WELCOME TO THE Third International Scientific Conference on Climate Change

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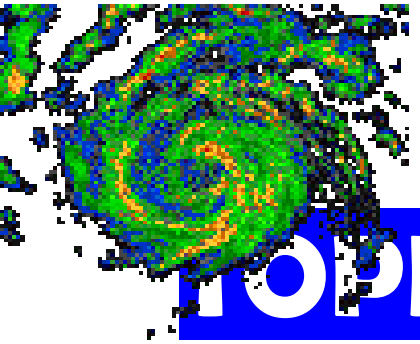
Location: BRAVIA HOTEL

Third International Scientific Conference on Climate Change From September 9 to 11, 2024 in Niamey, Niger Republic

Extreme Climatic Events and Disaster Risk in West Africa and the Sahel



TOPIC: Mapping flood risks using sentinel -1 data: A case study of Niamey, Niger.

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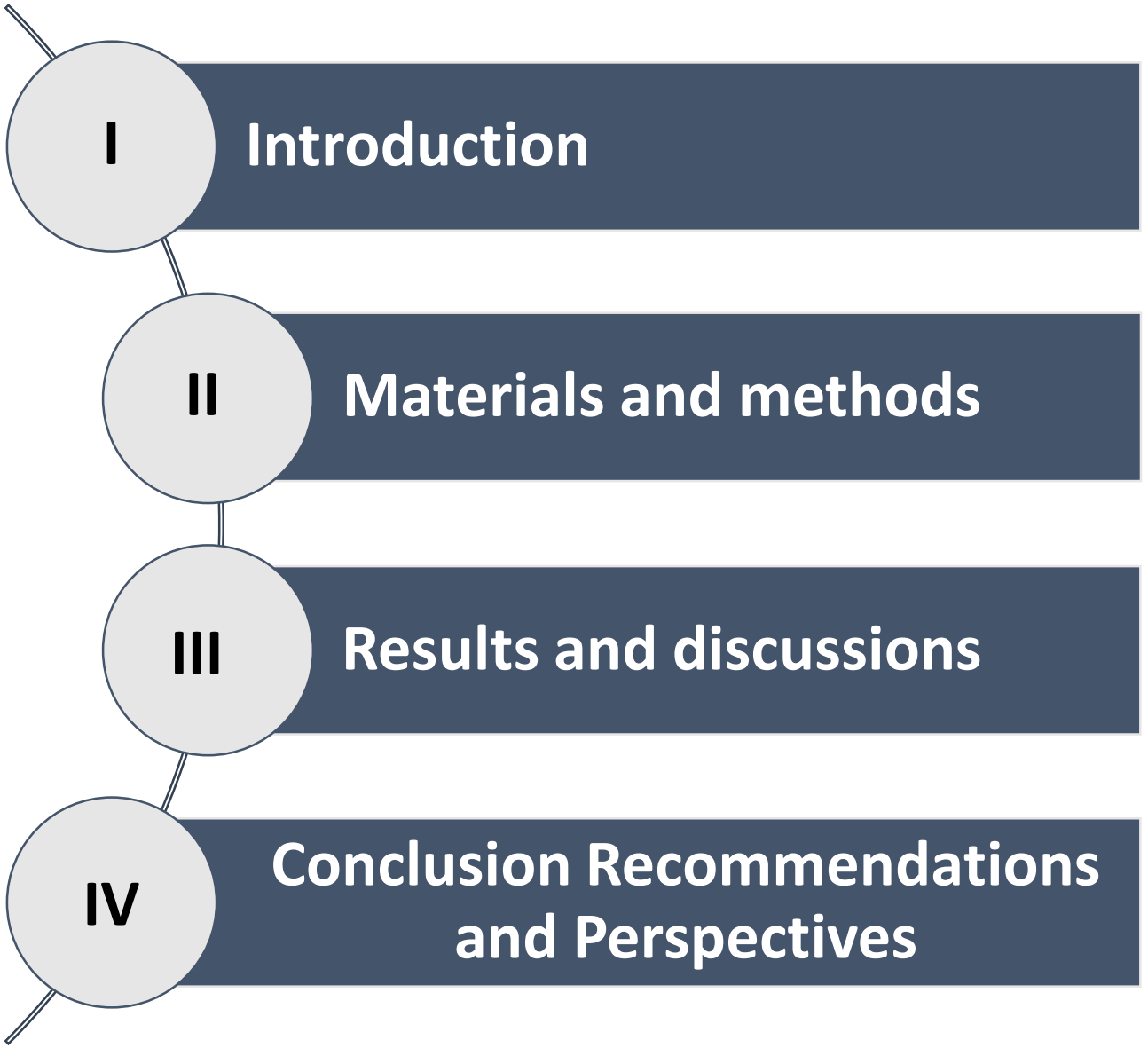
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INTRODUCTION

INTRODUCTION (1/5)

❖ Background

- Flooding has been the most common natural disaster by far, accounting for 43% of all recorded events natural disasters that occurred around the world between 1995 and 2015 which affected a further 2.3 billion people (Guha-Sapir et al. 2016).

- The 2011 World Urbanization Prospects identified approximately 890 million individuals residing in high-risk flood areas, with around 250 cities situated in or near such vulnerable zones.

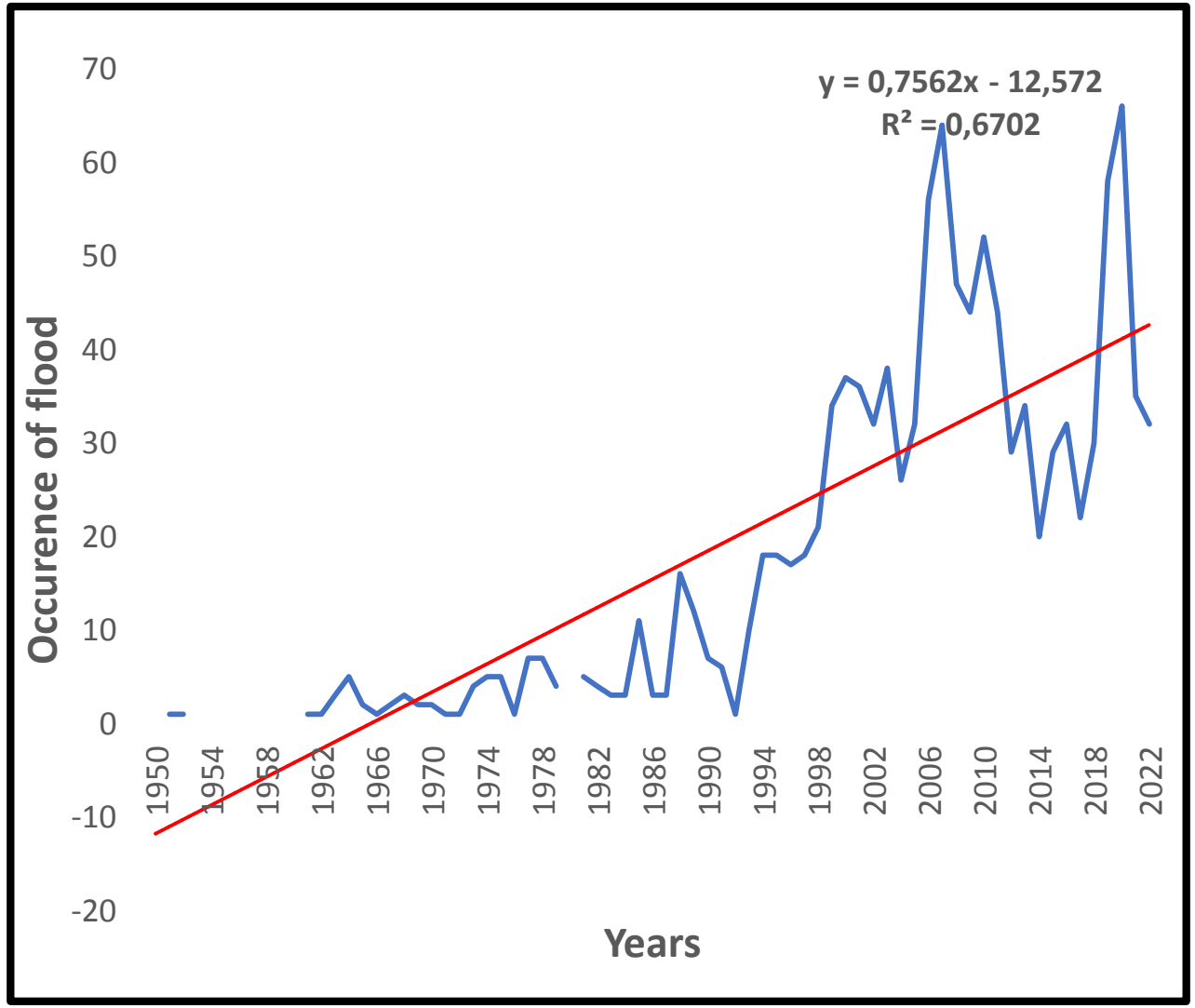


Fig 1: Flood trend in Africa (EM Data 2022)

INTRODUCTION (2/5)

❖ Problem statement

- In Niger republic flood is the most common disaster, frequently accompanied by loss of lives, properties and croplands and affect the livelihood of people, health, production, communication system, and ecosystems, with major impacts on human security.

Fig 2: Compound flooded

Fig 3 : House collapsed

Fig 4 : School compound flooded

Fig 5: Community leaving

- From 1998 to 2020, a total of 3,115,290 people in 7,100 localities were affected with more than 225,000 houses destroyed, losses of 205,000 hectares of crops and 46,540 TLU. (SAP, 2021)

INTRODUCTION (3/5)

❖ Problem statement

- In 2020, 119,809 people affected in Niamey (Tarchiani et al., 2021).

Fig 6: Main road flooded

Fig 7: AGRHYMET Compound flooded

Fig 8: District flooded

- To fill this gap, the present study titled **“: Mapping flood risk using sentinel -1 data: A case study of Niamey, Niger.**

Fig 9: Levee broken

INTRODUCTION (4/5)

❖ Aim and objectives

❑Main objective

This study aims to map potential flood areas after the 2020 flash flood using unsupervised classified sentinel 1 SAR images from the European Space Agency. We used the Digital Earth Africa Sandbox platform to get and analyse the results for the research purpose

INTRODUCTION (5/5)

➢ Study area

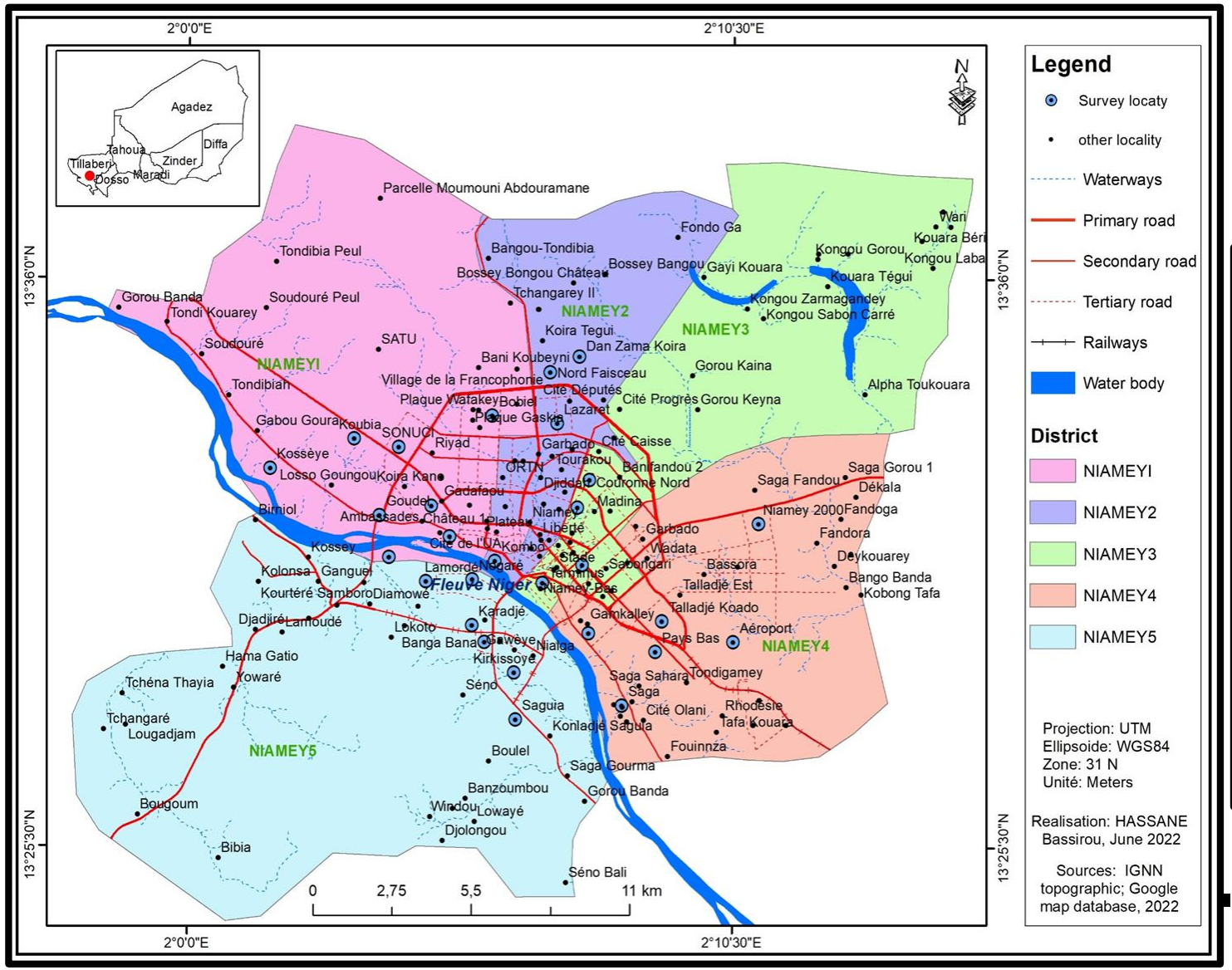


Fig 10: Location map of Niamey

- 13° 28 and 13 ° 35 north latitude
- 2 ° 03 and 2 ° 10 east longitude.
- 180 and 250 m above sea level.
- 555 km²; 1, 203, 766 hbt INS 2018
- Sahelian climate, 400 mm

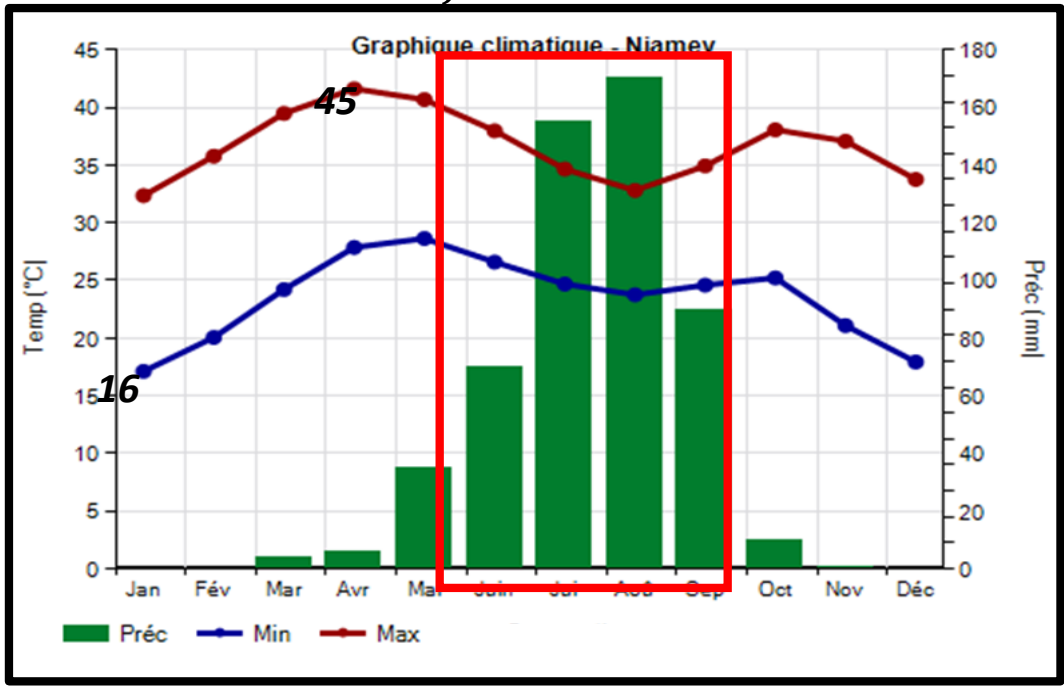


Figure 11: Average monthly Rain Fall and Temperature 1990 2020

- This river is the main source of water, Average of 2365 m³/s in floods and 5 m³/s during low flow.

MATERIALS AND METHODS

MATERIALS AND METHODS (1/4)

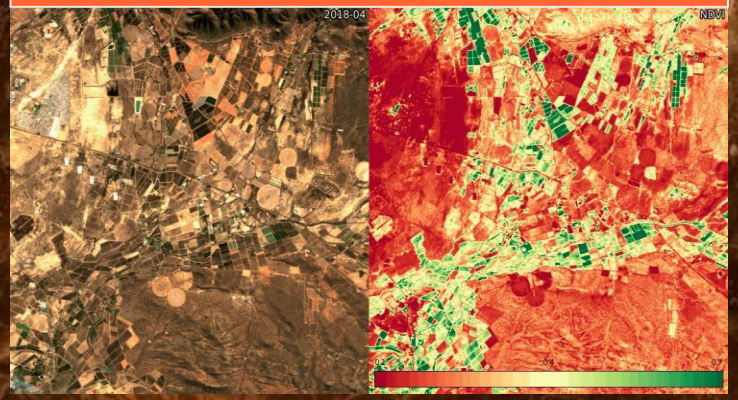
DE Africa provides Sentinel-1 data acquired in Interferometric Wide Swath (I.W.) mode and with dual polarisation (V.V. and V.H.). The dual polarisation backscatter time series can be used in applications for forests, agriculture, wetlands, and land cover classification. SAR's ability to see through clouds makes mapping and monitoring land cover changes in the wet tropics critical.

Satellite-based flood monitoring is a powerful tool to map inundated areas and distinguish water, vegetation, and urban settlements

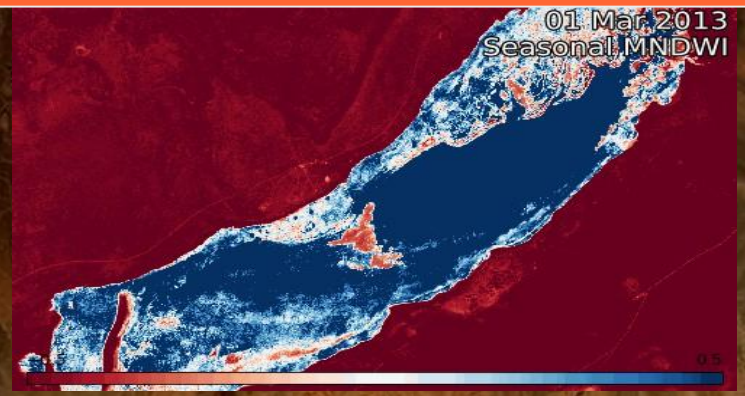
Our Vision

DE Africa provides a routine, reliable and operational service, using Earth observations to deliver decision-ready products enabling policy makers, scientists, the private sector and civil society to address social, environmental and economic changes on the continent and to develop an ecosystem for innovation in all sectors.

Agriculture and food security



Water resources and risks flood



Soil degradation

Urbanization

Coastal erosion

Eye of Sahara: Credit: Contains modified Copernicus Sentinel data 2021, processed by Digital Earth Africa.

Digital Earth AFRICA

MATERIALS AND METHODS 3/4

There are many ways to access DE Africa data:

Show data	**FROM Africa Map**	Digital Earth AFRICA MAP	http://maps.digitalearth.africa/
Analyze the data	**FROM Africa Sandbox**	Digital Earth AFRICA Digital Earth Africa Sandbox	https://sandbox.digitalearth.africa/
Other platforms:			
Access in GIS software	OWS Map Services		https://ows.digitalearth.africa/
Learn how to access data and to analyze them	Digital Earth Africa Learning Platform		https://learn.digitalearthafrica.org/

MATERIALS AND METHODS (4/4)

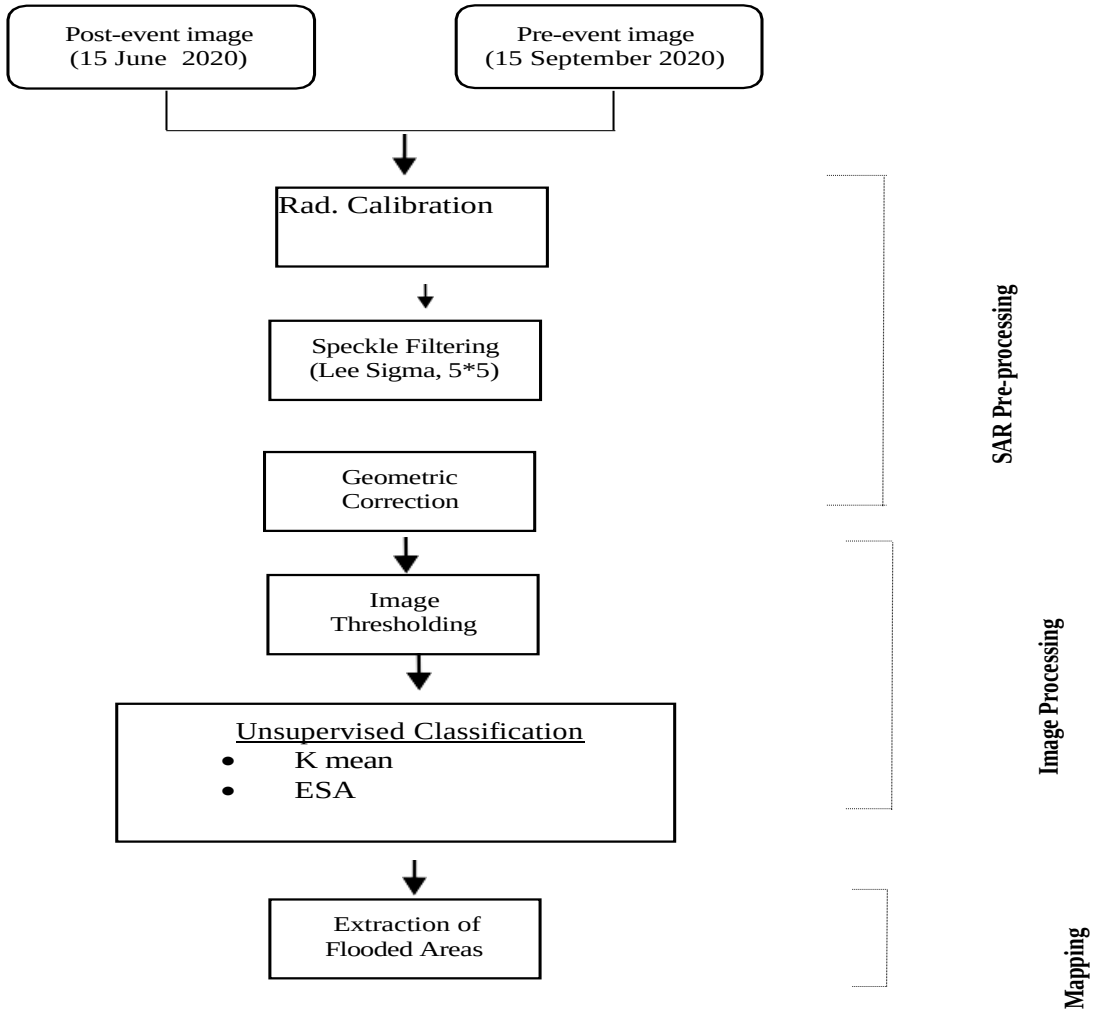


***Figure 1 Flowchart of the methodology adopted from*(Tavus et al., 2019)**

RESULTS AND DISCUSSIONS

RESULTS AND DISCUSSION (1 /19)

The overlapping of the recorded inundated area on the classified land cover map demonstrates that the flood could be affected approximately 149.541 Km^2, Built-up area highly prone to flooding: 18.325 km^2, Cropland area highly prone to flooding: 26.252 km^2, Built-up area medium prone to flooding: 79.318 km^2, Cropland area medium prone to flooding: 13.26 km^2,

Built-up area unaffected to flooding: 8.724 km^2, Cropland area unaffected to flooding: 3.662 km^2

This should be in your introduction

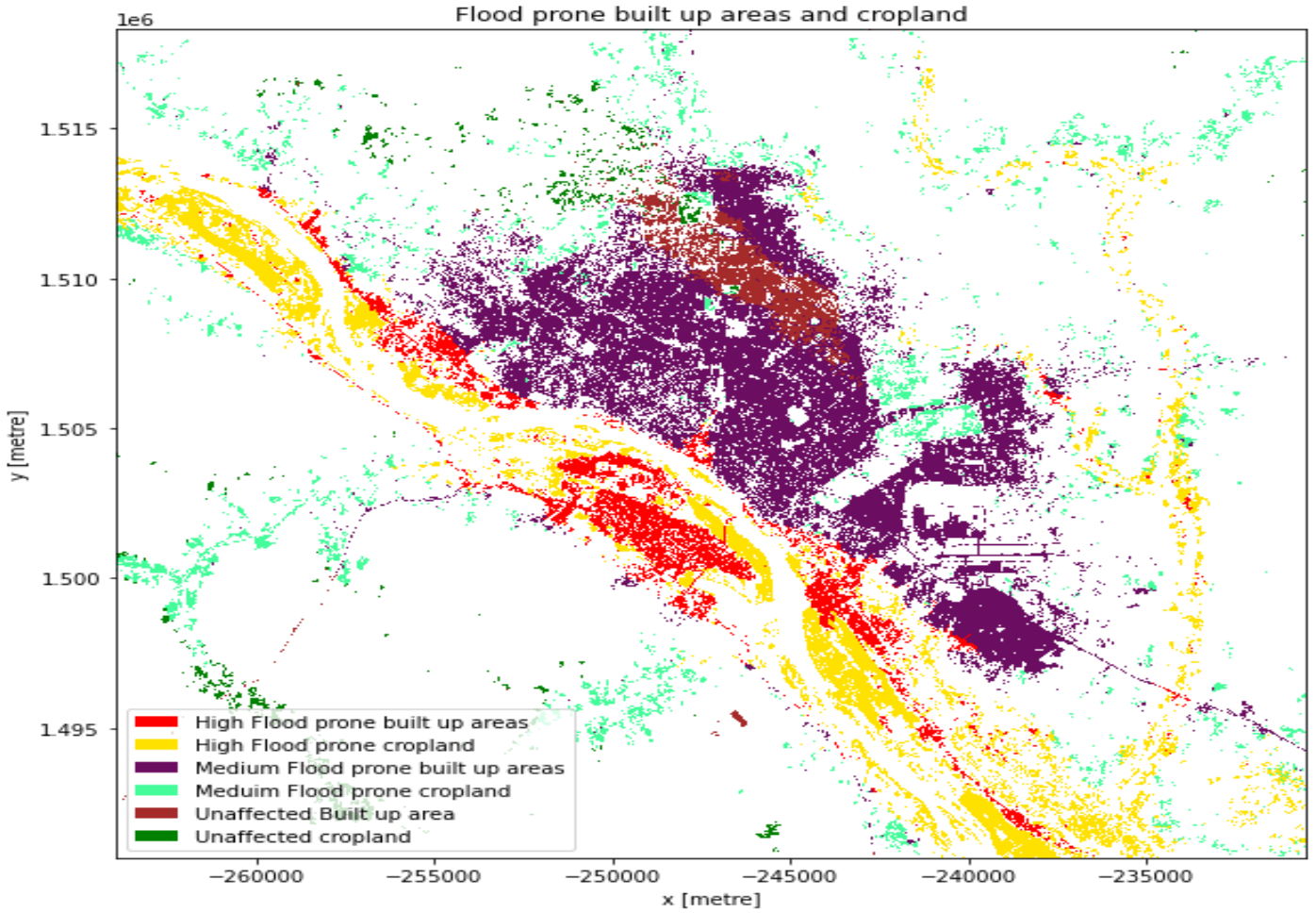


Figure: Flood prone built-up areas and cropland

RESULTS AND DISCUSSION (1 /3)

Sentinel-1 Synthetic Aperture Radar (SAR) data has proven effective for flood mapping, especially during heavy rainfall, as it operates in all weather conditions and penetrates cloud cover.

The 2020 Niamey floods underscored the need for better flood risk management. Similar trends were observed in South and Southeast Asia, where studies by Brackenridge et al. (2017) and Kuenzer et al. (2015) link increasing floods to climate change.

Bangira et al. (2021) demonstrated using Sentinel-1 SAR for real-time flood monitoring in Namibia, integrating SAR with local observations to improve flood map accuracy and response.

RESULTS AND DISCUSSION (2 /3)

While Sentinel-1 SAR data is highly effective for flood monitoring, there are some limitations to its use:

Limited Temporal Resolution: Although Sentinel-1 has regular revisit times (6–12 days depending on location), it may not provide the frequency needed for real-time monitoring during rapidly evolving flood events.

Complex Data Processing: SAR data requires advanced processing techniques to interpret, including correction for noise, speckle, and terrain effects, which can be time-consuming and require specialized expertise.

Despite these limitations, Sentinel-1 SAR remains a valuable tool for flood mapping and risk management.

RESULTS AND DISCUSSION (3/3)

❑ Flood risk mapping

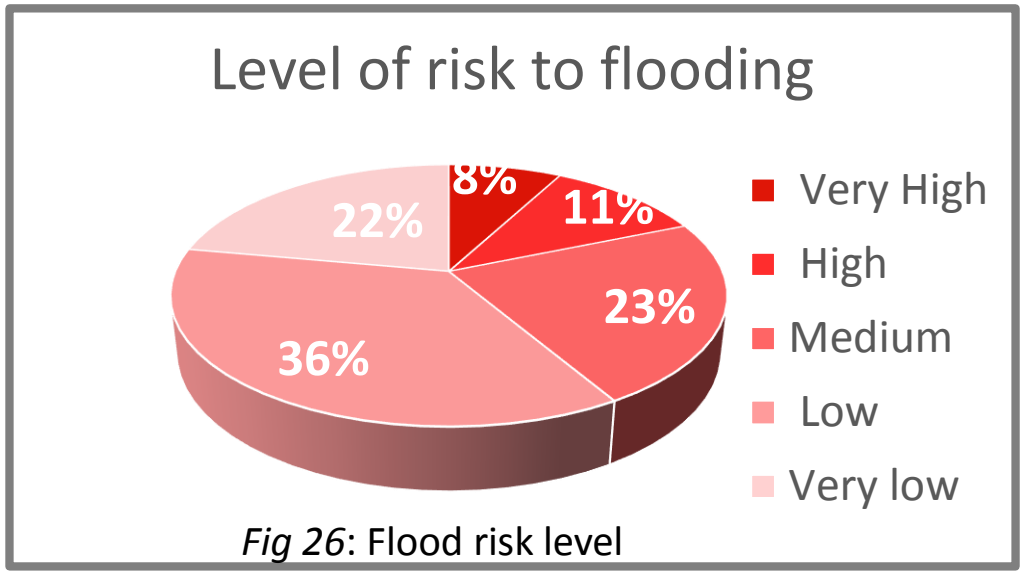


Fig 26: Flood risk level

- High and very high-risk zones is Niger River's alluvial plains 19%
- Moderate-risk areas with significant consequences due to their proximity to high-risk zones at lower elevations (23%)
- Very low and low-risk zones, comprising 58% of the Commune: minimal flood probability;

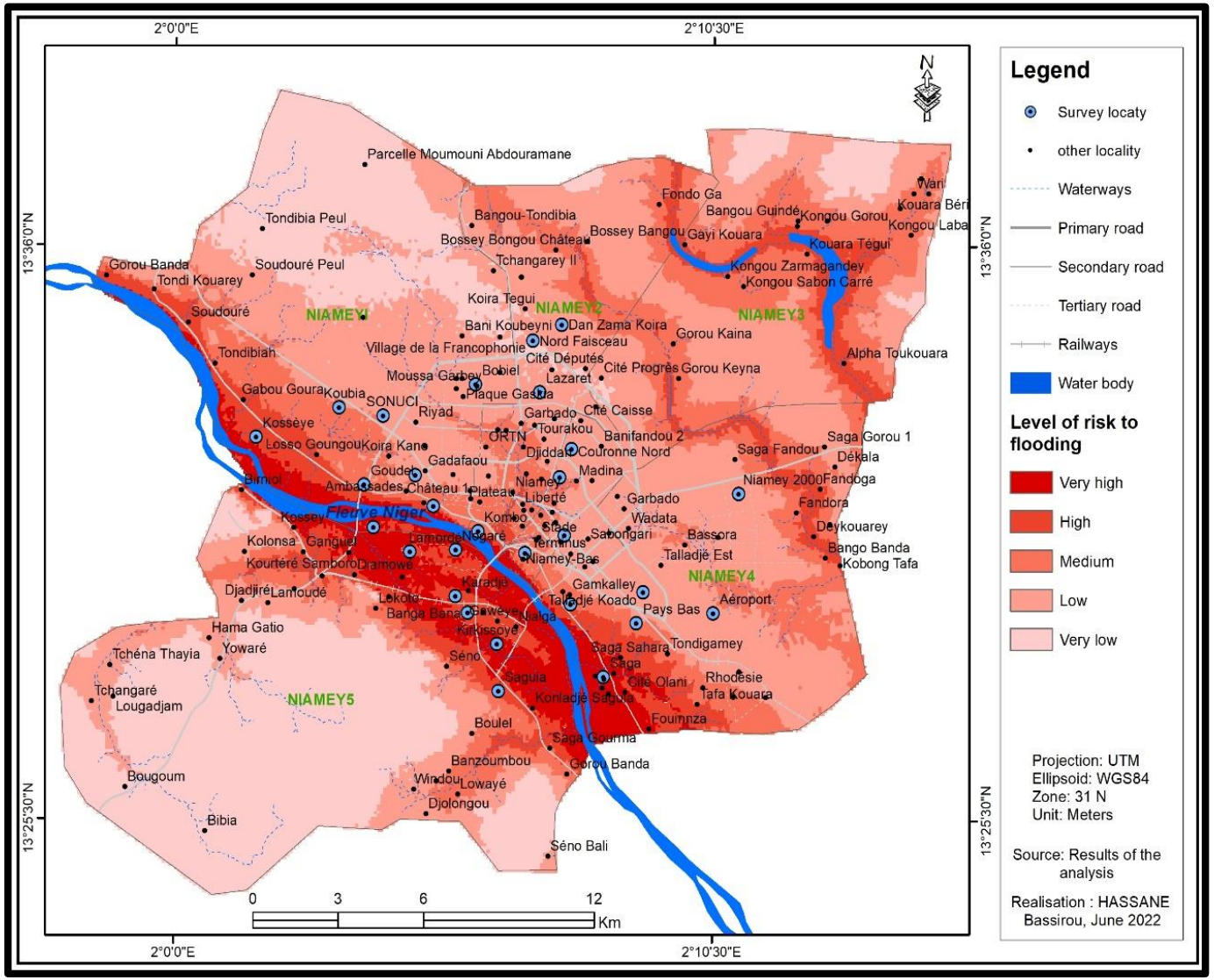


Fig 27: Flood risk map

CONCLUSION, RECOMMENDATIONS AND PERSPECTIVES

CONCLUSION, RECOMMENDATIONS AND PERSPECTIVES 1/3

❖ CONCLUSION

The research findings reveal that both the urban and agricultural sectors of Niamey are vulnerable to flooding. Several key factors contribute to this vulnerability:

1. **Inadequate Drainage Systems**
   Niamey's drainage infrastructure is insufficient to handle even moderate levels of rainfall. This limitation leads to significant surface water accumulation, exacerbating the risk of flooding. In contrast, other cities with better drainage systems are more resilient to similar rainfall conditions.

2. **Rapid Urban Growth Without Comprehensive Planning**
   Niamey's rapid metropolitan expansion has often occurred without the necessary comprehensive planning. As a result, many new developments have been established in flood-prone areas, including floodplains. These high-risk zones, which should ideally remain undeveloped, become more populated, increasing the likelihood of flood damage.

3. **Encroachment into Flood-Prone Areas**
   Informal settlements have increasingly been established in sensitive zones, particularly floodplains. These unplanned settlements lack the infrastructure and resources to withstand severe weather events, thereby heightening the danger to human life and property during floods.

CONCLUSION, RECOMMENDATIONS AND PERSPECTIVES1/3

❖ RECOMMENDATIONS

Niamey's flood resilience depends on collaborative efforts among government, urban planners, environmental organizations, and local communities. By maintaining and implementing effective flood risk reduction methods, they can create a more resilient and flood-resistant city, ensuring the safety of residents and supporting sustainable development..

1. Elaboration of an adequate city management plan;
2. Strengthen Emergency Response Capacity;
3. National Flood Insurance Programme;
4. Improving Data Collection and Modelling;
5. Strengthen International Cooperation;
6. Encourage Nature-Based Solutions.

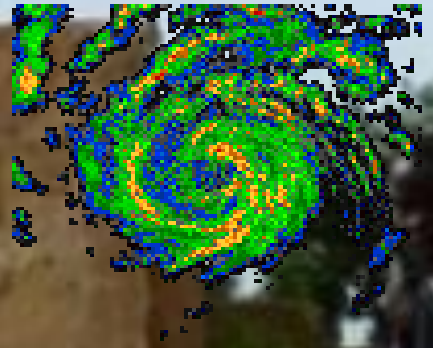
CONCLUSION, RECOMMENDATIONS AND PERSPECTIVES 3/3

❖ PERSPECTIVES

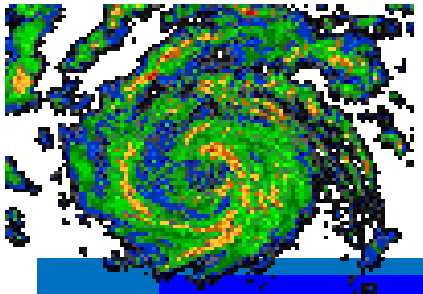
- **To enhance flood risk reduction, research using SWAT and FANFAR methodologies, gaining novel insights for a thorough examination of critical mitigation aspects.**

- **additional research should be carried out across various flood-prone regions within Niger and its neighbouring sub-regions;**

- **Explore how emerging technologies such as artificial intelligence enhance the precision and scope of future studies in flood disaster risk assessment;**



THANK YOU FOR YOUR ATTENTION



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Q & A Session