Geospatial Data for Mapping and Decision-Making

Lee Schwartz, The Geographer

Office of the Geographer and Global Issues
U.S. Department of State

TREPA Indaba

Southern African Wildlife College, September 6, 2023

(The views expressed are those of the author and do not reflect the official policy or position of the U.S. Department of State or the U.S. Government)

The Geographic Information Unit (GIU)

Office of the Geographer and Global Issues • U.S. Department of State

International Boundaries

As the U.S. Government authority on international boundary depiction and policy, the GIU:

- Coordinates production of the **Large Scale International Boundaries (LSIB)** dataset; most accurate worldwide digital data source, available to the public.

- Advises Department of State policymakers on international boundaries and disseminates international boundary policy to the U.S. Federal Government.
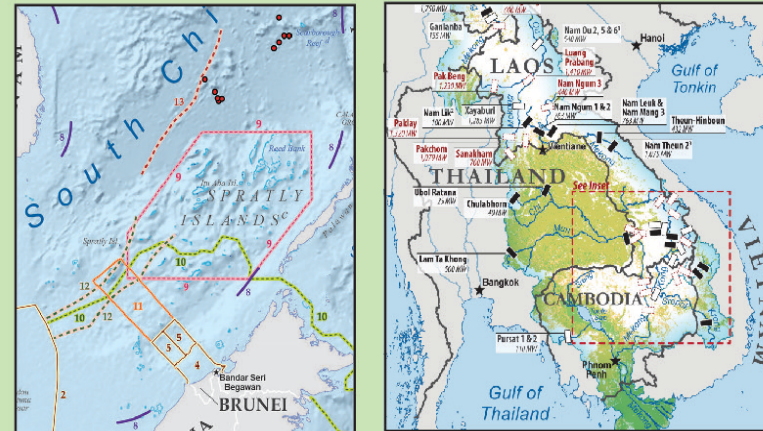

Mapping and GIS Support

The GIU supports the Department of State with mapping, and with geographic information systems (GIS) analysis and production, to further foreign policy objectives.

Geographic Names

GIU represents the Department on the **U.S. Board on Geographic Names,** and chairs the Board's Foreign Names Committee.

Sovereignty Issues

The GIU advises Department of State policymakers on political sovereignty issues with decades of supporting historical records; disseminates mapping policy to U.S. Government cartographers.

HIU

Building a global information network of institutions and individuals

Leveraging USG Geographic and Satellite Data

- NGA, USGS, NOAA
- High resolution commercial satellite imagery

Natural Disasters

- Preparedness and risk reduction
- Recovery and resilience
- Emergency response

Open Data

- Linked with White House Open Government Initiative
- Open data and open platforms for improved crisis mitigation and response

Partner Engagement

American Red Cross

UN Agencies

World Bank

Humanitarian OpenStreetMap Team

GeoDiplomacy

- Digital diplomacy through collaborative mapping
- Crowdsourcing new data
- Empowering local communities

HIU
HUMANITARIAN INFORMATION UNIT

The Humanitarian Information Unit (HIU) is a division of the Office of the Geographer and Global Issues in the Bureau of Intelligence and Research, U.S. Department of State. HIU is an interagency center staffed by personnel from the U.S. Department of State (DoS), U.S. Agency for International Development (USAID), U.S. Department of Defense (DoD), National Geospatial-Intelligence Agency (NGA), and other technical and specialist personnel.

Geographic Perspectives:

- *What is the question?*
- *Who is the customer?*

- We ask questions about who, what, when, where, and why;

- We ask if the story is better told in map form;

- What role does geography—physical or human—play in the story?

- What are the human-environment interactions?

- The importance of good data

August 24, 2023 in Vancouver, Canada: Joint Statement of the Nature Crime Alliance's Founding Members*:

"Today, we are joining together to form the Nature Crime Alliance– a new, multi-sector approach to fighting criminal forms of logging, mining, wildlife trade, land conversion, crimes associated with fishing, and the illegal activities with which they **converge**.*"*

*Governments of Gabon, the Kingdom of Norway, the United States of America; the UN Office on Drugs and Crime (UNODC); the Global Environment Facility (GEF); Indigenous Peoples Rights International; Amazon Conservation Association; Earth League International; Environmental Investigation Agency US; Fisheries Transparency Initiative (FiTI); Global Initiative to End Wildlife Crime; Indigenous Peoples Rights International; Instituto Igarape; Mongabay; Rainforest Foundation UK; Sustainable Fisheries Partnership; Wildlife Conservation Society; TRAFFIC; Wildlife Justice Commission; World Forest ID.

Nature Crime Alliance: Building Alliances **Across Disciplines, Geographies, and Jurisdictions**

NATURE CRIME ALLIANCE
people, planet, justice.

Mobilising against the criminal exploitation of natural resources, wildlife, and people.

The syndicates that carry out nature crime amass great wealth through violence, corruption, and intimidation.

Their crimes pose a dire threat to biodiversity, ecosystems, economies, Indigenous Peoples and local communities, wildlife species, and the global climate.

Nature crime includes criminal forms of logging, mining, fishing, wildlife trade, and land conversion. These crimes frequently converge with each other and other forms of international criminal activity. Globally, it is estimated that nature crime has become the largest financial driver of terrorism and other forms of conflict, generating $110–$281 billion in annual criminal proceeds[1] with an indirect impact of $1–2 trillion.[2]

Scale

Boundaries

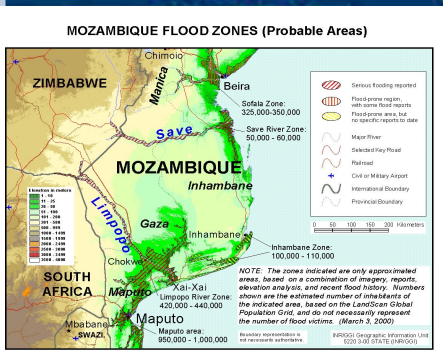Areas/Polygons

Data

Standards
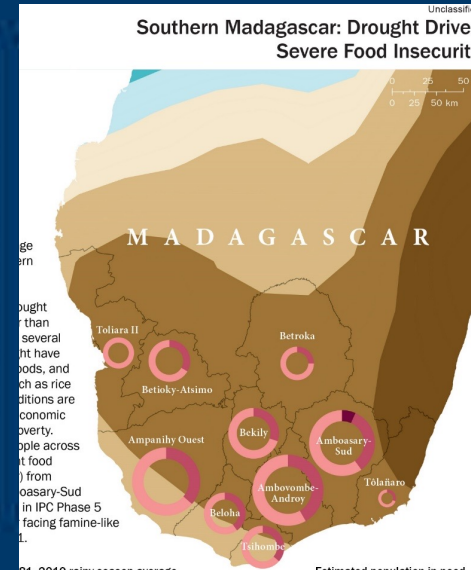
Methods (Collection/Analysis)

Knowledge

Action / Decisions (know your audience)

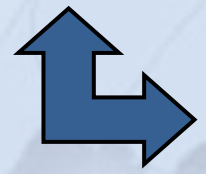Human Response

Ecological Response (Ethics)

Southern Madagascar: Drought Drives Severe Food Insecurity

MADAGASCAR

Toliara II

Betroka

Betioky-Atsimo

Ampanihy Ouest

Bekily

Amboasary-Sud

Ambovombe-Androy

Beloha

Tôlañaro

Tsihombe

MOZAMBIQUE FLOOD ZONES (Probable Areas)

ZIMBABWE

Chimoio

Beira

MOZAMBIQUE

Inhambane

Gaza

Inhambane

SOUTH AFRICA

Xai-Xai

Chokwe

Maputo

Maputo

Río San Juan de Nicaragua

Laguna Portilla

Figure 3: Above/Below Expenditures and PLHIV by District

TANZANIA

ZAMBIA

Chitipa

Karonga

Rumphi

Mzimba

Nkhata Bay

Lake Nyasa

MALAWI

MOZAMBIQUE

Kasungu

Nkhotakota

Ntchisi

Dowa

Salima

Mchinji

Lilongwe

Dedza

Mangochi

Ntcheu

Balaka

Machinga

Neno

Blantyre

Zomba

Mwanza

Chiradzulu

Mulanje

MOZAMBIQUE

Chikwawa

Thyolo

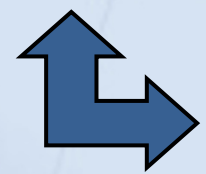Nsanje

SCALE

Global

GLOBAL SCALE

Land Use
Demographics
Global Climate
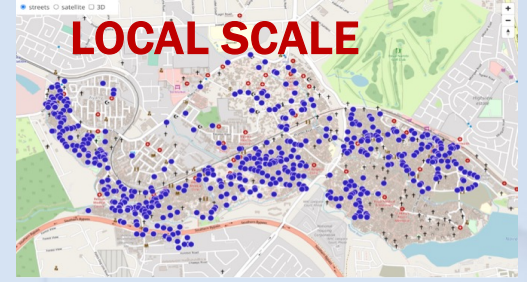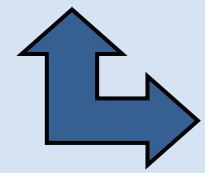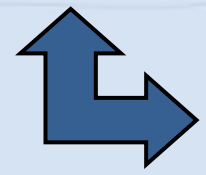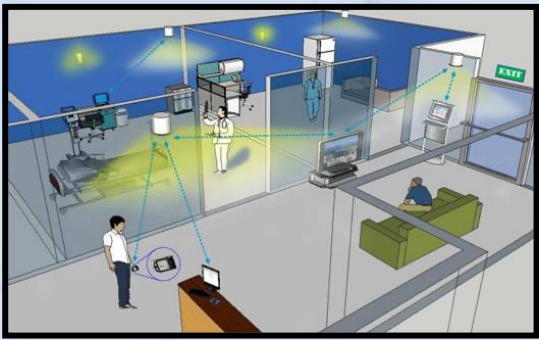Sea Surface Temperature
Digital Elevation

NATIONAL SCALE

Food and Fiber
Disaster Preparedness
Biodiversity
One Health
Coastal Sensitivity

STATE SCALE

Land Use/Land Cover
Precision Agriculture
Hydrologic Modeling
Transportation Planning

LOCAL SCALE

Smart Growth
One Health
Disaster Response
Weather

INDIVIDUAL SCALE

Participatory
Methods
Internet of Things

Local

(Adapted, with permission, from Dan Sui, Ohio State, "The New Digital Landscape")

SCALE Matters

Worldwide: Lack of Basic Sanitation, Child Deaths, and Economic Loss

Populations Impacted by Hunger and Disease *(September 2019)*
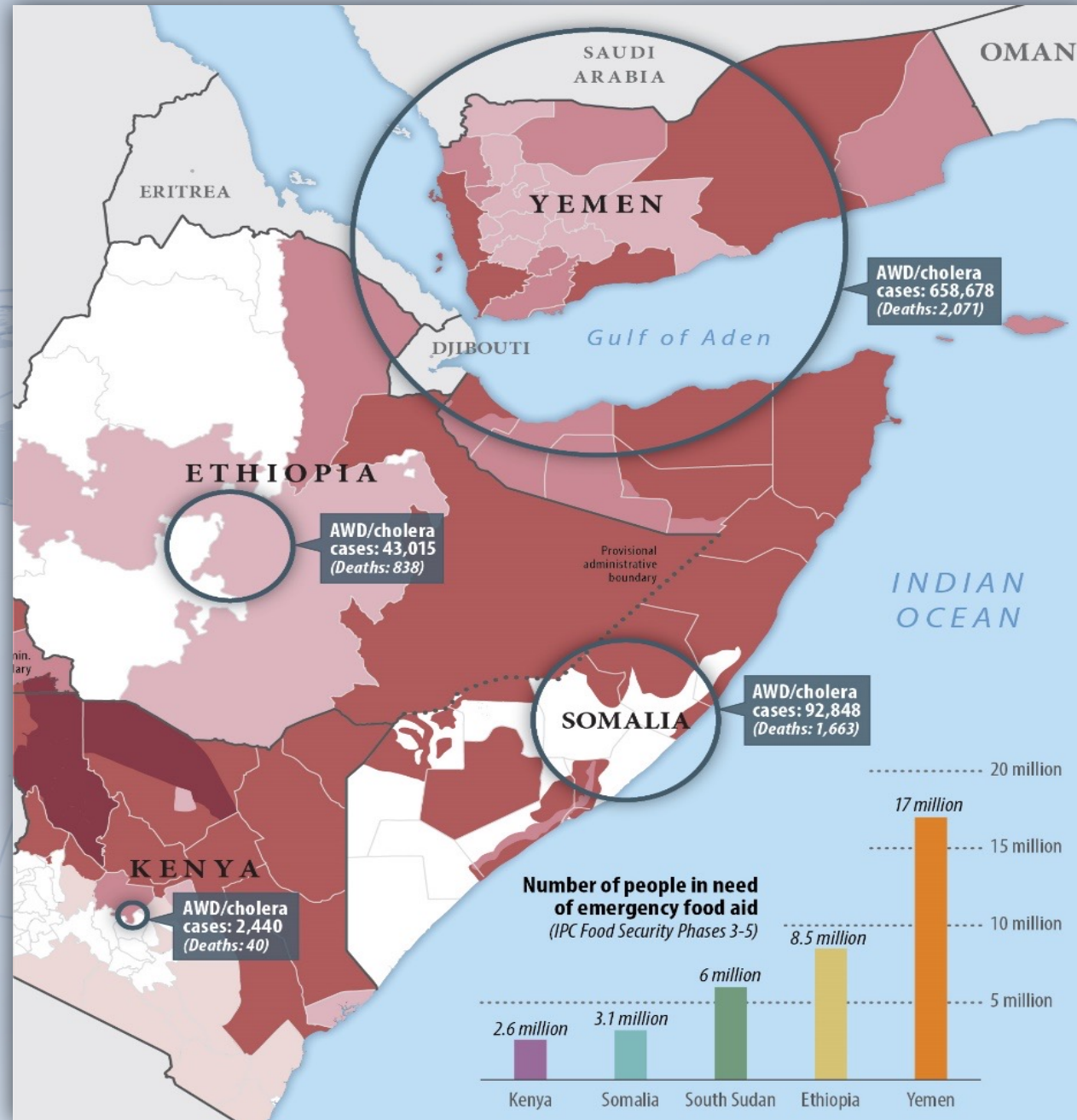
Eritrea-Ethiopia Boundary (Ura Plateau)

The town of Ura was put in Eritrea, but it is impossible to get to it without coming from Ethiopia. Moreover, its school and church are on the Ethiopian side.

Kershibti

Adi Tesfa
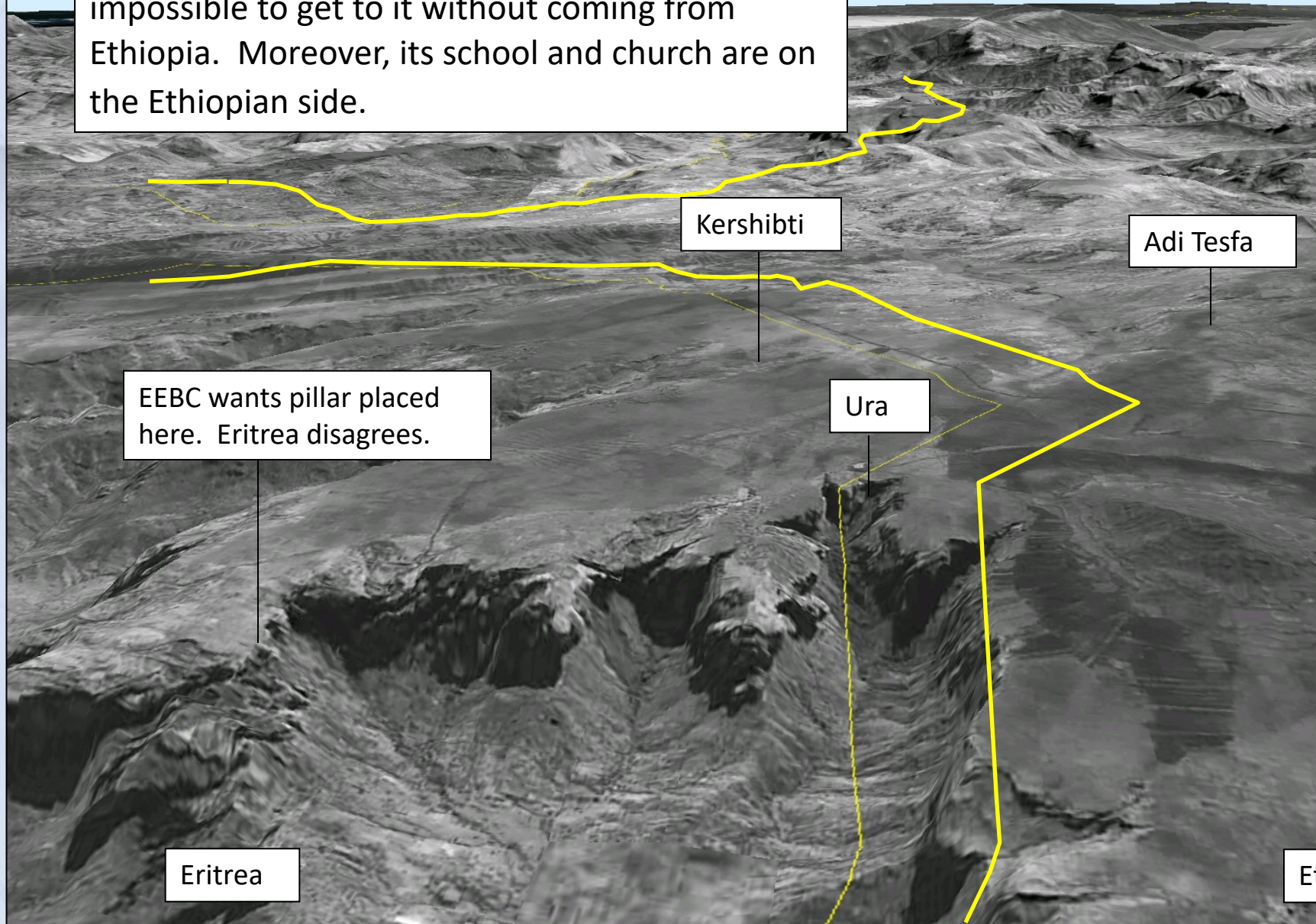
EEBC wants pillar placed here. Eritrea disagrees.

Ura

Eritrea

Ethiopia

Transhumance and wildlife trafficking

Legend:
- Pastoralist destination
- Cattle migration routes
- Elephant poaching
- Trafficking routes
- Ivory trading hub
- Ivory carving hub
- Protected area
- ★ Capital city
- • Populated place
- International boundary
- Road
- River

Scale: 0 — 100 — 200 Miles
0 — 100 — 200 Kilometers

Sources: USAID, Wildlife Conservation Society, Crisis Group/KO, Protectedplanet, Natural Earth

Pit

Abou
Telfane

Nyala

Babanusah

Kadugli

Zakouma

Siniaka
Minia

Bahr
Salamat

Aouk-
Aoukale

Andre
Felix

Abyei
Area

Nile

Manda

Aouk

Ouandjia-
Vakaga

Yata-
Ngaya

Boro

Chelkou

Zeraf

Sagh

Avakaba

Manovo-
Gounda-
Saint Floris

Meshra

Bamingui-
Bangoran

Zone
Pilote
de la
Sangba

Kotto

Wau

Sudd

Badingilo
Extension

Gribingui-
Bamingui

CENTRAL
AFRICAN
REPUBLIC

Chinko

Chinko

Zemongo

Numatina

SOUTH
SUDAN

Southern

Kaga
Bandoro

Badingilo

Bangassou

Juba

Bangassou

Bomu

Bomu

Bomu

Lantoto

Bangui

Bili-Uere

Yambio

Garamba

Abumonbazi

Uele

Gangala-na Bodio

Gulu

Aketi

Maika-
Penge

Watsa

Rubi-Tele

Isiro

Aruwimi

Bunia

Lake
Albert

DEMOCRATIC
REPUBLIC OF
THE CONGO

Okapi

::::: Pastoralist destination

⟷ Cattle migration routes

Yangambi

Kisangani

Maiko

Beni

UGANDA

Kampala

Jinja

▨ Elephant poaching

→ Trafficking routes

◉ Ivory trading hub

▪ Ivory carving hub

▢ Protected area

★ Capital city

Lyondji

Maiko

Tshuapa

Congo

Lake
Edward

Goma
RWANDA

Lake
Kivu

Kigali

Gitarama

Lake
Victoria

Mwanza

Sometimes Boundaries DON'T Matter!

Conflicts Without Borders

BOUNDARIES

3 GOOD HEALTH AND WELL-BEING

HIU
HUMANITARIAN INFORMATION UNIT
U.S. Department of State
hiu_info@state.gov
http://hiu.state.gov

UNCLASSIFIED

Disease Without Borders: Ebola in West Africa

Countries across Africa have implemented border closures, flight and maritime travel restrictions, and traveler monitoring procedures in an effort to prevent the spread of Ebola outside of the countries currently affected.

Confirmed Ebola cases*
Suspected Ebola cases*
Points of entry where crossings are limited and monitored
International border
Border closed

*CDC data by administrative unit current as of August 24, 2014

Travel restrictions as of August 27

Ebola outbreak timeline

Case counts include suspected and laboratory confirmed cases

Aug. 26 total
1,552 deaths
3,069 cases

Guinea
March 25

Sierra Leone
May 27

Liberia
March 31

Nigeria July 25

422 deaths
1,026 cases

694 deaths
1,378 cases

430 deaths
648 cases

6 deaths
17 cases

Liberia and **Sierra Leone** have declared states of emergency and have closed their borders. Prevention and control measures by military and police personnel include quarantines of selected areas, travel protocols for passenger screening, and restrictions on public gatherings.

Guinea recently declared a national health emergency with tighter border controls, isolation of suspected cases, and regulation of burial practices.

Nigeria has also declared a health emergency and ordered the closure of schools until mid-October.

Names and boundary representation are not necessarily authoritative
UNCLASSIFIED

Sources: CDC, USG, WHO

August 28, 2014 - U1078 STATE (HIU)

World Water Day, March 22, 2022
Aquifer Depletion Across Boundaries

HIU
Humanitarian Information Unit

World Water Day in 2022 highlights the importance and challenges of managing groundwater in a changing climate, while also recognizing 25% of the global population lacks access to safe water. Groundwater reserves represent the largest portion of freshwater on the planet, yet increasing human population sizes, changes in climate, and the transboundary nature of many aquifers are presenting challenges to managing and sharing these resources.
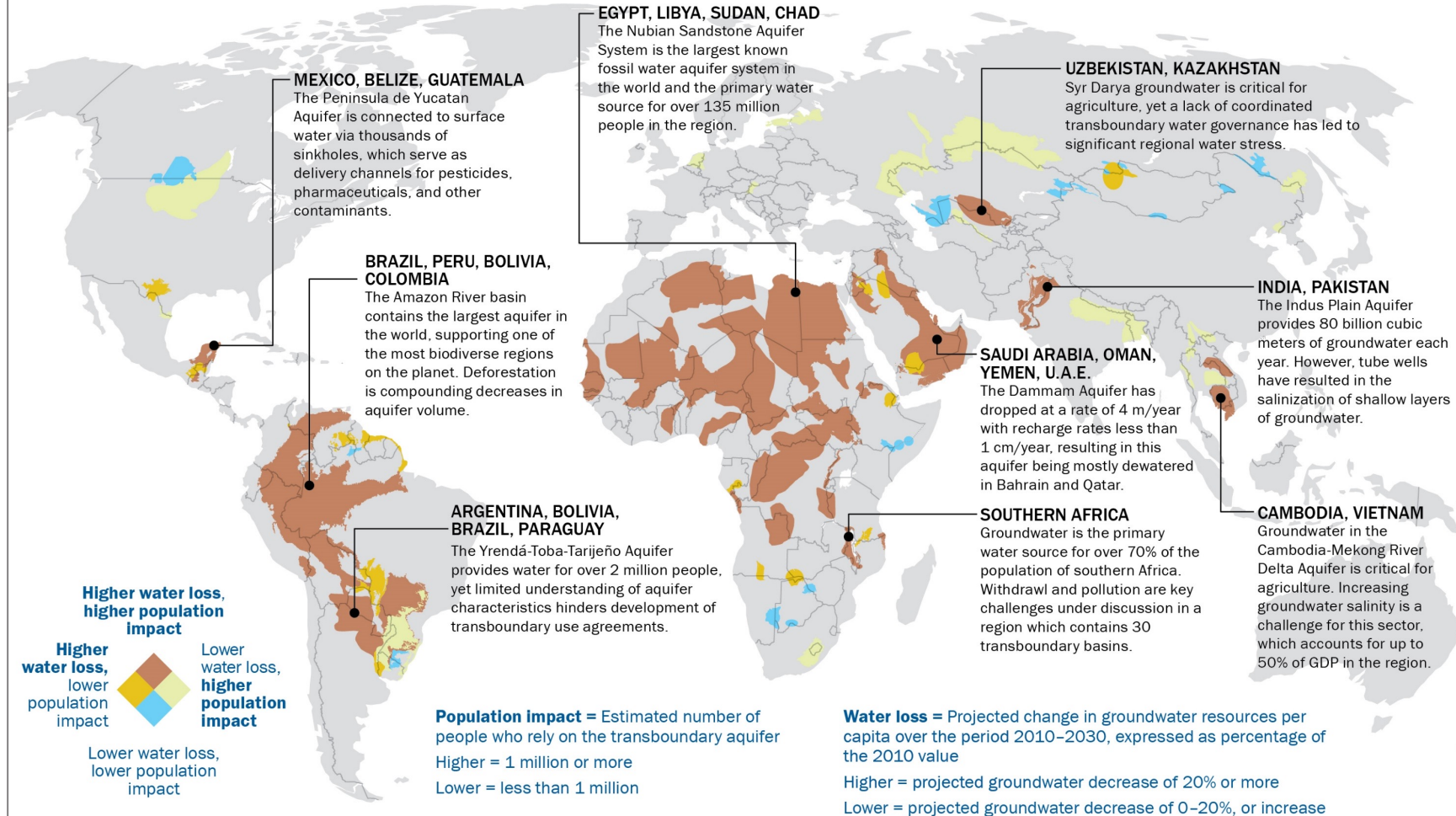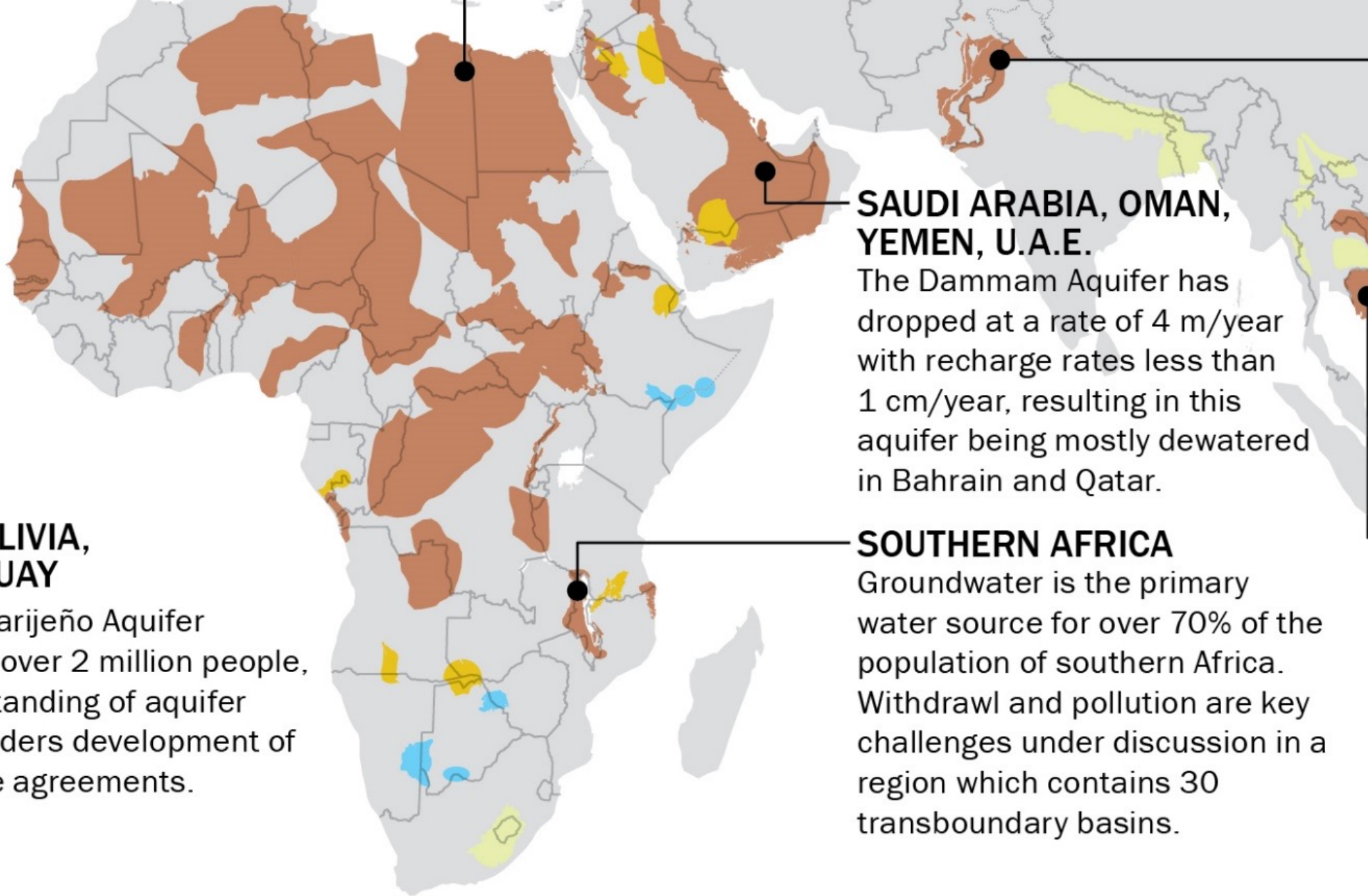
EGYPT, LIBYA, SUDAN, CHAD
The Nubian Sandstone Aquifer System is the largest known fossil water aquifer system in the world and the primary water source for over 135 million people in the region.

UZBEKISTAN, KAZAKHSTAN
Syr Darya groundwater is critical for agriculture, yet a lack of coordinated transboundary water governance has led to significant regional water stress.

MEXICO, BELIZE, GUATEMALA
The Peninsula de Yucatan Aquifer is connected to surface water via thousands of sinkholes, which serve as delivery channels for pesticides, pharmaceuticals, and other contaminants.

BRAZIL, PERU, BOLIVIA, COLOMBIA
The Amazon River basin contains the largest aquifer in the world, supporting one of the most biodiverse regions on the planet. Deforestation is compounding decreases in aquifer volume.

INDIA, PAKISTAN
The Indus Plain Aquifer provides 80 billion cubic meters of groundwater each year. However, tube wells have resulted in the salinization of shallow layers of groundwater.

SAUDI ARABIA, OMAN, YEMEN, U.A.E.
The Dammam Aquifer has dropped at a rate of 4 m/year with recharge rates less than 1 cm/year, resulting in this aquifer being mostly dewatered in Bahrain and Qatar.

ARGENTINA, BOLIVIA, BRAZIL, PARAGUAY
The Yrendá-Toba-Tarijeño Aquifer provides water for over 2 million people, yet limited understanding of aquifer characteristics hinders development of transboundary use agreements.
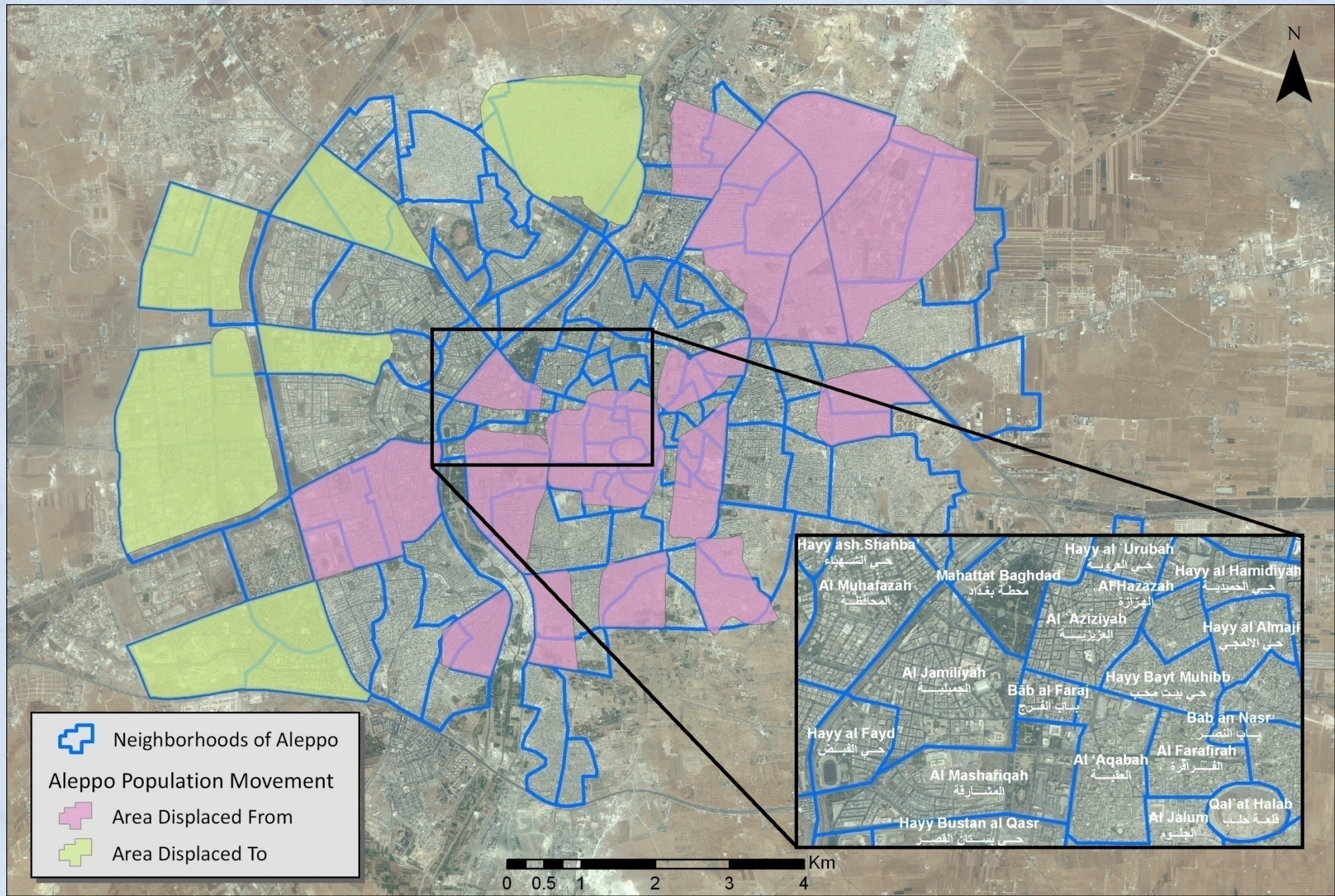
SOUTHERN AFRICA
Groundwater is the primary water source for over 70% of the population of southern Africa. Withdrawl and pollution are key challenges under discussion in a region which contains 30 transboundary basins.
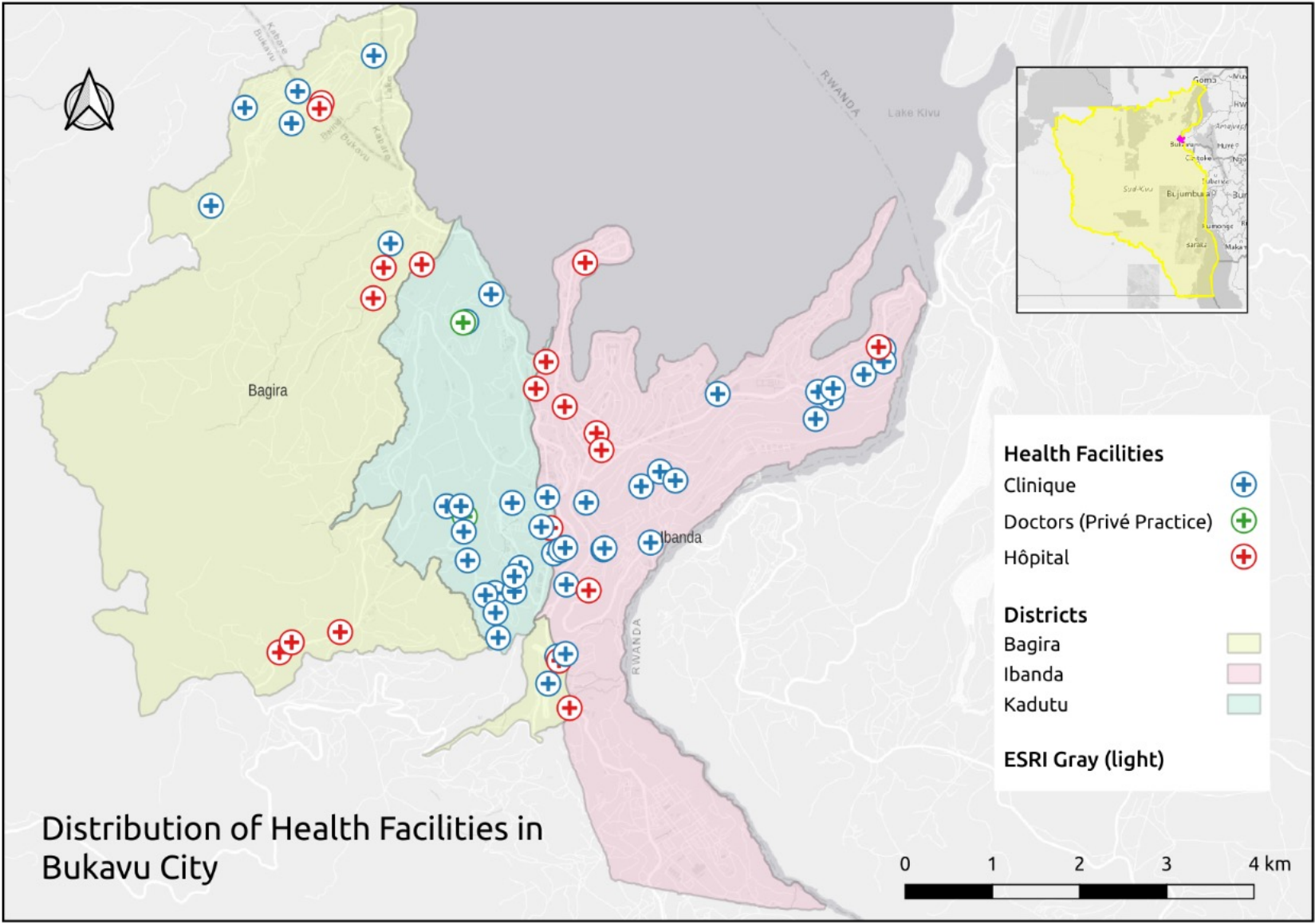
CAMBODIA, VIETNAM
Groundwater in the Cambodia-Mekong River Delta Aquifer is critical for agriculture. Increasing groundwater salinity is a challenge for this sector, which accounts for up to 50% of GDP in the region.

Legend:
- Higher water loss, higher population impact
- Higher water loss, lower population impact
- Lower water loss, higher population impact
- Lower water loss, lower population impact

Population impact = Estimated number of people who rely on the transboundary aquifer
Higher = 1 million or more
Lower = less than 1 million

Water loss = Projected change in groundwater resources per capita over the period 2010–2030, expressed as percentage of the 2010 value
Higher = projected groundwater decrease of 20% or more
Lower = projected groundwater decrease of 0–20%, or increase

Names and boundary representation are not necessarily authoritative.
U.S. Department of State • @StateHIU • hiu.state.gov

Sources: Transboundary Waters Assessment Programme, World Bank

March 21, 2022
U2570 STATE (HIU)

SAUDI ARABIA, OMAN, YEMEN, U.A.E.
The Dammam Aquifer has dropped at a rate of 4 m/year with recharge rates less than 1 cm/year, resulting in this aquifer being mostly dewatered in Bahrain and Qatar.

SOUTHERN AFRICA
Groundwater is the primary water source for over 70% of the population of southern Africa. Withdrawl and pollution are key challenges under discussion in a region which contains 30 transboundary basins.

, BOLIVIA, RAGUAY
ba-Tarijeño Aquifer
r for over 2 million people,
derstanding of aquifer
s hinders development of
y use agreements.

Neighborhood Mapping - Aleppo

Legend:

Neighborhoods of Aleppo

Aleppo Population Movement

Area Displaced From

Area Displaced To

Inset labels:

Hayy ash Shahba' حي الشهباء

Al Muhafazah المحافظة

Mahattat Baghdad محطة بغداد

Hayy al 'Urubah حي العروبة

Al Hazazah الهزازة

Hayy al Hamidiyah حي الحميدية

Al 'Aziziyah العزيزية

Hayy al Almaji حي الالمجي

Al Jamiliyah الجميلية

Bāb al Faraj باب الفرج

Hayy Bayt Muhibb حي بيت محب

Hayy al Fayd حي الفيض

Bab an Nasr باب النصر

Al Mashariqah المشارقة

Al 'Aqabah العقبة

Al Farafirah الفرافرة

Qal'at Halab قلعة حلب

Al Jalum الجلوم

Hayy Bustan al Qasr حي بستان القصر

Km 0 0.5 1 2 3 4

Distribution of Health Facilities in Bukavu City

DATA

Health Facilities
Clinique ⊕
Doctors (Privé Practice) ⊕
Hôpital ⊕

Districts
Bagira
Ibanda
Kadutu

ESRI Gray (light)

Data Integrity Workshop

- Ethics:
    - -Field data
    - -Community participation
    - -Open data
- Data:
    - - Collection
    - - Verification
    - - Validation
- Metadata protocols
- Licensing
- Quality Assurance/ Quality Control

Secondary Cities Boke-Kamsar, student participants

Participatory Mapping

MAP GIVE

Secondary CITIES
OFFICE OF THE GEOGRAPHER
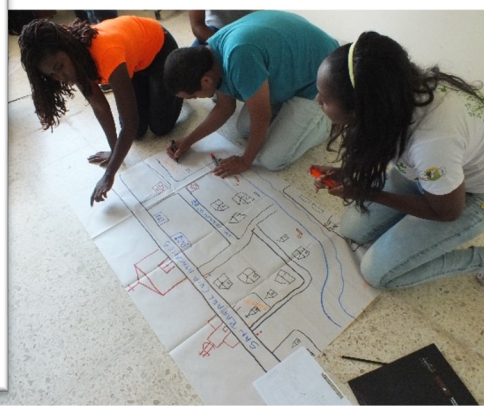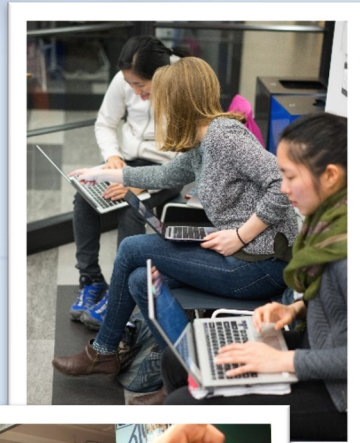
Open Data and Human Geography Mapping

Volunteered Geographic Information

DATA

Tech volunteers + NGO's + Govt = Crisis Commons
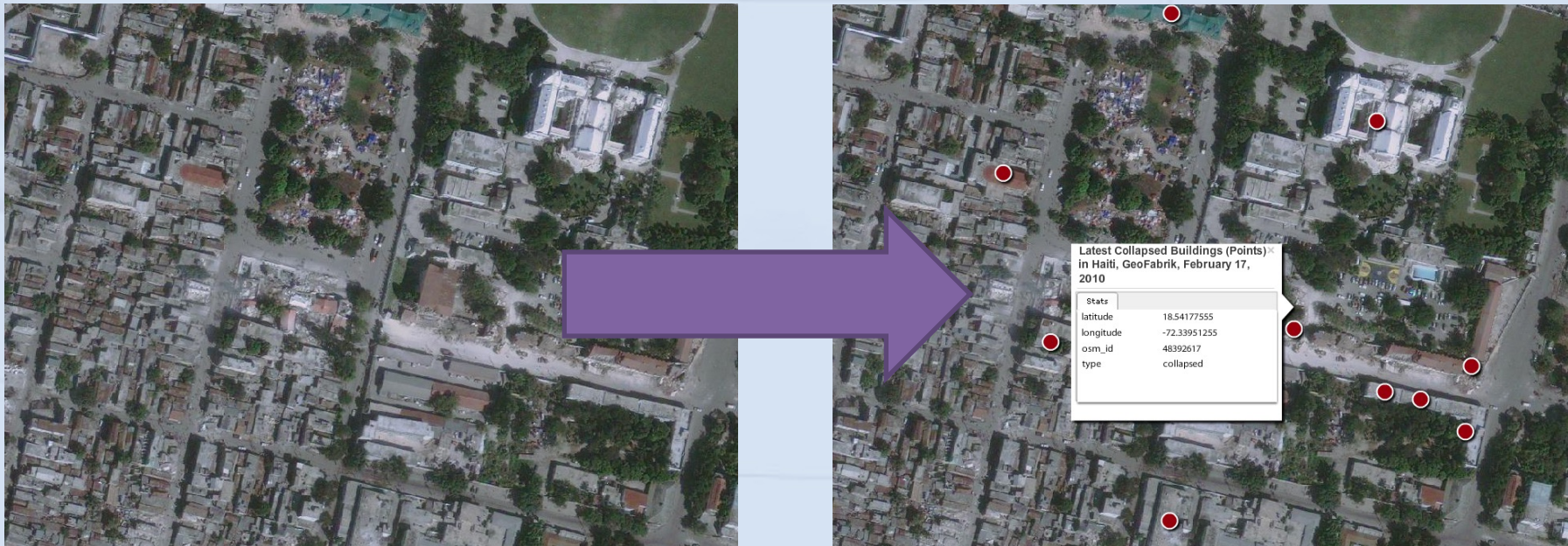
GeoCommons, Ushahidi, Google MapMaker, etc.

Fieldwork: Mozambique and Madagascar

Combatting Wildlife Trafficking

Material usado para recolha de dados

a) GPS
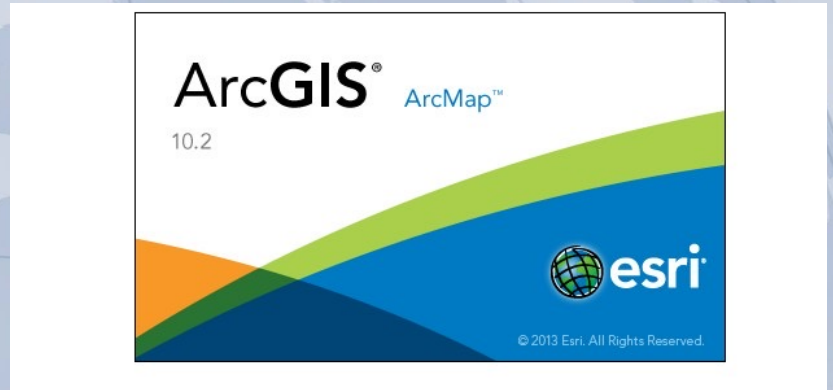
b) Field Papers

Communication						
	Possible Answer		Fiber, Cell Tower, Radio Antenna, Phone Equipment	(any text)	First and last names	e.g. 1990
ID	X	Y	What is the type of communication?	It has comments?	Who is the owner?	When(year) was it built?
1	662476	8566013	rádio antena, escritorios	bloco e betão	rádio sem fronteiras	
2	662369	8566530	phone equipment-movitel, escritorios	block concrete	private	
3	662322	8566421	phone equipment-tmcel, escritorios	block concrete	goverment	
4	662710	8566314	phone equipment-vodacom, loja	block concrete	private	
5	662662	8565809	fiber-tvm, escritorios	block plats	goverment	
6	663158	8565577	rádio antena , escritorios	block plats	radio wimbe private	2012
7	663207	8565703	rádio antena , escritorios	connteiner	radio zumbo private	2016
8	663575	8565857	jornal Noticias S.A , escritorios	block concrete, plats	jornal noticias S.A	2009
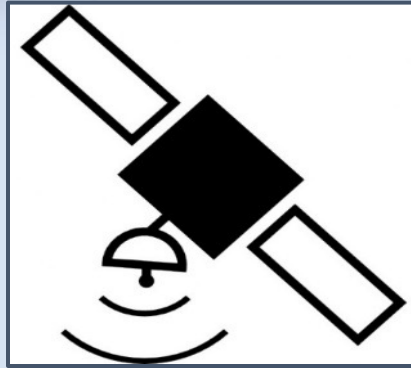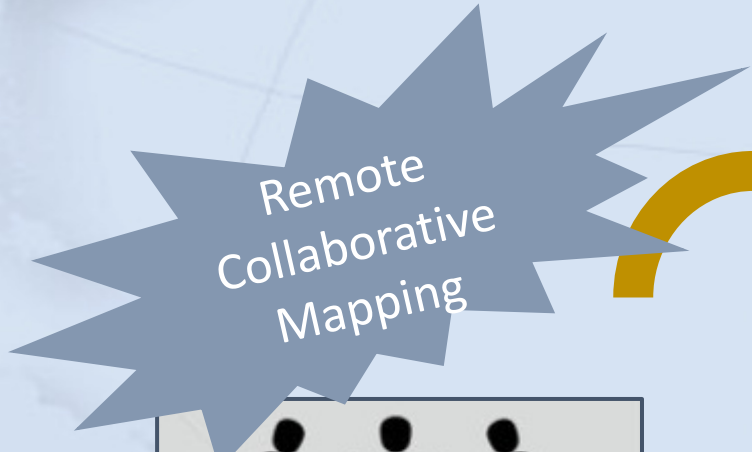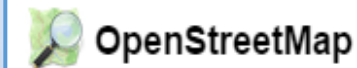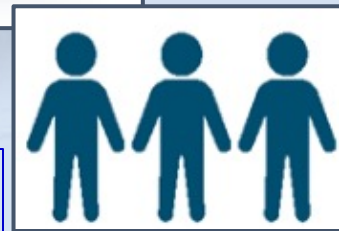
• C)**Tablet**

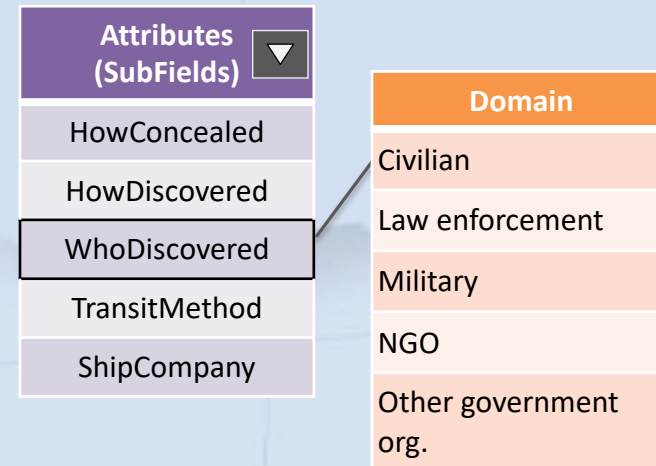# Combatting Wildlife Trafficking
With standardized geospatial data

Geospatial standards for combating wildlife trafficking incorporate multiple attributes and domains relevant to source, **transit,** and destination geographies.

Phase ▼
- Source
- Transit
- Destination
- Unknown

Status (Fields) ▼
- LiveAnimal
- DeadAnimal
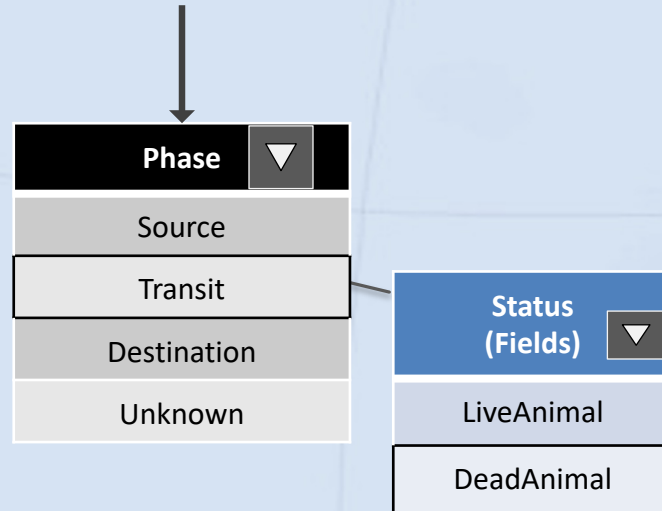
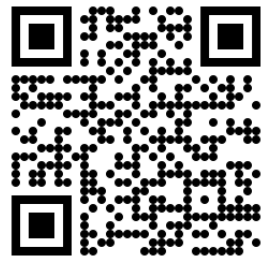**Fields** in the data dictionary are **dynamic**, meaning attribute entries trigger **sub-fields** that only appear to the user if the sub-fields are relevant.

Attributes have restricted **domains**, permitting only predetermined data types (i.e. integer, decimal, text, or date) or even offering a drop down list of acceptable entries.

Fields and domains are themselves dynamic and subject to **additions and revisions** by the user community.

Attributes (SubFields) ▼
- HowConcealed
- HowDiscovered
- WhoDiscovered
- TransitMethod
- ShipCompany

Domain
- Civilian
- Law enforcement
- Military
- NGO
- Other government org.

Scan QR code to view geospatial data standards

Iterative editing and **open** availability allow the data dictionary to be a living document yet still subject to community-derived standards that enable sharing and analysis to help combat wildlife trafficking.

STANDARDS

geospatial standards

FOR COMBATING ILLEGAL WILDLIFE TRADE INCORPORATE MULTIPLE **ATTRIBUTES** AND **DOMAINS** RELEVANT TO SOURCE, TRANSIT, & DESTINATION GEOGRAPHIES.

TRAFFICKING GEOGRAPHY

Source
Transit
Destination
Unknown

FIELDS

Live animal
Dead animal

Iterative editing and **open** availability allow the data dictionary to be a living document yet still subject to community derived standards that enable interoperability and analysis to help combat illegal wildlife trade.
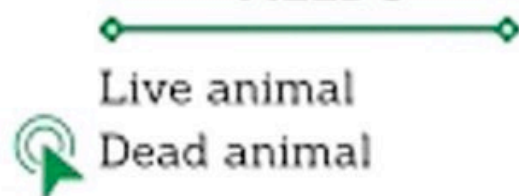
Fields in the data descriptors are *dynamic*, meaning attribute entries trigger sub-fields that only appear to the user if the sub-fields are relevant.

Attributes have restricted *domains* permitting only predetermined data types (e.g., integer, decimal, text, date) or even offering a drop-down list of acceptable entries.

Fields and attributes may change and be subject to additions and revisions by the user community.
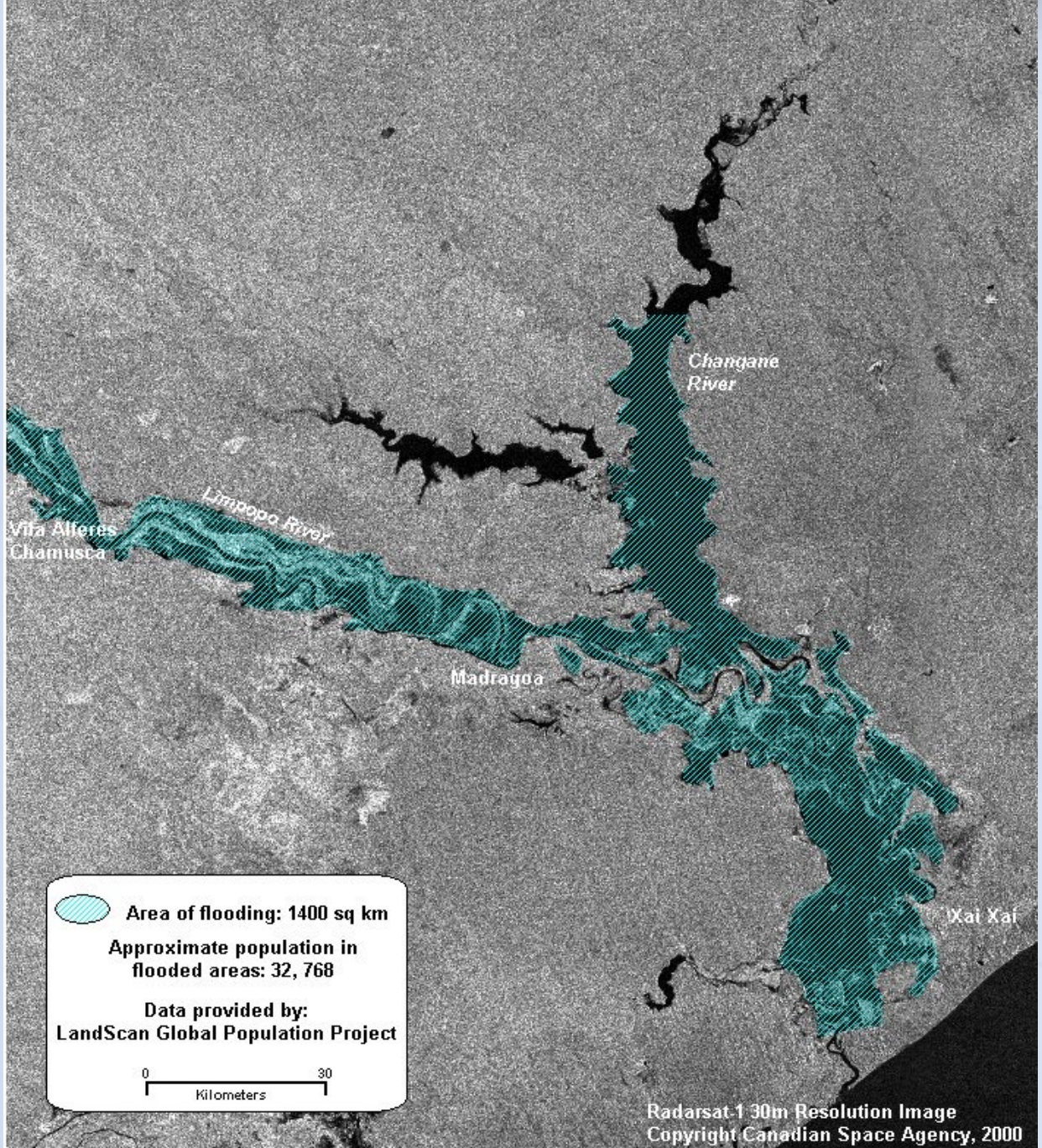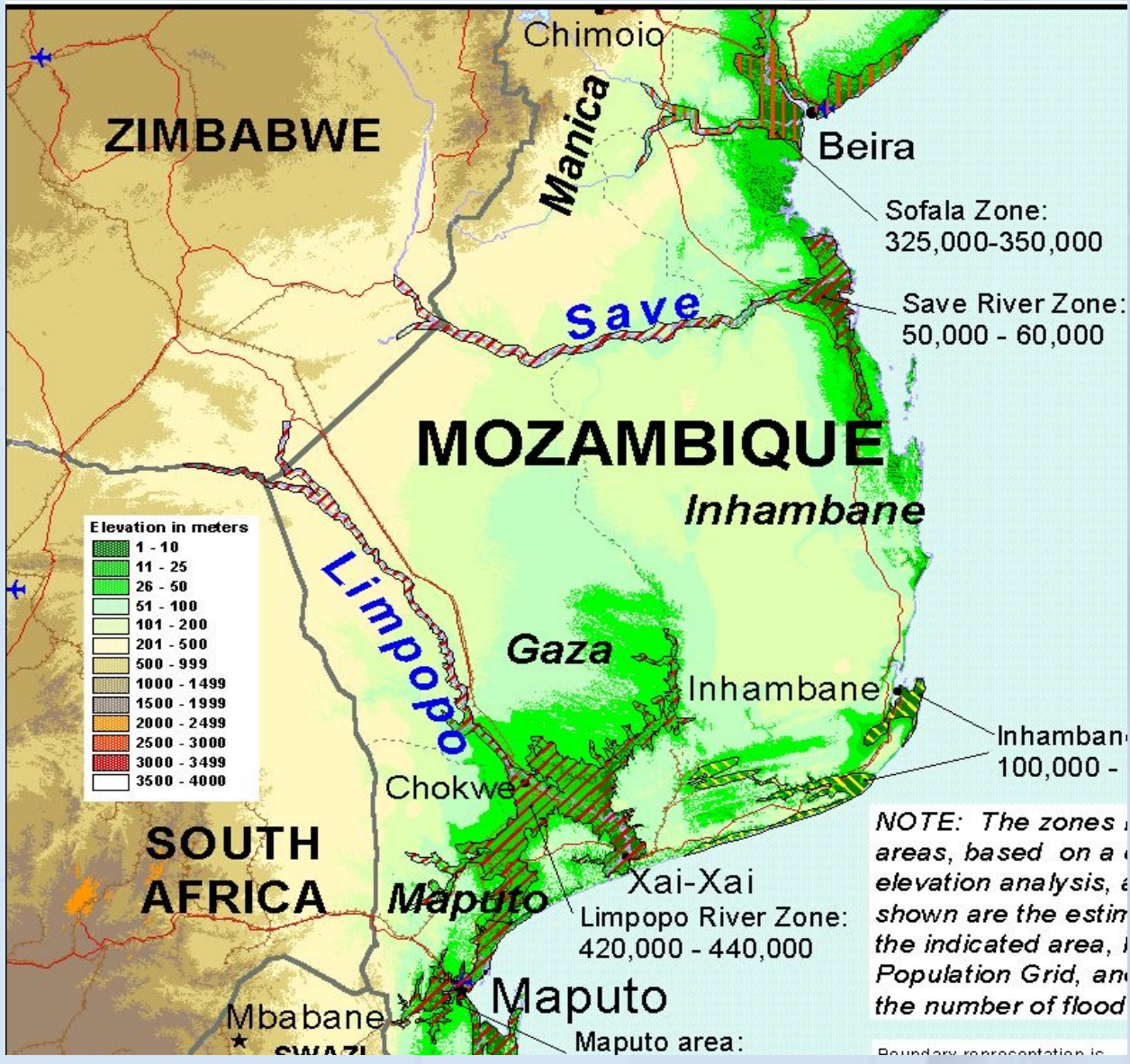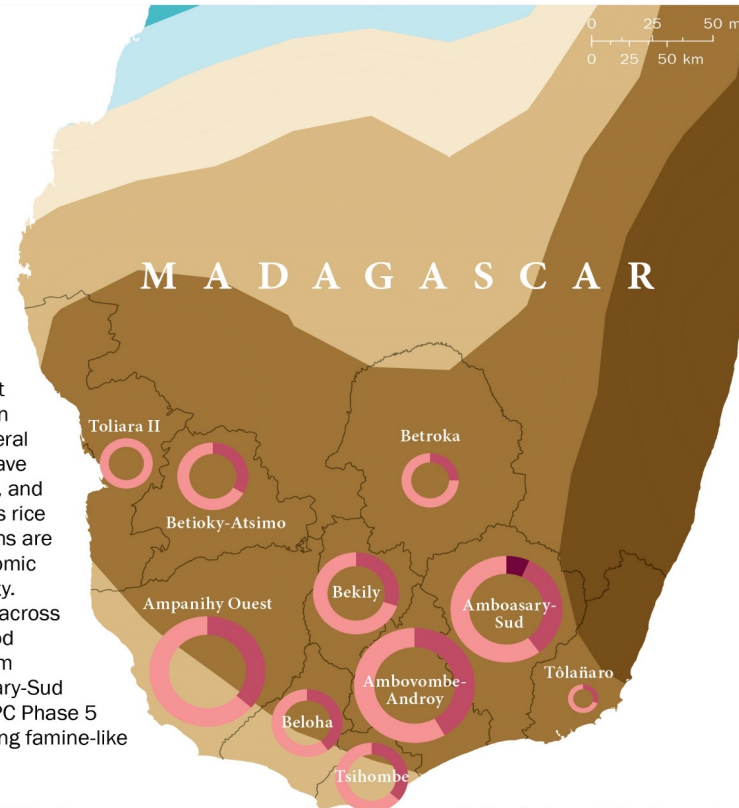
ATTRIBUTES

HowConcealed
HowDiscovered
WhoDiscovered
TransitMethod
ShipCompany

Civilian
Law enforcement
Military
NGO
Government
Other (specify)

Mozambique Floods: Limpopo River Drainage Basin

Changane River

Limpopo River

Vila Alferes Chamusca

Madragoa

Xai Xai

Area of flooding: 1400 sq km

Approximate population in flooded areas: 32, 768

Data provided by: LandScan Global Population Project

0   30
Kilometers

Radarsat-1 30m Resolution Image
Copyright Canadian Space Agency, 2000

28 February 2000

KNOWLEDGE

Chimoio

ZIMBABWE

Manica

Beira

Sofala Zone:
325,000-350,000

Save

Save River Zone:
50,000 - 60,000

MOZAMBIQUE

Inhambane

Elevation in meters
1 - 10
11 - 25
26 - 50
51 - 100
101 - 200
201 - 500
500 - 999
1000 - 1499
1500 - 1999
2000 - 2499
2500 - 3000
3000 - 3499
3500 - 4000

Limpopo

Gaza

Inhambane

Inhamban
100,000 -

Chokwe

SOUTH
AFRICA

Maputo

NOTE: The zones
areas, based on a
elevation analysis,
shown are the estim
the indicated area,
Population Grid, and
the number of flood

Xai-Xai
Limpopo River Zone:
420,000 - 440,000

Mbabane

Maputo area:

SWAZI

HIU
Humanitarian Information Unit

Southern Madagascar: Drought Drives Severe Food Insecurity

MADAGASCAR
INDIAN OCEAN
Area shown

M A D A G A S C A R

According to the UN, climate change is driving food insecurity in southern Madagascar and contributing to famine-like conditions. Southern Madagascar is facing its worst drought in 40 years and experiencing drier than normal rainy seasons for the past several years. Consecutive years of drought have led to low harvests, loss of livelihoods, and limited access to staple foods, such as rice and cassava. Food insecurity conditions are further aggravated by COVID-19 economic impacts, rising food prices, and poverty. It is estimated that 1.3 million people across southern Madagascar need urgent food assistance (IPC Phase 3 or higher) from October–December 2021. In Amboasary-Sud district, nearly 28,000 people are in IPC Phase 5 (Catastrophe), double the number facing famine-like conditions estimated in April 2021.

Toliara II
Betroka
Betioky-Atsimo
Ampanihy Ouest
Bekily
Amboasary-Sud
Tôlañaro
Ambovombe-Androy
Beloha
Tsihombe

0   25   50 mi
0   25   50 km

Precipitation difference from the 1981–2010 rainy season average,
in inches, Nov. 2020–Apr. 2021

-25 -15 -9 -3 0 3 9

Rainy season: November–April for southern Madagascar

Southern Madagascar total precipitation deficit/surplus by rainy season
in inches, Nov. 2011–Apr. 2021

2011/2012 rainy season

Mean: 23.8 in.
1981–2010 average total precipitation received during rainy season (Nov.–Apr.)

Season	Value
'12/'13	-3.1
'13/'14	-3.0
'14/'15	-0.4
'15/'16	-1.2
'16/'17	-3.6
'17/'18	3.1
'18/'19	-5.5
'19/'20	4.1 in. surplus
'20/'21	-13.0
	-13.5 in. deficit
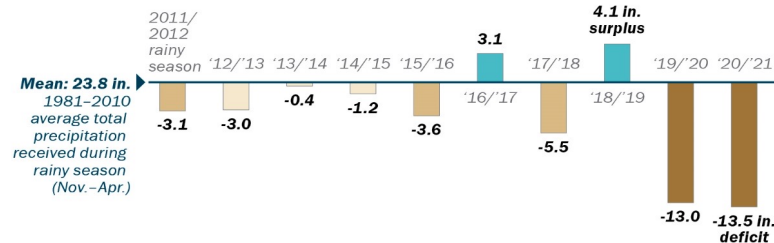
Estimated population in need of urgent food assistance (IPC Phases 3, 4, or 5)
by district*, Oct.–Dec.2021

250,000
150,000
50,000
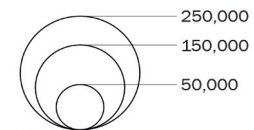
■ **Phase 3: Crisis**
■ **Phase 4: Emergency**
■ **Phase 5: Catastrophe**

*IPC analysis Oct-Dec 2021 is limited to ten districts. The number of people in need of urgent food assistance in Tôlañaro district is based on only five communes in the southern part of the district.

KNOWLEDGE

KNOWLEDGE

Accountability and Justice requires systematic data compilation

Malawi: Total PEPFAR Expenditures, People Living With HIV (PLHIV), and Above/Below Median Expenditures and Prevalence by District

PEPFAR — U.S. President's Emergency Plan for AIDS Relief

HIU — HUMANITARIAN INFORMATION UNIT

U.S. Department of State
hiu_info@state.gov
http://hiu.state.gov

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Figure 1: Total PEPFAR Expenditures (USD)
- $167,929 - $599,999
- $600,000 - $999,999
- $1,000,000 - $1,999,999
- $2,000,000 - $2,999,999
- $3,000,000 - $9,181,140

Figure 2: Percent of Total PLHIV in District
- 1.4% or less
- 1.5% to 2.4%
- 2.5% to 4.4%
- 4.5% to 6.9%
- 7.0% to 12.9%

Figure 3: Above/below Expenditures and PLHIV by district
- Above median expenditures; above median PLHIV
- Below median expenditures; below median PLHIV
- Below median expenditures; above median PLHIV
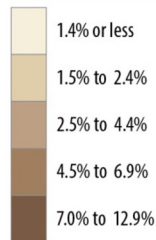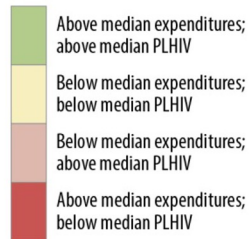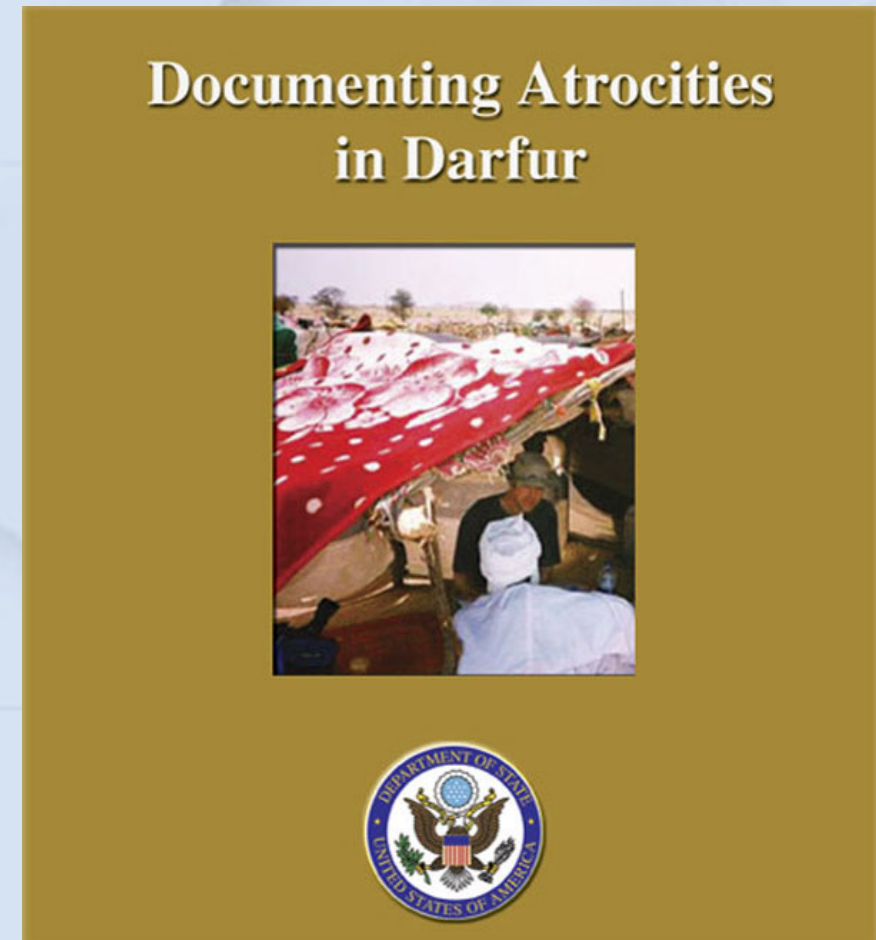- Above median expenditures; below median PLHIV

Names and boundary representation are not necessarily authoritative

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Sources: PEPFAR Malawi; DHS Malawi 2010

August 21, 2014 - U1072 STATE (HIU)

Declaration of Genocide in Darfur

Thank You!