"General Elections in Angola 2022,
A STEP TOWARDS DEMOCRACY?"
Annual Meeting of the German Round Table on Angola
Berlin, June 8th and 9th, 2022

Climate Change Adaptation in Southern Angola

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Sr. Hydrogeologist & Water Resources Management Specialist

- Aleix Serrat Capdevila,

Project Leader

WORLD BANK GROUP
Water

www.worldbank.org/water | www.blogs.worldbank.org/water |



Outline

1. Introduction, problem statement and some facts about the drought in Angola

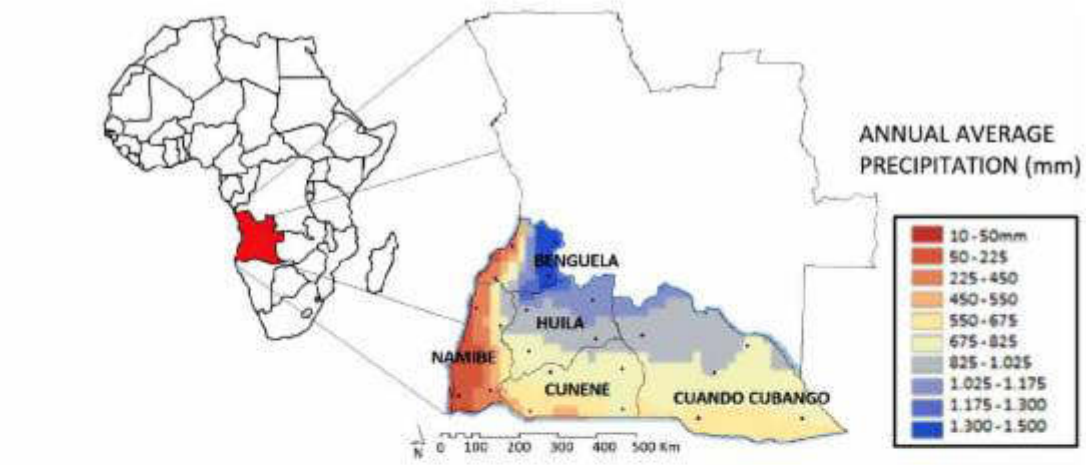
2. Preliminary studies, approaches and findings: recommendations of rural water investments

3. New World Bank Project: Resiliencia Climática e Agua em Angola, RECLIMA

4. Challenges for Adaptation and Resilience in Angola



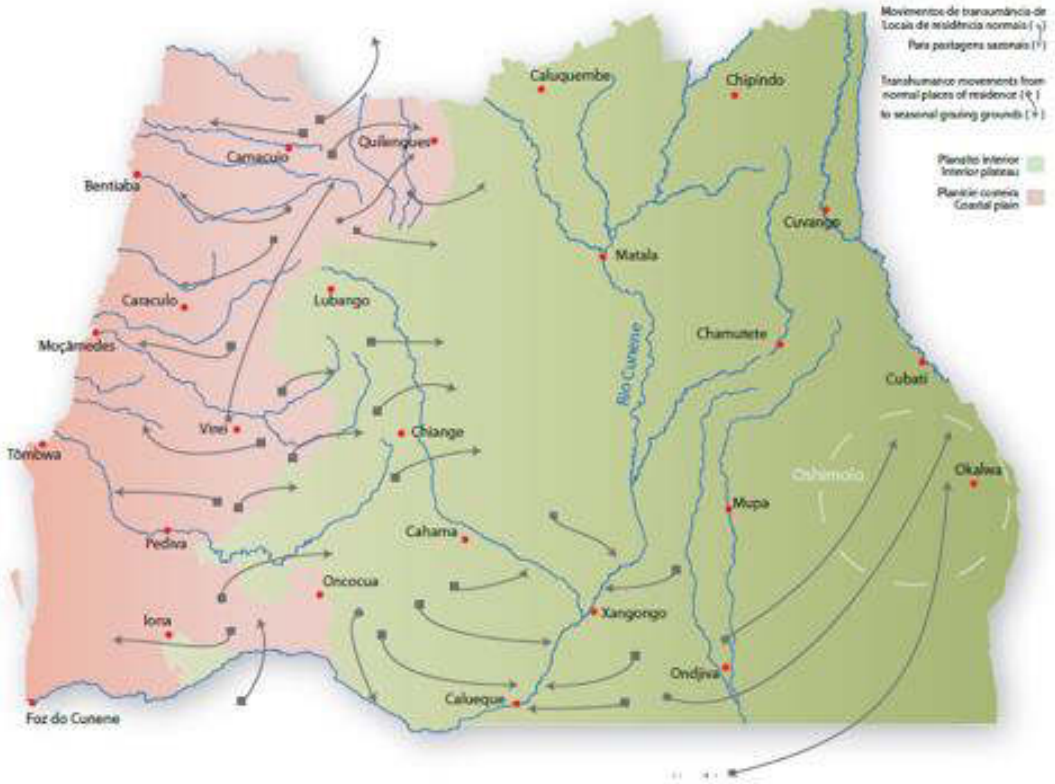
Targeted area



- The study area has a combined **population of nearly 6.5 million**, most of which is concentrated in Huila and Benguela. **Rural population is about the 65%**
- It rains less than 800 mm per year as an average in most of the south, parts of the southern coast < 200 mm
- **There are substantial changes in rainfall within each season and among them**
- **Year by year variance is moderate in the entire region,** variation coefficients frequently beyond 50%, which contributes to the **unpredictability of the rain totals and the difficulty to use averages as reliable references**

This area shows less socio-economic development than the remaining part of Angola, it is sparsely populated and many rural communities are marginal

Drought in southern Angola from ~2012



Transhumance routes in the South of Angola (Mateo Tonini. Projecto PIRAN - Projecto Resiliência Angola Namíbia).

SEVERAL IMPACTS (PDNA)

- 76% of the population affected.
- Economic impact of US$749 million.
- Agriculture, livestock (main activity) and fisheries sector = 75% of the economic impact.
- Increase in livestock mortality.
- Longer and more intense transhumance.
- Failure of crops.
- Increase in the admission cases of malnutrition, family abandonment, domestic violence, charcoal production and deforestation.

Drought, what is it and why should we care?



The term is widely used but there is confusion about some drought-related concepts

… such confusion often leads to misguided approaches and actions

Drought is an exceptional deficiency of precipitation (or flow) that often results in a water shortage for the environment or society

Aridity refers to permanent and usual conditions of water scarcity.
It is a characterizing feature of certain climates

Water shortage is the existence of less available water supply than the society demands, caused by droughts or by poor water management

SOURCE: http://www.droughtmanagement.info/find/glossary/

Drought, what is it and why should we care?

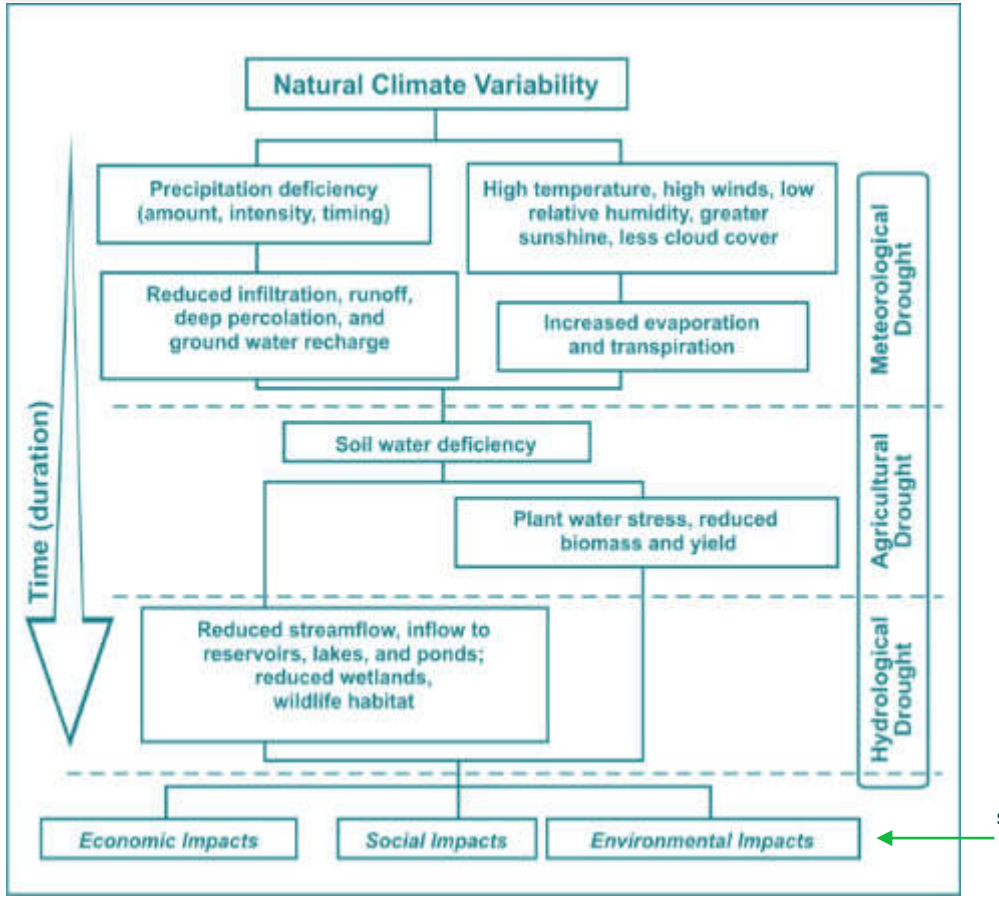
Typical ways of characterizing droughts:

- **Meteorological drought**
- **Agricultural drought**
- **Hydrological drought**

Each one is a deficit compared to the normal amount of water expected in rainfall, soil and vegetation, or water bodies such as groundwater, streams, and lakes

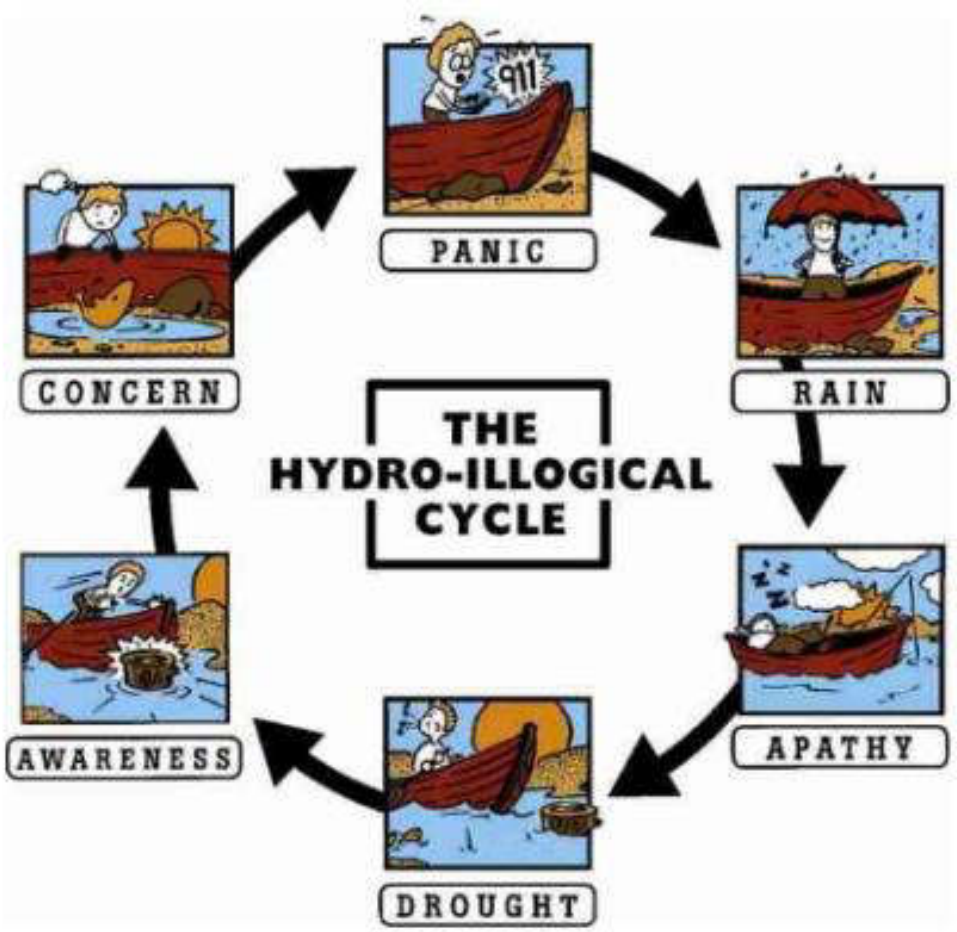
Other natural hazards might seem more dangerous, but **droughts actually kill more people over time** (e.g., famines), and generate **more losses**

Although these can overlap, their onsets and ends differ; the complete sequence occurs only if the rainfall deficit lasts for an extended period



How do we approach drought preparedness and mitigation? Can we do better?

Typical Drought Management = Crisis Management



IDMP & US Drought Mitigation Center

"If you do what you've always done, you'll get what you've always got"

"We MUST adopt a paradigm for drought management!"

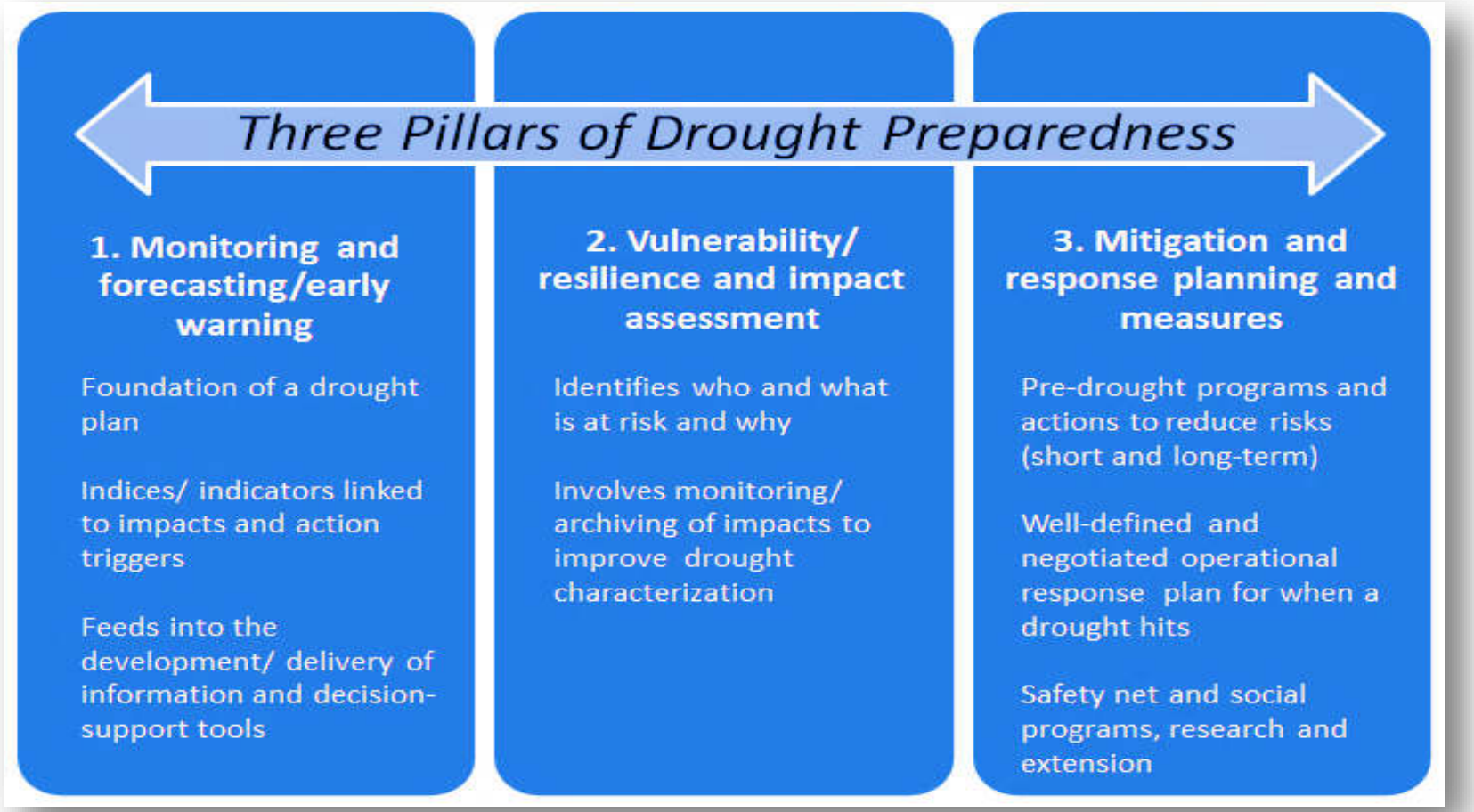
- **Ineffective, treats symptoms of drought**
- **Untimely, response actions**
- **Increases reliance on government/donors**
- **Poorly coordinated, national to local level actions**
- **Expensive, large expenditures**
- **Increases vulnerability?**

How do we approach drought preparedness and mitigation? Can we do better?

Proactive risk management is socio-economically **optimal compared with reactive crisis management**, but the shift to risk management is happening very slowly. Most approaches deployed are reactive (relief)

*"Without a coordinated national drought policy […] nations will continue to respond to drought in a reactive, crisis management mode" (*Expert Meeting on the Preparation of a Compendium on National Drought Policy, WMO, 2011)

The 3 pillars (championed by the Integrated Drought Management Programme) represent a common way of structuring the work toward an integrated approach



Why governments and donors should work on drought resilience?

Tackling drought is about livelihoods, resilience to climate variability and change, and sustainable management of natural resources – it entails **working towards several Sustainable Development Goals** in client countries:

- ✓Goal 1: No Poverty
- ✓Goal 2: Zero Hunger
- ✓Goal 6: Clean Water and Sanitation
- ✓Goal 13: Climate Action → **There are few better ways to build climate resilient communities than through proactive drought management**



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From a reactive approach to building drought resilience

"The effects of drought depend on the presence, or absence, of adequate institutional policies and efforts, adequate infrastructure and on the degree of its functionality"



From 2019, in coordination with DNA, INRH, GABHIC (MINEA), Governos Provinciais and development partners: UNICEF, PNUD, DW, ISPT, UAN

Study objectives

1. Characterize Drought Risk in the South of Angola:
   - Hazard characterization
   - Vulnerability and exposure characterization

   find priority areas under high risk (target)



2. Understand observed impacts, field groundtruthing and **confirm priority areas and challenges** (governance, functionality issues, etc.)

3. Evaluate **investment options**. Three detailed case studies:
   - Bacia do Cuvelai: surface water harvesting
   - Provincia Namibe: sand dams NBS.
   - Lubango: urban water shortage issues

4. Provide recommendations



Initial explorations

Where are the needs?→ find priority areas under high risk

Prioritization of vulnerable sites: based on population, distance from water sources, and groundwater drought risk

Assessment of water availability that can be mobilized considering observed weather extremes

(desk study)

What is Working? (or not working)→ confirm priority areas and challenges

Evaluation of effectiveness of existing Infrastructure

- Infrastructures exist but many are not functional
- Others may still be functional but needing maintenence

(field information)

What is best in each site?→ investment options

Informed Decision Making at the Local Scale: Using global expertise and local knowledge and capacity: best available water supply options.

(field visits, local participation, resilient decisions)

How to prioritize and target interventions?

The drought-prone South of Angola covers a large area

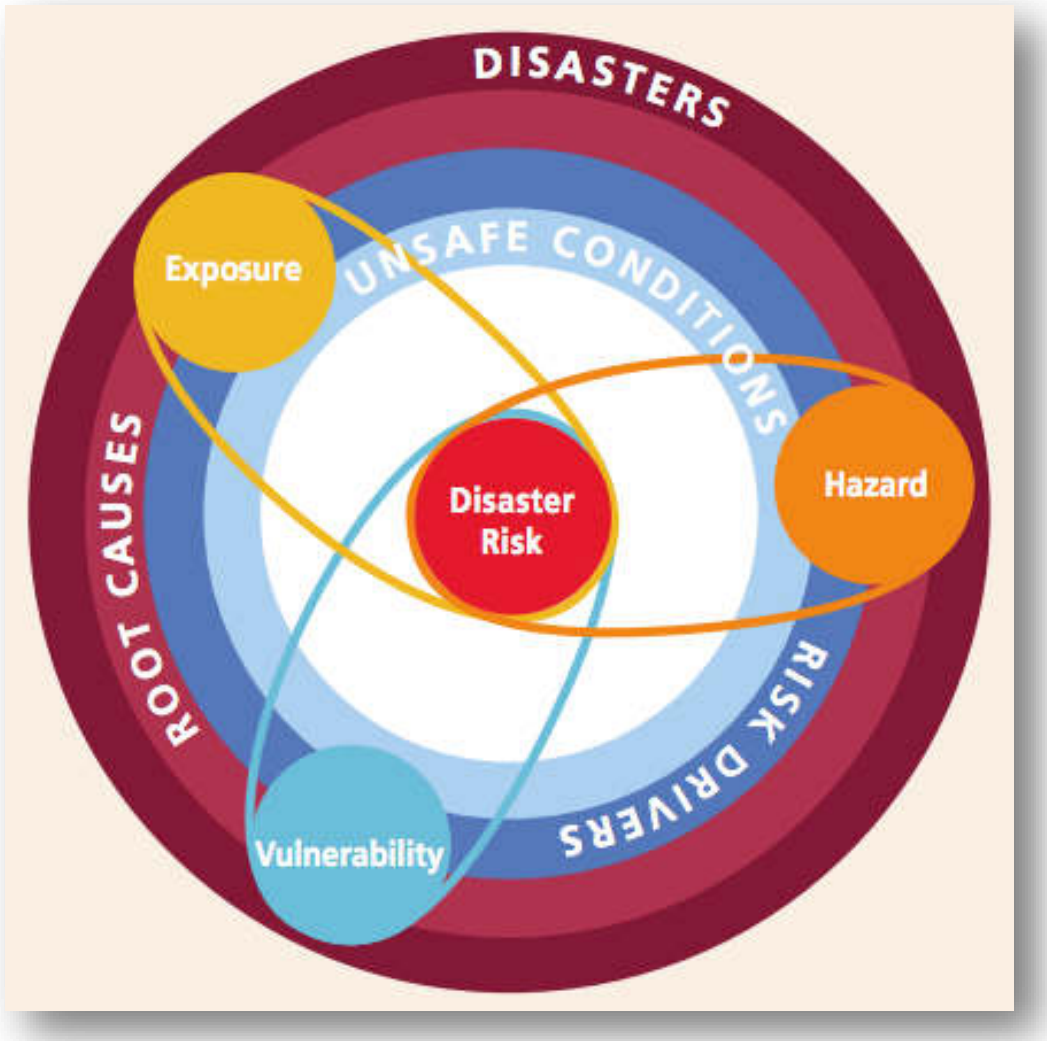
The need for water infrastructures is big and is spread across the region:

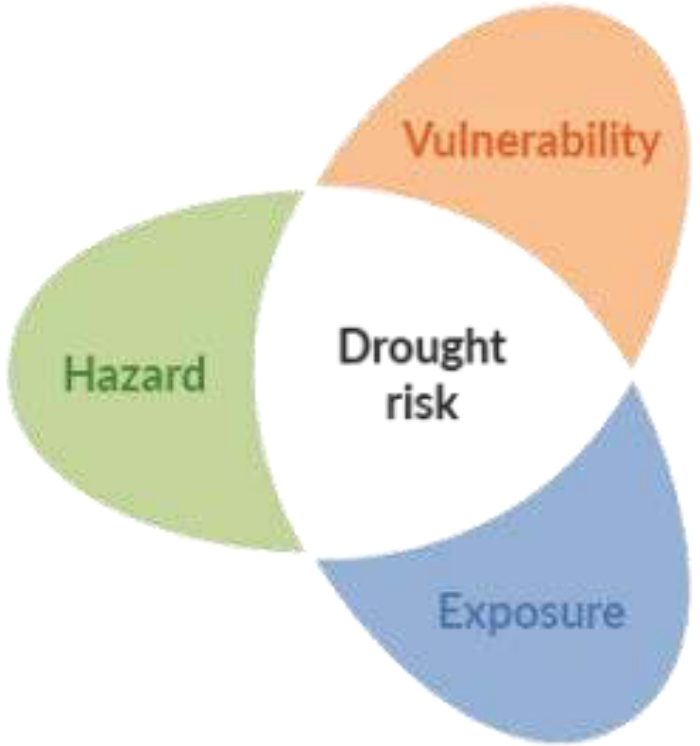
…where do we start ? How to be systematic?

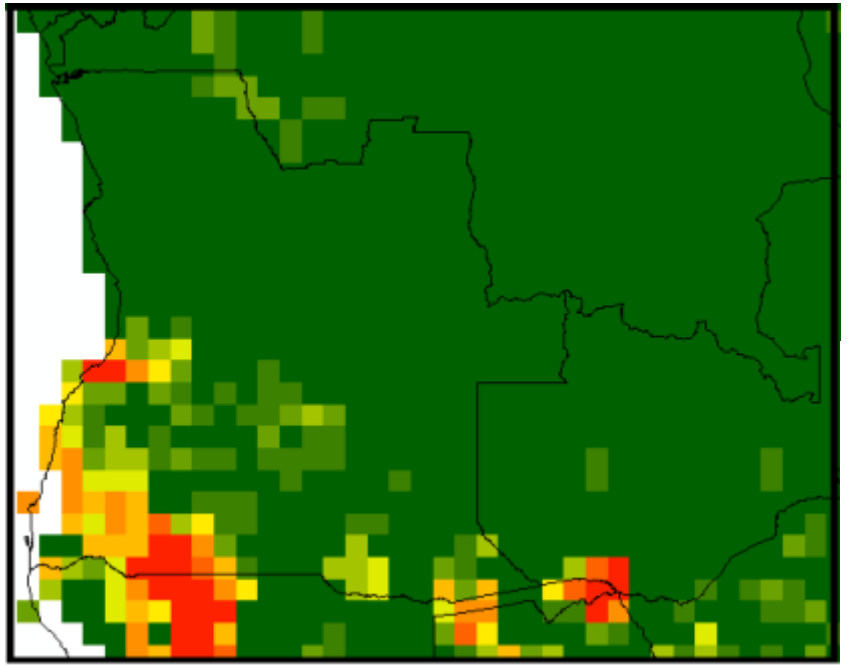
- Need to support the coordination of donor activities (often poorly coordinated)
- Lack of data often results in poor planning, mis-guided implementation
- Need for well-informed solutions and local involvement

Maximize existing information through collaboration with development partners and use of global datasets to assess drought risk and evaluate the ground- and surface water resources that can be mobilized to support **sustainable water supply investments**

How to prioritize and target interventions?

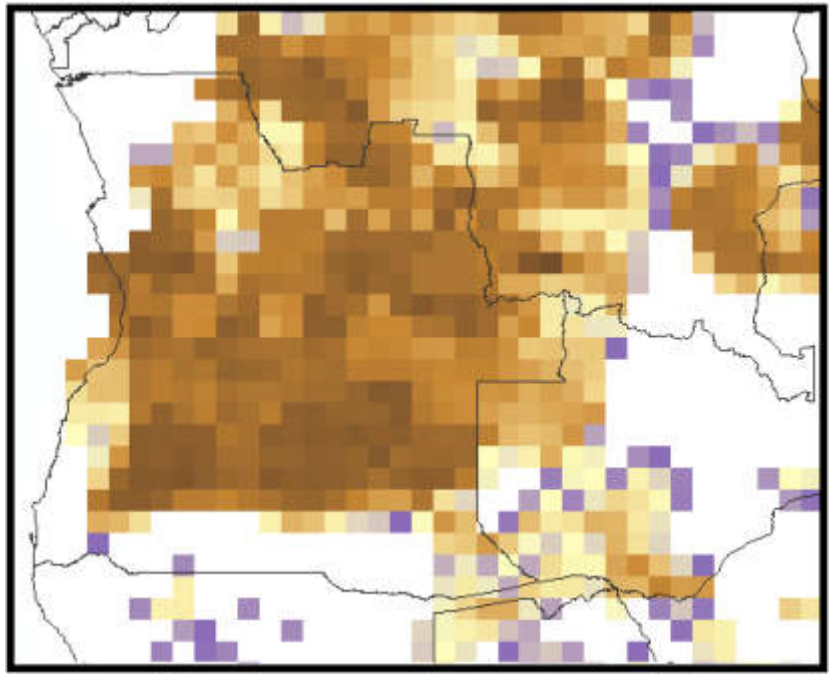




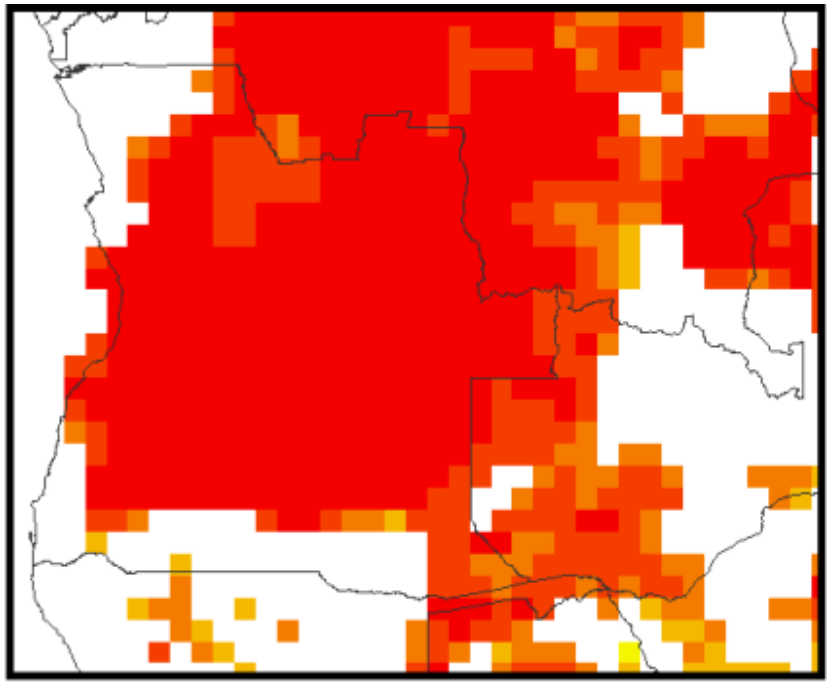


Number of flash droughts, namely going from wetness to mild drought conditions in just one pentad, 1979- 2020

Trends in % of time under drought conditions 1901 - 2016
Purple: time under drought is decreasing
Brown: time under drought is increasing
White: no significant trend

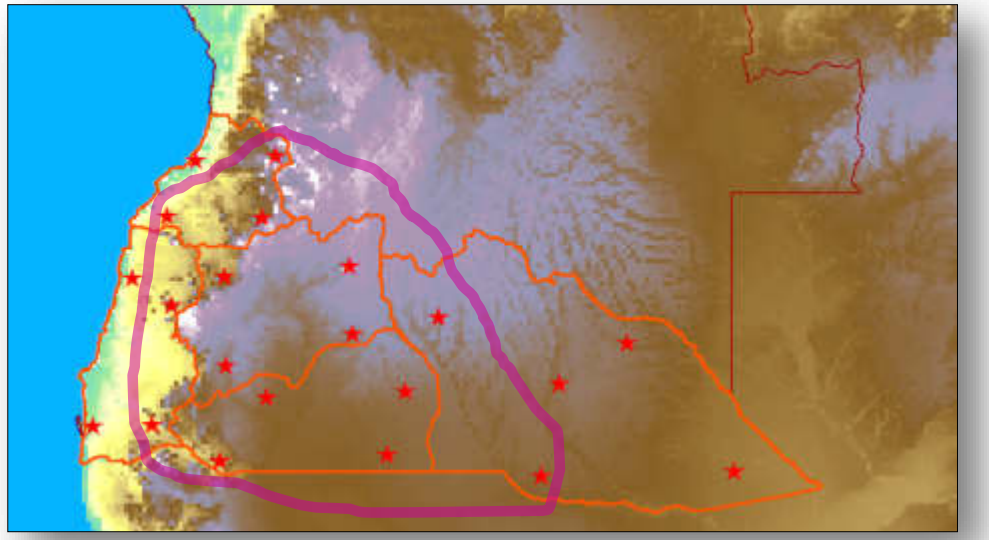


Trends in intensity of drought 1901- 2016
Red and orange tones: intensity of droughts is increasing
White: no significant trend

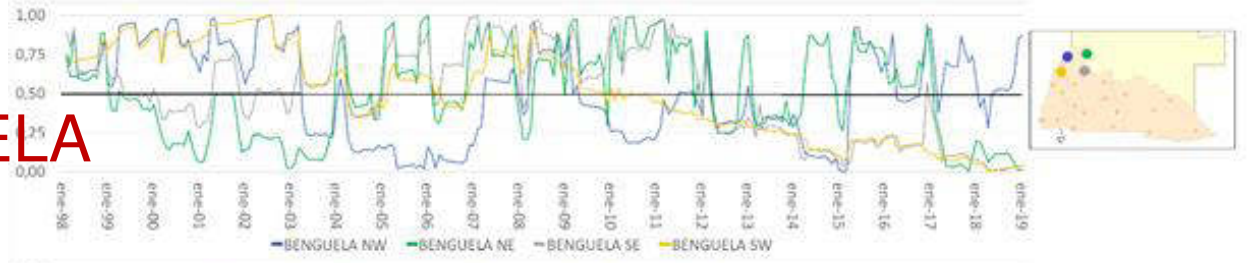


Drought severity

Drought Exceedance Probability INDEX (DEPI)



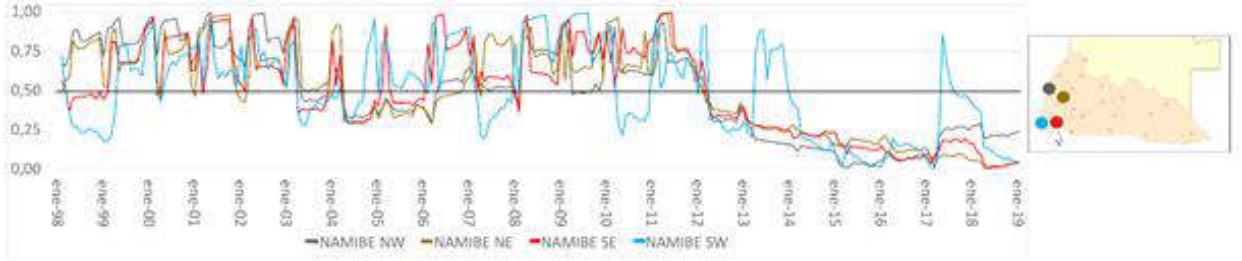
BENGUELA



HUILA



NAMIBE





CUNENE

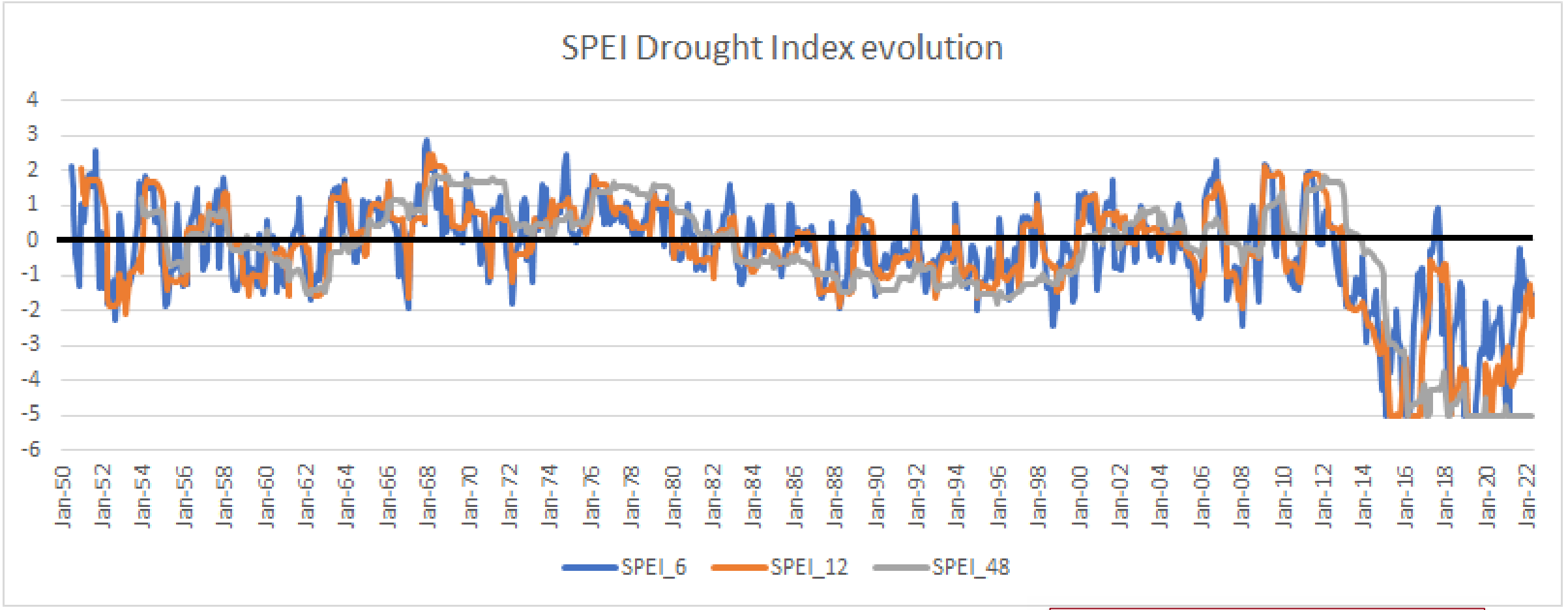


CUANDO CUBANGO

Drought has been severe and long!

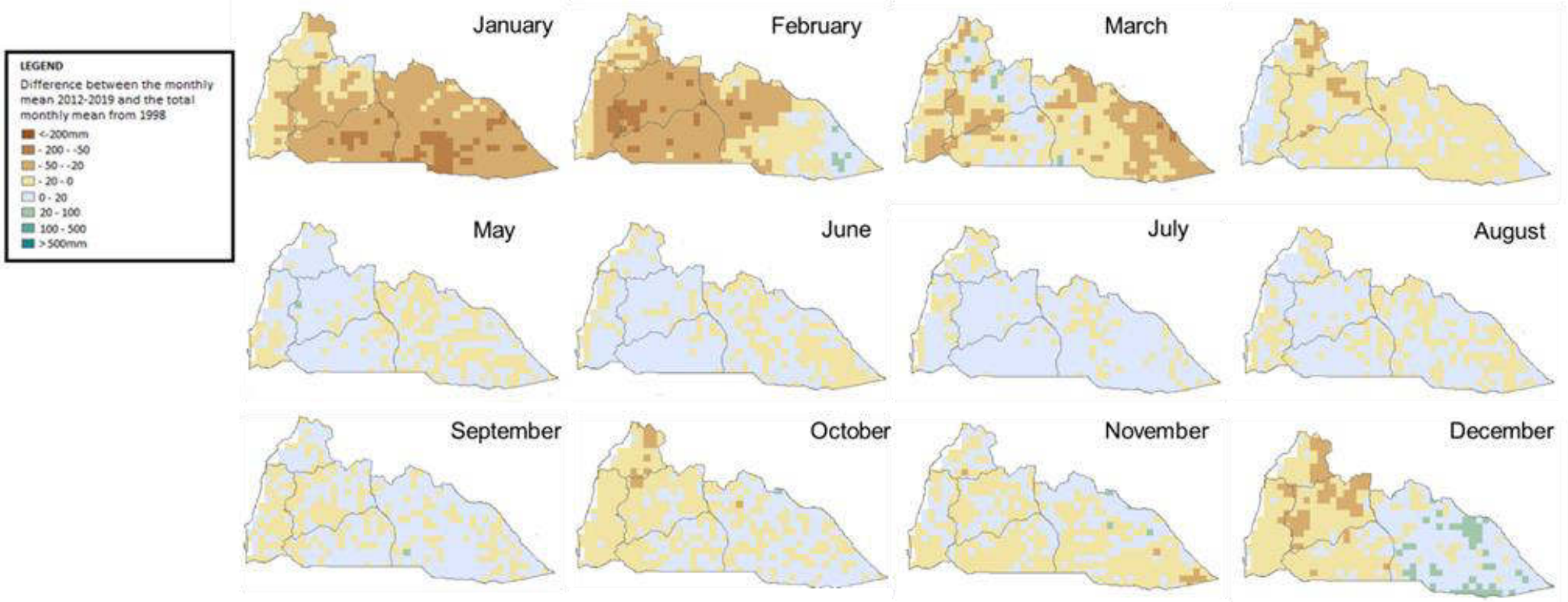
Drought severity

Standardized Precipitation - Evaporation Index (SPEI), pixel at the center of the Angolan South



Drought has been severe and long!

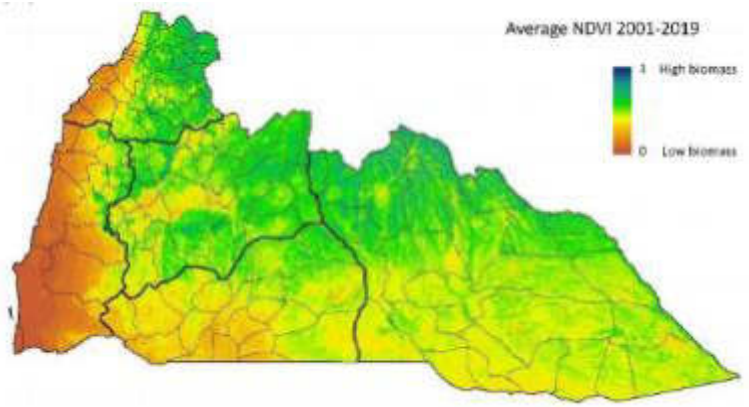
Anomalies in water yield by month (P-Eta) (2012-2019 vs. 1998-2019)

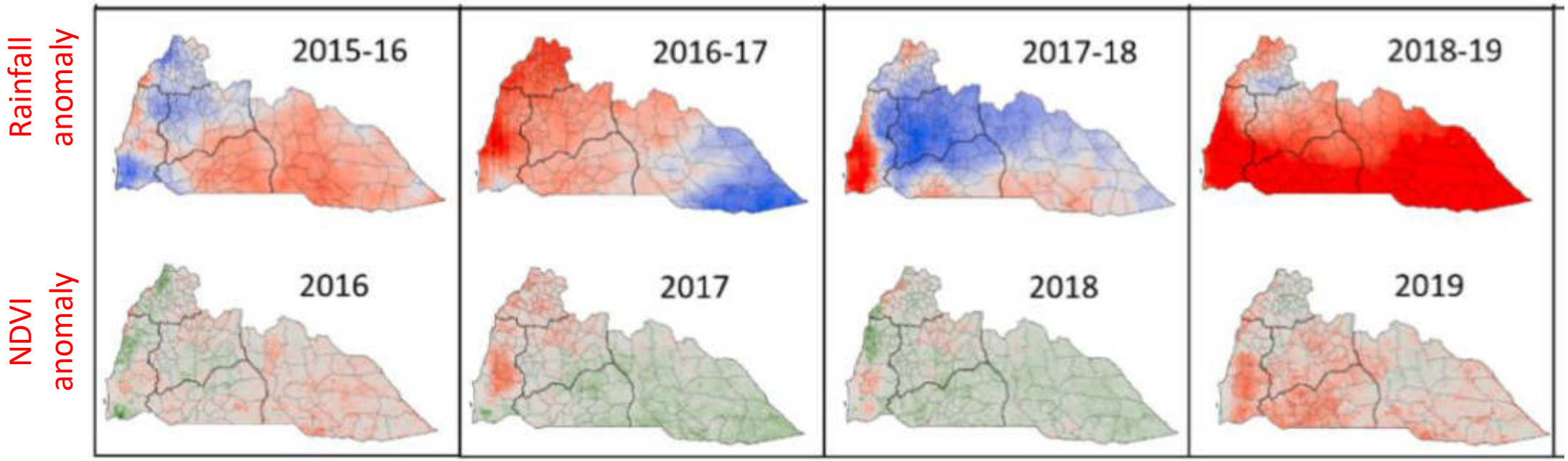


The largest negative **anomalies** from 2012-2019 are **concentrated in the wet months**, the only ones in which surface runoff production is possible, in most of the region. **Substantial and ongoing deficits**.

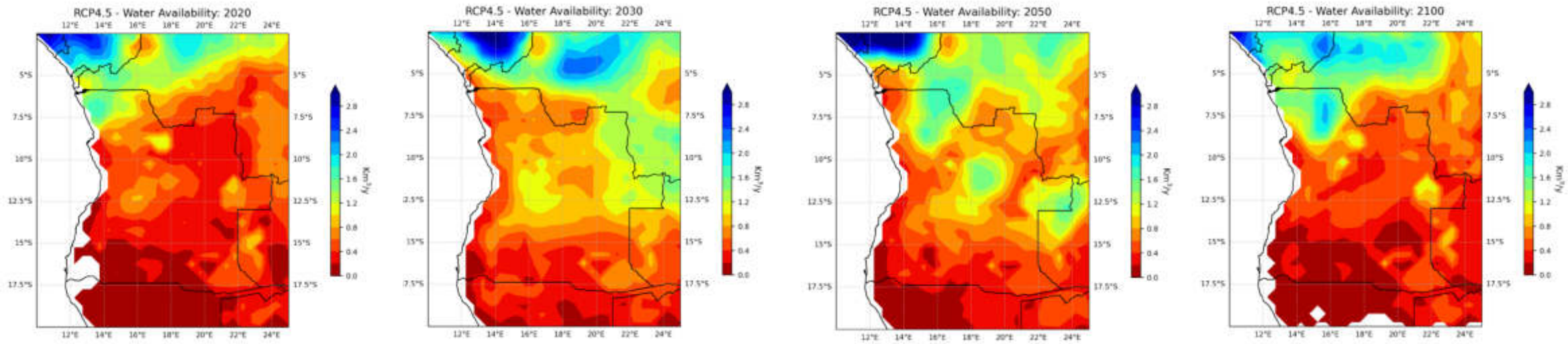
Agricultural and pasture drought

- The NDVI Vegetation Index (MODIS Satellite) makes it possible to identify areas particularly affected by losses in bioproductivity.
- Forage availability for livestock has been heavily impacted by the recent drought, impacting transhumance routes and putting pressure on remaining working water points..





Expected future trends of the drought hazard



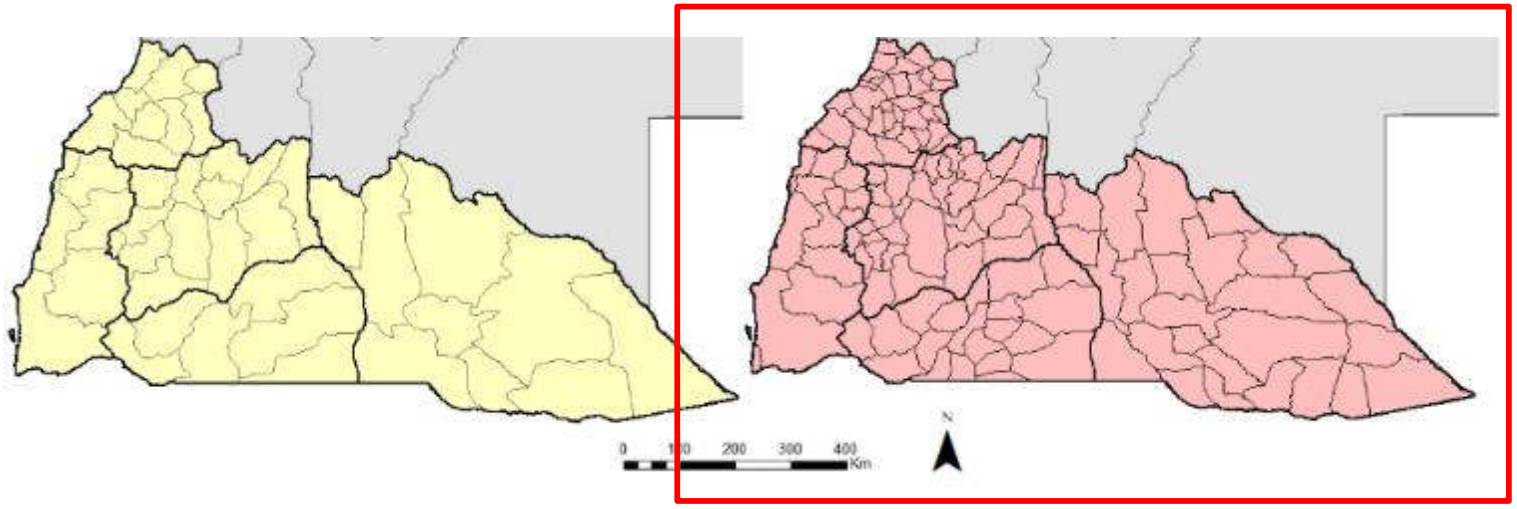
- All the scenarios modelled for the Angolan CCDR point to certain aridification of parts of the country towards the end of the century, especially the Southern region

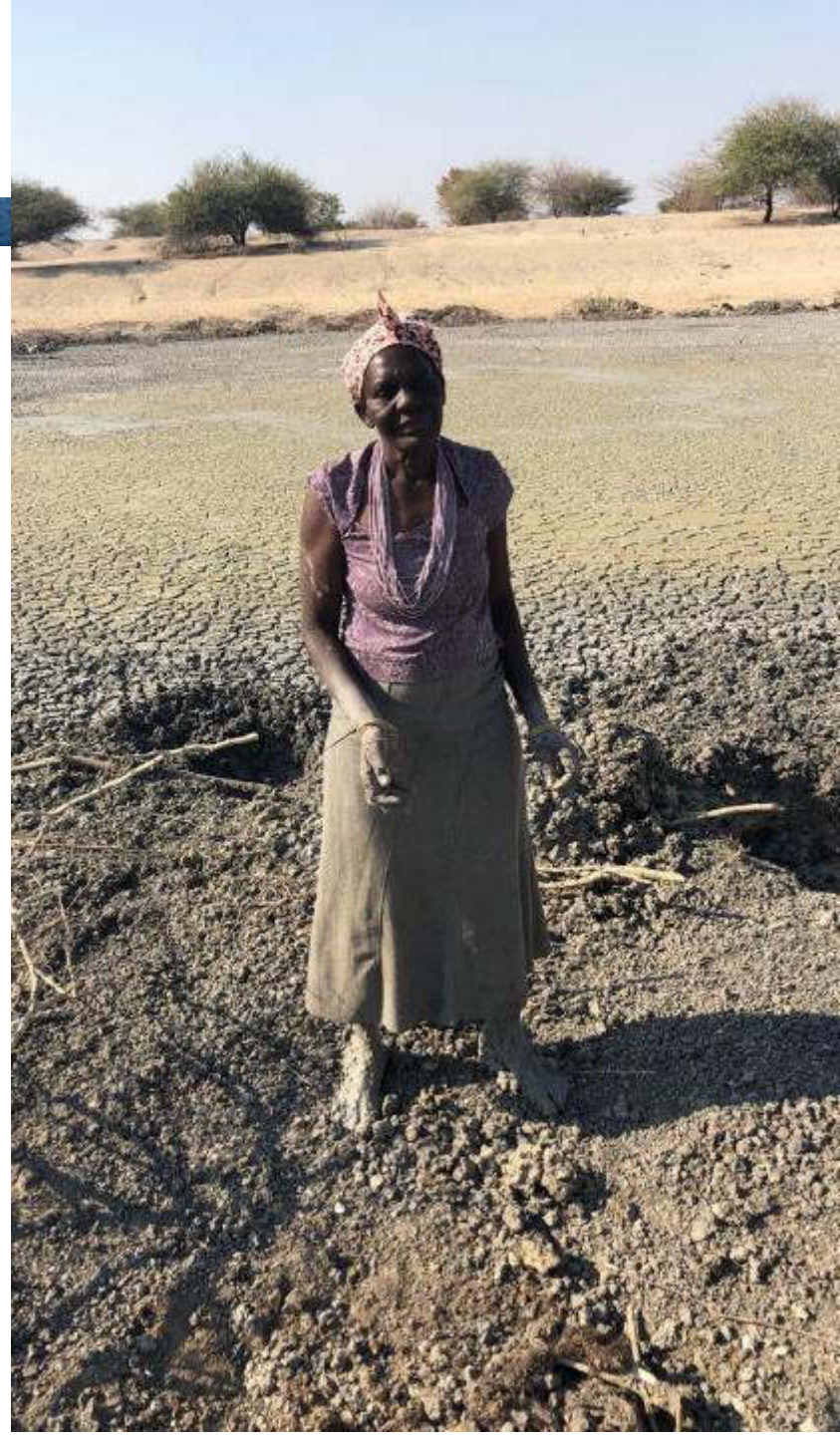
Vulnerability assessment

Main information source:

Censo INE (2014) comuna level,

EXAHUSTIVE AND RELIABLE

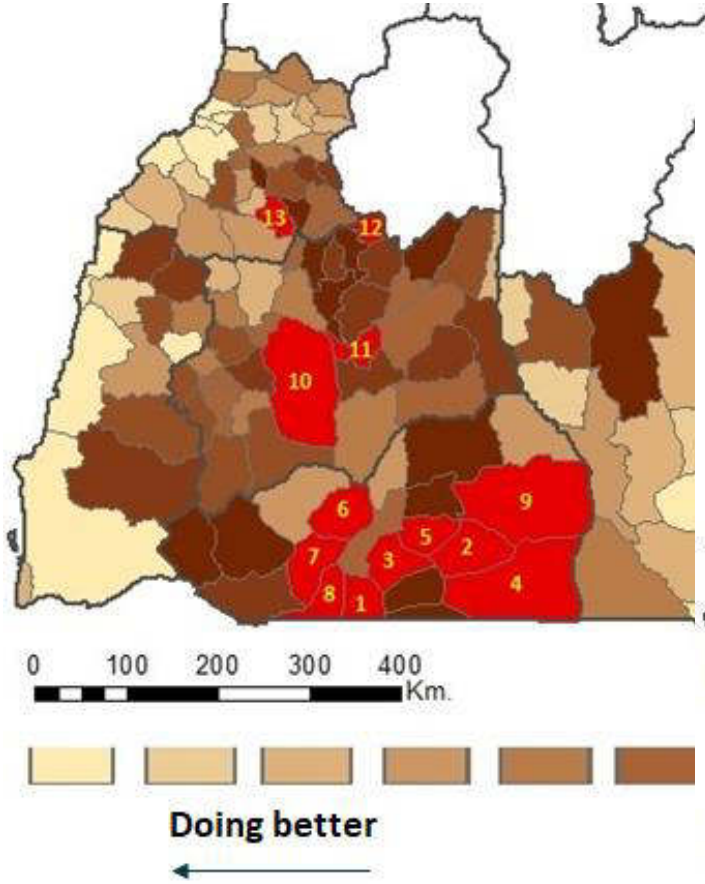




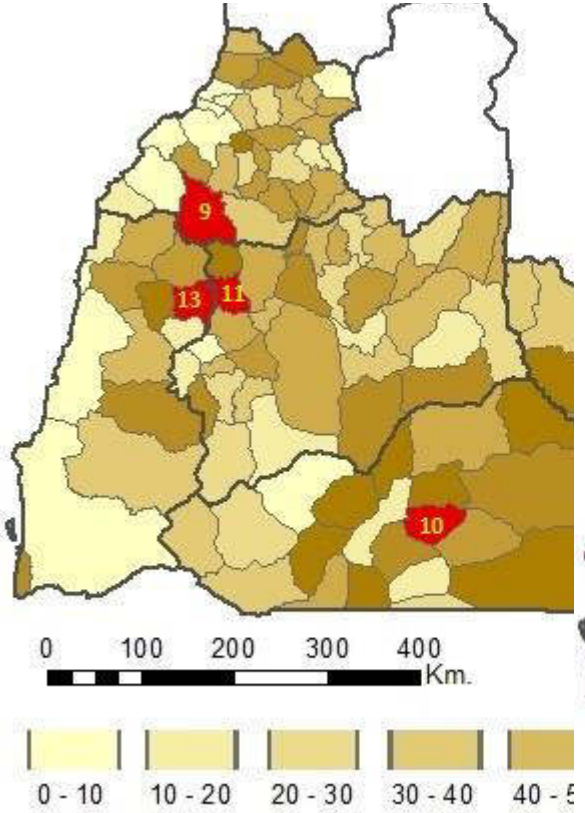
Some of the 11 indicators used to characterize vulnerability

Understanding the structural features of society and the environment is critical to understanding its susceptibility → 11 indicators of sensitivity and coping ability

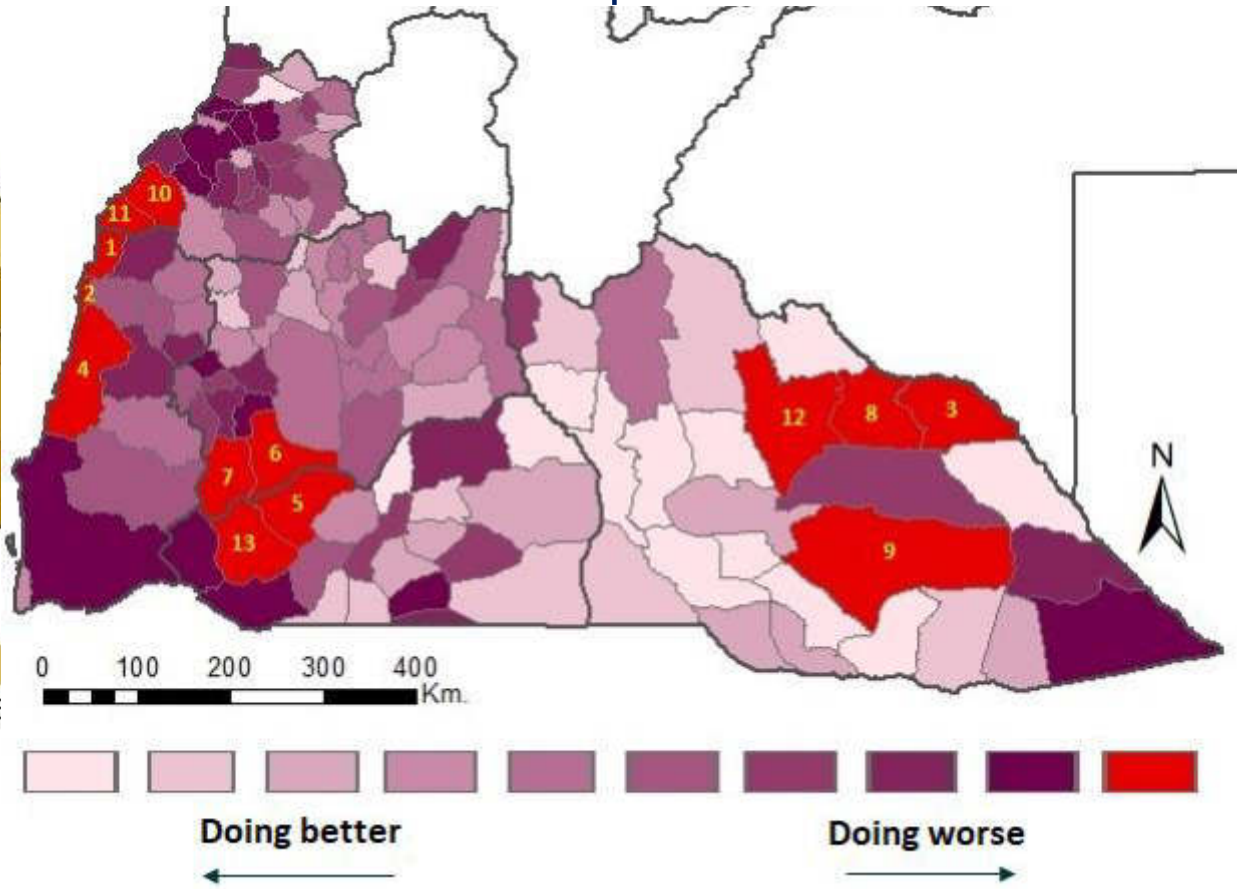
Indicator #1: Water source unreliability



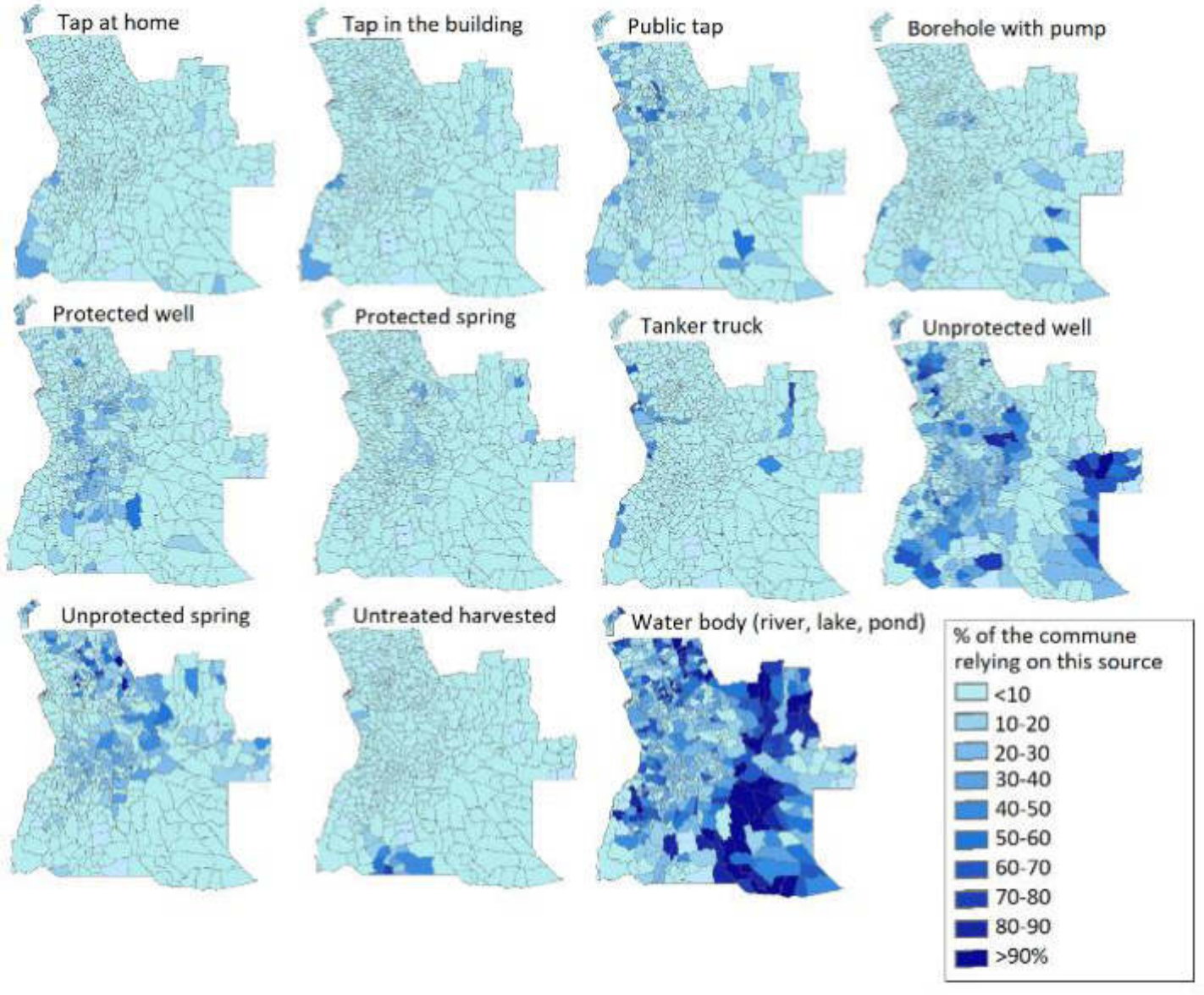
Indicator #2: Water sources unsafeness



Indicator #3: Financial dependence



Calculated indicators for the entire country



Abastecimento de Agua em Angola (Censo INE 2014)

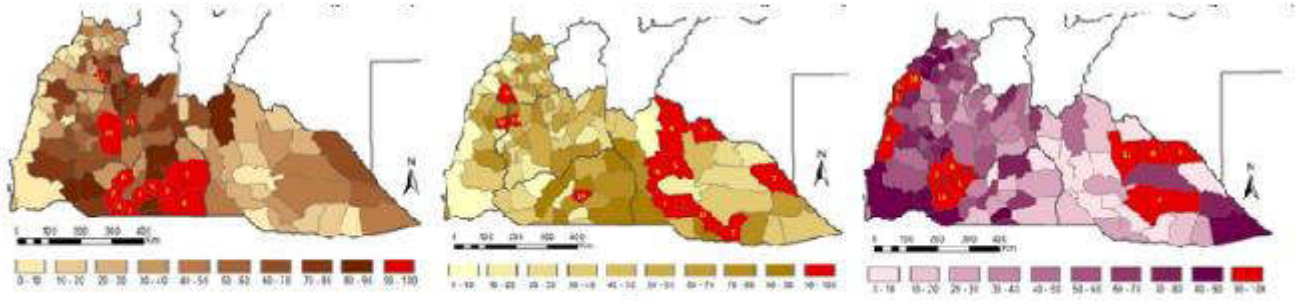
Identificação de comunas com maior risco

DROUGHT HAZARD



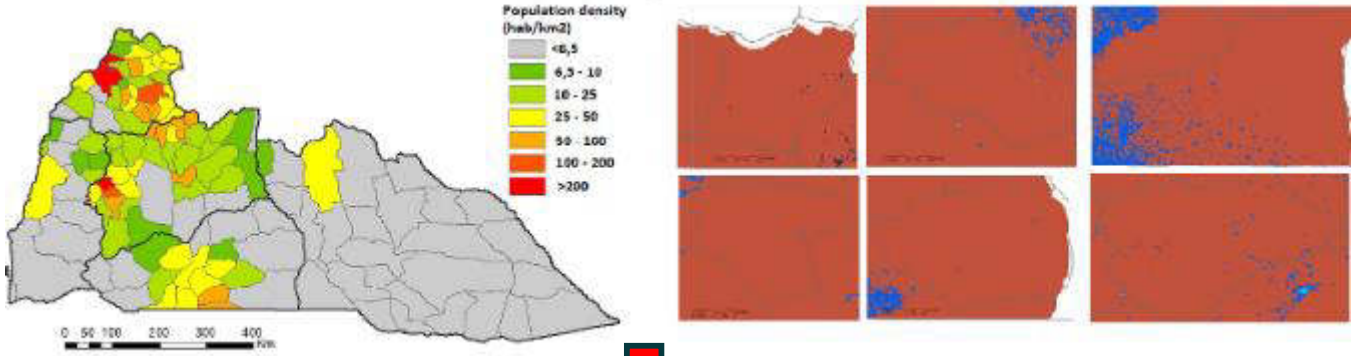
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DROUGHT VULNERABILITY



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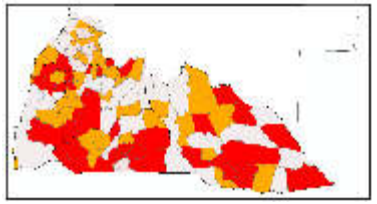
EXPOSURE



DROUGHT RISK

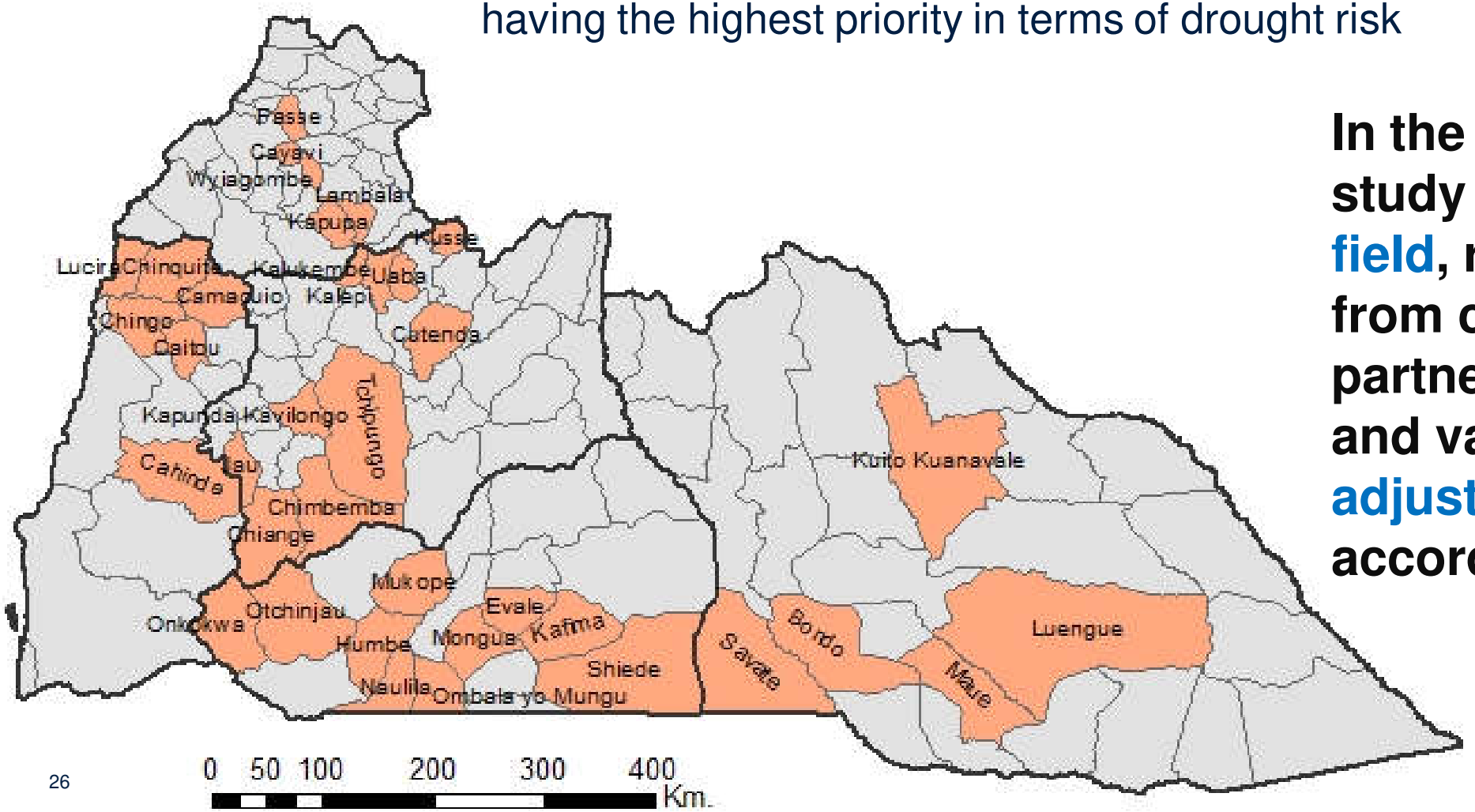


PRIORITY COMMUNITIES LIST



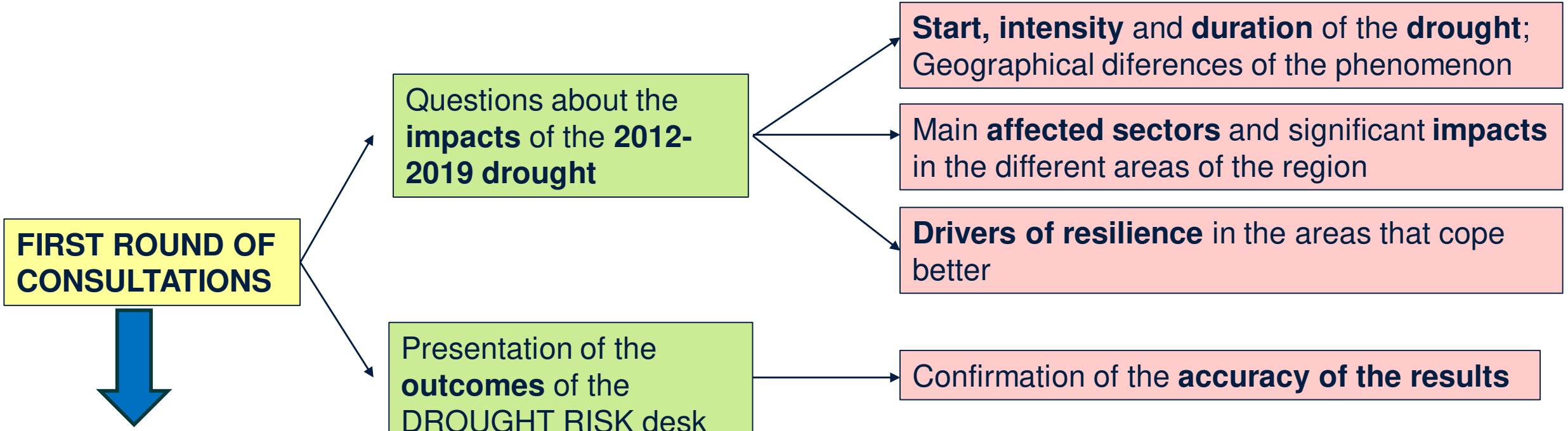
Priority communes

As a consequence of the overlap analysis, several communes emerge as having the highest priority in terms of drought risk



In the next stage of the study we went to the field, received feedback from communities, partners and authorities and validated and adjusted the results accordingly

Impacts: Local experts and stakeholder's consultations



Selection of communes to visit during the 1st field trip

Institutions and partners consulted: Fundo de Apoio Social (FAS), UNICEF, UNDP, Civil Protection, Instituto Nacional de Recursos Hidricos (INRH) and FAO teams in the South of Angola

Impacts: Workshops and field work in the municipalities

SECOND ROUND OF CONSULTATIONS AND FIELD WORK

Identification of the main issues that affect the selected communes

Focus Group Discussions, with a more targeted questionnaire.

(Facilitated by FAS)

Water availability and water supply analysis

Socioeconomic and environmental characteristics of the municipality and the communes that condition resources management and water supply

The nature, degree and distribution of impacts suffered from 2012 in each of the communes within the municipality

Interventions to adapt & mitigate the impacts

Representatives of the municipalities: Head of the municipality, several farmers and herders, members of the municipal goverment dealing with water supply, livestock and agriculture management.

Identified drivers of vulnerability

i. **Lack of efficient monitoring** of the status of water points, lack of information, and lack of **water resources knowledge base**

ii. **Lack of infrastructure** and reliable access to water resources & lack of **water storage**

iii. **Lack of governance capacity** to repair rural water points & prepare for droughts, from community to provincial and national levels



Identification of Investments in Rural Infrastructures

- **No single water resources solution can provide water security** for all uses in southern Angola

- Thus, a **mix of solutions** is recommended, both capturing surface water and capturing groundwater

- The choice of **infrastructure to be built in each community will largely depend on the availability, variability and quality of the water** resources that can be mobilized, to provide the most reliable and safe supply, given the climate variability and the scenarios of change

- It is essential to have **sufficient knowledge of the resources**: groundwater and surface water, and to **involve the community** to identify appropriate governance arrangements



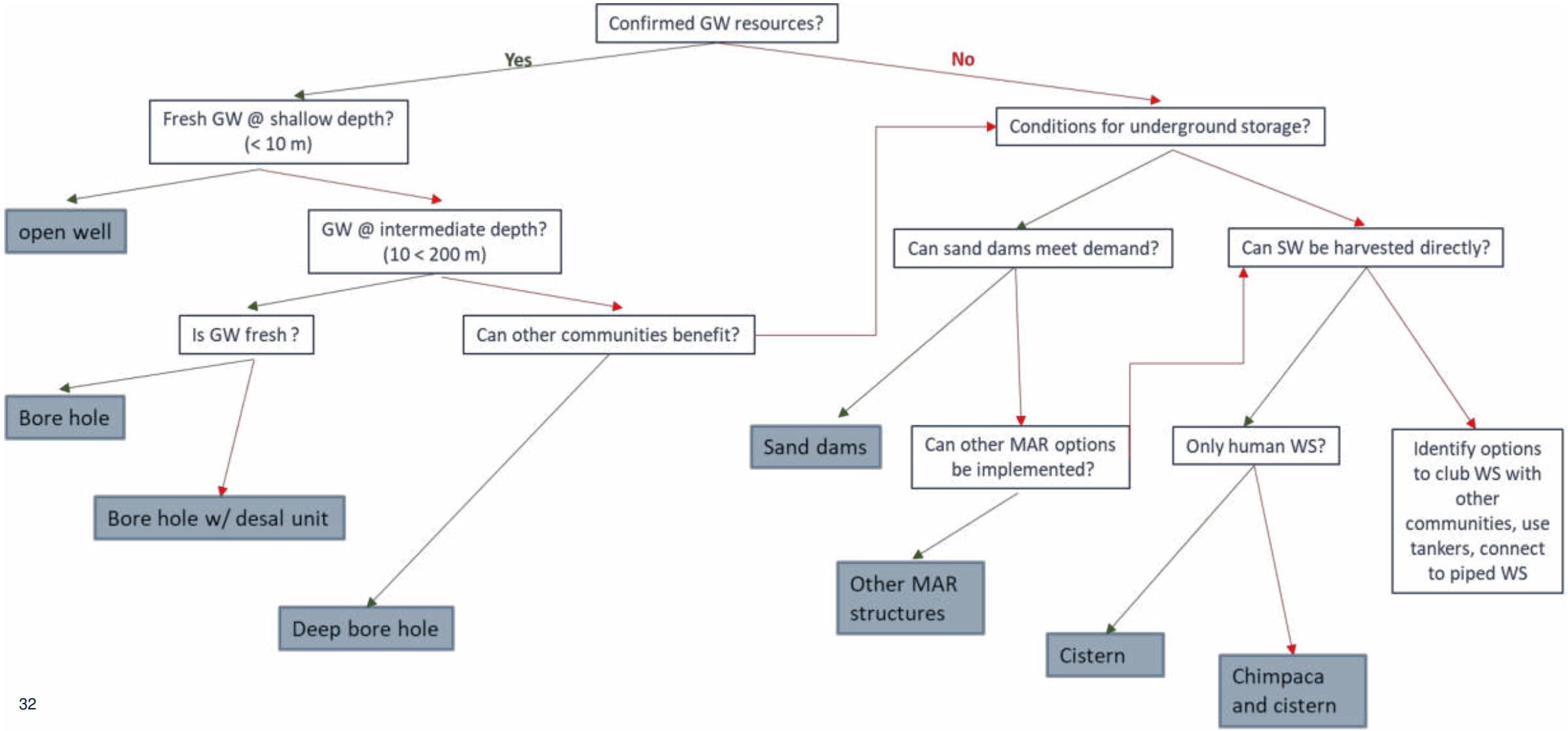
Identification of Investments in Rural Infrastructures

- **Groundwater is the preferred water supply option** because it tends to be less vulnerable to climate variations and is protected from pollution.
- Unfortunately, **groundwater potential varies widely** in southern Angola and the information available is very limited
- **Where groundwater is not available, surface water solutions should be developed**: sand dams, improved cisterns and chimpacas, others…



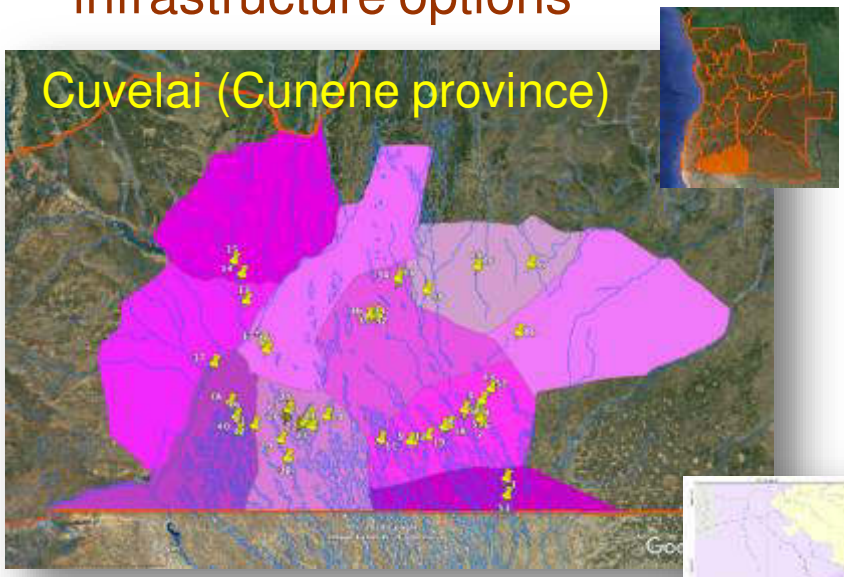


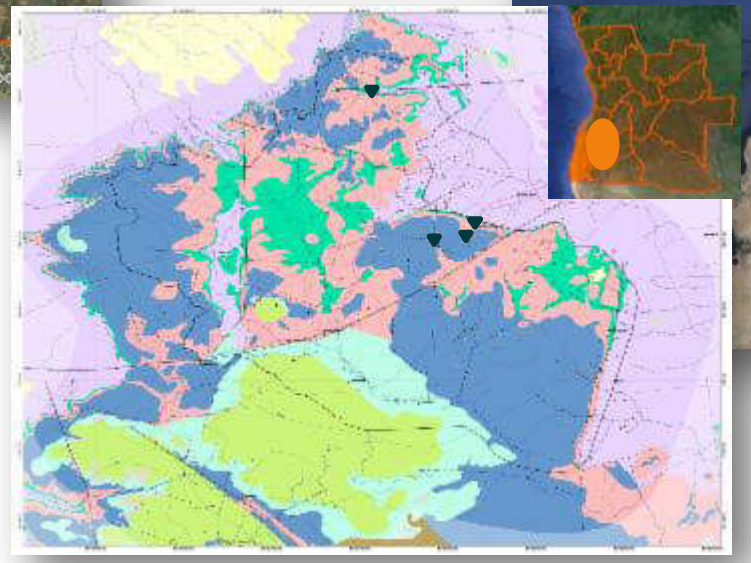

Identification of Investments in Rural Infrastructures



Detailed Case Studies: Lubango, Cuvelai basin and Namibe

Field missions → hydrological, hydrogeological and water quality surveys and to explore infrastructure options







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4. Challenges for Adaptation and Resilience in Angola



Based on Previous Technical Work…

New Project: Resiliencia Climática e Agua em Angola, RECLIMA

BM ($300M) & AFD ($150M)

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AFD

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The Project Development Objective is to improve Water Supply Services and strengthen Water Resources Management for Climate Resilience in selected areas.

Overview and Components

1. **Improve water services in rural and urban areas**

a) Institutional Support EPAS, IRSEA

b) Infrastructure EPAS

c) Rural Sector Surtainability

2. **Strengthen WRM**

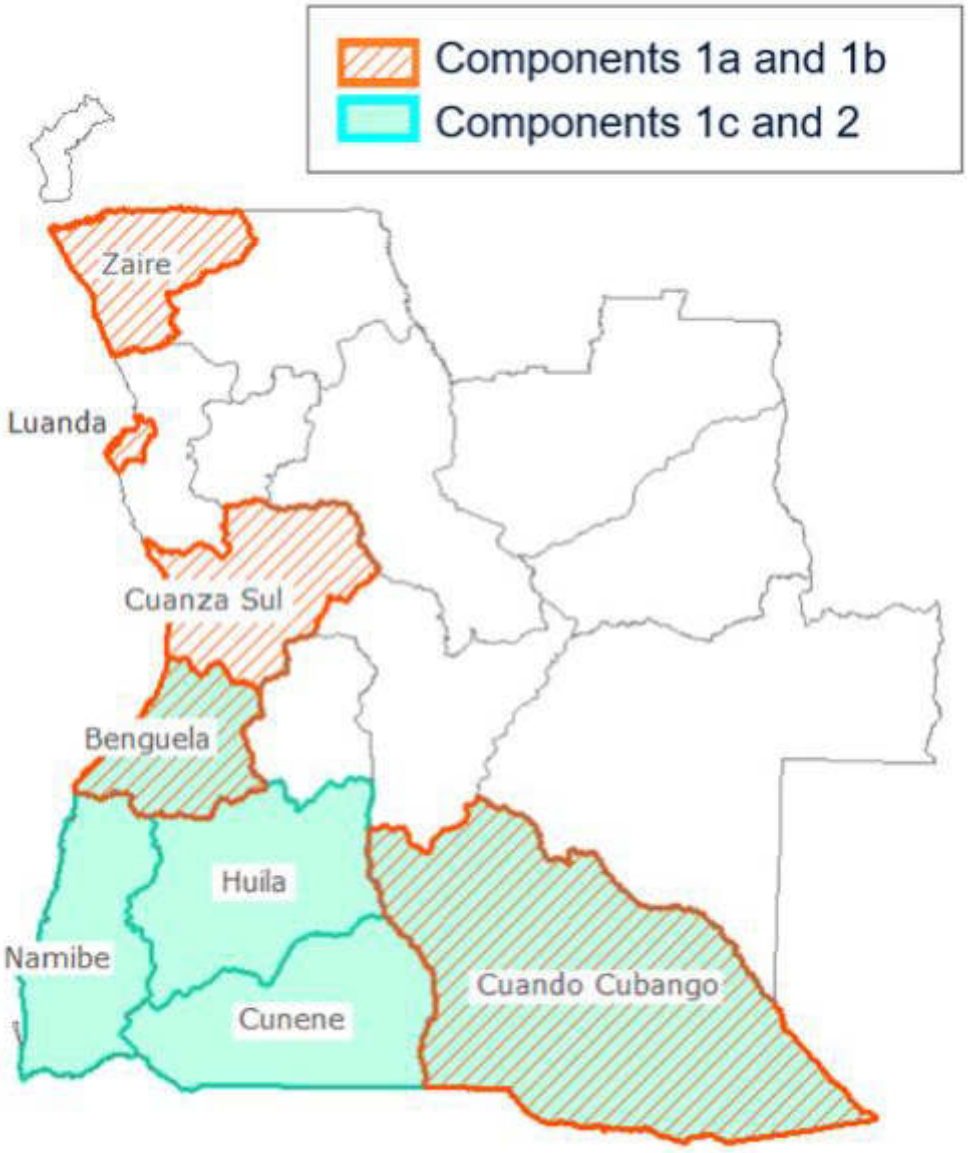
a) Rural WR Infrastructure

b) Institutional Support & WR assessments and studies (GABHIC / INRH)

c) Dam reconstruction, Operations and Safety

3. **Project Management and Inter-institutional Coordination**

4. **CERC: Emergency Component($0)**



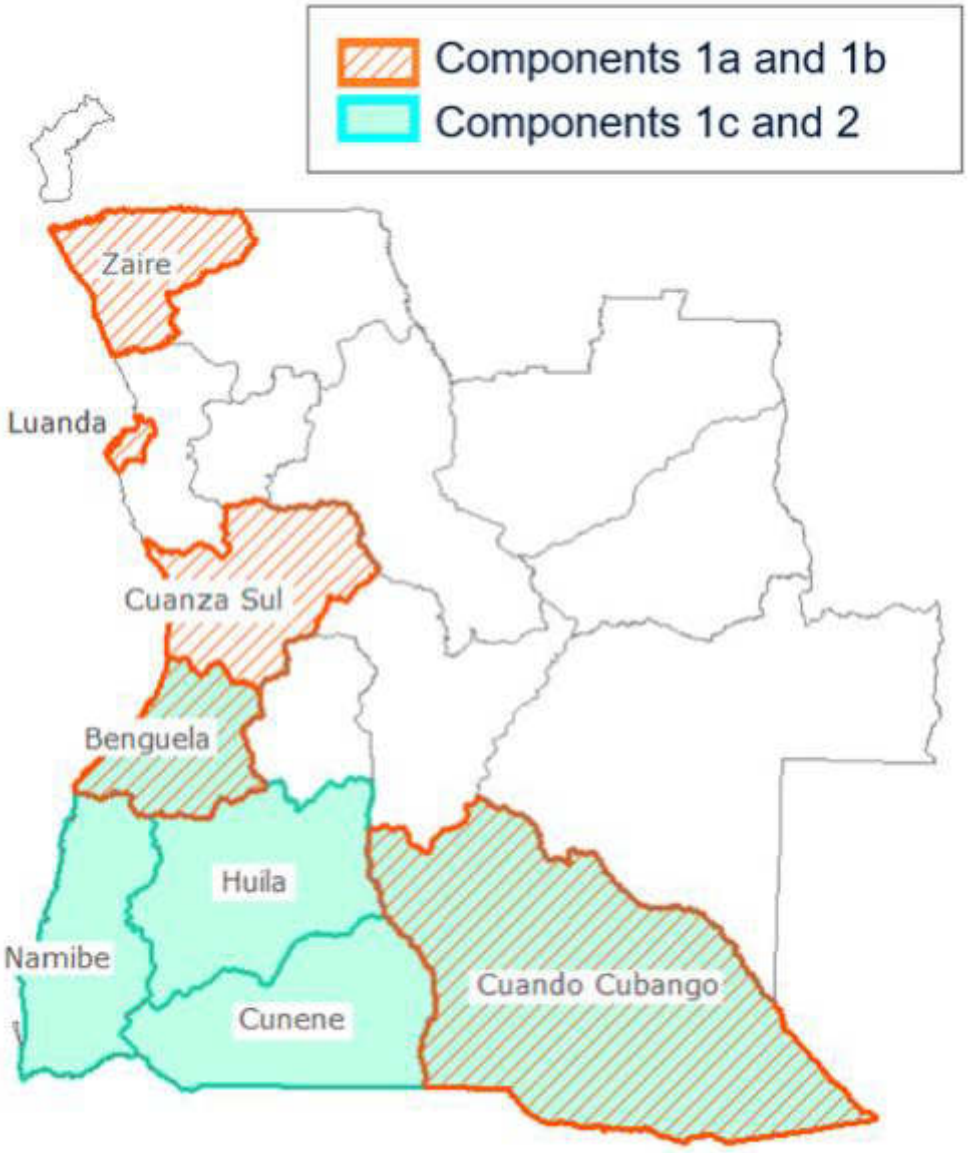
Overview and Components

1. Improve water services in rural and urban areas

a) Institutional Support EPAS, IRSEA in the South, with Technical Assistance, Climate Resilience Planning preparation, Planos Dir. de Saneamento. *Benguela, Cuando Cubango(*), Kwanza Sul, Zaire(*) e Luanda*

b) Infrastructure EPAS: connections, production and distribution. *Benguela, Cuando Cubango(*), Kwanza Sul, Zaire(*) e Luanda*

c) Rural Sector Surtainability, Technical Assistance to provinces and municipalities, community organization (creation of Grupos de Agua e Saneamento) and Municipal Water Plans preparation, with Drought Planning. Sector analysis. *Benguela, Namibe, Huila, Cunene, Cuando Cubango*



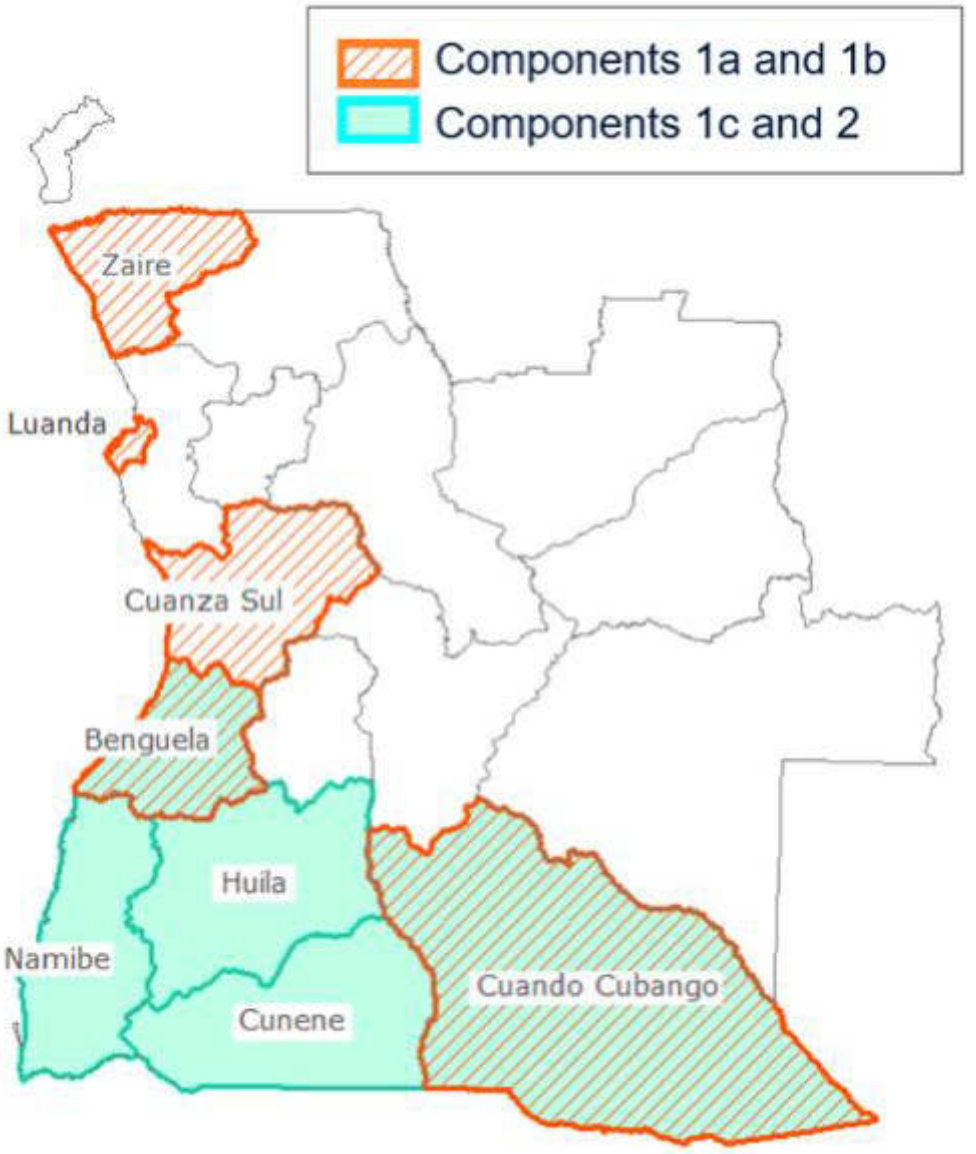
Overview and Components

2. **Strengthen WRM** *Huila, Cunene, Namibe, Benguela, Cuando Cubango*

a) Rural WR Infrastructure. Rehabilitation and new construction of Boreholes, Sand Dams, Acudes and Small Dams, Chimpacas, Soil and Watershed Conservation Measures, and others.

b) Institutional Support to GABHIC: Operational establishment in the South and strengthening to fulfill its mandate tp monitor & cadastre. Drought Contingency Plans. Cunene Basin Plan. Targeted Hydrogeological studies. Support the creation of Basin Councils. For INRH: Hydrogeological Studies outside the GABHIC area, Basin Plan of the Namibe basins.

c) Reconstruction of Sendi Dam (Quipungo), studies and associated plans. Dam Operation/Safety Training.



Component 2 : Strengthen WRM

Climate Resilience with storage investments and improvement of WRM

WR assessment, monitoring and management capacity, Tecnical Assistance to GABHIC and connected activities
Drought Planning + DNA, INRH

STORAGE IN THE CATCHMENTS: sand dams, water harvesting, soil conservation, watershed protection, etc.

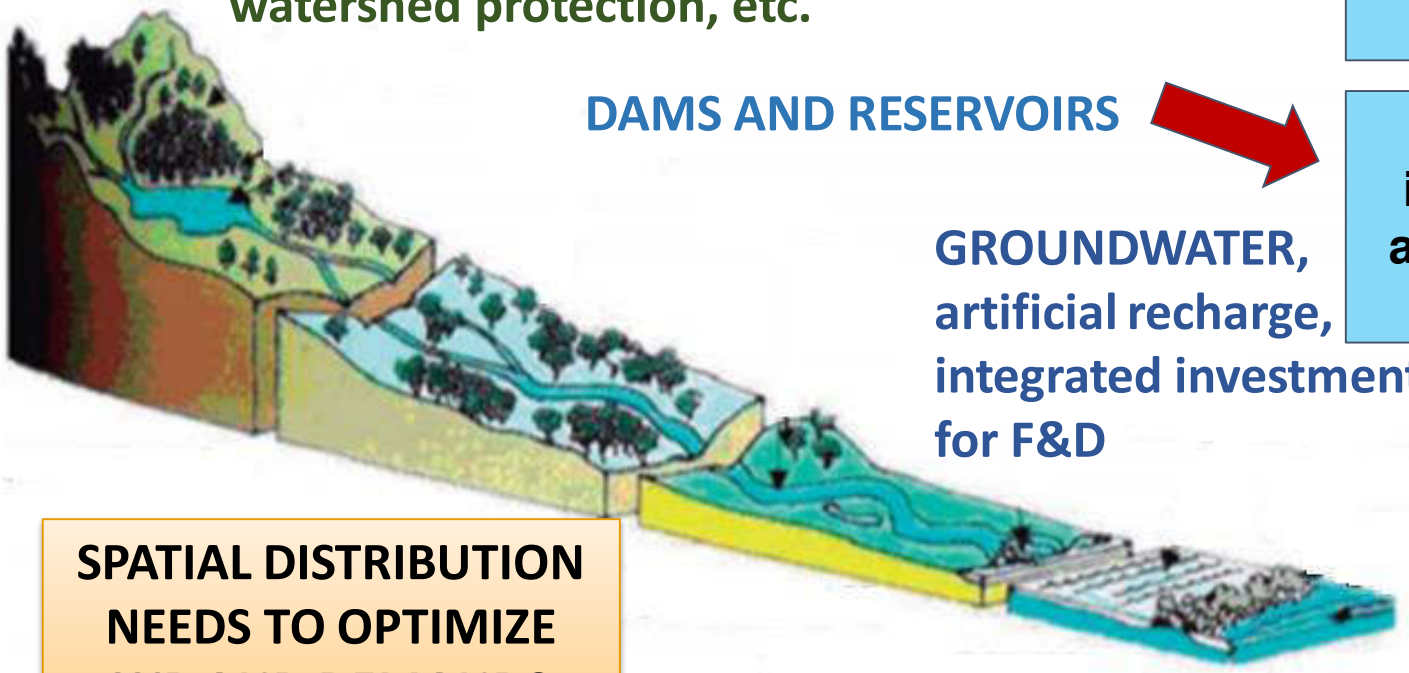
Community level investments for harvesting, developing and storing WR, NBS. *Coordinated under the Municipal Water Plans*

DAMS AND RESERVOIRS

Pre-feasibility studies, NBS, siting studies, integrated and optimized water management & allocation assessments, etc. *Coordinated under the Municipal Water Plans*

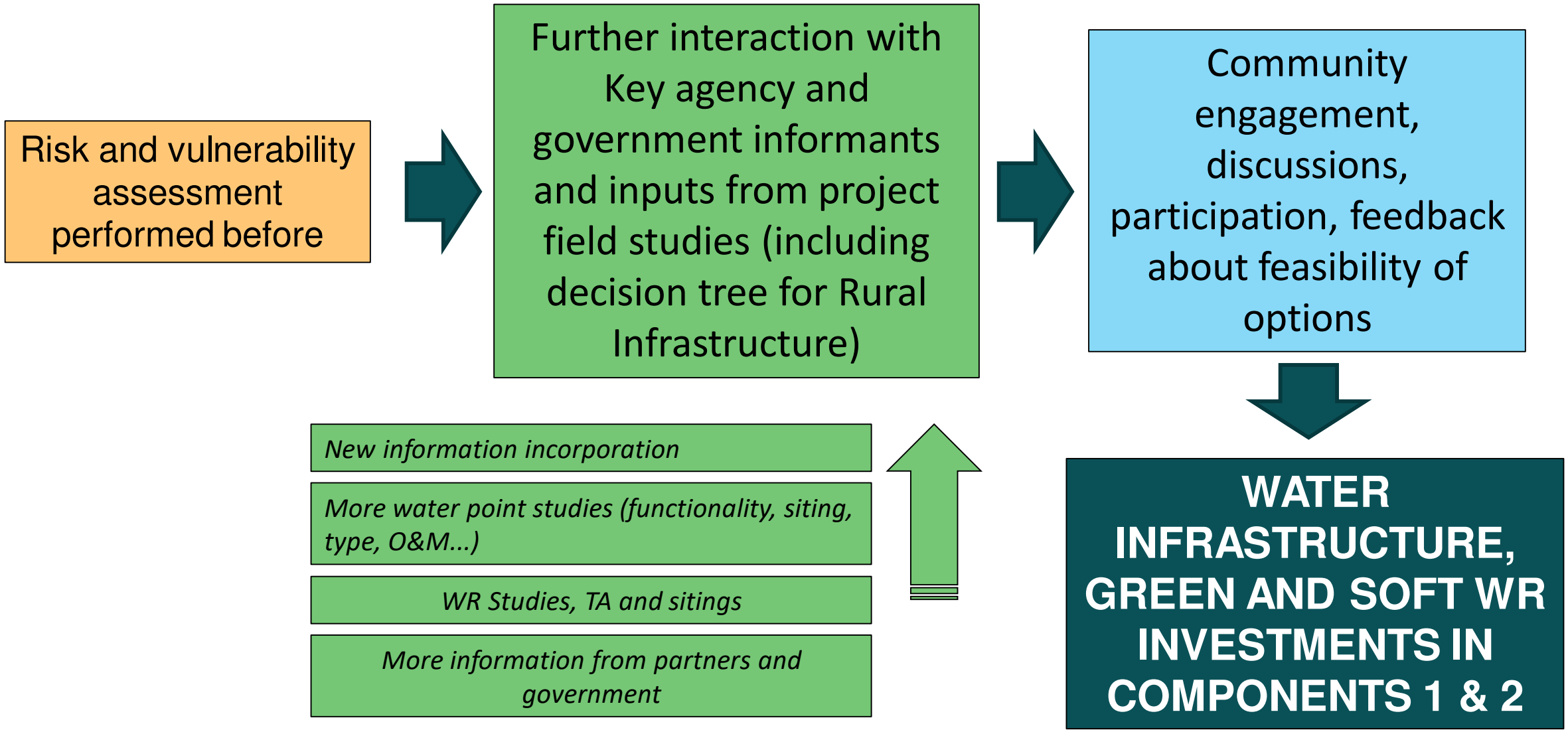
GROUNDWATER, artificial recharge, integrated investments for F&D

Exploration investments, hydrogeological studies, MAR feasibility . *Coordinated under the Municipal Water Plans*



SPATIAL DISTRIBUTION NEEDS TO OPTIMIZE WR AND DEMANDS

Selection of beneficiary areas (based on the previous risk assessment)



Lack of sustainability is a main risk in Angola

Ensuring the sustainability of investments, including operation and investment management mechanisms, is a key element of the project:

It is essential to create sustainability in the rural sector and strengthen coordination and management mechanisms between Province-EPAS-Municipalities and communities, with 3 key dimensions:

- Municipal/provincial capacity for maintenance and repair of water points; Attention needs to be paid to the basic mechanisms of operation and maintenance in the municipalities/provinces. Who is the owner, operator, responsibilities. Strengthening of local technical capacities
- Community organization in coordination with the previous
- Participatory development of Municipal Water Plans (drought resilience plans)

Municipal Water Plans (Planos de Agua Municipais)

Processos de planejamento, preparação e gestão a nível municipal, para criar resiliência a nível local.

Municipal Water Plans, including management, planning and contingency preparedness, using the local level knowledge

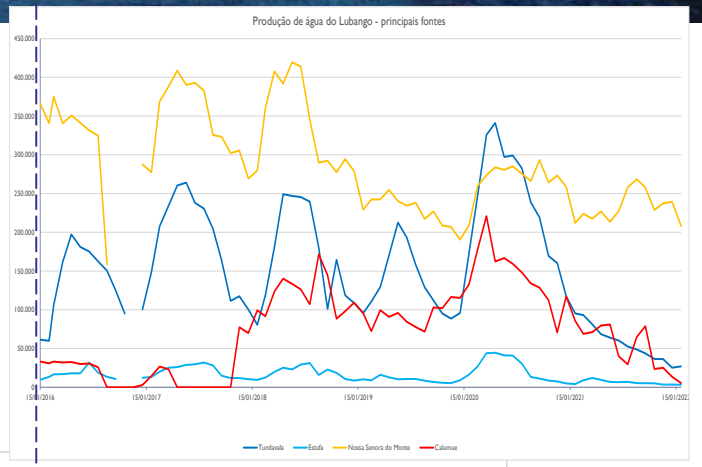
- ✓ Inventory of Surface and Underground Water Resources in the Municipality
- ✓ Diagnoses of water supply and demand in/by the communities
- ✓ Water balance and interventions at the Municipal scale
- ✓ Prioritization and costs analyses
- ✓ Alternatives:
  - + Infrastructure
  - + Water Governance Model
  - + Financial Models!
  - + Technical and O&M models

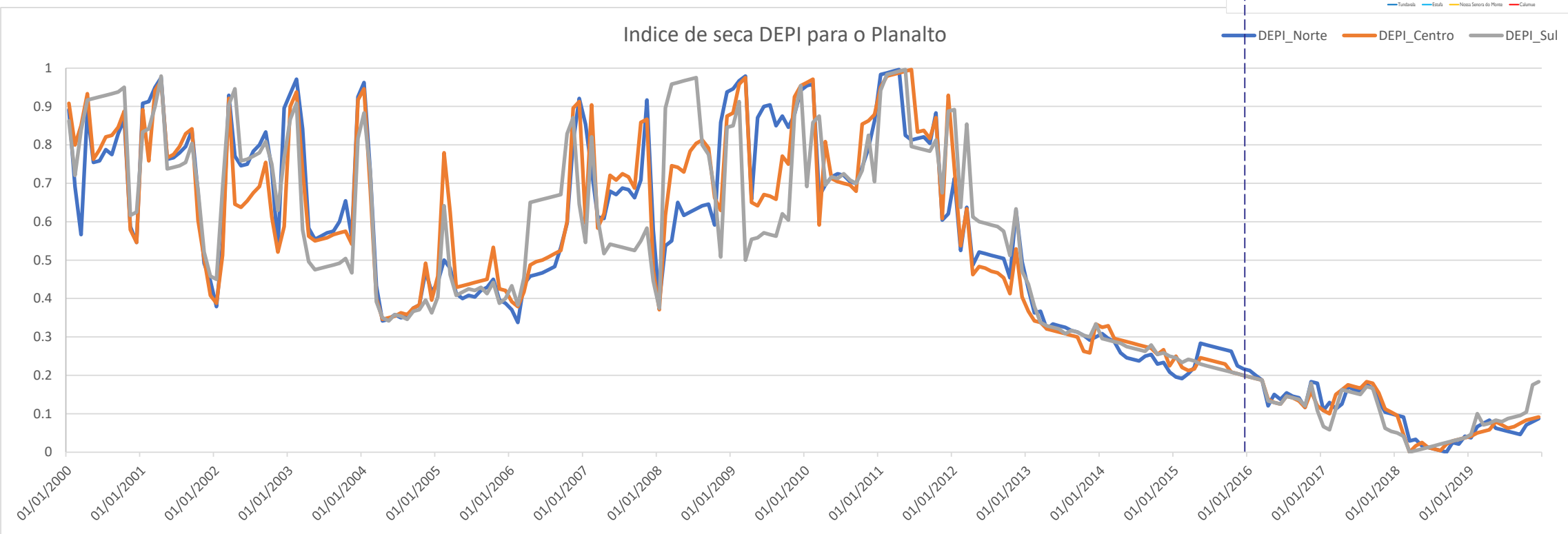


Lubango groundwater drought assessment

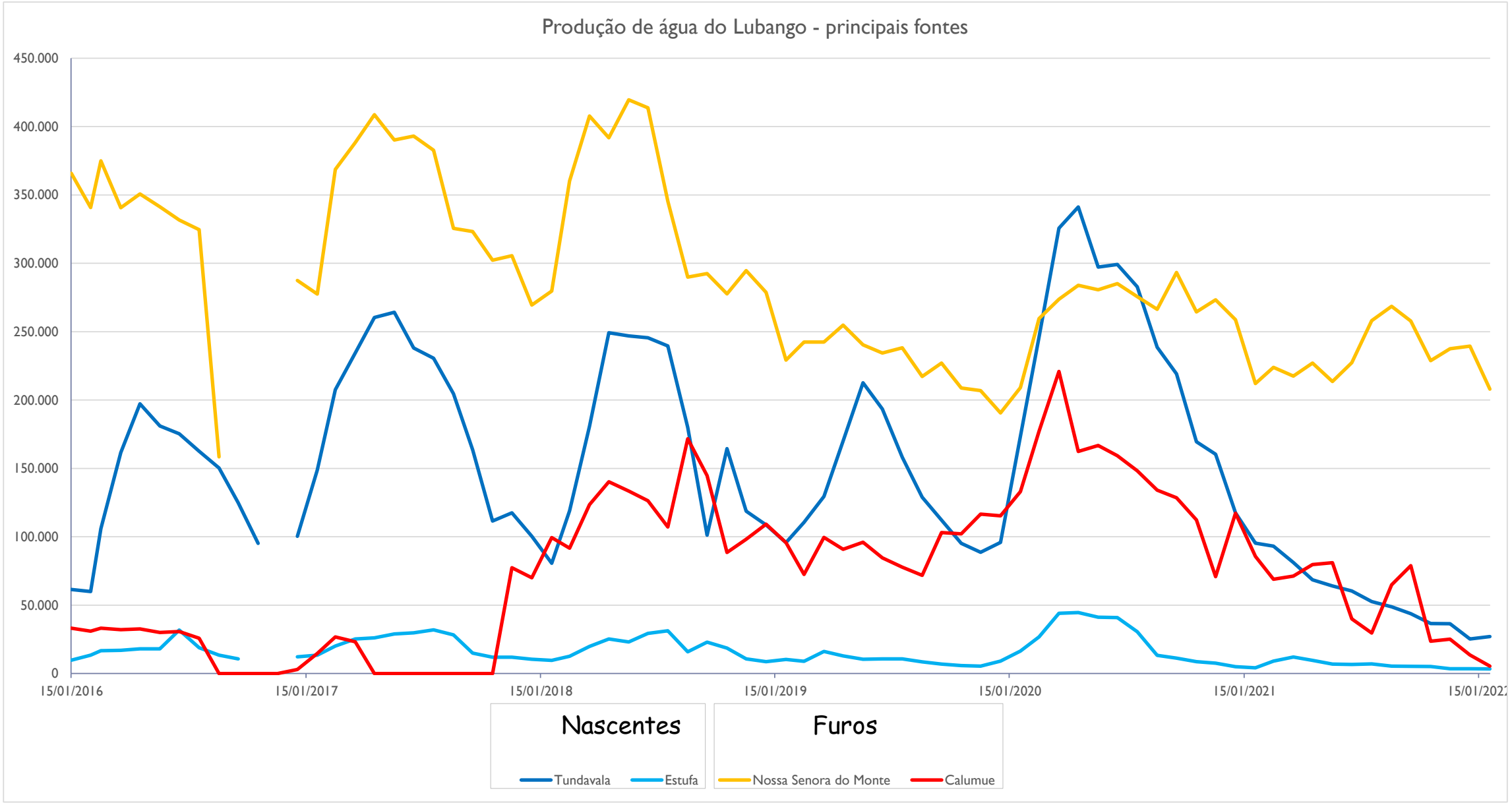


Climate Variability





Seasonality & Trends in Lubango Water Sources



Nature Based solutions. Why sand dams?

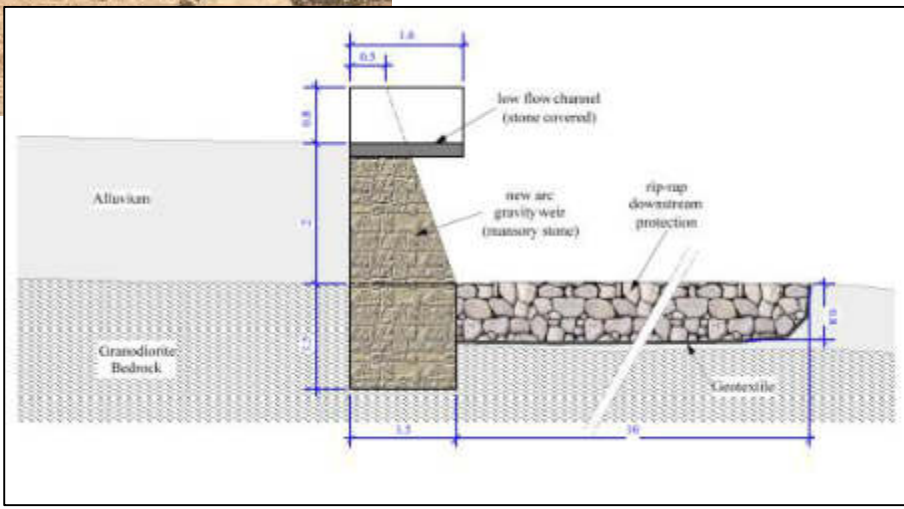
Sand dams are a **cheap & cost-effective** method of water conservation in dryland environments→ their cost in Angola is estimated in less than 50K



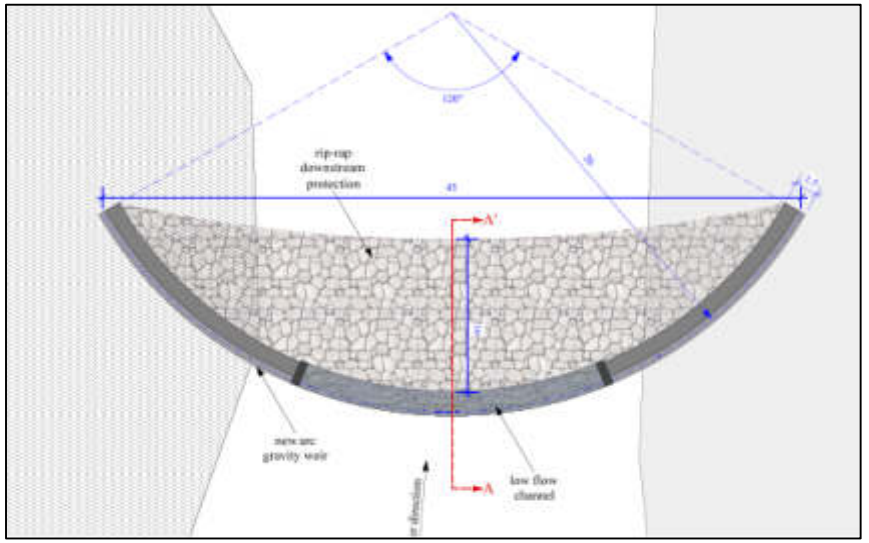
They provide an improved, local and more **dry- season resistant/ drought resistant source of water** for remote, rural areas→ flow lows are buffered like for other storage but, since water is stored in the sand, evaporation is less significant



Sand dams are applicable to most dryland environments, even if they are not common in Angola

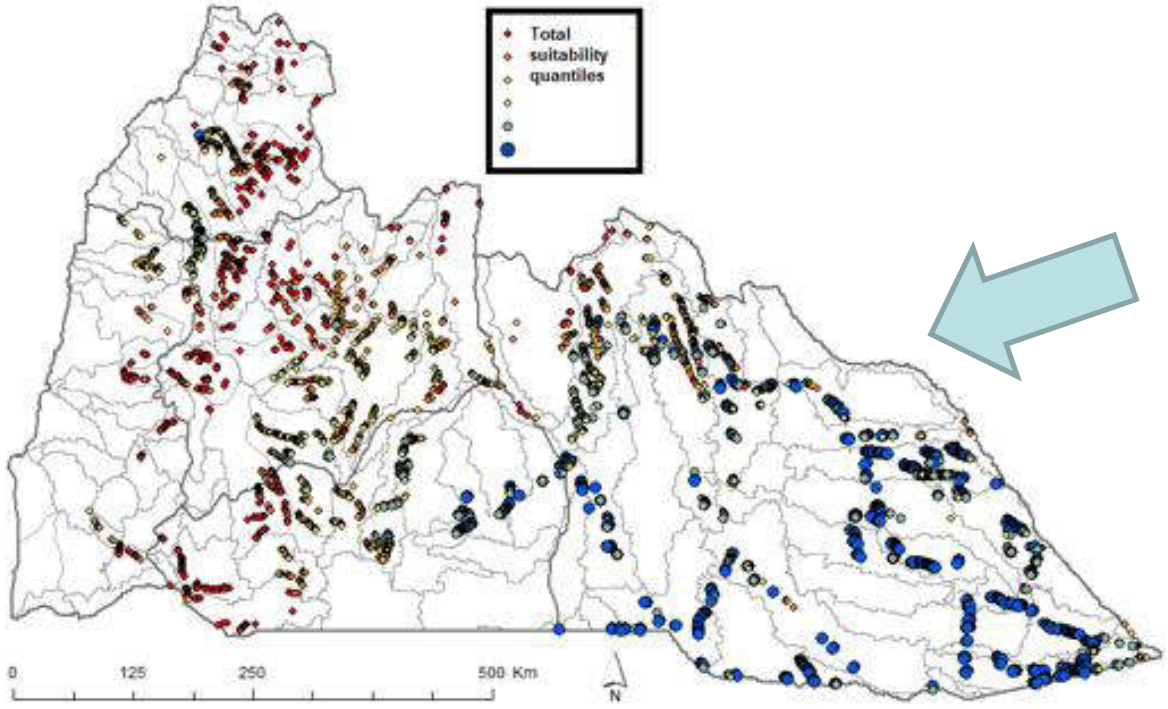


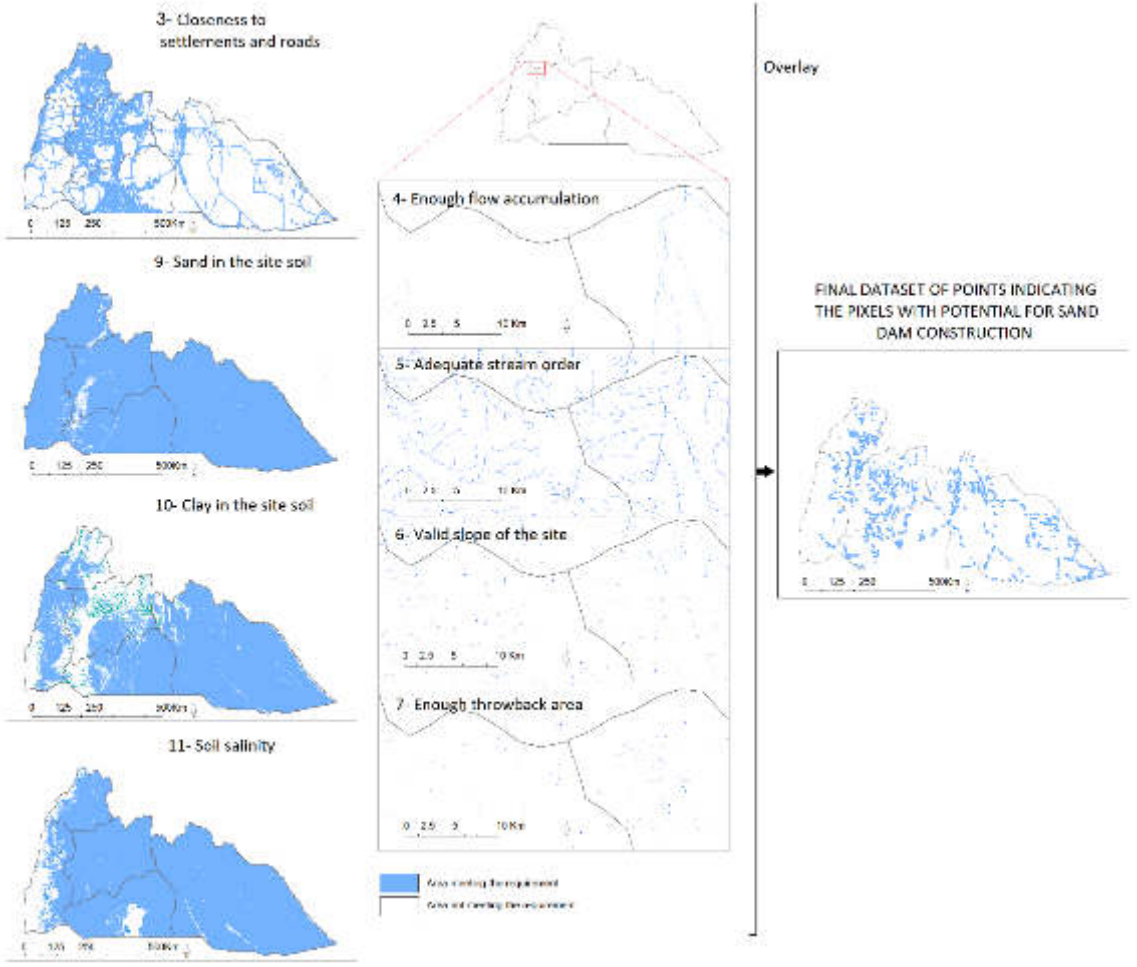
They require a **seasonal river with sufficient sandy sediment**, **enough throwback and bedrock** that is accessible in the river-bed



Sand Dams planning

A GIS tool was developed that, based on hydrological, geomorphological, vegetation, human and soil criteria, identifies potentially suitable locations for the construction of sand dams





Verification of Suitability of Sites for Sand Dams

In order to validate the methodology and its adequacy to the needs of the community, 19 sites identified in the provinces of Benguela and Namibe were studied in depth.

The suitability of a site is based on socioeconomic value, technical feasibility, the volume of water that can be stored and the estimated cost of the infrastructure.

6. SITE CODE: B6

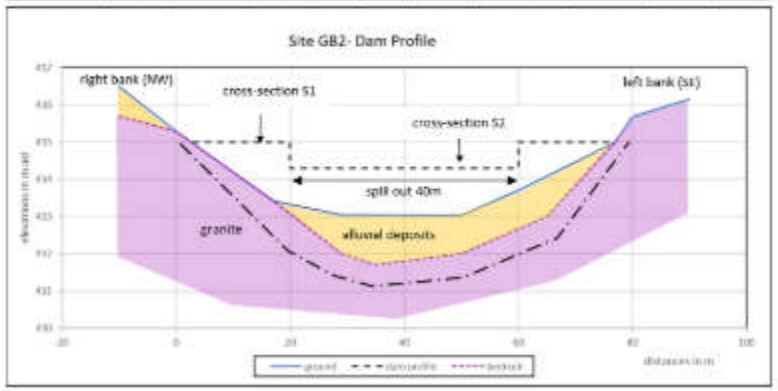
Location: Chongoroi, Chongoroi (Benguela)
Date visited: 09/04/2022
Coordinates: S -13.831033°, E 13.901988°
Elevation: 786 m
Suitability: Positive

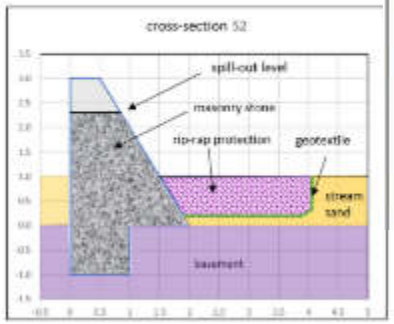


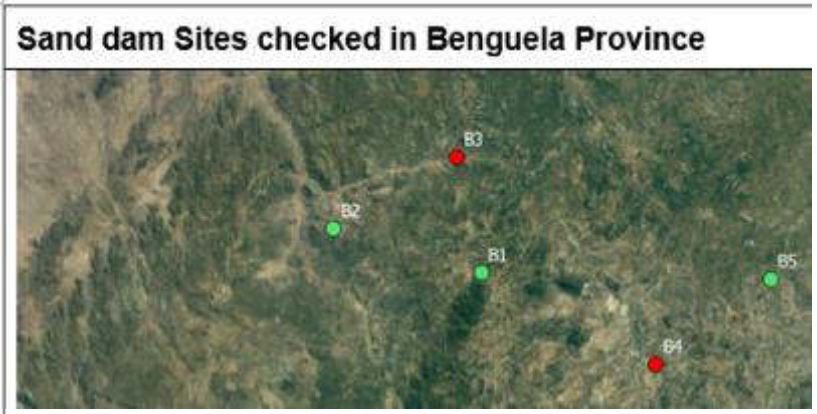




runoff volume	mean yield peak month	runoff days	peak yield	stored water volume	dam lenght	dam height on stream bed	max alluvial thickness	dam wall volume	rip-rap volume
m³/year	m³/sec		m³/sec	m³/flow	m	m	m	m³	m²
2.54E+07	7.2	60	68	3,240	75	2.0	2.0	282	144







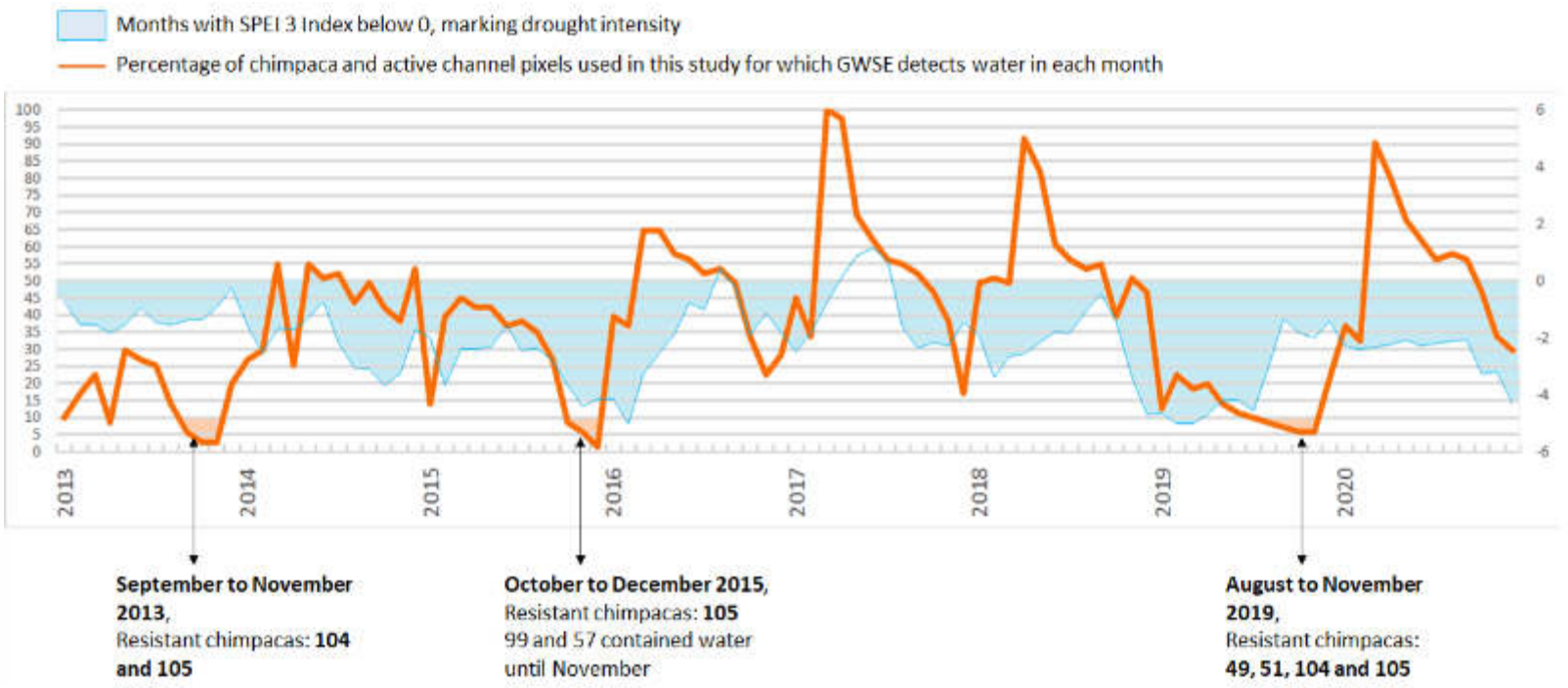
Resilience and water harvesting in improved chimpacas



Overall objective: to determine whether chimpacas can continue to be the main water supply for livestock - and therefore the main source of livelihood - in the Cuvelai, and what can be done (design, rehabilitation, construction and O&M) to improve their operation, so that storage lasts longer

Preliminary study with Global Surface Water Explorer (GSWE)

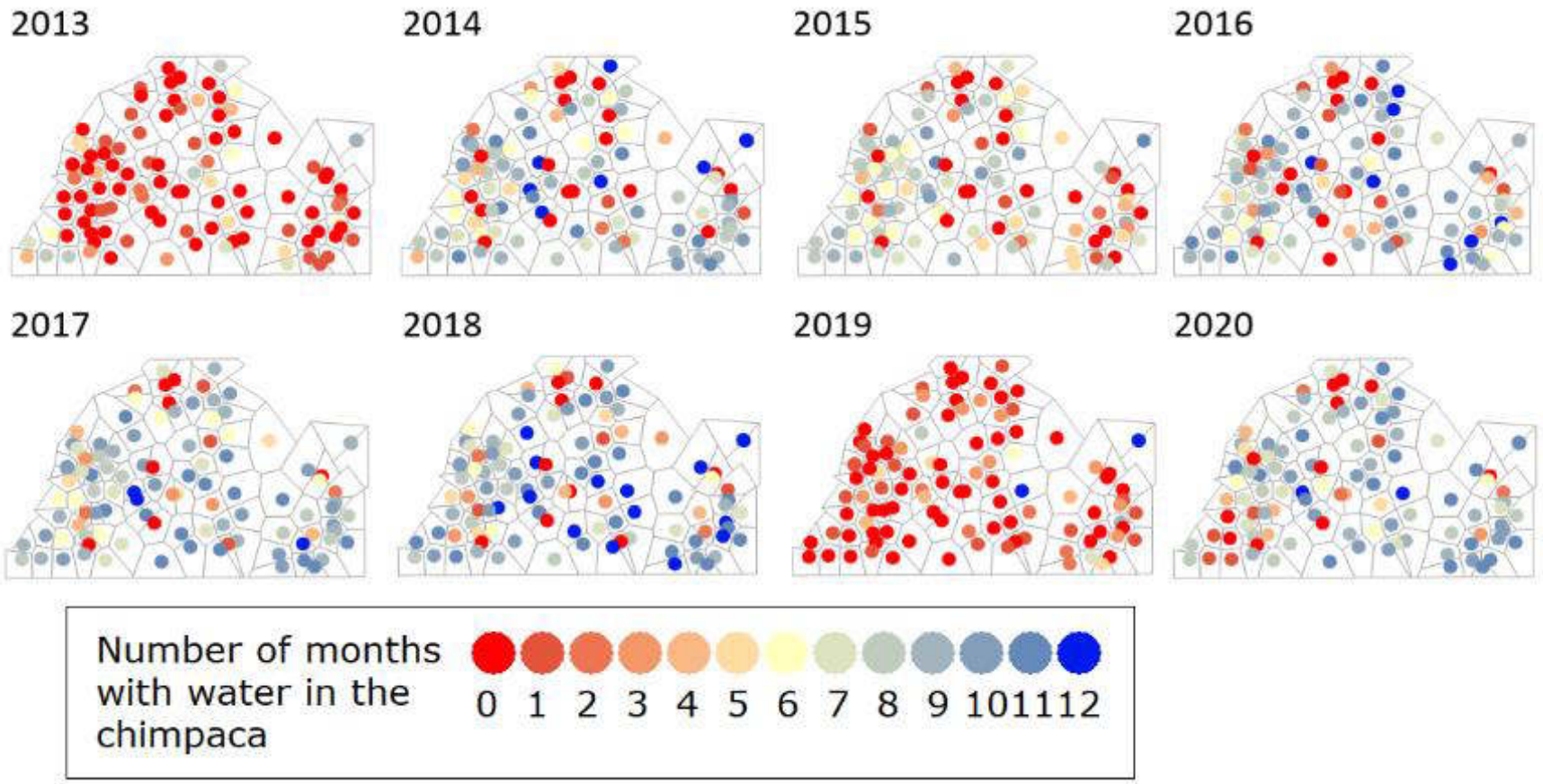
During the worst times of the drought, i.e. 2013, 2015 and 2019, **only a few chimpacas in the entire territory survived** and none of the most active pixels in the surrounding channels (frequently inundated pixels) had water



Drought Chronology in the Chimpacas



The fact that there is high spatial heterogeneity again suggests that it seems possible to have a good chimpaca anywhere in the region if there are adequate design, construction and O&M skills

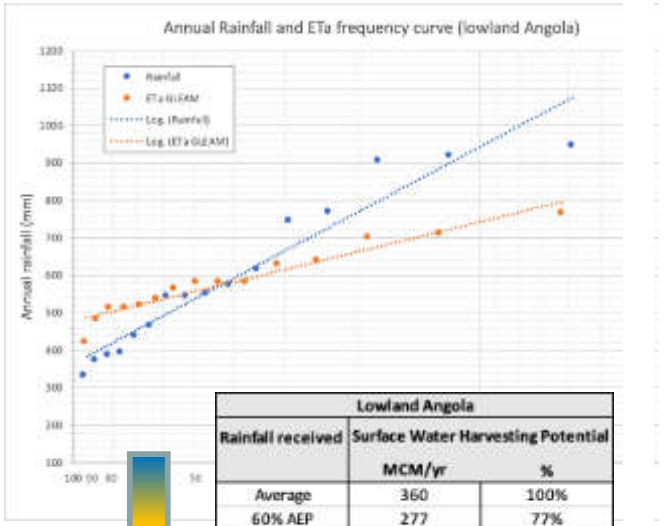


The importance of designing the chimpacas optimally

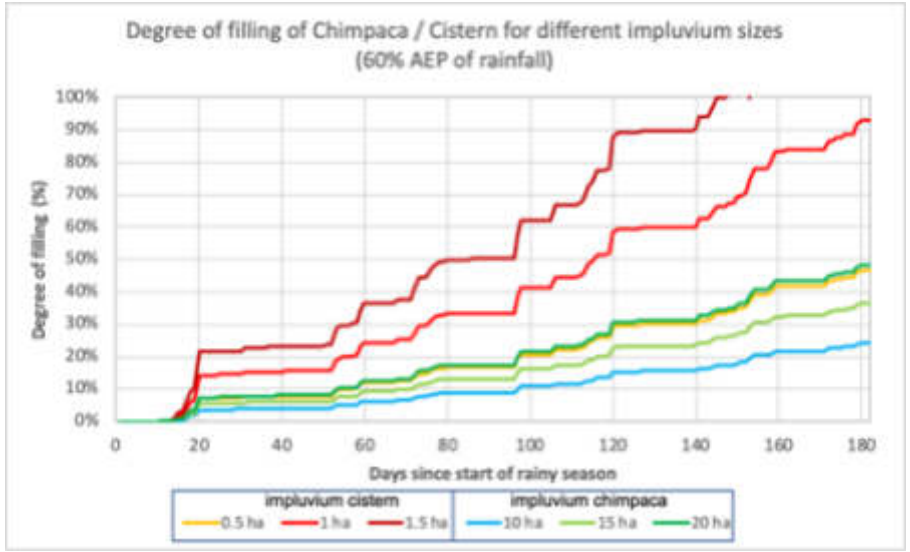
The analysis of the meteorological data series for the Cuvelai shows that in years with less than average precipitation, Evapo-Transpiration rapidly exceeds the amount of Precipitation received in the same year (AEP = ≈45%)

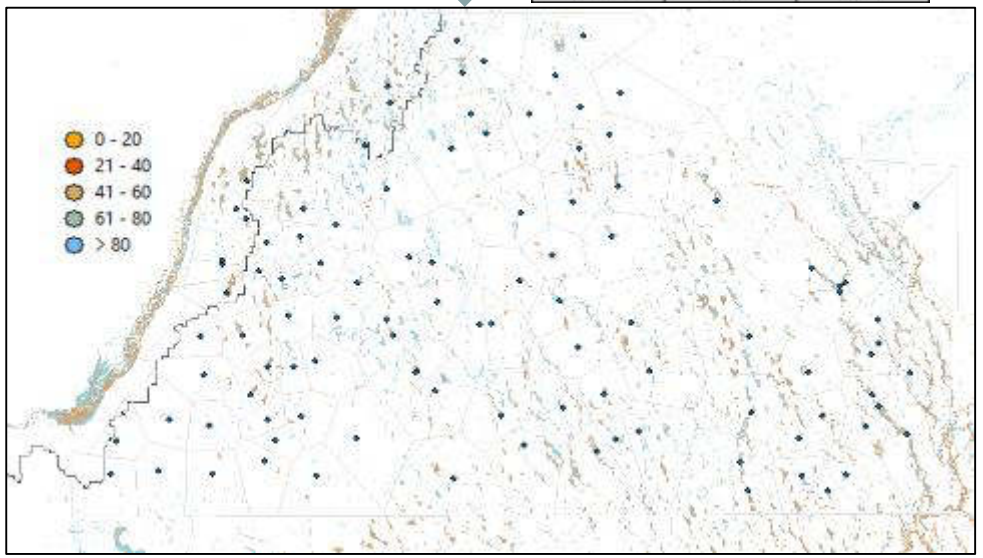
To make chimpacas more drought resistant, it won't help to build more in one place or make them bigger. Resilience can be strengthened:

- Building them deeper
- Planning and designing them adequately so they harvest correctly, so maximum storage is guaranteed in drier times
- Creating O&M mechanisms for keeping the storage capacity



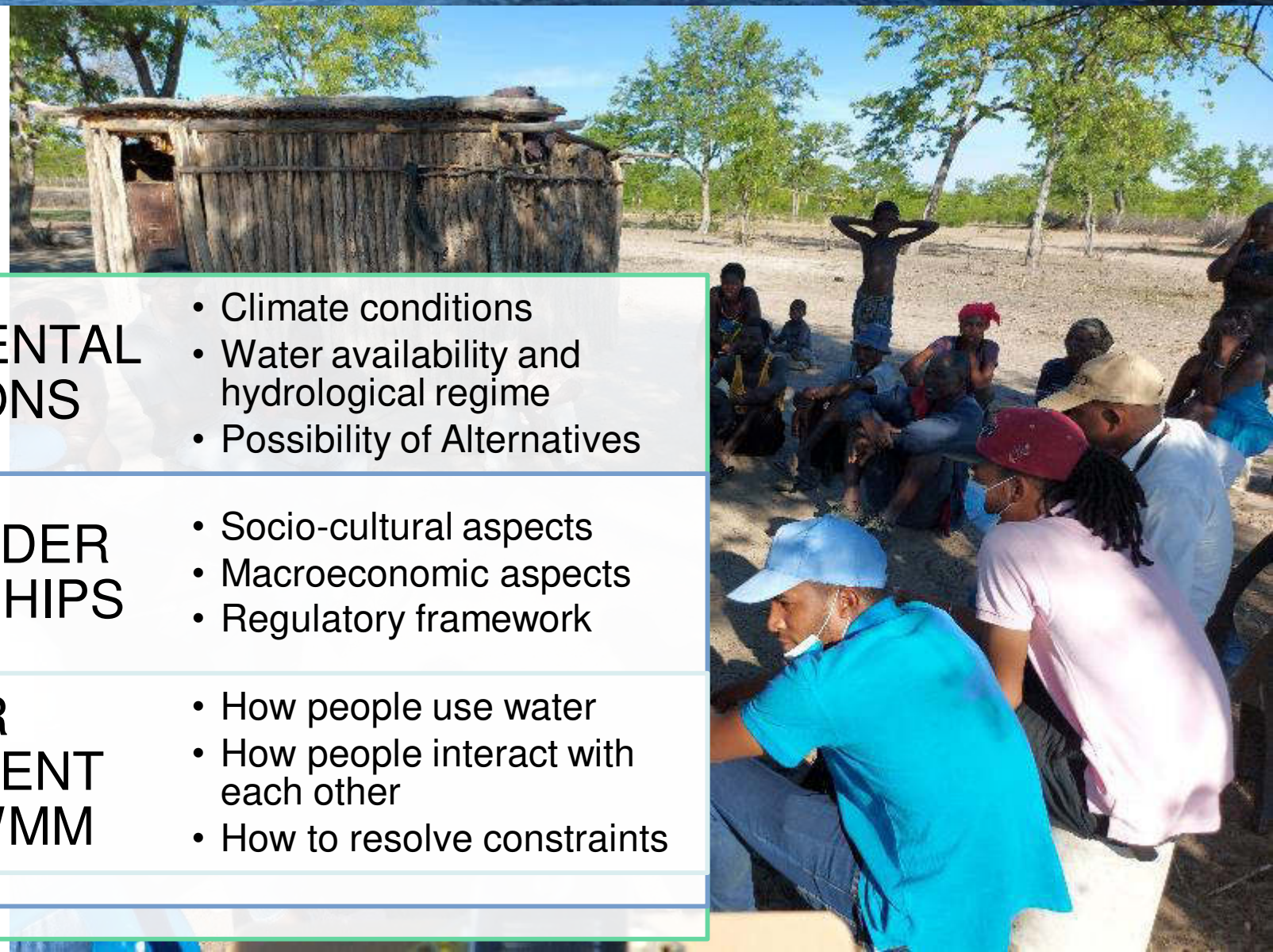
Lowland Angola		
Rainfall received	Surface Water Harvesting Potential	
	MCM/yr	%
Average	360	100%
60% AEP	277	77%
70% AEP	202	56%
80% AEP	169	47%
90% AEP	103	29%





Analysis of water governance models. What to improve ?

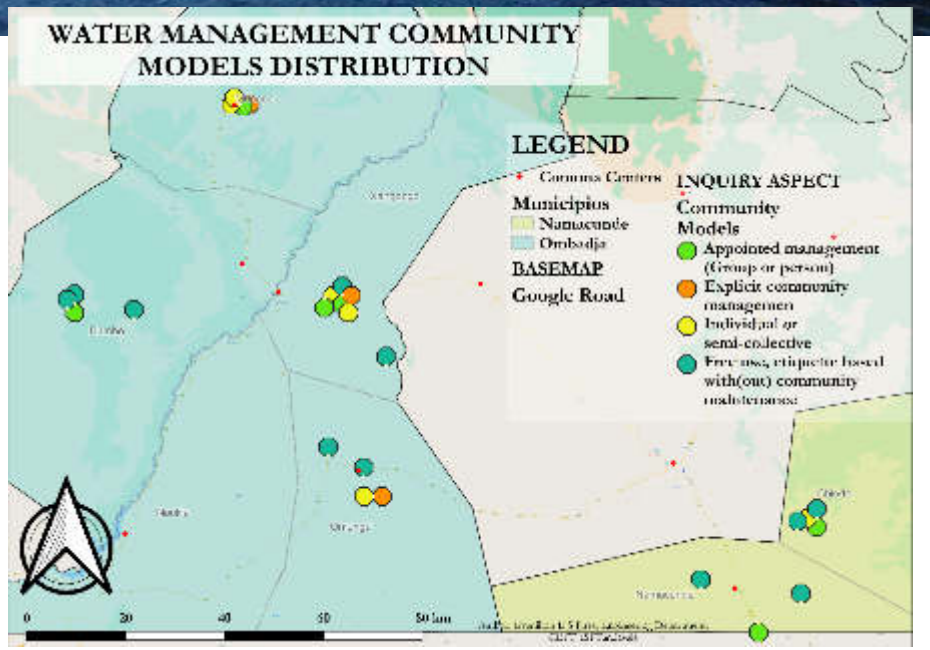
OBJECTIVE: evaluation of existing Water Management Models (WMM), including their strengths, weaknesses, and overall performance, as well as some key relationships with important variables.



ENVIRONMENTAL CONDITIONS	• Climate conditions • Water availability and hydrological regime • Possibility of Alternatives
STAKEHOLDER RELATIONSHIPS	• Socio-cultural aspects • Macroeconomic aspects • Regulatory framework
WATER MANAGEMENT MODEL, WMM	• How people use water • How people interact with each other • How to resolve constraints

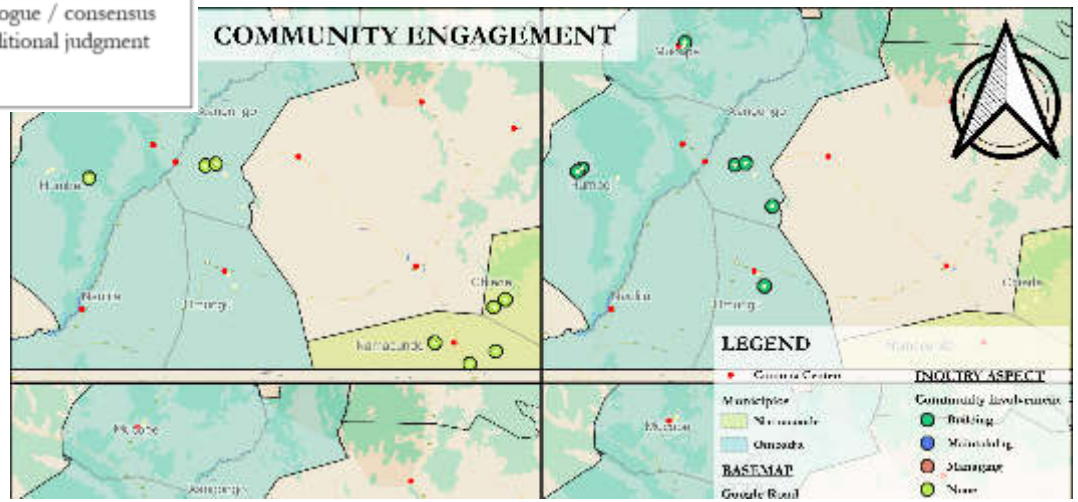
Analysis of Water Governance Benefits & Limitations

MODELS \ ASPECTS	FREE USE		COMMUNITY MANAGEMENT		INDIVIDUAL/ SEMI-COLLECTIVE		APPOINTED MANAGEMENT	
Model benefits	- Provide supply - Reduces conflict - Freedom of use		- Provides supply		- Provides supply - Reduces conflicts - Not prone to overcrowd		- Provides supply - Reduces conflicts - Helps constancy	
Model limitations	- Drought sensitive (very) - Difficult for communities to improve sources (technically) - Prone to unjust consumption - Prone to overcrowd - Prone to trespass		- Drought sensitive		- Risk of difficulty for communities to improve sources (technically and sensitive to financial conditions)		- Difficult for communities to improve sources (technically) - Sensitive to financial conditions - Prone to overcrowd	
Conflict occurrences	**What/How**	**When**	**What/How**	**When**	**What/How**	**When**	**What/How**	**When**
	- Priority disputes - Violence	- Most of the time - Dry season	- Priority disputes	- Dry season	- Dispute - Violence	- Dry season - Dry season	- Priority disputes - Dispute w/ manager	- All the time - Dry season
Reasons	- Overcrowd / Transhumance (scarcity related) - Trespassing		- Overcrowd / Transhumance (scarcity related)		- Trespassing		- Misunderstanding - Disrespect for the rules - Manager absence	
Resolutions	- Dialogue / consensus - Community judgment - Alternative source construction		- Dialogue / consensus		- Dialogue / consensus - Community judgment		- Dialogue / consensus - Traditional judgment	









Outline

1. Introduction, problem statement and some facts about the drought in Angola

2. Preliminary studies, approaches and findings: recommendations of rural water investments

3. New World Bank Project: Resiliencia Climática e Agua em Angola, RECLIMA

4. Challenges for Adaptation and Resilience in Angola



CHALLENGE 1: Frequent water point failure

- Many secure water points (boreholes) are out of order. The most common problems are broken or stolen water pumps, and damaged solar panels.

- Once out of order, water points are rarely repaired, due to a lack of financial resources and access to parts.

- As a result, many communities rely on rudimentary water sources. This leads to unhealthier conditions, more vulnerability to drought, longer trips to fetch water, etc.



CHALLENGE 2: High dependence on unsecure sources (i)

Cacimbas are usually excavated in wadis beds or banks. At the end of the wet season, most of them get dry.

Very unreliable when drought occurs.

Frequently, shared by humans and animals for their drinking water needs (unhealthy sanitary conditions).



CHALLENGE 2: High dependence on unsecure sources (ii)

Chimpacas are used both by human and livestock for their drinking water needs, resulting in unhealthy sanitary conditions.

Efficiency and capacity of *chimpacas* varies widely. Most of them dry up before the end of the dry season.

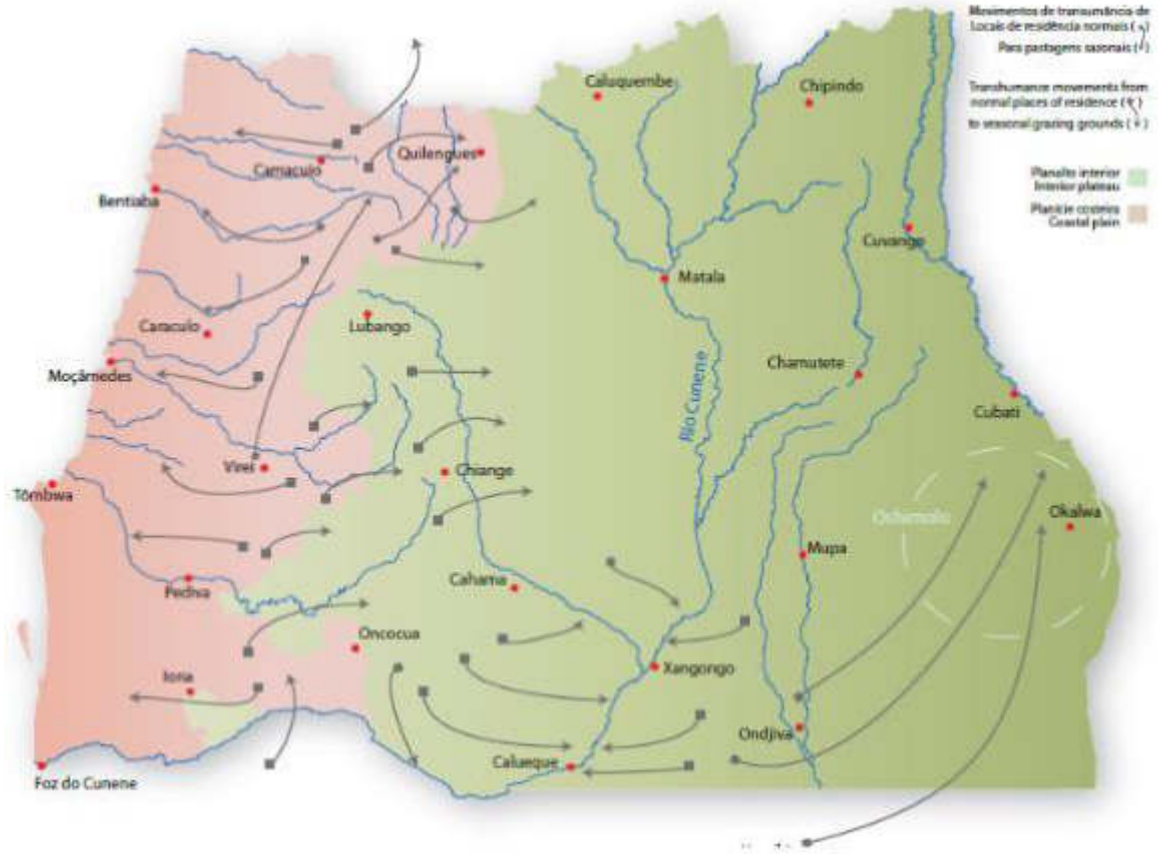
Once *chimpacas* dry up, inhabitants dig holes inside them to use shallow groundwater for remaining months.



CHALLENGE 3: Longer and further transhumance

In southern areas, cattle are moved almost every year in search of water supply and foraging grounds.

When drought intensifies, these movements are over a greater distance and longer period of time. This adds greatly to the limited resources of the receiving areas, and leads to many negative impacts in the origin areas (less work force, etc.).



Based on maps produced by Mateo Tonini. Projecto PIRAN (Projecto Resiliencia Angola Namibia).

CHALLENGE 4: Lack of water point & water resource information

- Water point and WR information is scarce and scattered.
- Although municipalities are required to have inventories of their water points, these lists rarely include precise geographical information
- In the communes where drought is common, the local administrators and water technicians have a vast knowledge of their water points and reasonable knowledge on their WR. The opposite is true when communes are not used to drought

Understanding the existing WR & water infrastructure in a region is essential to recognize priority settlements, or areas, that have development difficulties related to their vulnerability to drought.

CHALLENGE 5: Low institutional capacity and poor water governance



- Institutions lack financial, organizational and human means to implement their mandates
- Lack of experience and specific technical capacity in the implementation of sustainable water resource & water point management practices
- Poor data and information management and sharing practices
- Top-down decision making models and low involvement of local governments and stakeholders in planning, implementation and management of water infrastructure

"General Elections in Angola 2022,
A STEP TOWARDS DEMOCRACY?"

Annual Meeting of the German Round Table on Angola

Berlin, June 8th and 9th, 2022

THANKS!

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