



# Copernicus in support of conflict prevention in the Sahel

Environmental-related transhumance patterns and the risk for farmer-herder conflicts



Funded by



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DLR Space Administration

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Damien Jusselme, Eduardo Zambrano (IOM)

2021 Session of the Committee on the  
Peaceful Uses of Outer Space

# Armed conflicts and population displacement

The New Humanitarian (Formerly IRIN News)

Aid and Policy | Conflict | Environment and Disasters | Migration | About us

News Human Rights 22 December 2009

## Farmer-pastoralists' clash leaves 32 dead

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August 6, 2018 1:02PM EDT

## Farmer-Herder Conflicts on the Rise in Africa

Published in Inter Press Service (IPS) News Agency

**Juliana Nnoko-Mewanu**  
Researcher, Women's Rights Division  
@NnokoMewanu



INSIGHTS

## Herders vs Farmers: Resolving deadly conflict in the Sahel and West Africa

Apr 16, 2018

Ousman Tall, Sahel and West Africa Club (SWAC/OECD)



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Sahel region of West Africa desert and above the Si

## Why clashes are on the rise between farmers and herders in the Sahel

May 2, 2016 1:56pm EST



Pastoralists on a dry plain in central Mali, one of the seven Sahel countries hit by a wave of deadly attacks. (SPRING) Reuters

TheNEWS News Politics Sports Business Opinion Arts Life Education Video International

## Fulani national leader: Why our herders carry AK47s...

Monday, May 2, 2016 1:58 pm



Baba Othman Ngetzama, the National Secretary, Miyetti Allah Cattle Breeders Association

Baba Othman Ngetzama, the National Secretary, Miyetti Allah Cattle Breeders Association of Nigeria, otherwise known as Fulani herdersmen explains why Fulani herdersmen carry gun, origin of the their clash with farmers and other security issues. Here is the full interview aired on Channels Television:

I want to believe that you have seen part of the Grazing Bills and the question is, do you think that would solve the problem?

Finally, before I say anything, let me use this opportunity to condemn in totality what has taken place in Enugu, it is extremely shocking and I want to sympathize with the government and people of Enugu State irrespective of who has done it. People have lost their lives. It is

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Nigeria Violent
- January 21, 2018  
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# IOM's Transhumance Tracking Tool (TTT)

## TRANSHUMANCE TRACKING TOOL (TTT)

### CHAD – DEPARTEMENT OF GRANDE SIDO

**DASHBOARD #1**

*Data collection: September 2019*

*Date of publication: October 2019*

### 3,406

Total number of animals

### 1,747

Bovines

### 872

Caprines

### 787

Ovines

### 393

Herders

### 5

Nationalities

### 21%

Girls

### 27%

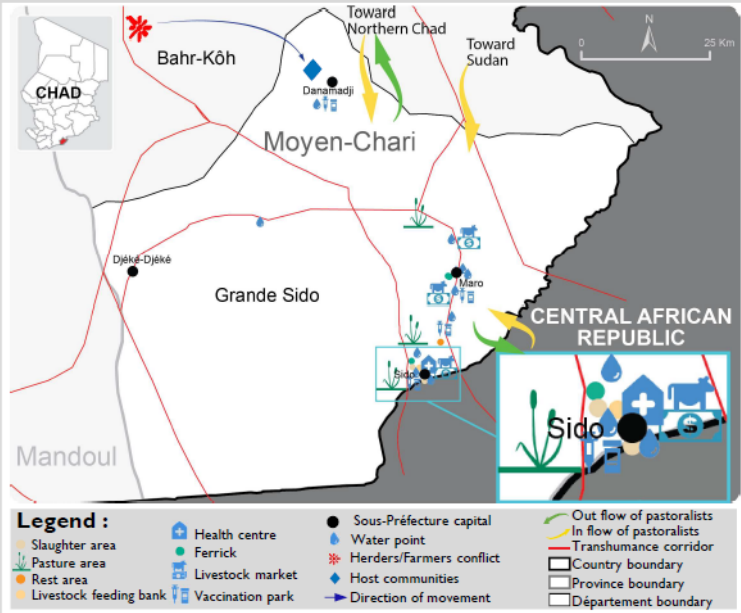
Boys

### 21%

Women

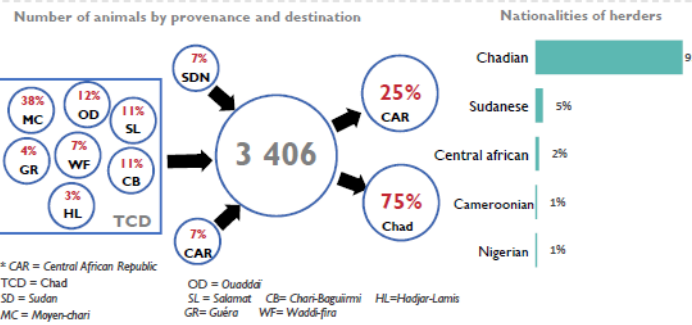
### 31%

Men



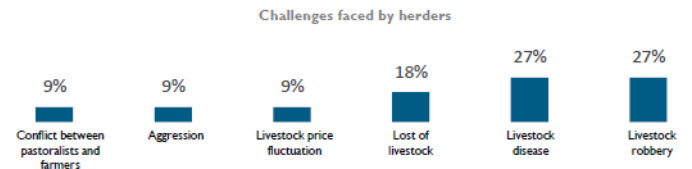
### Context and methodology

According to a 2016 assessment by the International Crisis Group on transhumance in Central Africa, transhumance movements between the Central African Republic and Chad are among the largest in the world. Herders are moving cyclically along traditional transhumance corridors, both within the country's boundaries and across borders, in search of pastures for their livestock. These movements are often accompanied by conflicts that most of the time generate displacements of populations. As part of the prevention and management of these conflicts, IOM is implementing a project in the département of Grande Sido (Moyen-chari province), whose components include the tracking of transhumance movements and the collecting of alerts related to agro-pastoral conflicts. Data is collected from herders over the course of their journey in search of pastures for their livestock (both internal and cross-border movements are counted). This dashboard presents results of data collections carried out in the département of Grande Sido during the month of September 2019.



*This map is for illustrative purposes only. Representations and the use of boundaries and geographical names on this map may include errors and do not imply judgment of the legal status of a territory, nor official recognition or acceptance of these boundaries by IOM. Geographic coordinates of villages and sites were collected during field assessments. However, some locations, especially those of the sous-préfecture of Kaïgo-kindjira, were evaluated remotely due to security reasons in particular.*

Provenance of herders	Destination country of herders	%
Central African Republic	Chad	4%
Sudan	Central African Republic	9%
Chad	Central African Republic	16%
Chad	Chad	71%



- EO data are exploited for an assessment of the spatio-temporal dynamics of environmental parameters that influence transhumance patterns
- Holistic consideration of various static and dynamic parameters
- Intelligent and repeatable model for transhumance suitability
- Results being used in conflict prevention to help identify potential conflict zones and periods and to better prioritize interventions



Sentinel-2



Sentinel-1



Landsat-8











MODIS



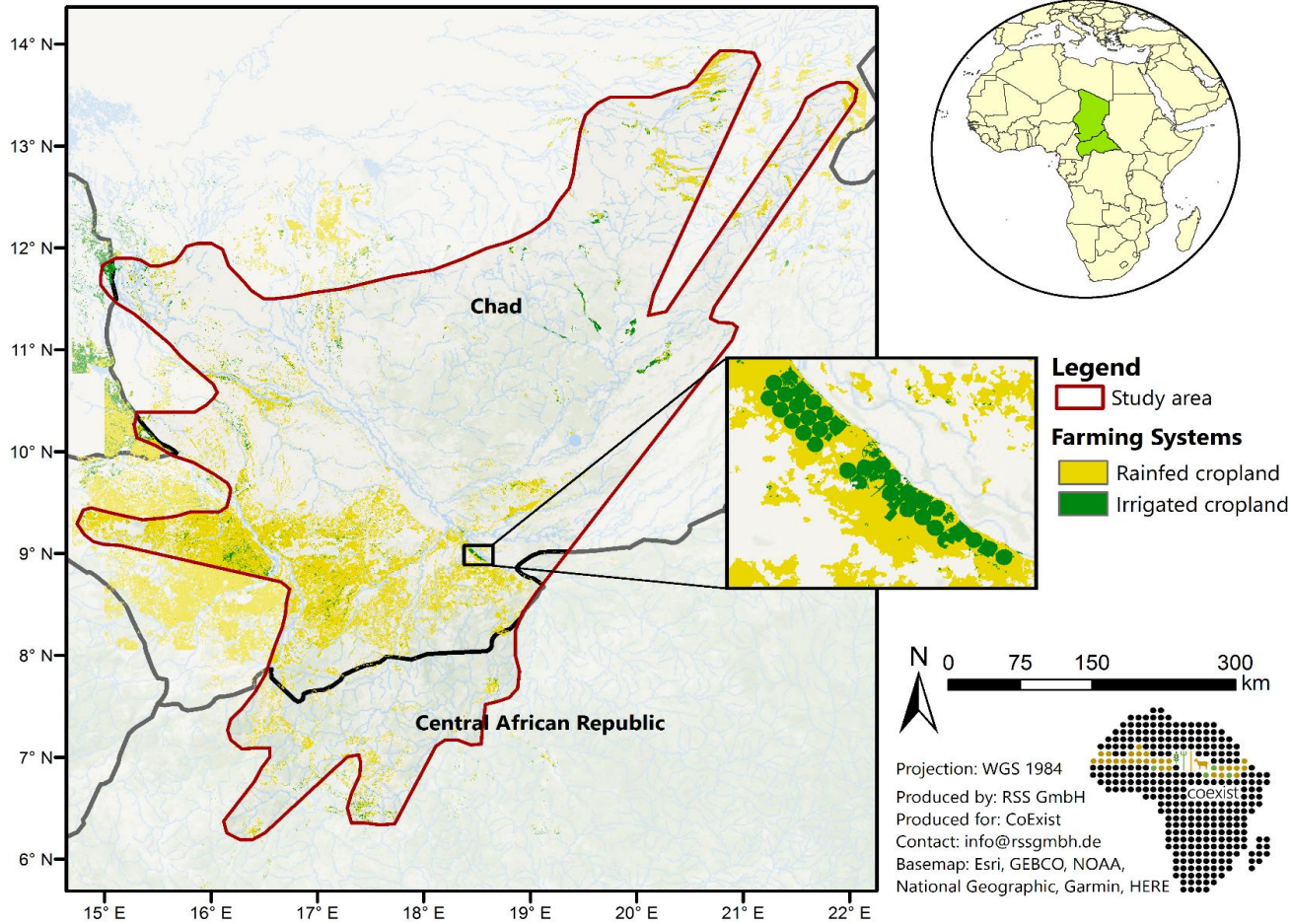
Satellites used by CoExist

# Environmental variables from EO data

	Product	Source Data	Spatial Resolution	Temporal Resolution	Product period
	Drought probability	MODIS, CHIRPS, FAO	~ 1km	8/16 days MODIS comp., monthly CHIRPS	Monthly (May – Oct.)
	Farming Systems	Sentinel-2	10m	~ 5 days (2016 – 2019)	2019
	Landcover	Copernicus	~ 100m	Static	2018
	Population Density	Facebook	~ 30m	Static	2018
	Surface Water Dynamics	Sentinel-1, Sentinel-2	10m	12 days, ~5 days	2019
	Rangeland Productivity	Sentinel-2	10m	~5 days	Monthly (Jan. – Dec.)
	Rainfall Data	CHIRPS	~ 5km	Monthly	Monthly (Jan. – Dec.)
	Burned areas	Sentinel-2	10m	~5 days	Monthly (Dec. – Mar.)



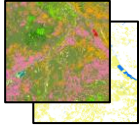
# Example: Farming Systems



Tobias Landmann, David Eidmann, Natalie Cornish, Jonas Franke & Stefan Siebert (2019) Optimizing harmonics from Landsat time series data: the case of mapping rainfed and irrigated agriculture in Zimbabwe, Remote Sensing Letters, 10:11, 1038-1046, doi:10.1080/2150704X.2019.1648901

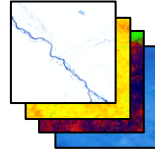
# Concept for suitability maps

## Mask



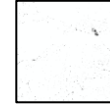
- Landcover (urban)
- Water
- Farming Systems (irrigated)
- Restricted areas
- Burned areas

## Environmental variables



- Surface Water Dynamics
- Drought Probability
- Rangeland Productivity
- Rainfall
- Distance to urban
- Distance to water
- Other landcover
- Farming systems (rainfed)

## Socioeconomic factors



- Population density
- Socioeconomic places (markets, vets, etc.)
- TTT (origin, destination)
- Conflict data

masking

weighting

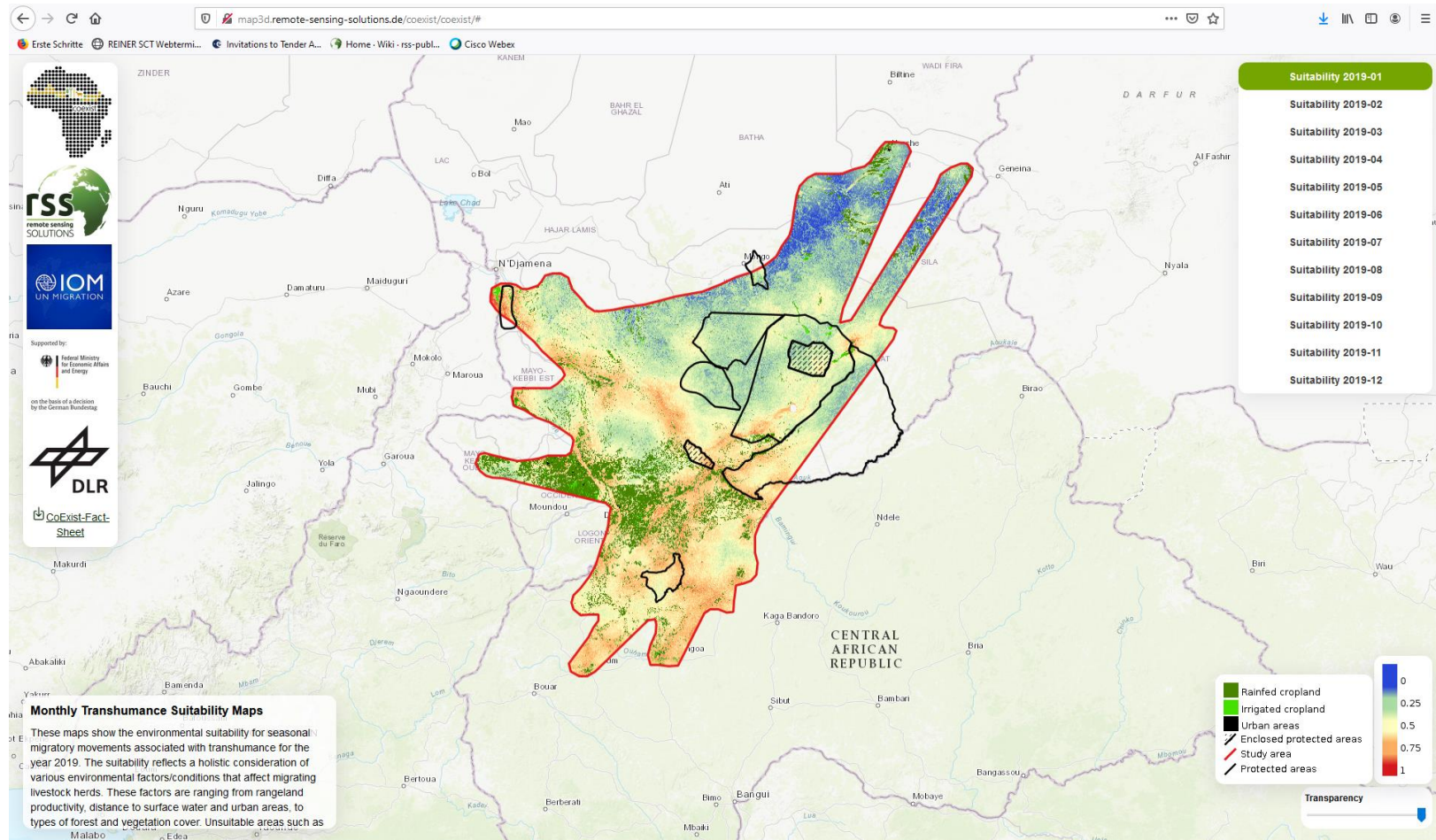
overlay

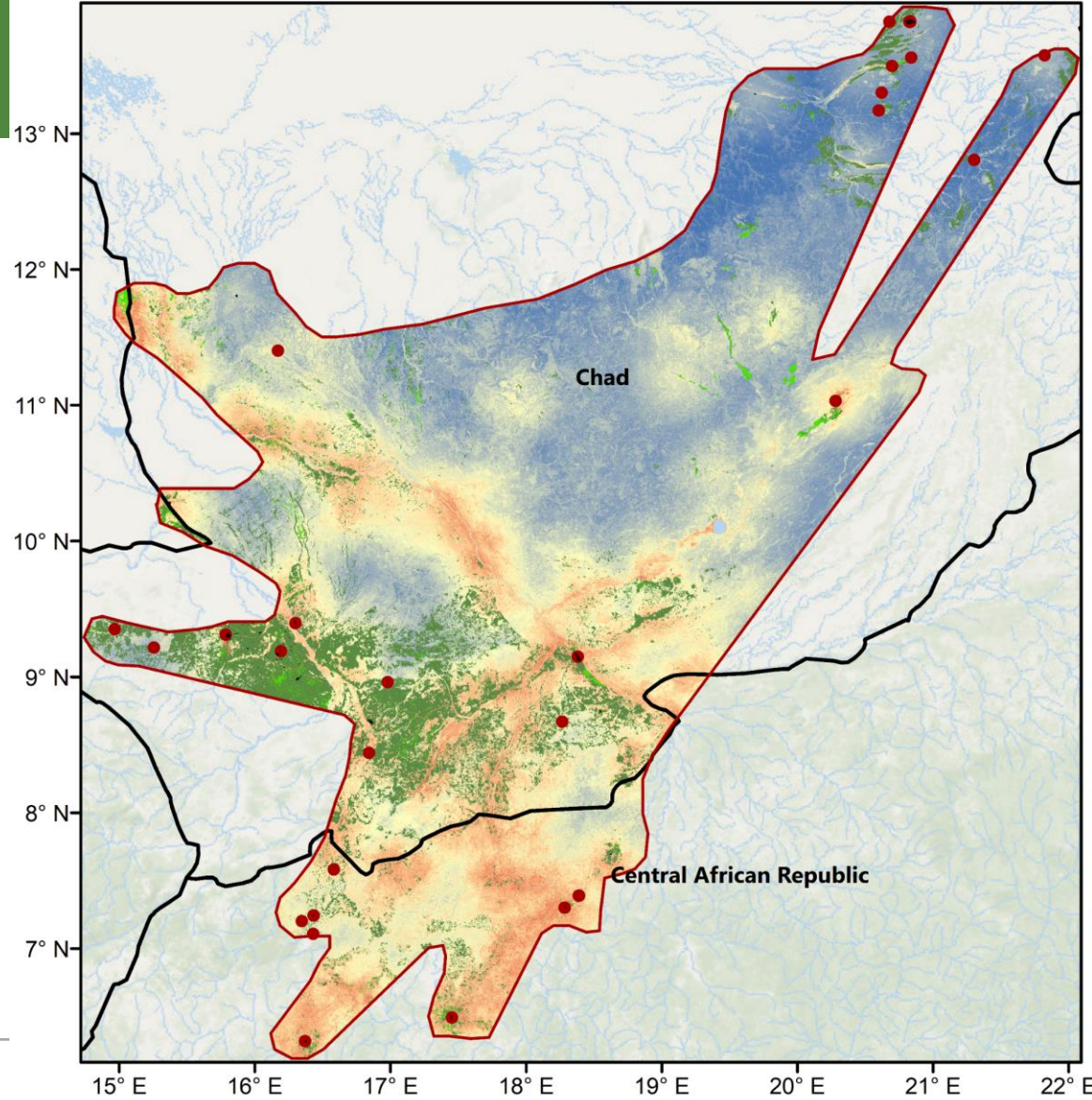
Environmental-related  
suitability maps

Final transhumance  
suitability maps
















**Legend**

-  Study area
-  Urban areas
-  Rainfed cropland
-  Irrigated cropland
-  Conflicts

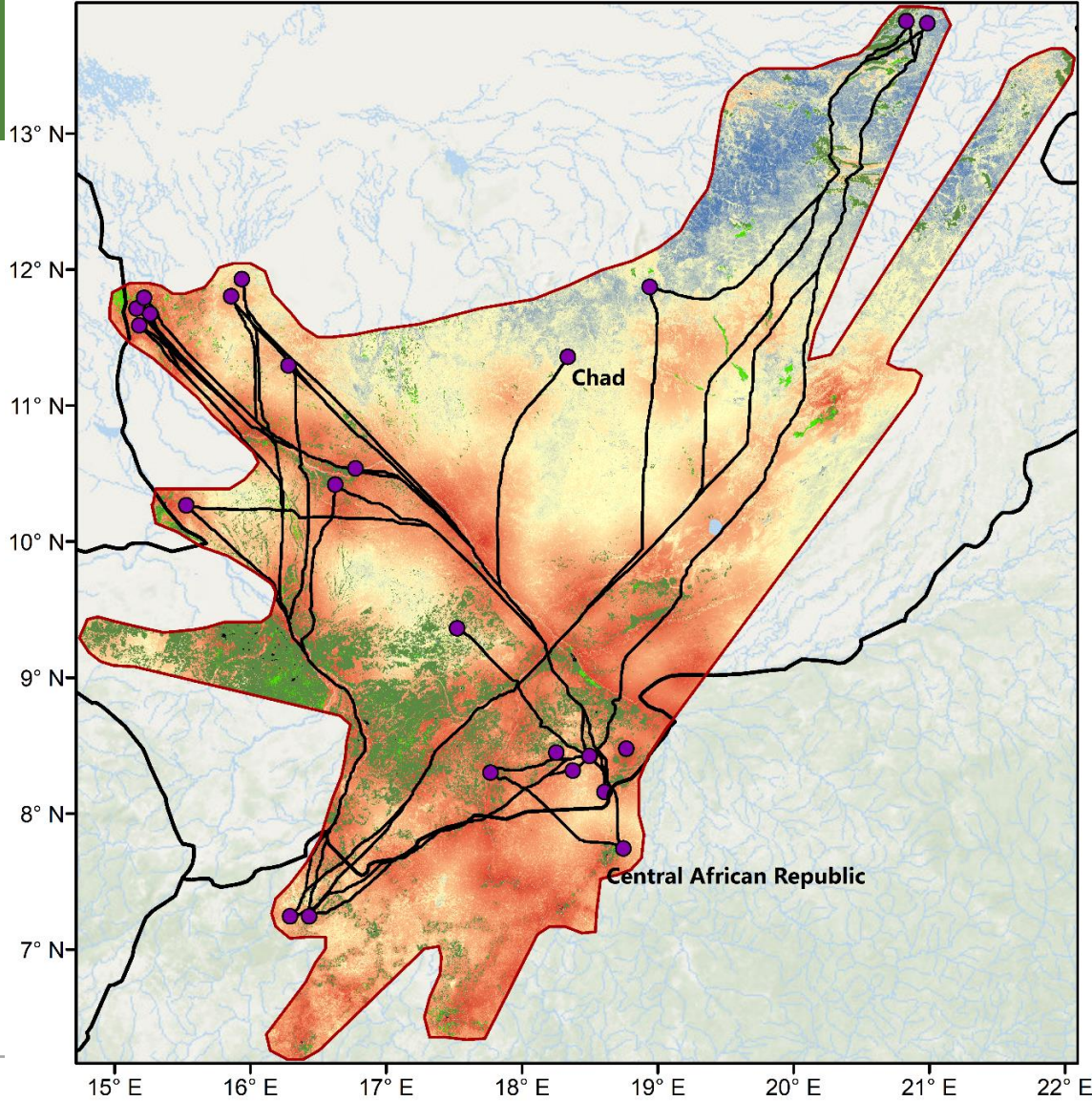
**Suitability (2019/02)**

- Value**
-  High : 1
  -  Low : 0



Projection: WGS 1984  
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 Produced for: CoExist  
 Contact: info@rssgmbh.de  
 Basemap: Esri, GEBCO, NOAA,  
 National Geographic, Garmin, HERE

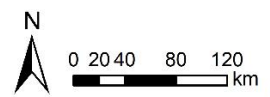
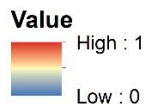




**Legend**

- Study area
- TTT Points
- Potential movement corridors
- Urban areas
- Rainfed cropland
- Irrigated cropland

**Suitability (2019/10)**

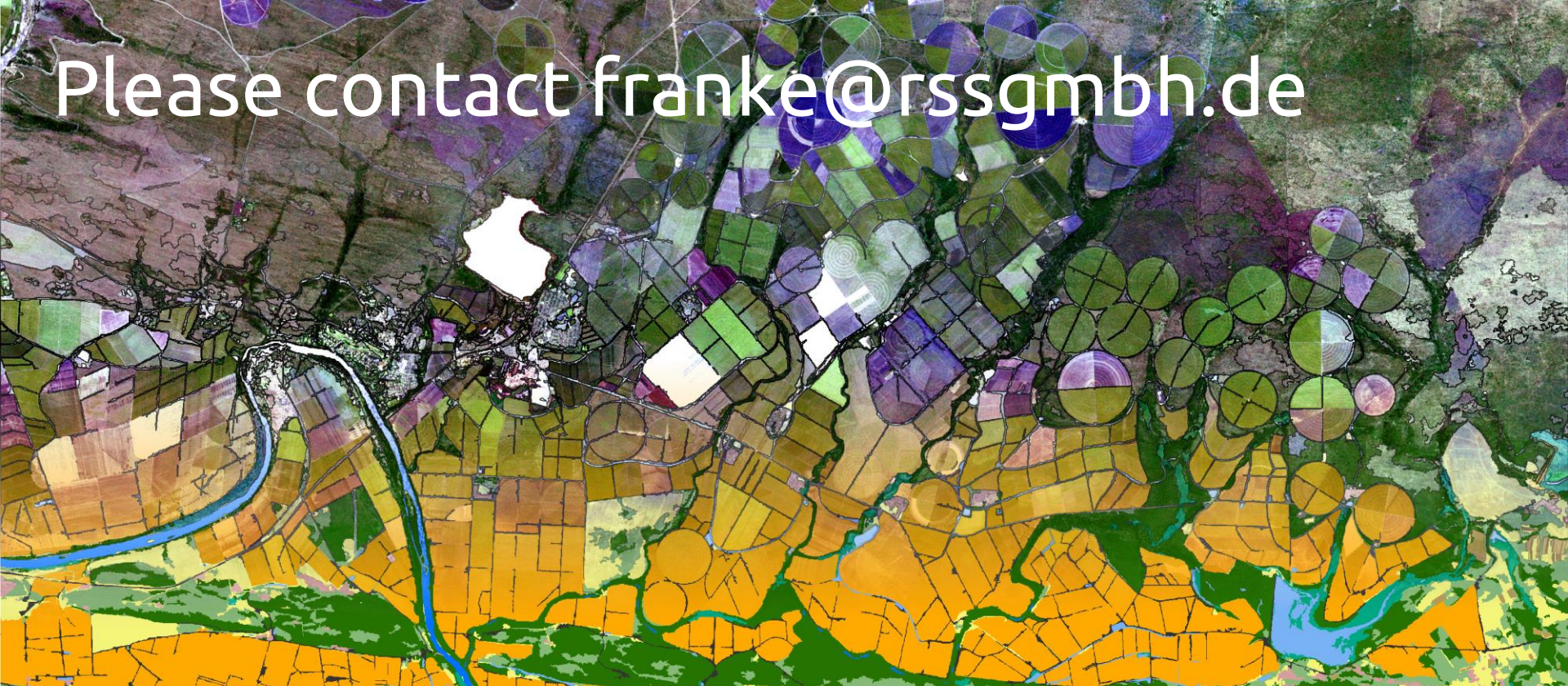


Projection: WGS 1984

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Please contact [franke@rssgmbh.de](mailto:franke@rssgmbh.de)



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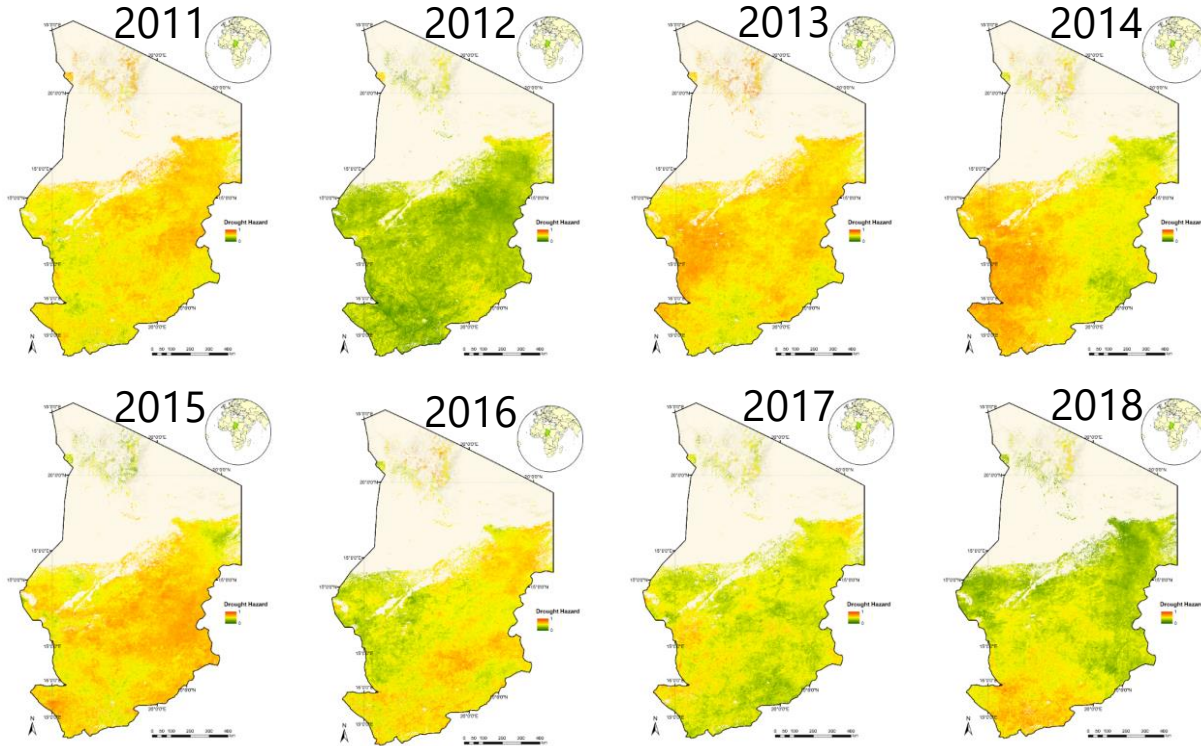
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[www.remote-sensing-solutions.com](http://www.remote-sensing-solutions.com)

# Example: Monthly and yearly drought hazard

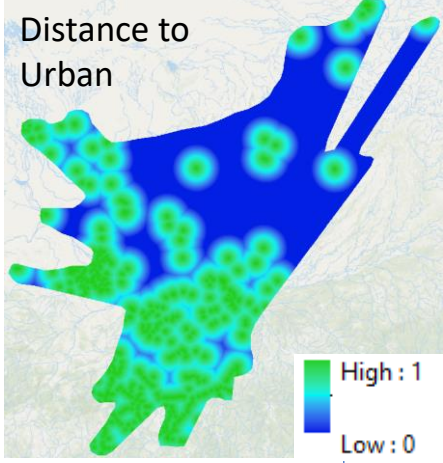
Drought  
hazard



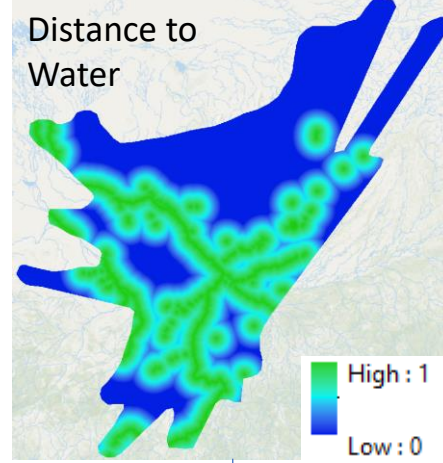
Maximilian Schwarz, Tobias Landmann, Natalie Cornish, Karl-Friedrich Wetzel, Stefan Siebert, Jonas Franke (2020) A Spatially Transferable Drought Hazard and Drought Risk modeling Approach Based on Remote Sensing Data. Remote Sensing 12:237, doi:10.3390/rs12020237

# Suitability

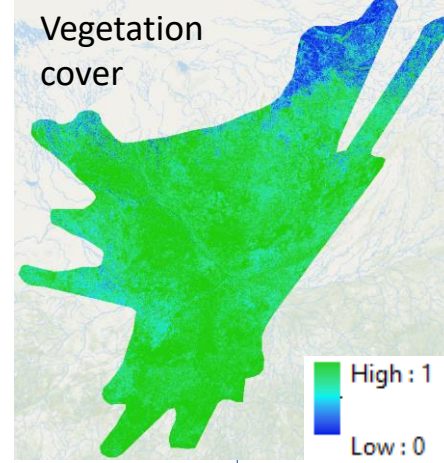
Distance to Urban



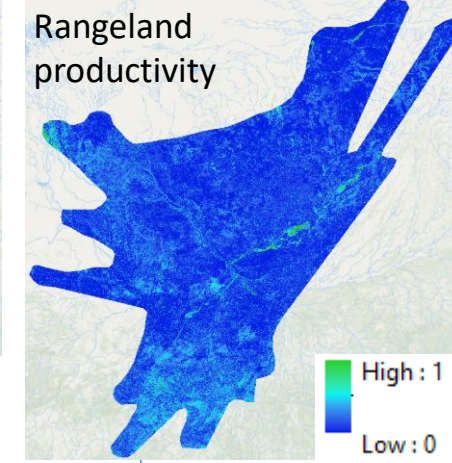
Distance to Water



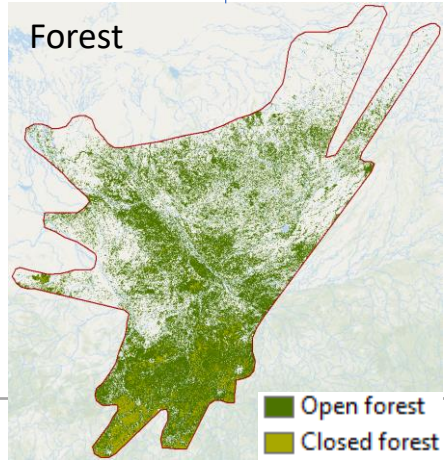
Vegetation cover



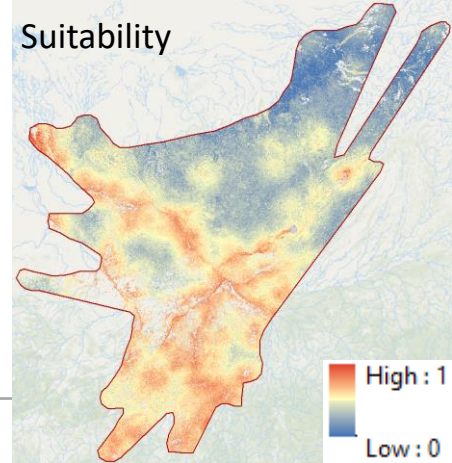
Rangeland productivity



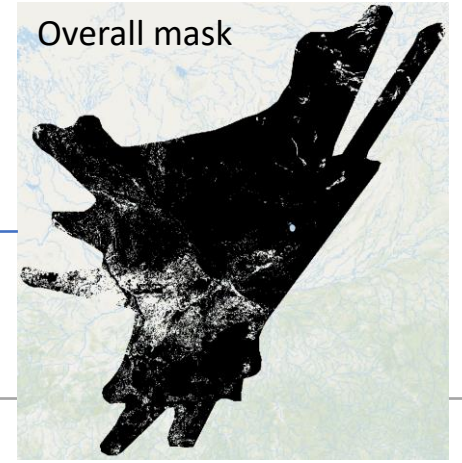
Forest



Suitability



Overall mask



Mask

