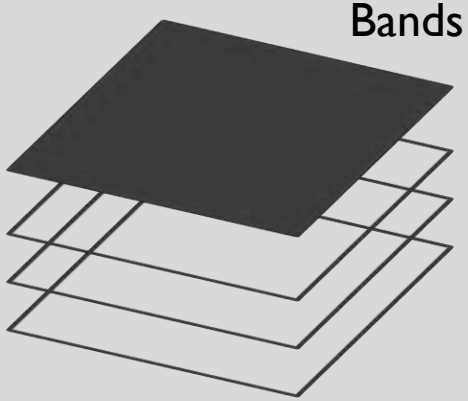
Biophysical/Remote Sensing Protocol

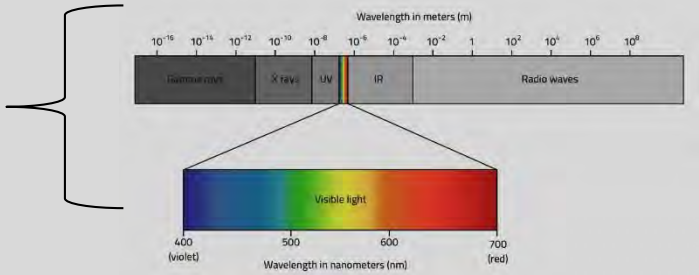
- Reference sampling of various land covers (all three countries)
- UAS flights in Namibia (n=58) and Botswana (n=40)
- Two methods in-situ data collection
  - Intercept for above woody ground cover combined with pseudo-quadrat photo series for ground cover (NAM)
  - Intercept and woody species measurements (BOT)

Kolarik et al., 2020, ISPRS *JPRS*., Gaughan et al., 2022, *RS*

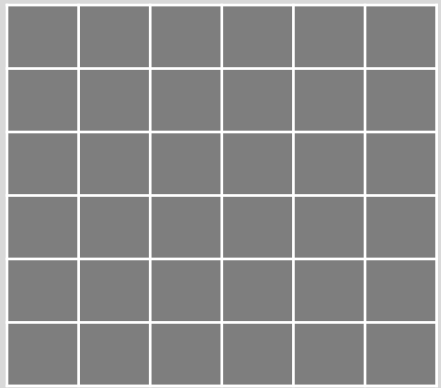
Approach (3)

Bands





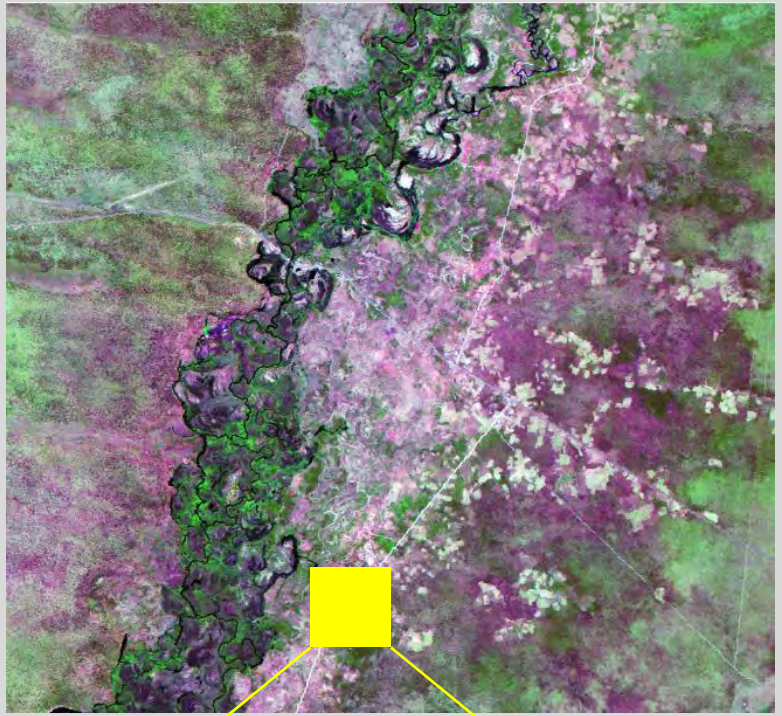
Electromagnetic Spectrum

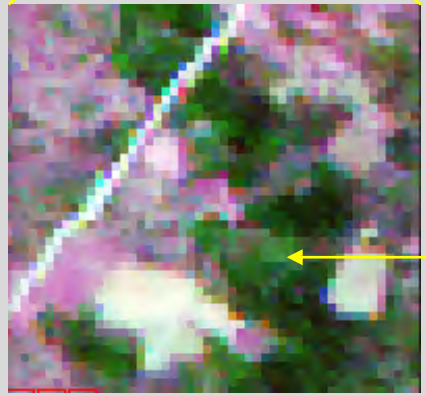


Columns and Rows

Pixel

Biophysical/Remote Sensing Protocol





Landsat TM
April 22, 2007
Caprivi, Namibia

Approach (3)

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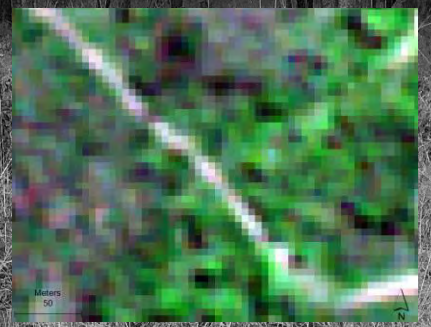
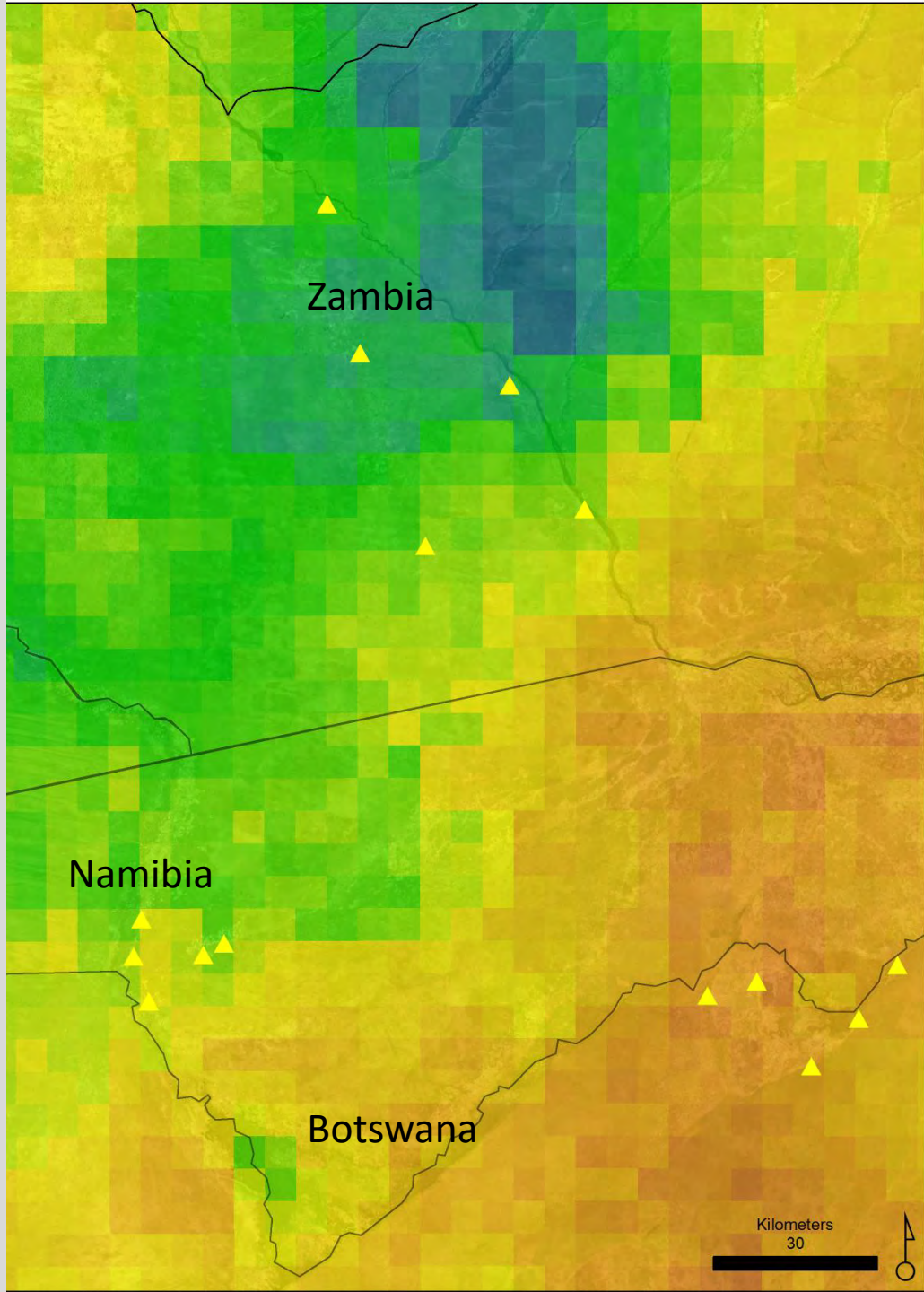


Kolarik et al., 2020, ISPRS *JPRS*., Gaughan et al., 2022, *RS*

Remote Sensing Data – Rainy Season Length

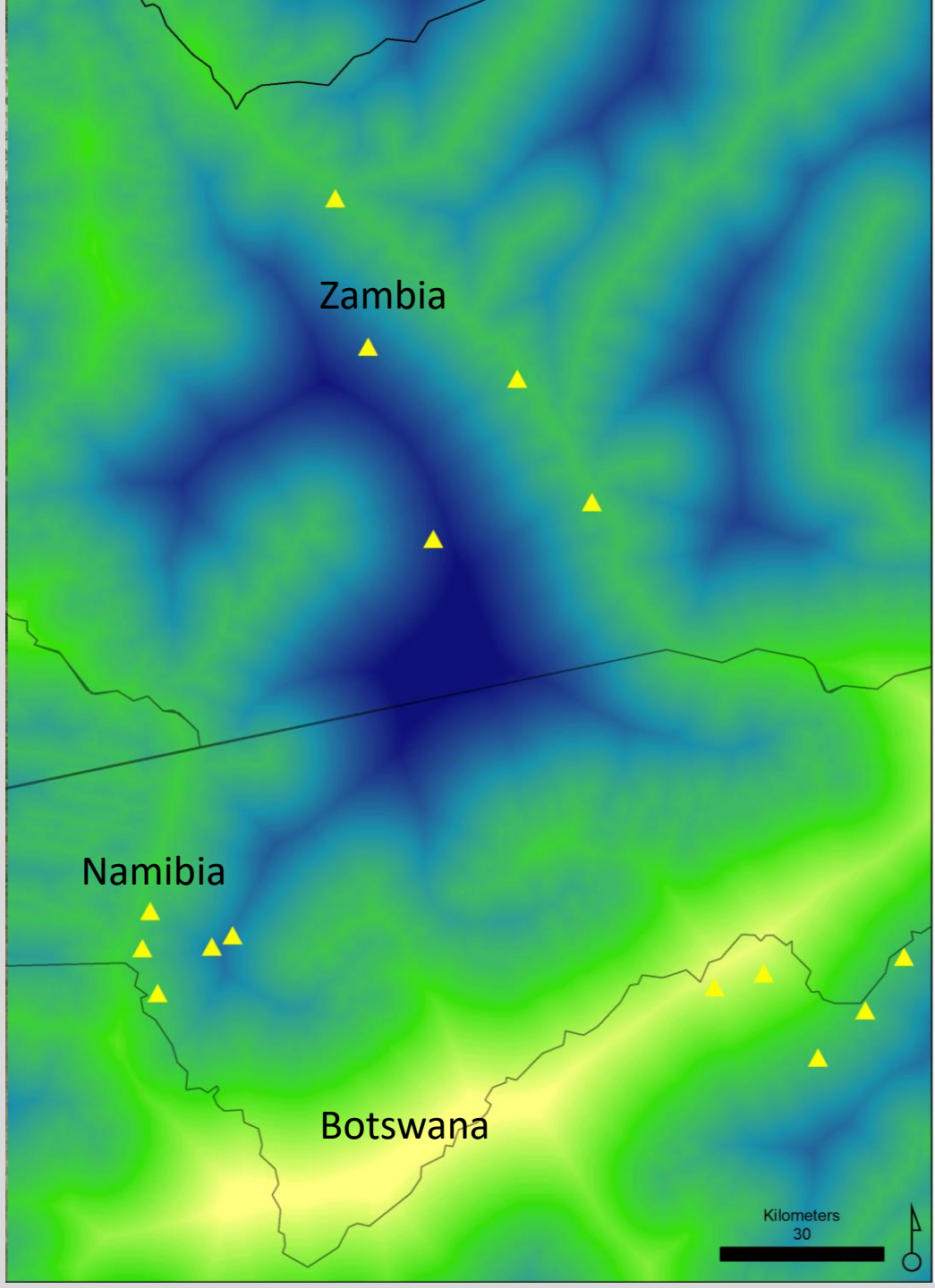
This data represents the number of days between the first and last pentad in the CHIRPS data, starting with the water year on October 1st.

These rainy season lengths are then averaged across 1982-2017 and then aggregated to household buffers as an average.



Remote Sensing Data – Floodplain

This data represents the average distance within each household's one km buffer to the outer edge of the long-term floodplain.



Floodplain Distance (m)

< 25,000

> 25,000

Nardi et al., 2019, *SciData*

Study Objective

Empirically link aspects of agropastoral-related land function to households' capacity to adapt to food-insecurity.

<u>Research Question</u>

How do changing land systems and their functions affect household vulnerability?

Stevens et al., *in prep*

Vulnerability Framework – Vulnerability to What?

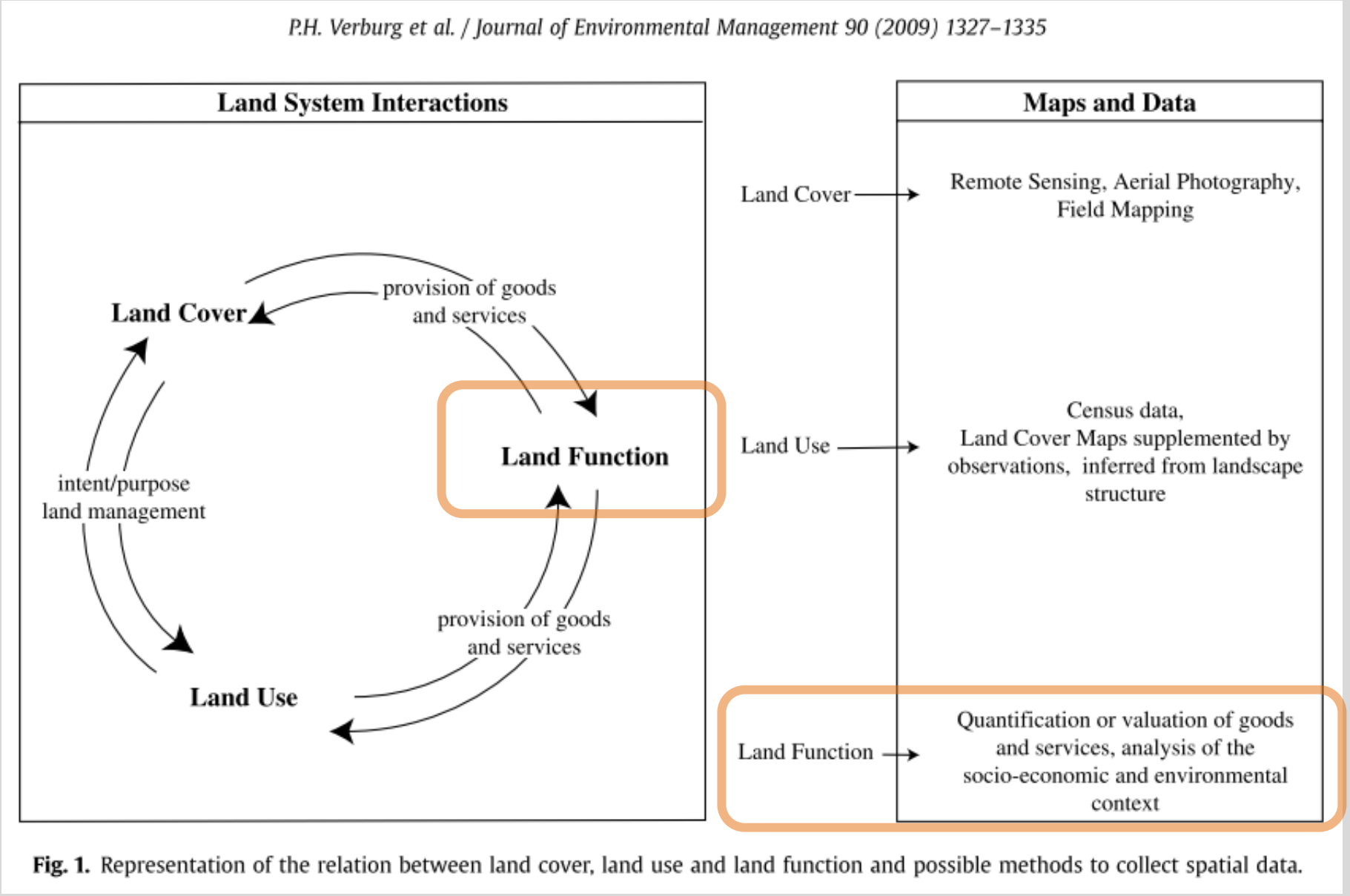
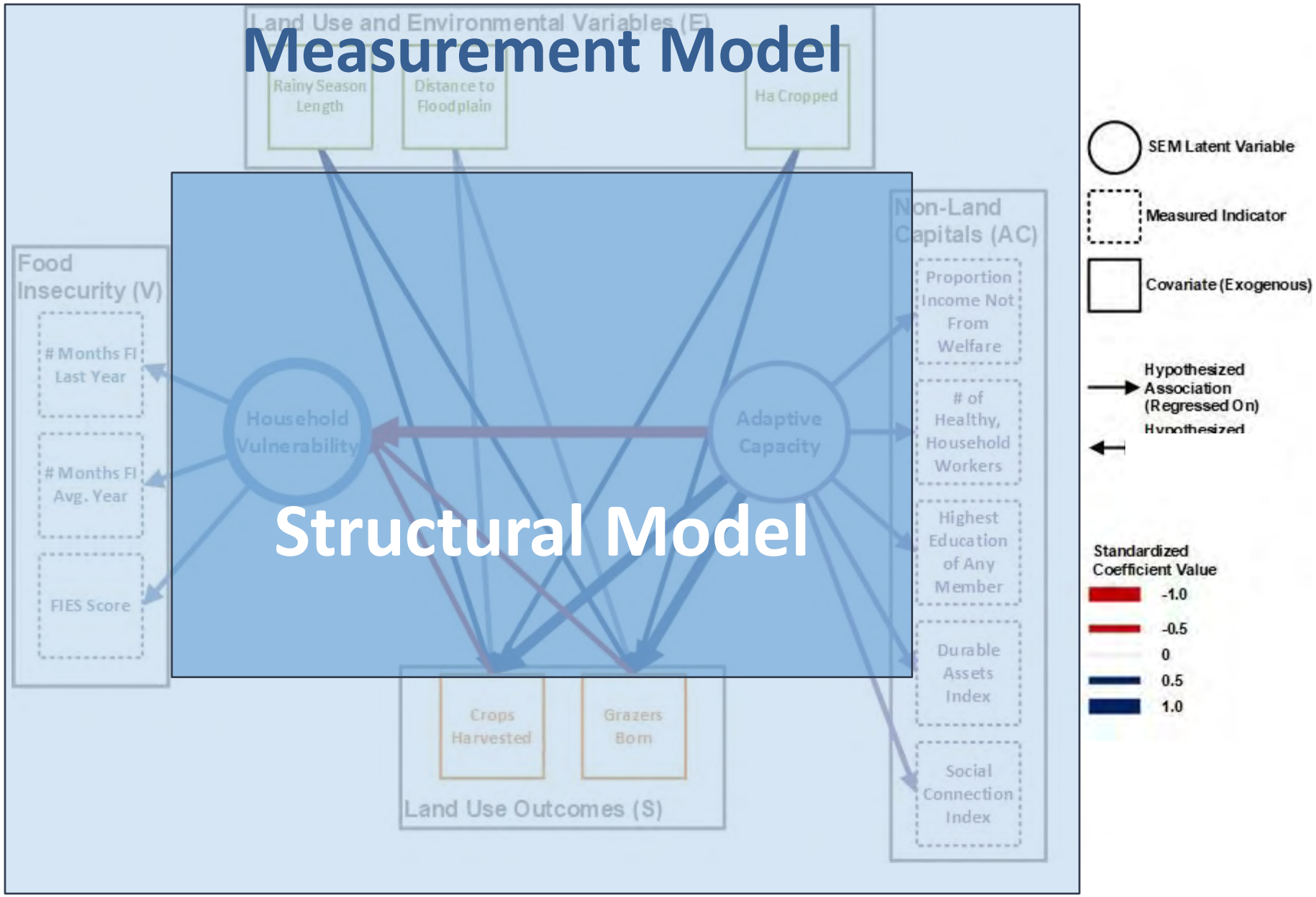
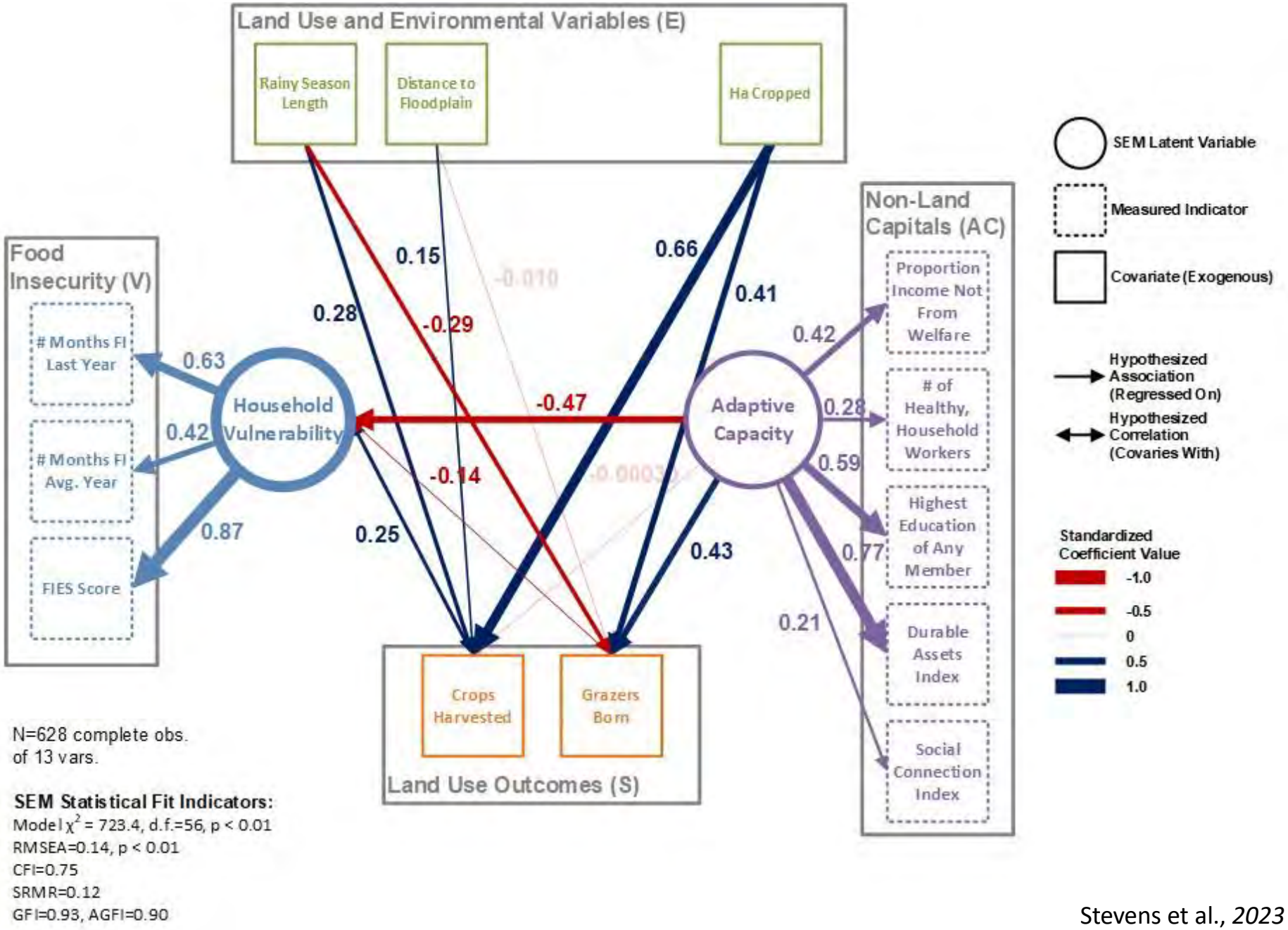


Fig. 1. Representation of the relation between land cover, land use and land function and possible methods to collect spatial data.

Vulnerability Model



Vulnerability Model



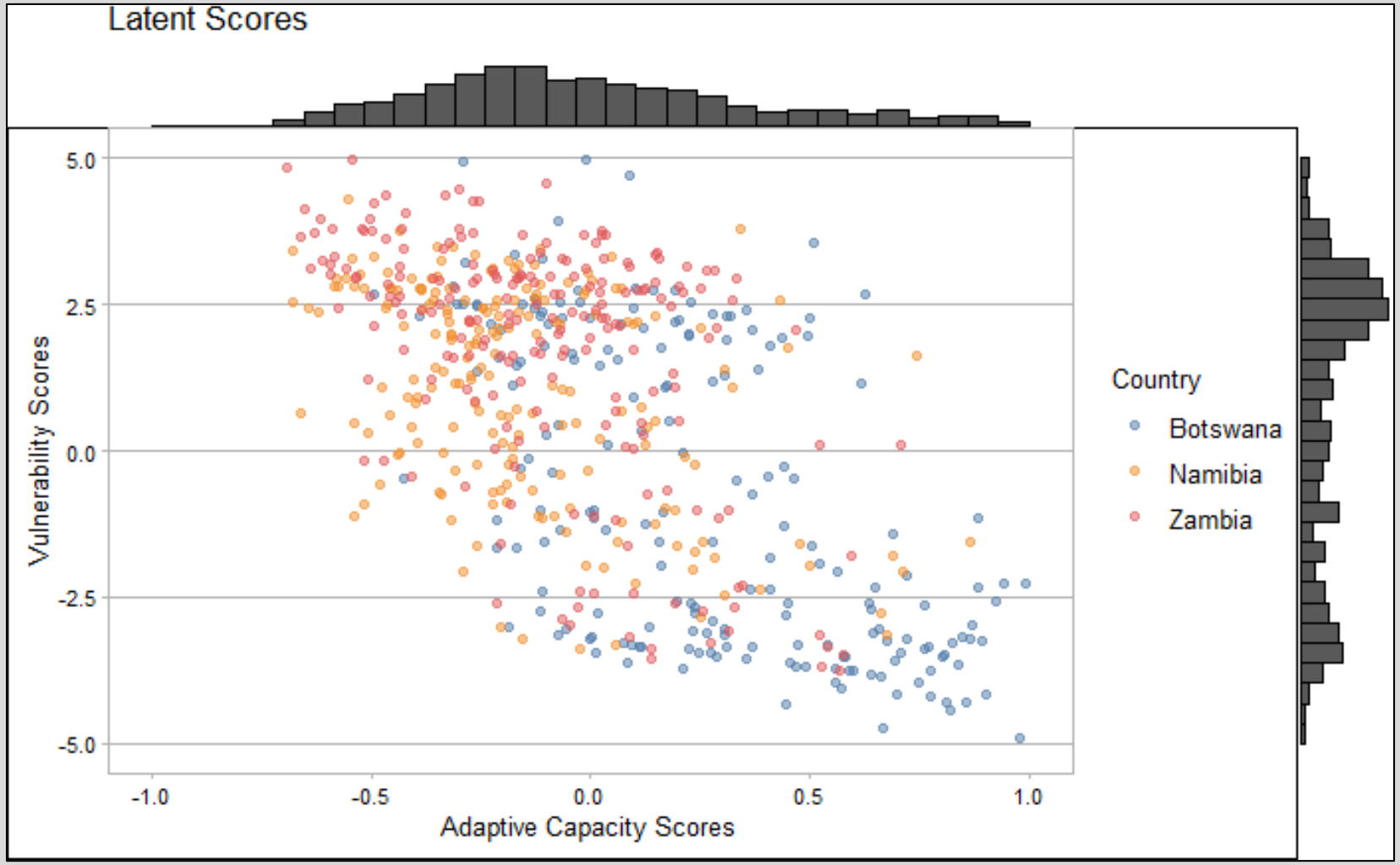
N=628 complete obs.
of 13 vars.

SEM Statistical Fit Indicators:

Model χ^2 = 723.4, d.f.=56, $p < 0.01$
RMSEA=0.14, $p < 0.01$
CFI=0.75
SRMR=0.12
GFI=0.93, AGFI=0.90

Stevens et al., *2023*

Structural Equation Model – Model Fit



The KAZA Human-Environment System

- We operationalize V as food insecurity predicted by E, S, and AC
- **Environmental conditions**, captured through theoretical E-S linkage, are significant; further environmental analysis may add explanatory power
- But… **adaptive capacity** is very important – has the strongest relative total pathway effect on household vulnerability, **having controlled for environmental variability**
- Significant in-country variation in V and AC which suggests that targeting broad interventions is not enough to reach the most vulnerable

MAY 27, 2021

The Rhino Hunter

Listen Transcript

Image credits: Image Credit: Andrea Mongia

Back in 2014, Corey Knowlton paid $350,000 for a hunting trip to Namibia to shoot and kill an endangered species. He's a professional hunter, who guides hunts all around the world, so going to Africa would be nothing new. The target on the other hand would be. And so too, he quickly found, would be the attention.

This episode, producer Simon Adler follows Corey as he dodges death threats and prepares to pull the trigger. Along the way we stop to talk with Namibian hunters and government officials, American activists, and someone who's been here before - Kenya's former Director of Wildlife, Richard Leakey. All the while, we try to uncover what conservation really means in the 21st century.

Reported & produced by Simon Adler with production help from Matthew Kielty.

Special thanks to Chris Weaver, Ian Wallace, Mark Barrow, the Lindstrom family, and everyone at the Aru Game Lodge in Namibia.

Thanks also to Sarah Fogel, Ray Crow, Barbara Clucus, and Diogo Veríssimo.

Spotify version

Further Information

KAZAVA

KAZA Vulnerability and Adaptation

kazava.weebly.com

https://arcg.is/1rSD9q

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NSF GSS Grant
#1560700

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