



Exploration of the statistical relationships between rainfall indices and cotton yields in northern Cameroon, to strengthen the resilience of farmers to climate change.

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Jérémy LAVARENNE
Frédéric ROSSEL**

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OVERVIEW

I. Context

II. Objective

III. Materials and Methods

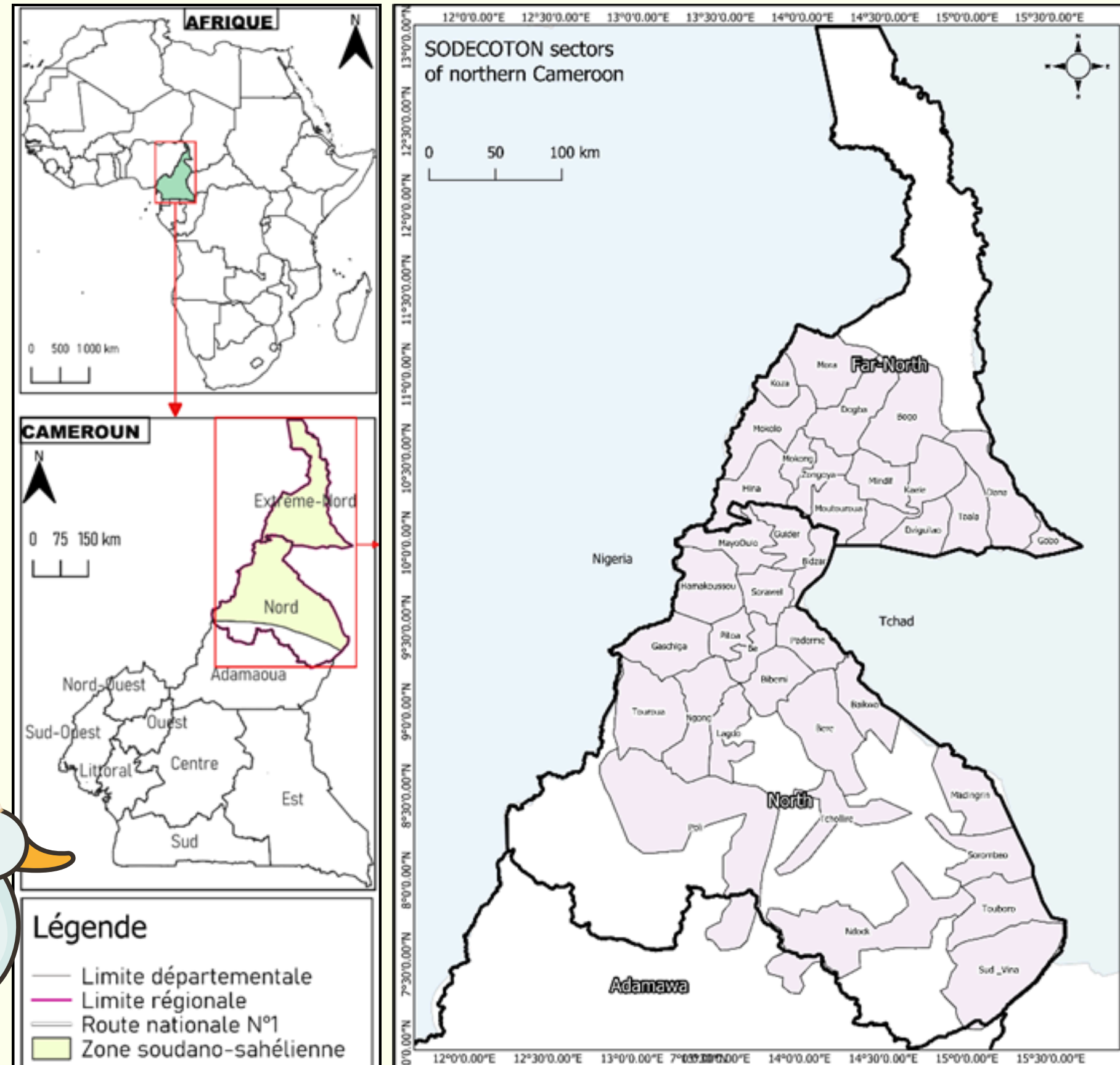
IV. Results

V. Discussion

VI. Corrigendum

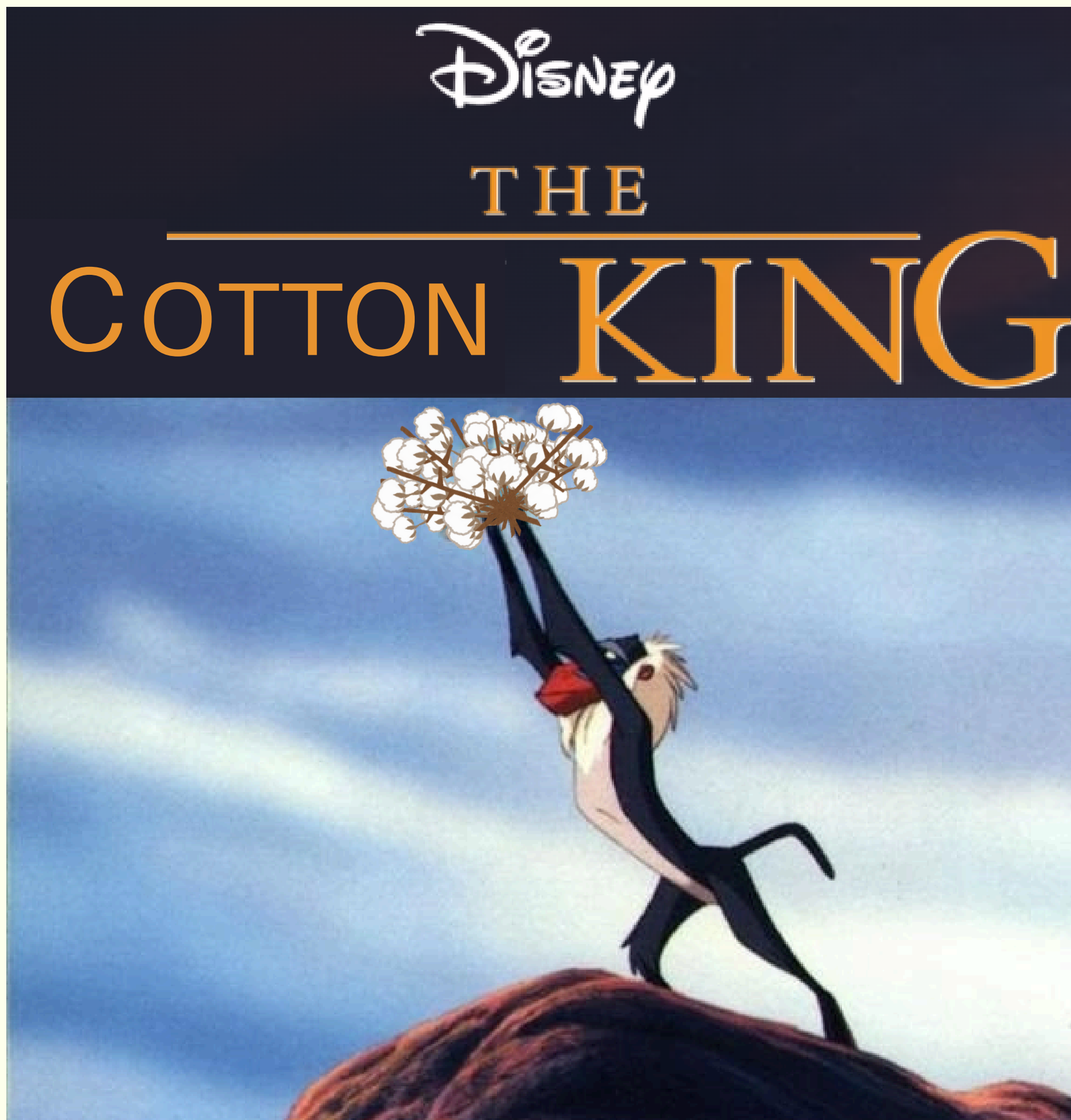
VII. Conclusion

CONTEXT

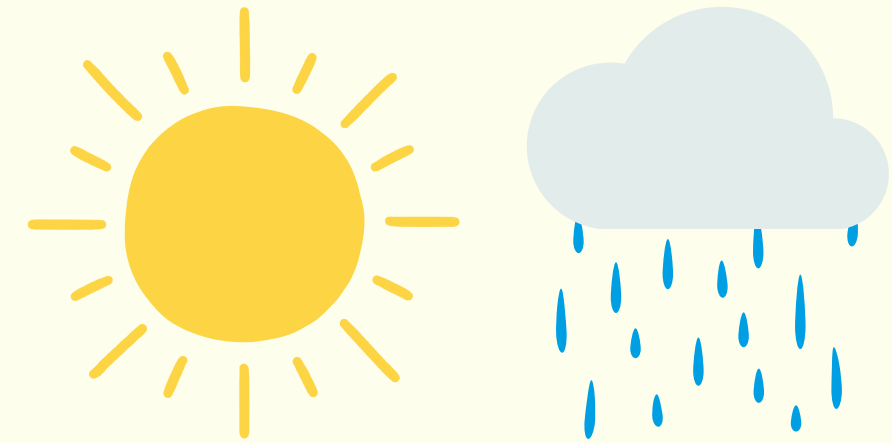


Northern Cameroon:

- North and Far North regions
- 900 to 1300 mm of rainfall
- 21 to 35 °C

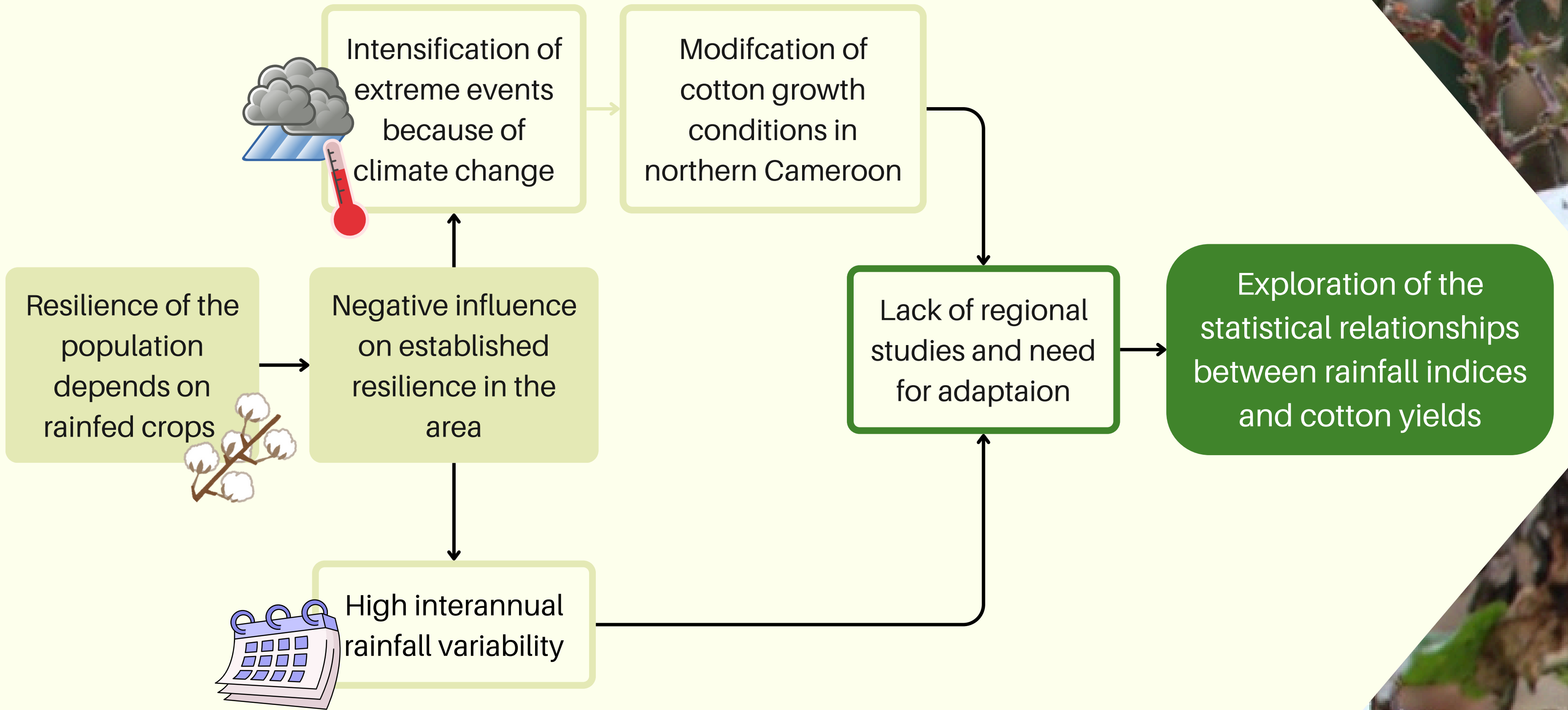


Conditions:



Economic Significance:

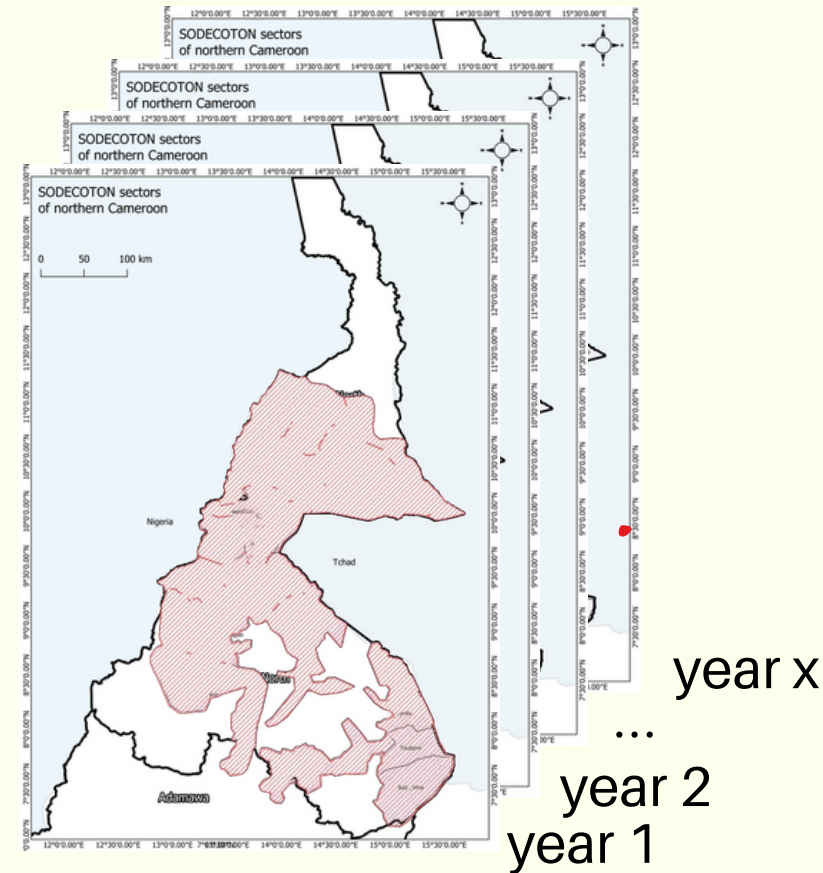
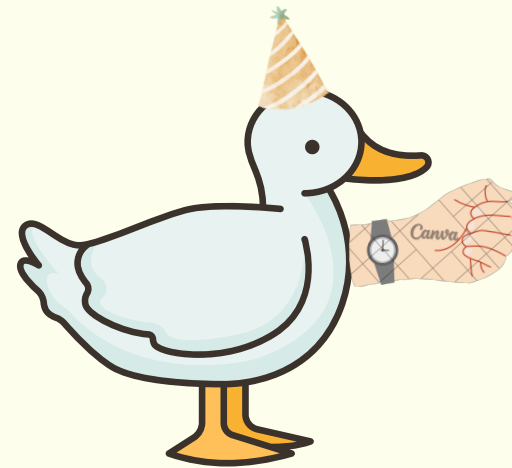




Context regarding the Master thesis

25 indices
analysed
between
1991 and
2010:

**Temporal
dimension:**



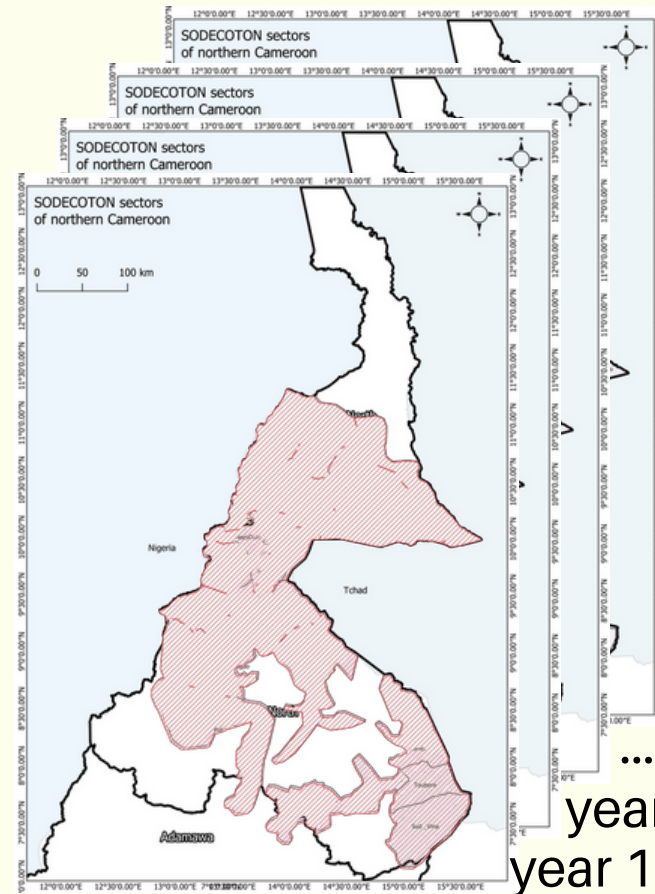
Spatial aggregated
cotton yield and index
values for the entire
area for every year

**Spatial
dimension:**



Temporal aggregated
cotton yield and index
values for each sector
for the entire time
period

Correlation between seasonal rainfall amount and cotton yields:



Temporal
dimension:

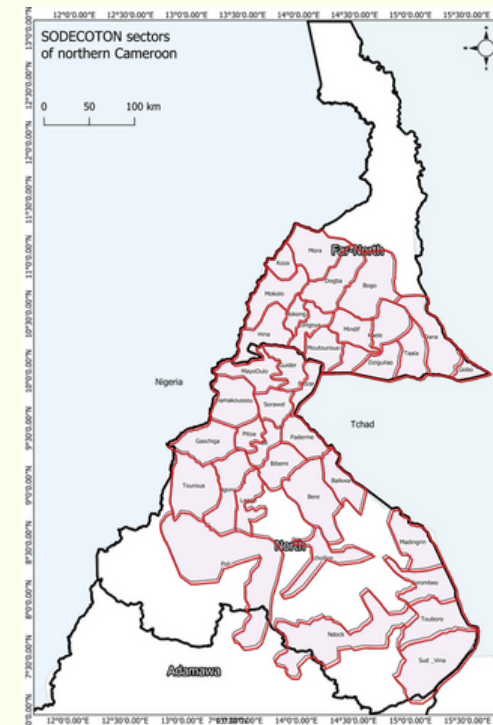
Pearson = -0.69

year x

...

year 2

year 1



Spatial
dimension:

Pearson = 0.53

all years

Why do we have a negative impact in the temporal dimension while having a positive one in the spatial dimension?

OBJECTIVE

- I. Understanding the spatial distribution of seasonal rainfall and cotton yields
- II. Gaining insights into the statistical relationships for single sectors

MATERIALS and METHODS



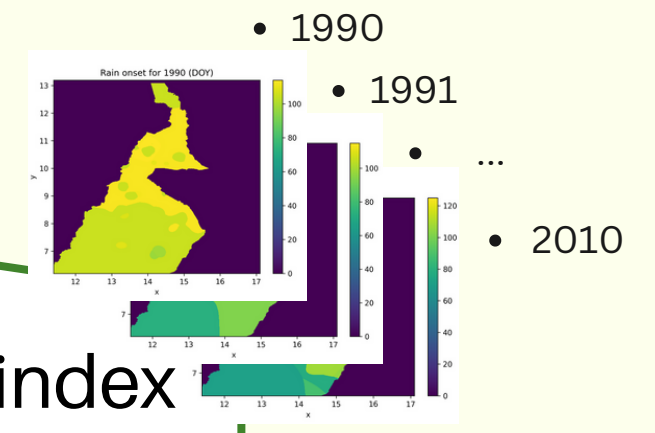
DOI: [10.5281/zenodo.10156437](https://doi.org/10.5281/zenodo.10156437)

North Cameroon rain gauge rainfall dataset (NoCORA)

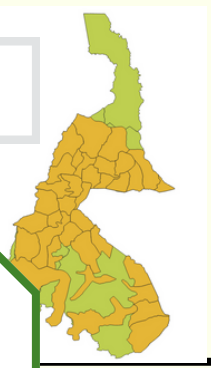
Interpolation of rainfall data

Calculation of seasonal rainfall amount index

Yearly index maps



Sector-dataset



Cotton yield data (SODECOTON)

Understanding the spatial distribution

Average index and cotton yield maps

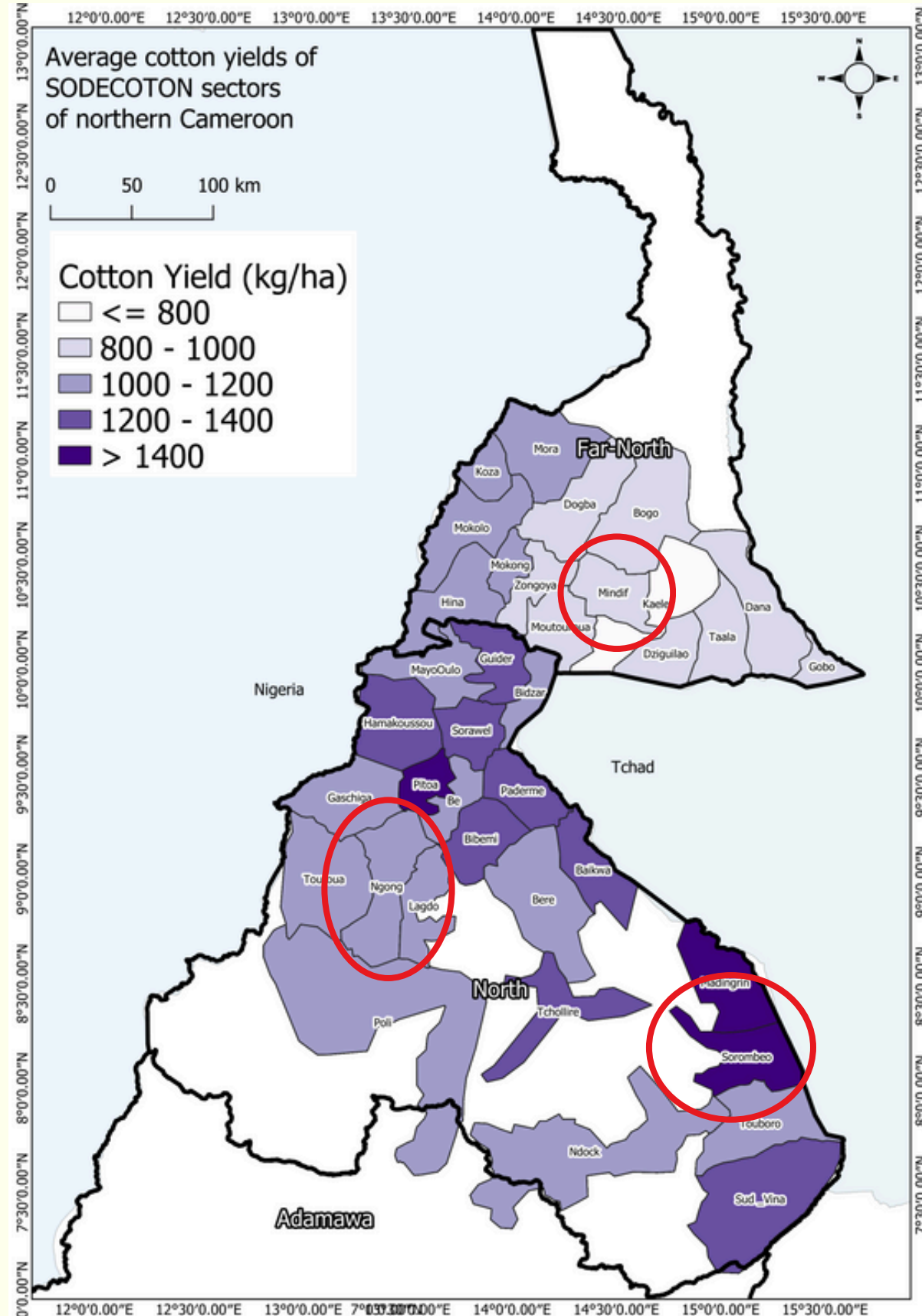
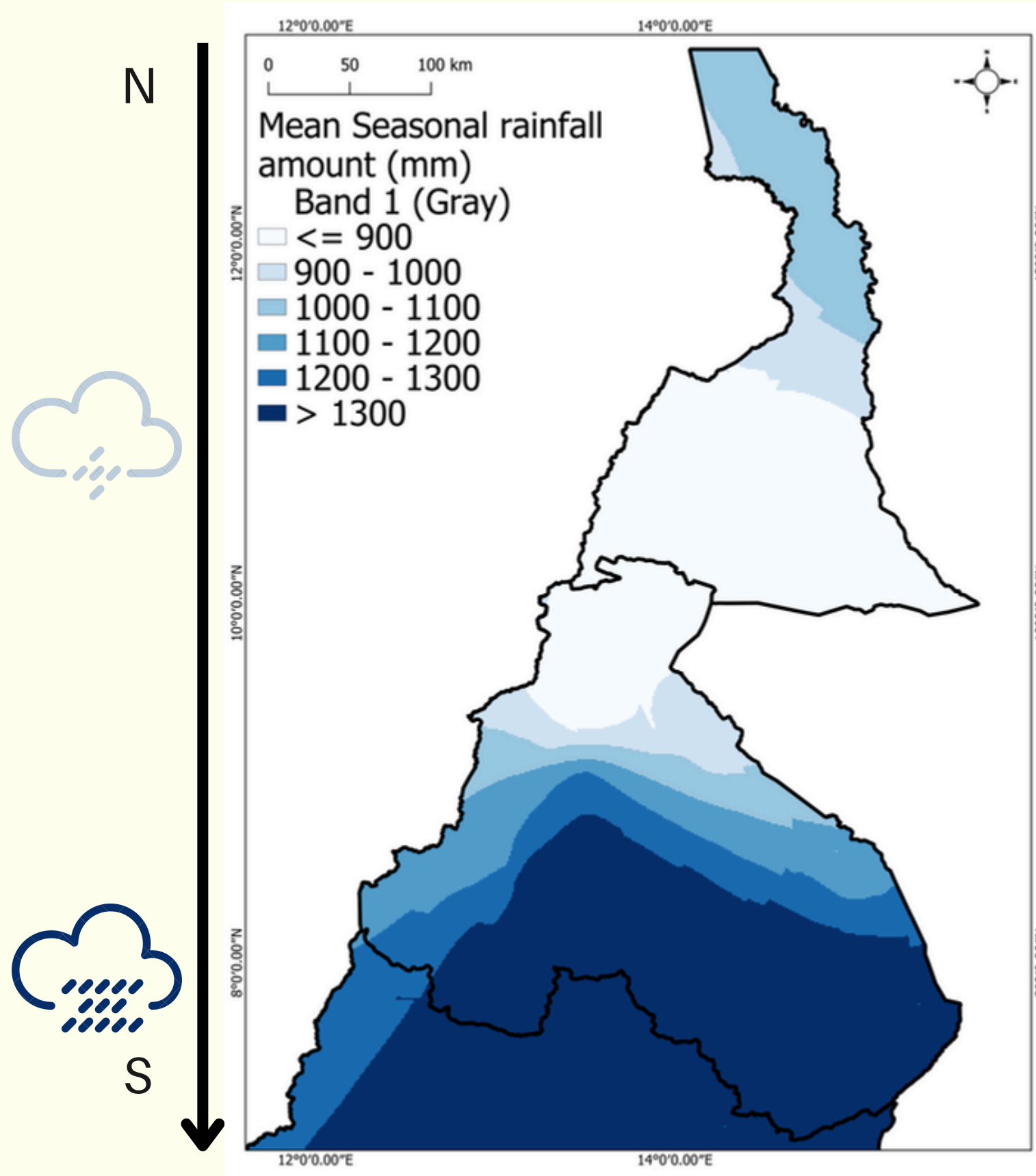
Pearson correlation and linear regression

Gaining insight into single sectors

Statistical relationship for single sectors



RESULTS



Mindif:

- 900 kg/ha
- 850 mm

Ngong:

- 1200 kg/ha
- 1150 mm

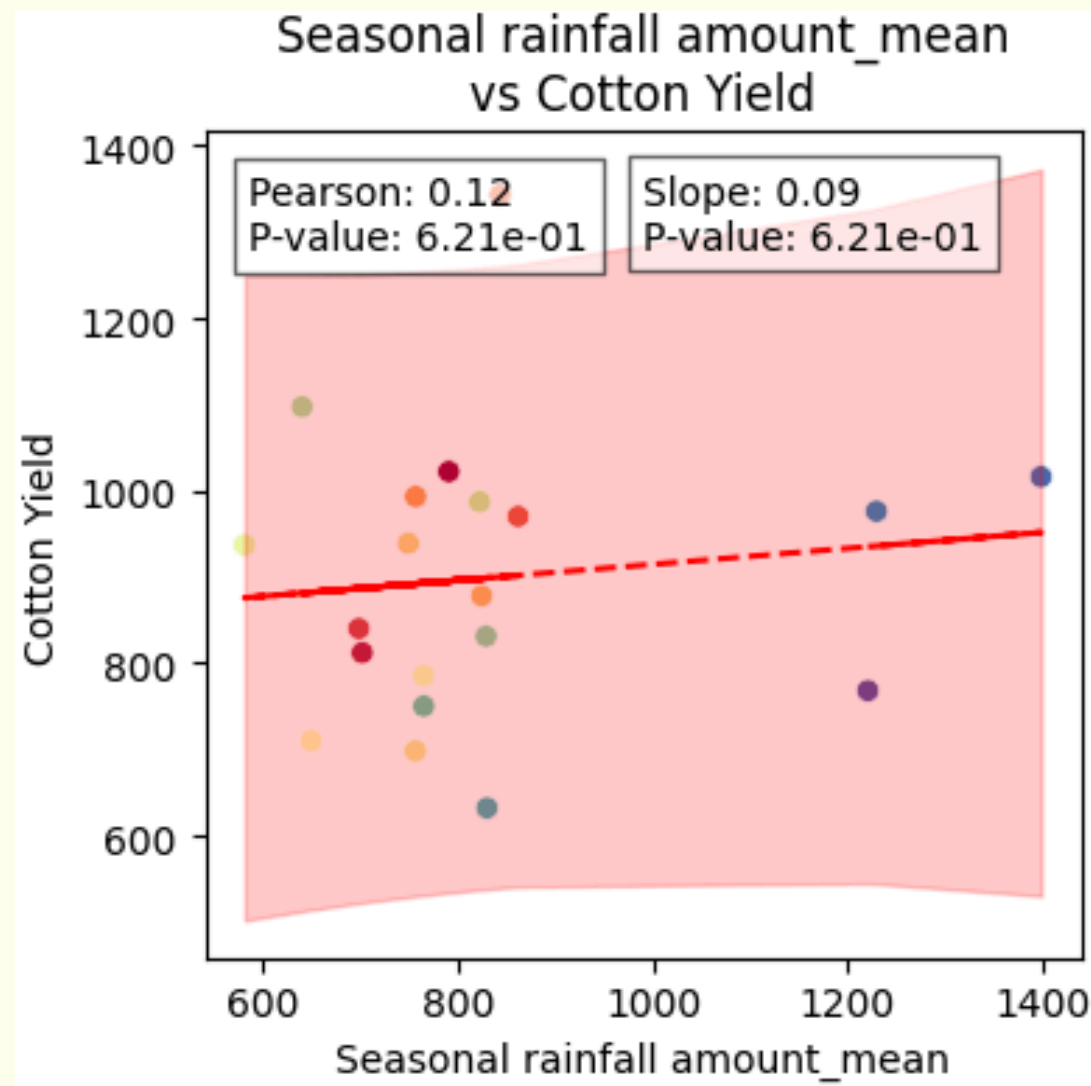
Sorombeo:

- 1500 kg/ha
- 1350 mm



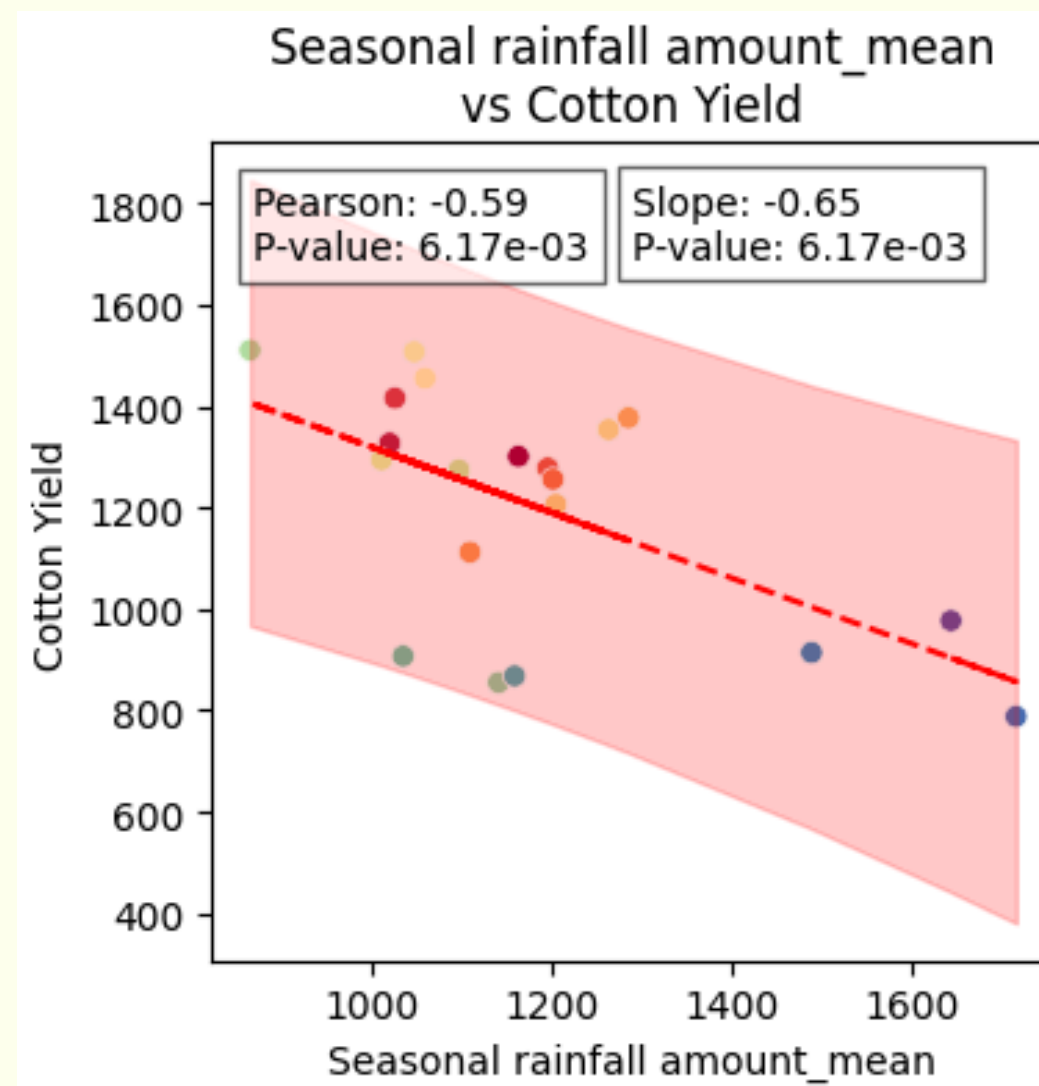
Correlation between seasonal rainfall amount and cotton yields:

Mindif:



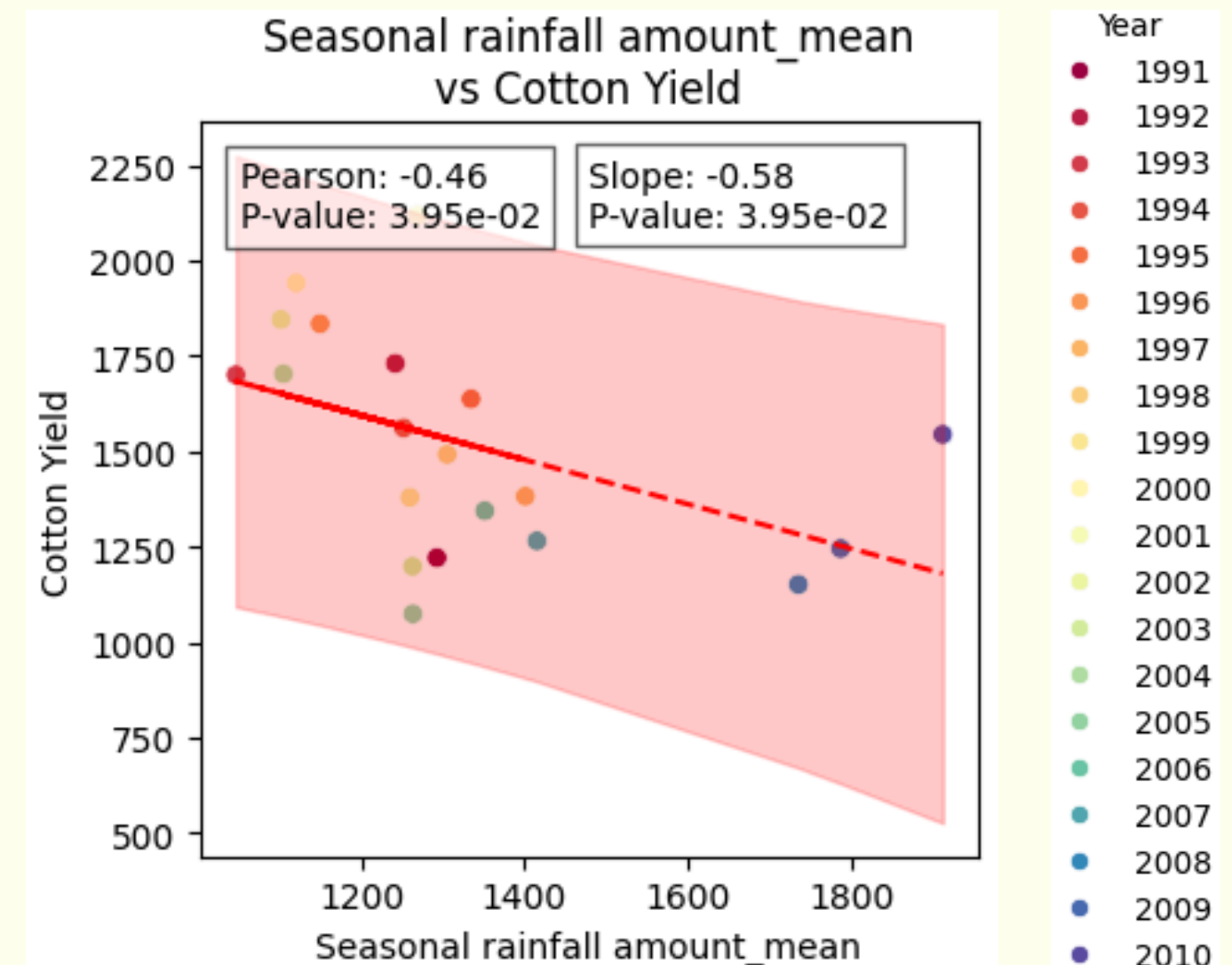
Pearson = 0.12

Ngong:



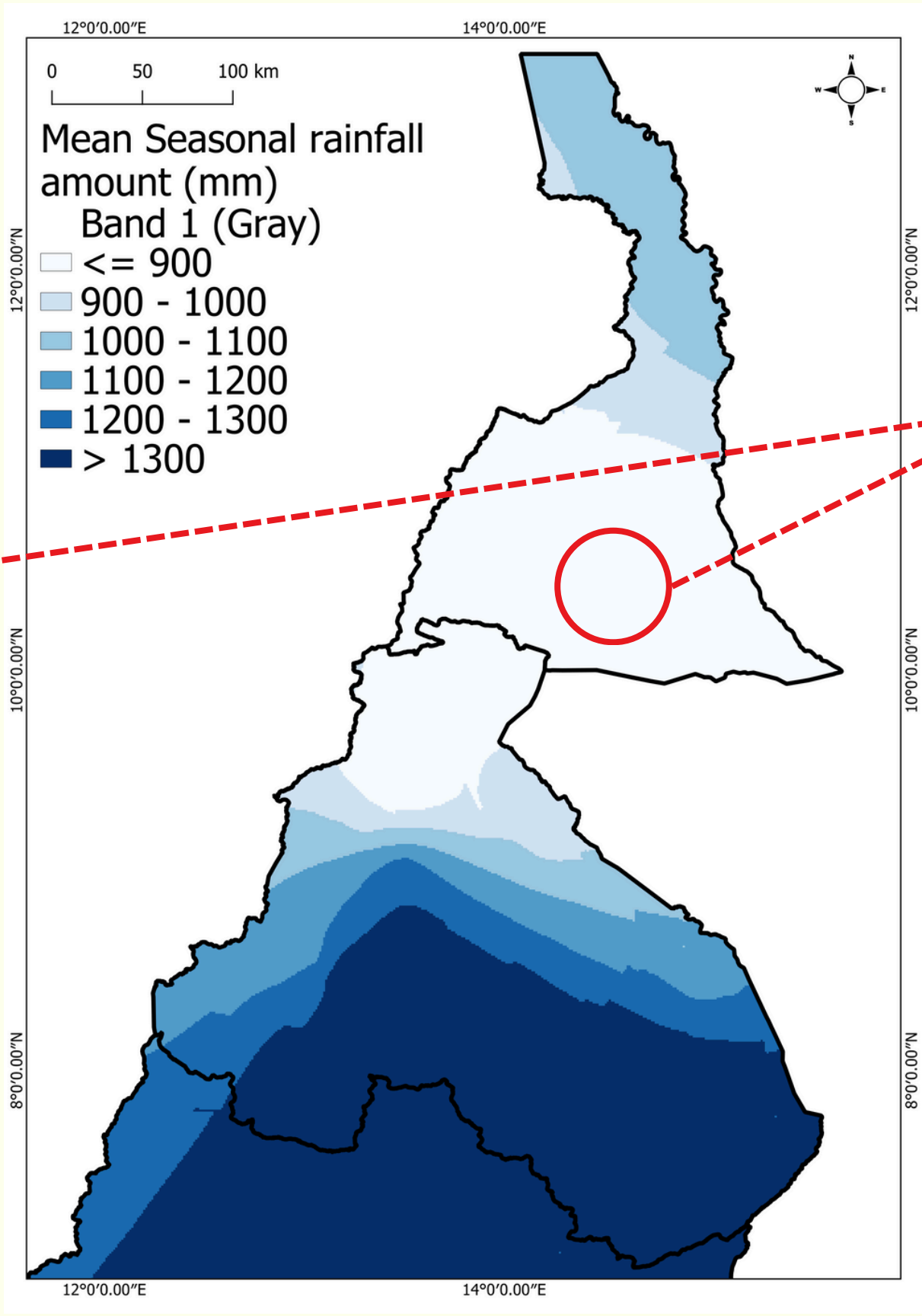
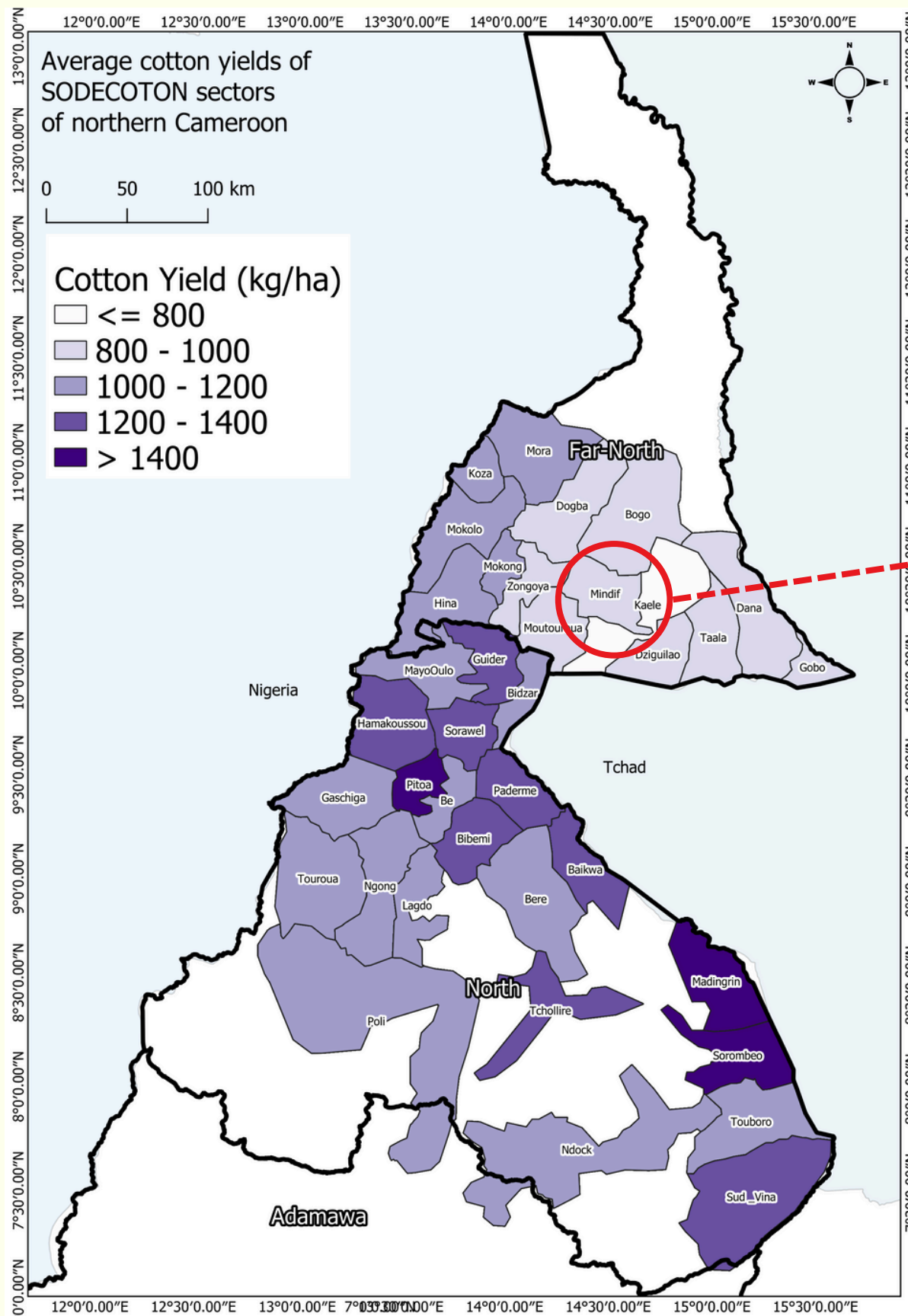
Pearson = -0.59

Sorombeo:

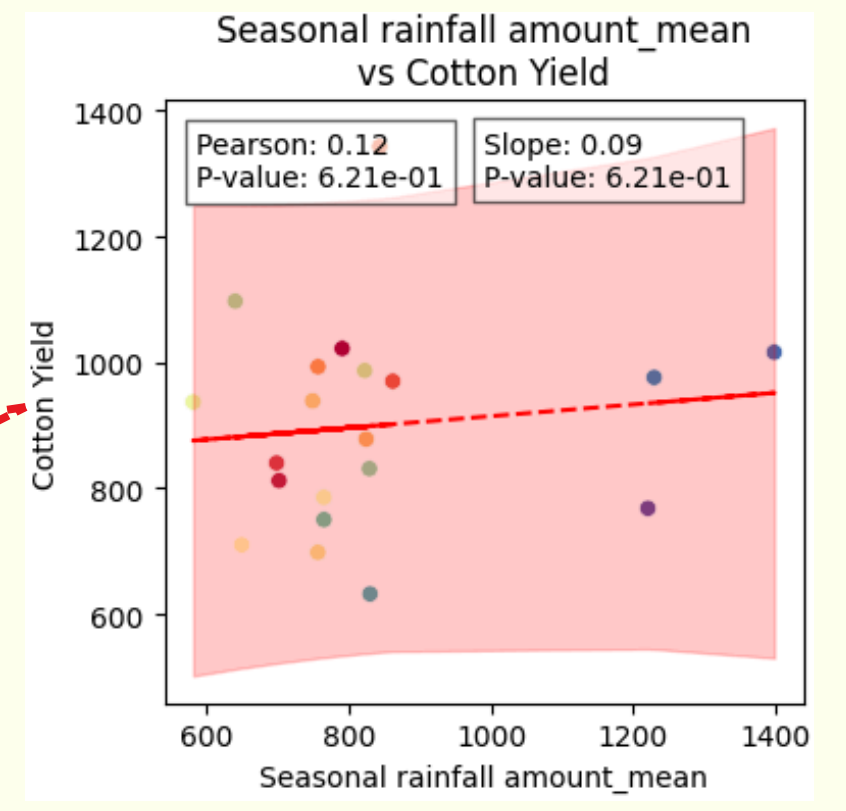


Pearson = -0.46

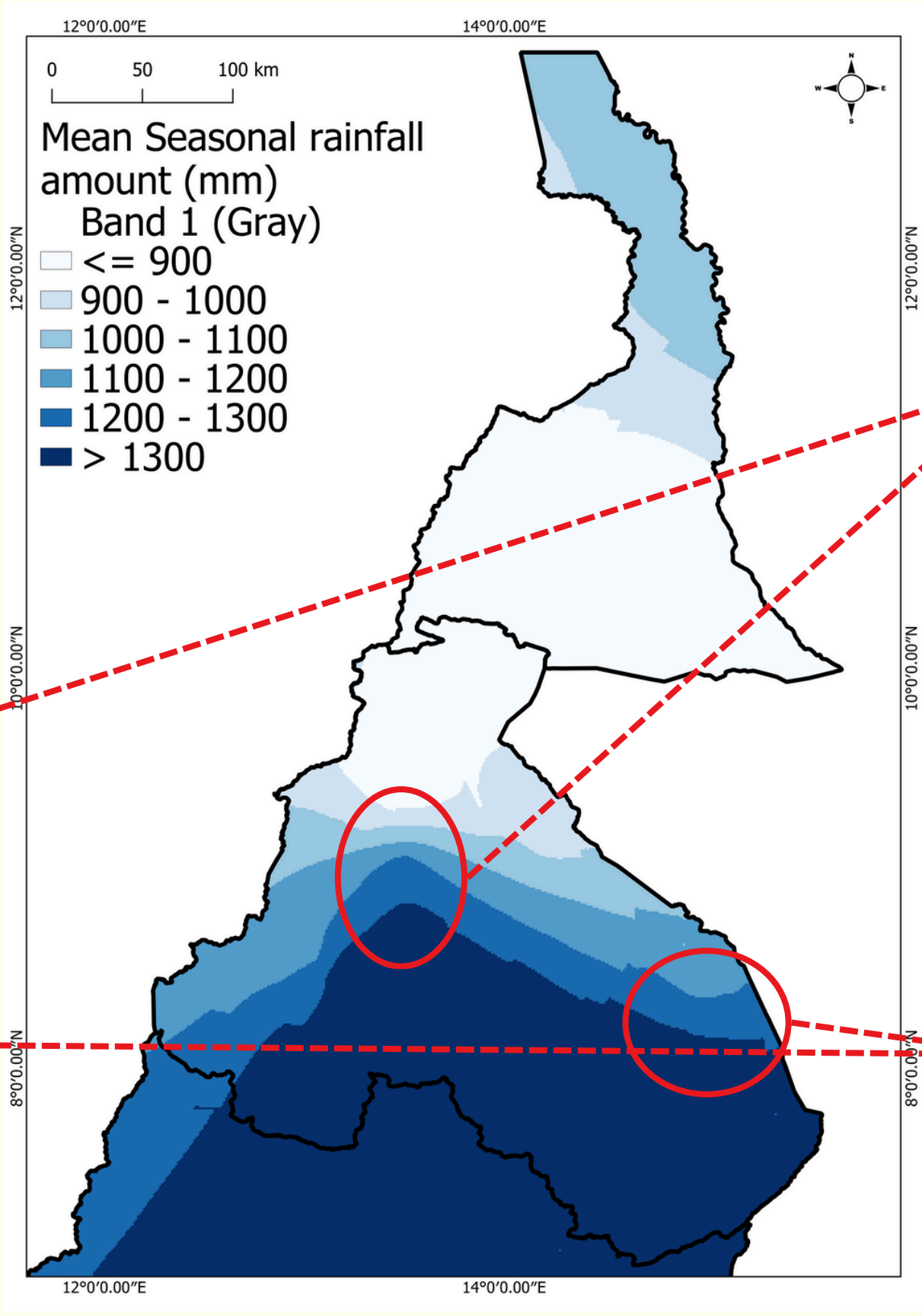
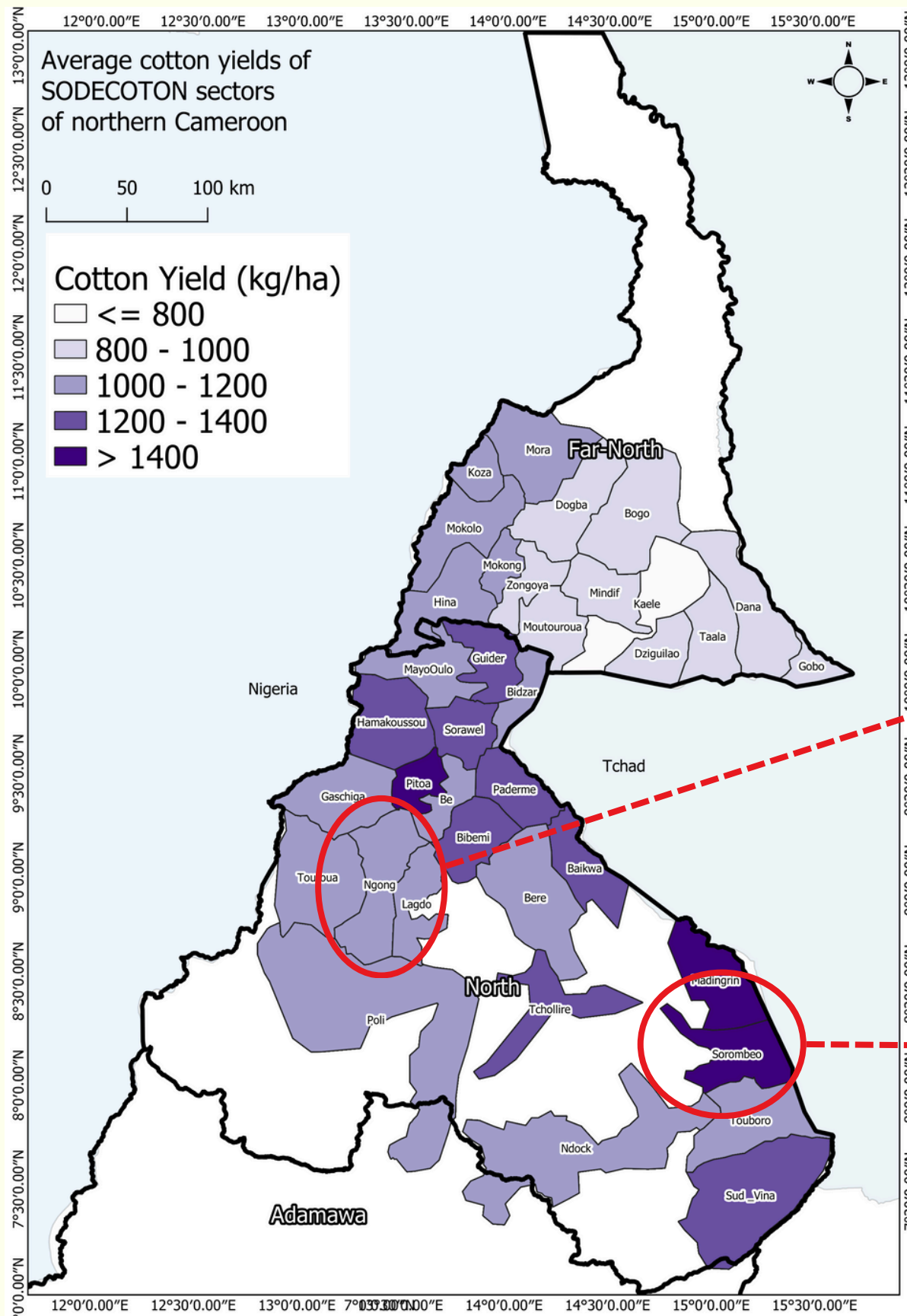
*Cotton yield in kg/ha and season rainfall amount in mm



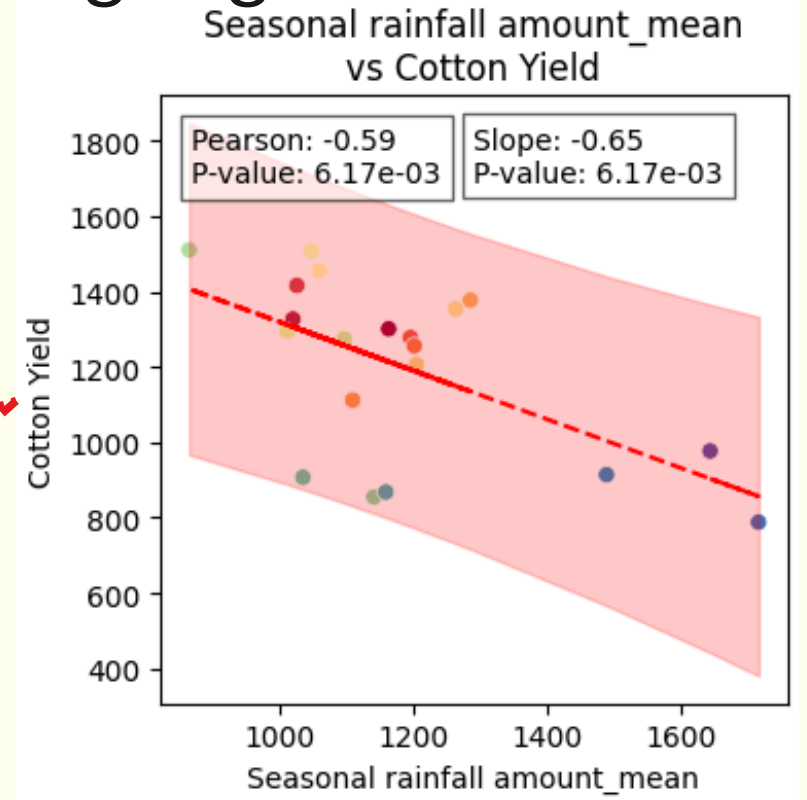
Mindif:



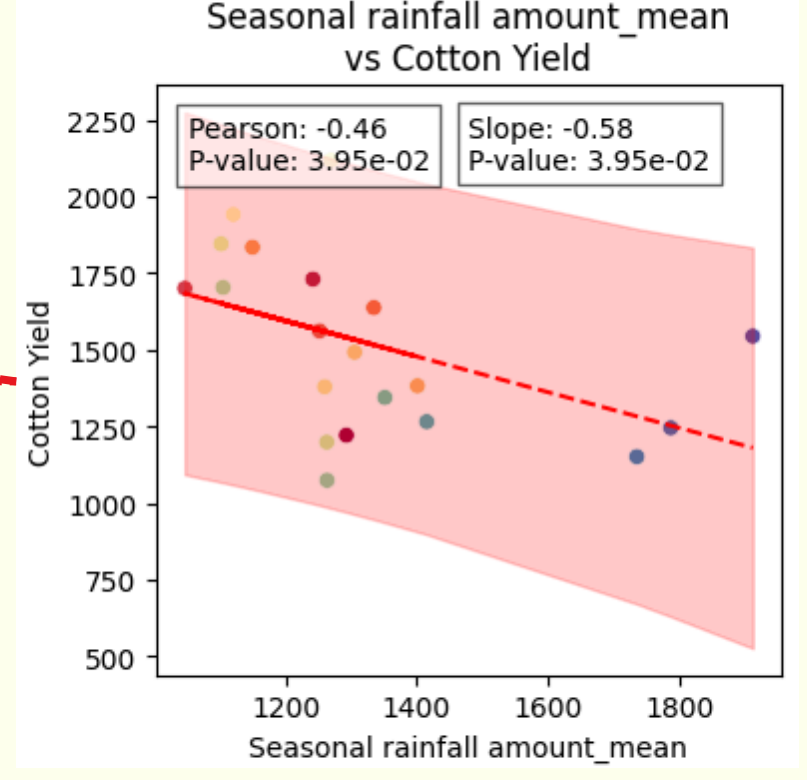
Seasonal rainfall amount detached from cotton yields



Ngong:



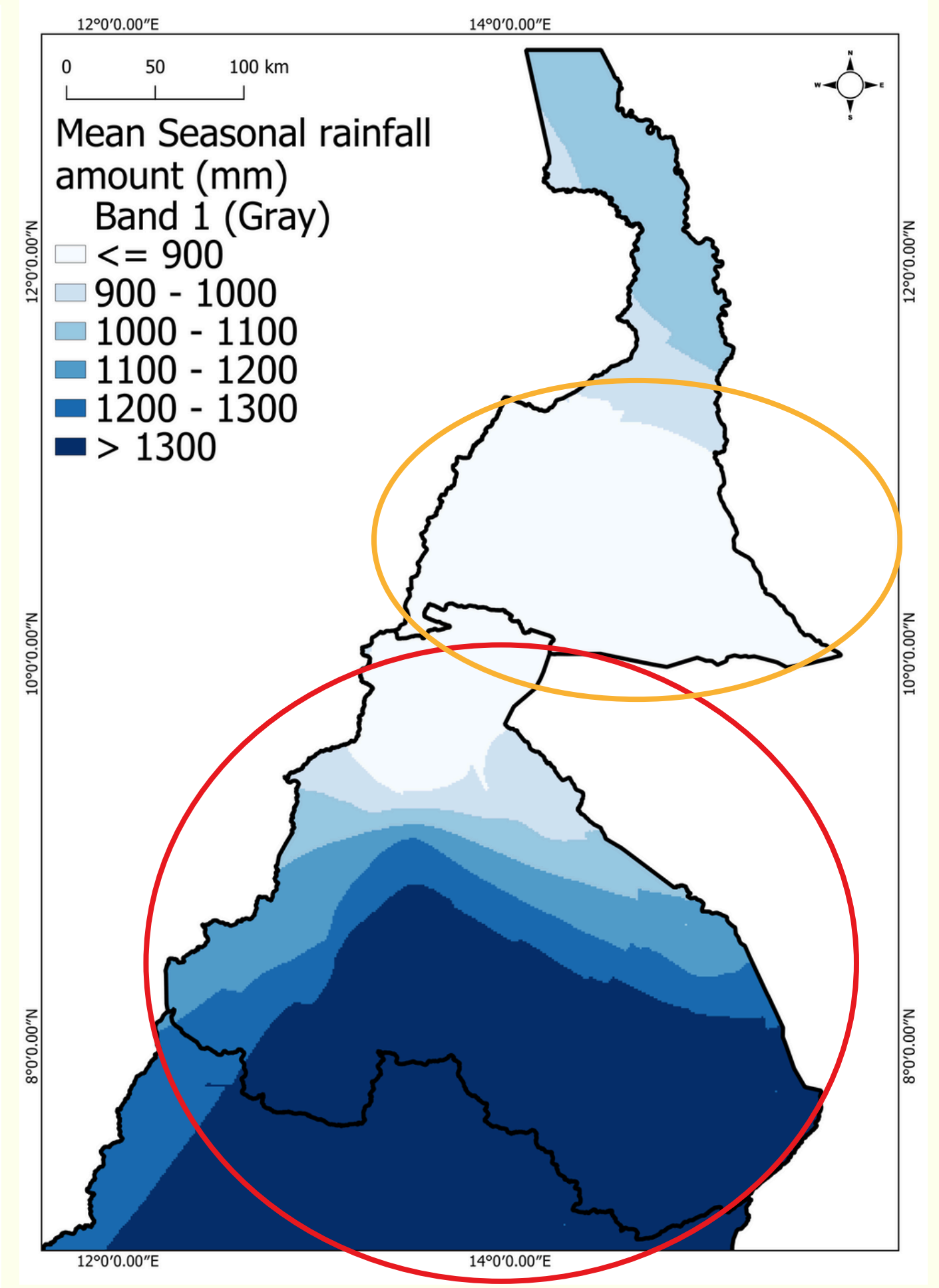
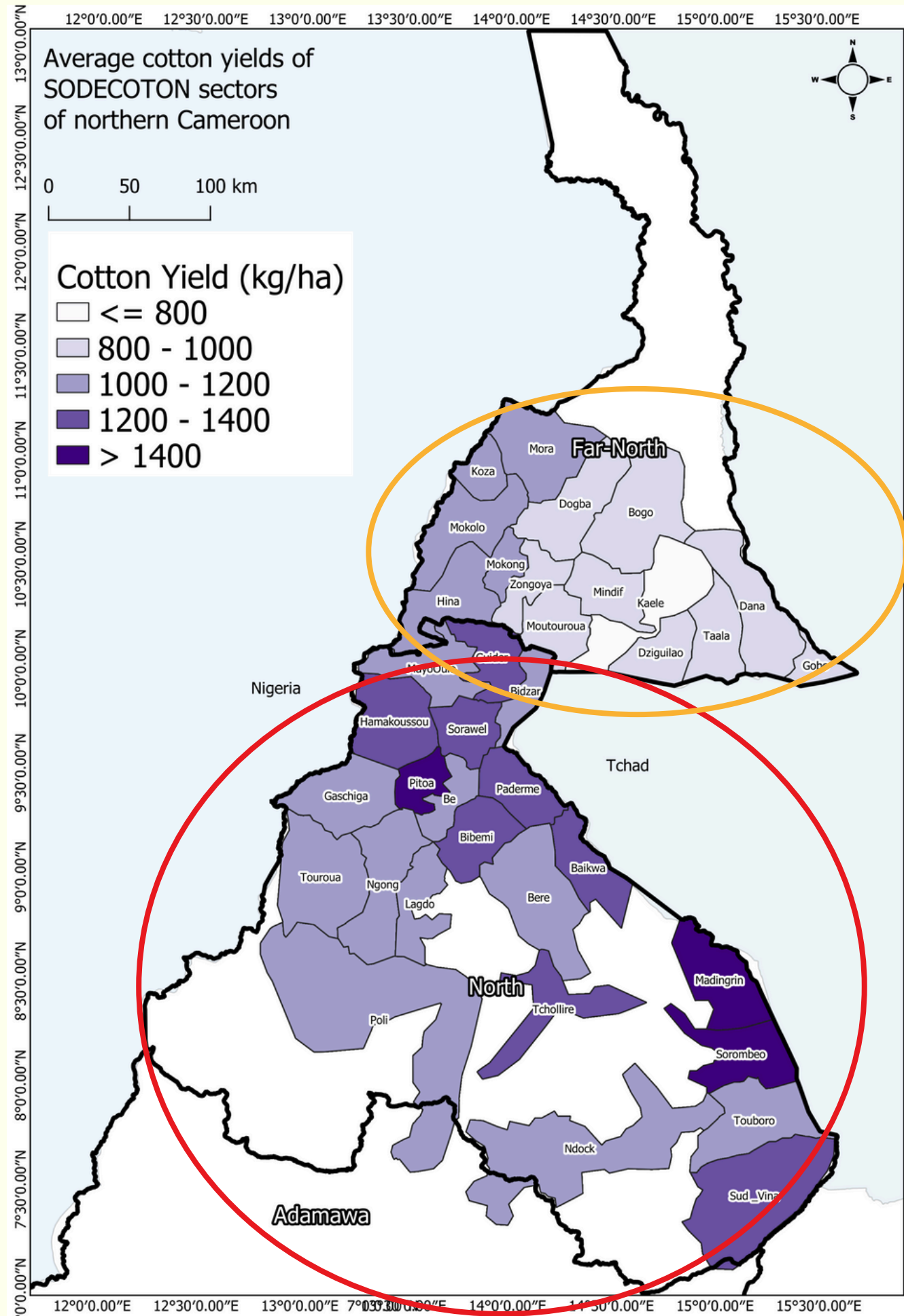
Sorombeo:



Strong impact of seasonal rainfall amount on cotton yields

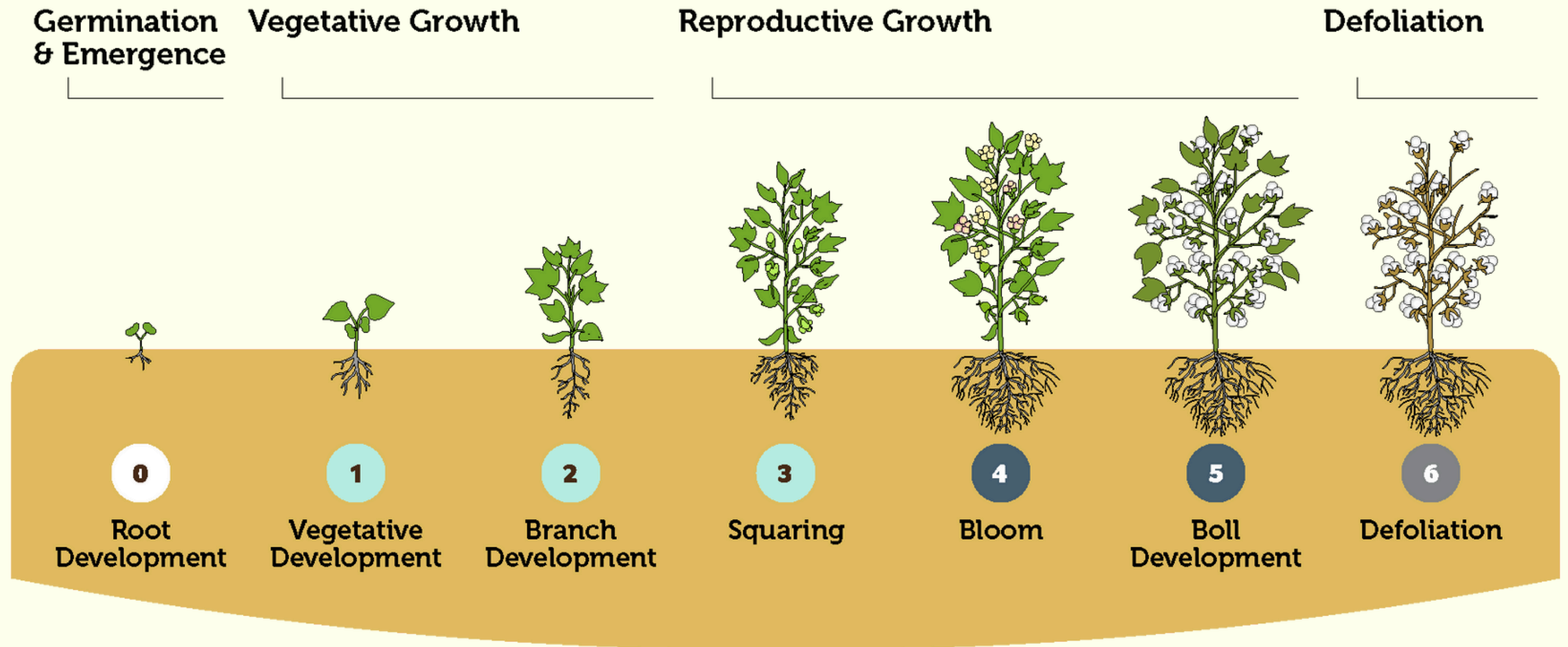
DISCUSSION

- Two distinct patterns in North and Far North regions



DISCUSSION

- Cotton varieties
 - > Far North:
Short cycle
 - > North:
Long cycle



DISCUSSION

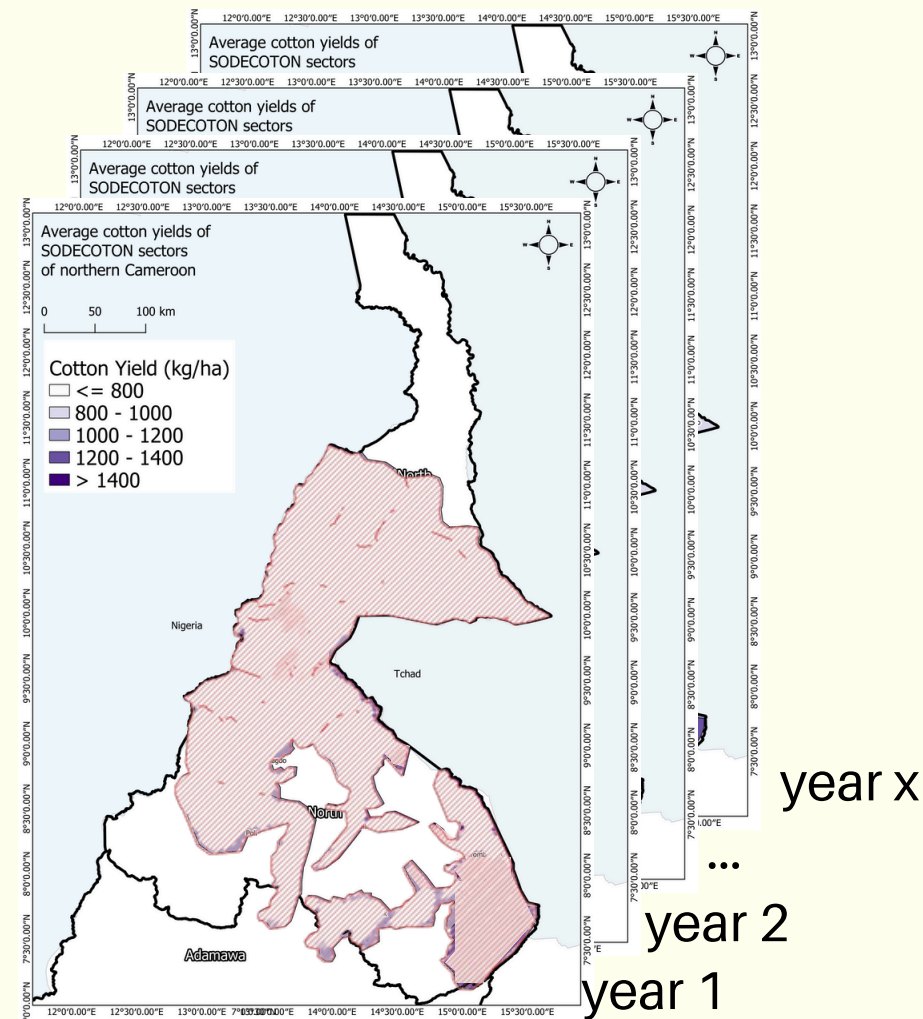
- Floods
 - > N-leaching
 - > Water logging



DISCUSSION

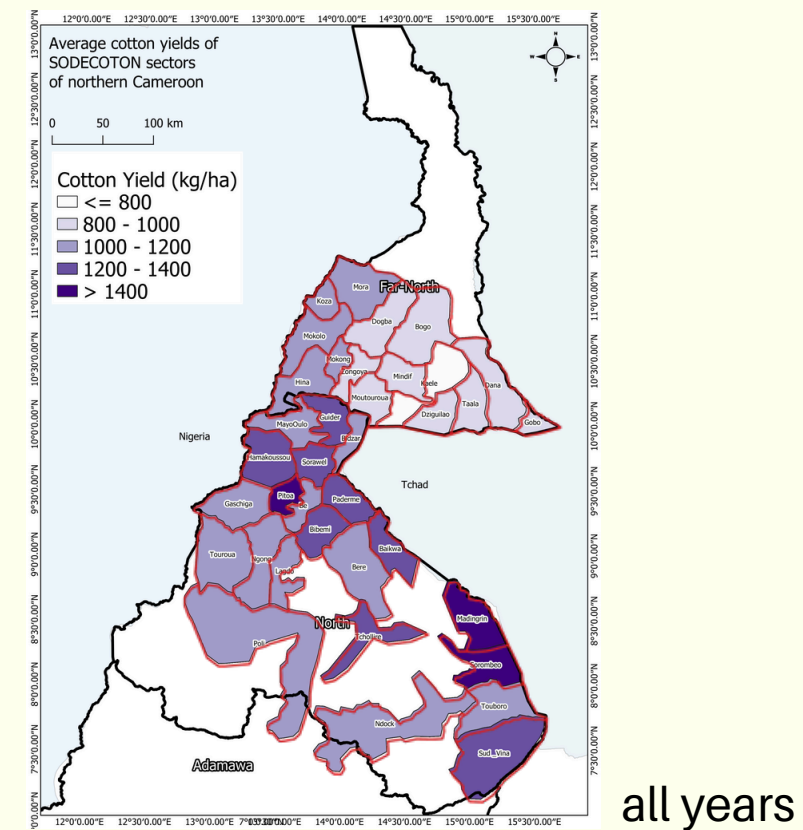
Why do we have a negative impact in the temporal dimension while having a positive one in the spatial dimension?

Temporal dimension



Region's vulnerability to interannual variability

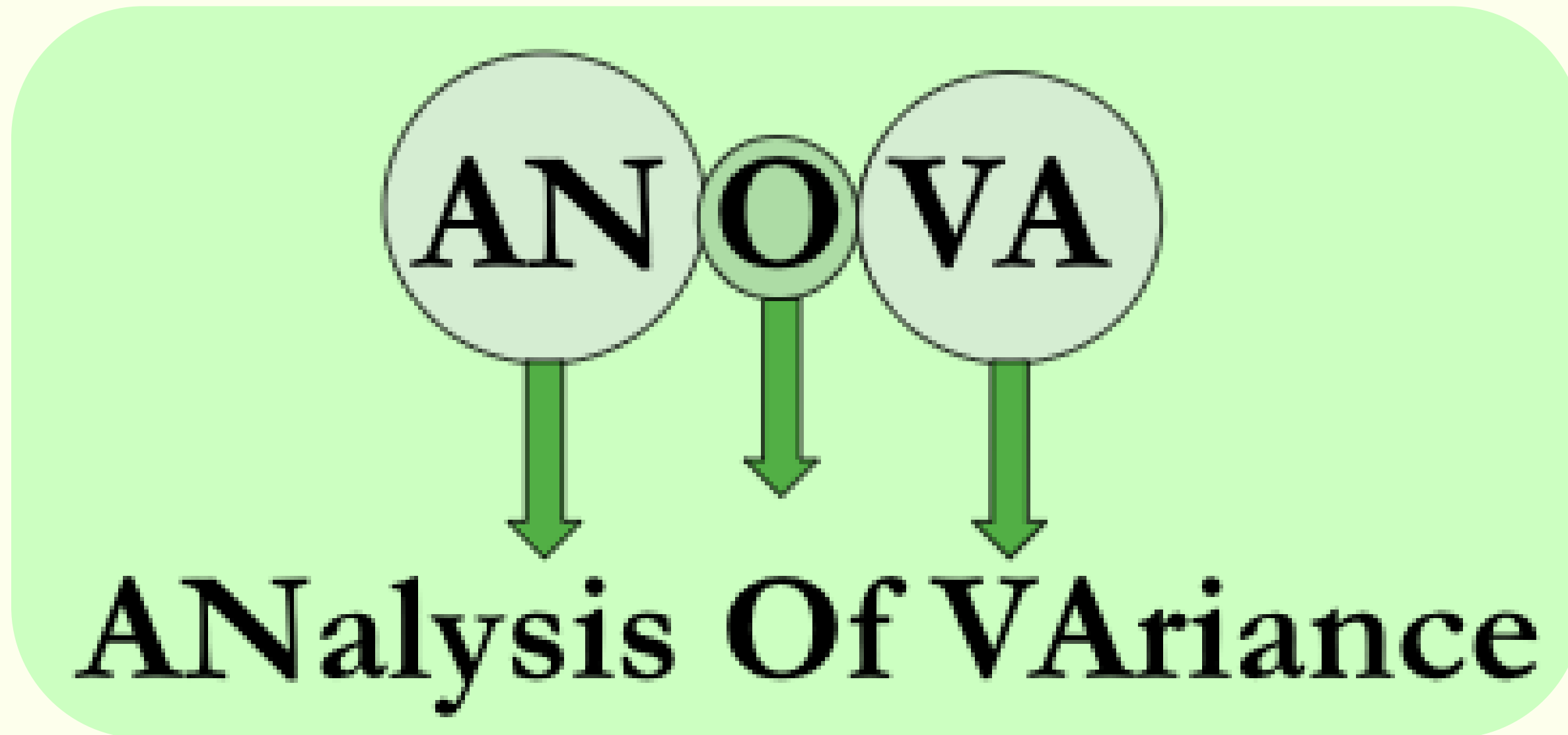
Spatial dimension



Sector-specific characteristics

DISCUSSION

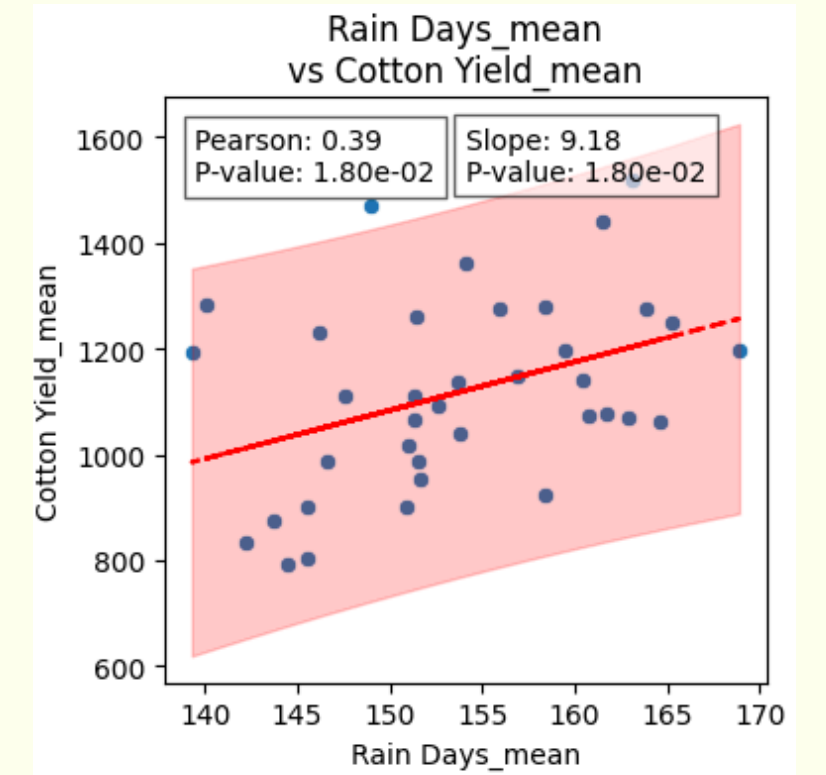
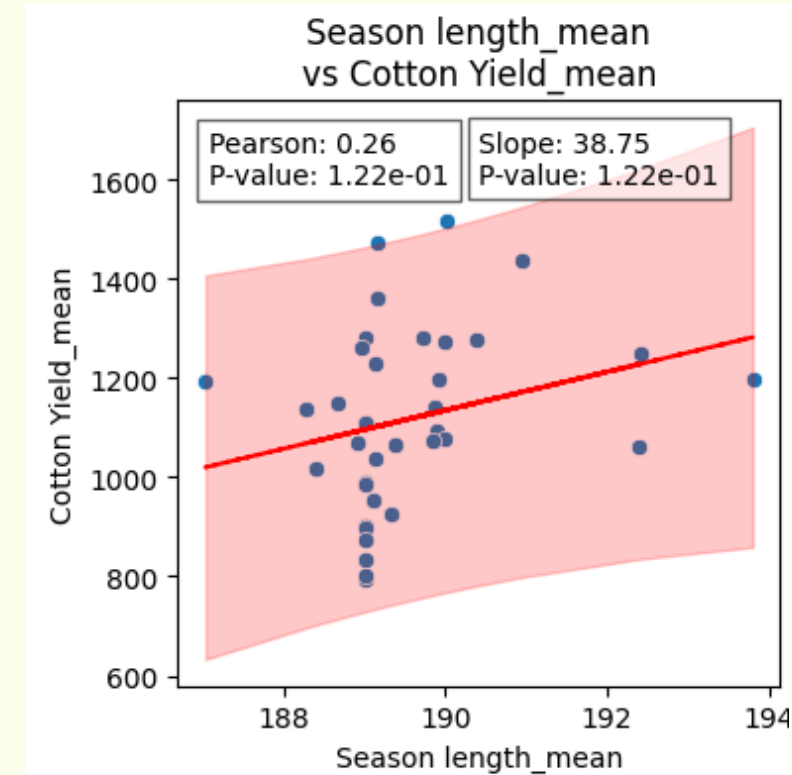
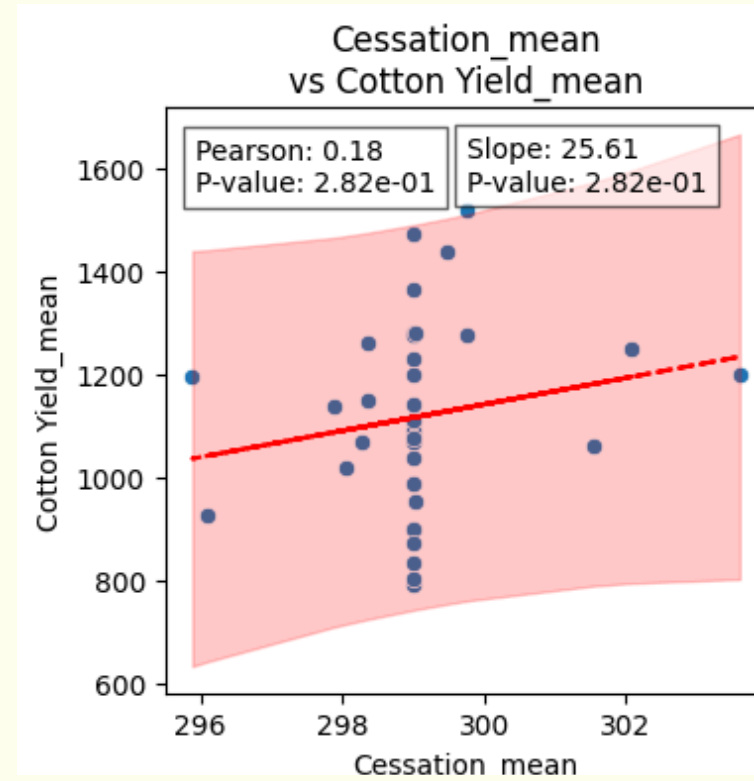
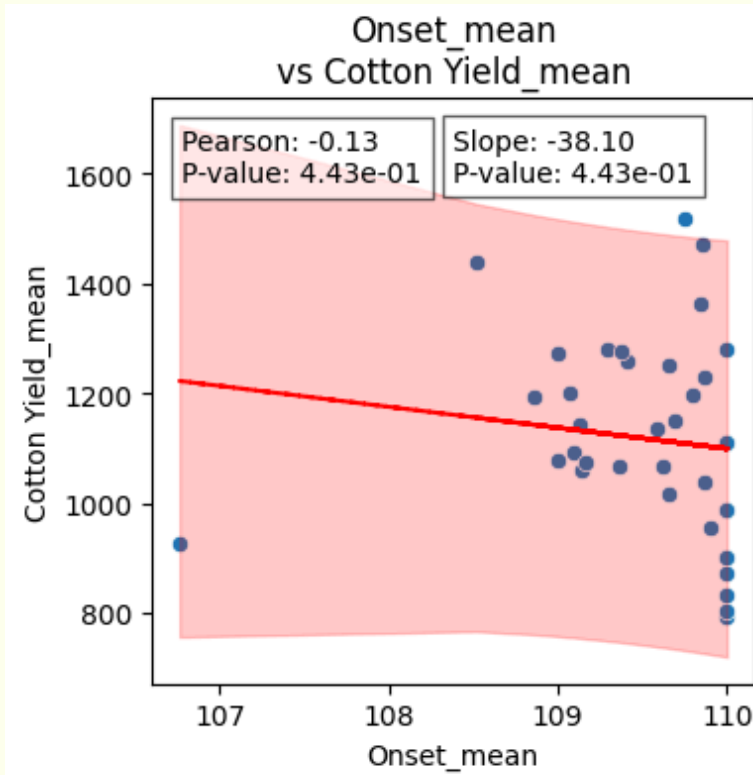
! Loss of interannual variability and spatial characteristics



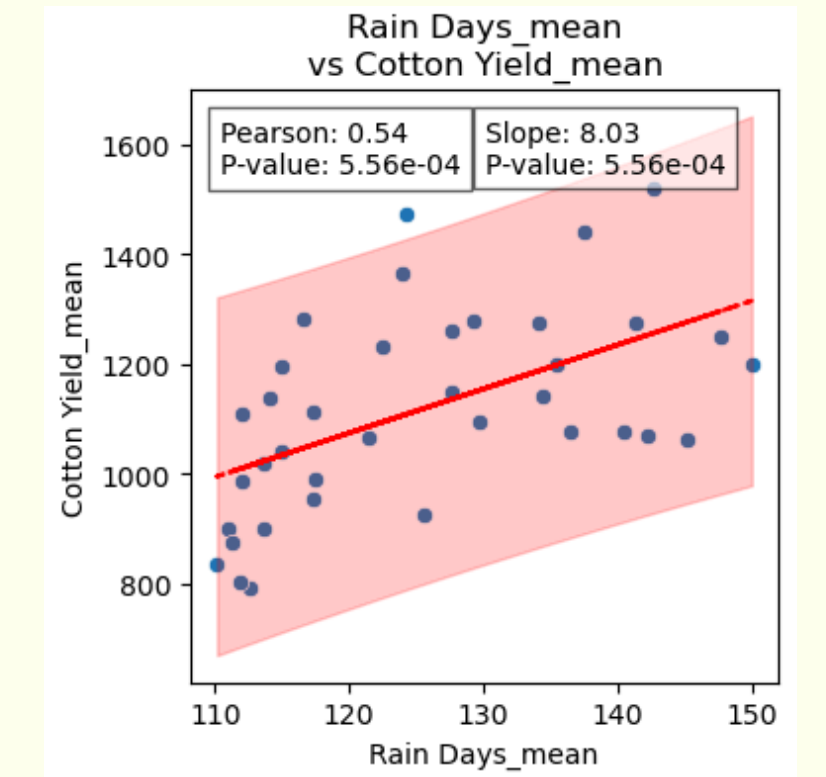
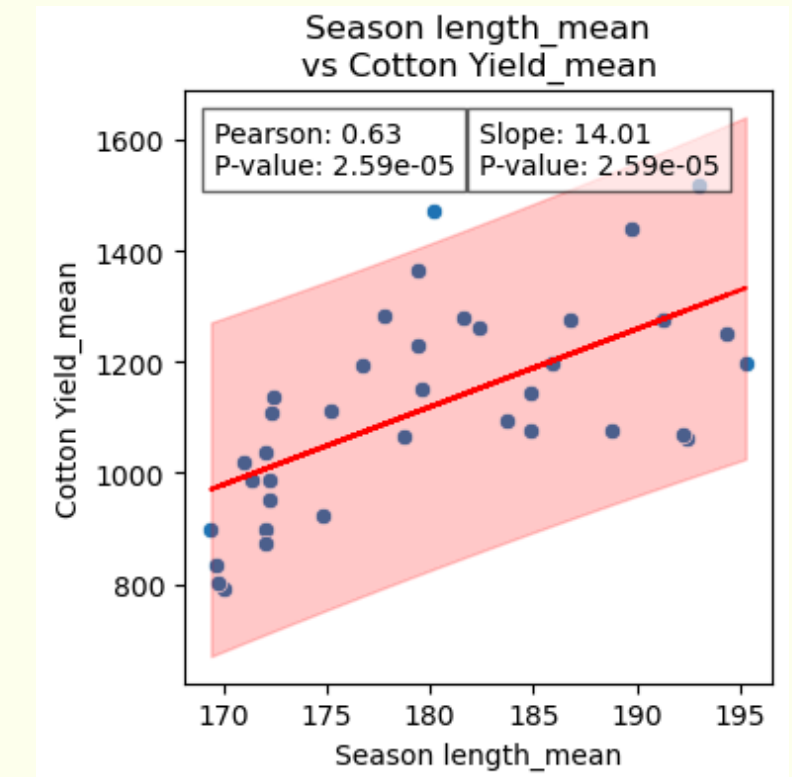
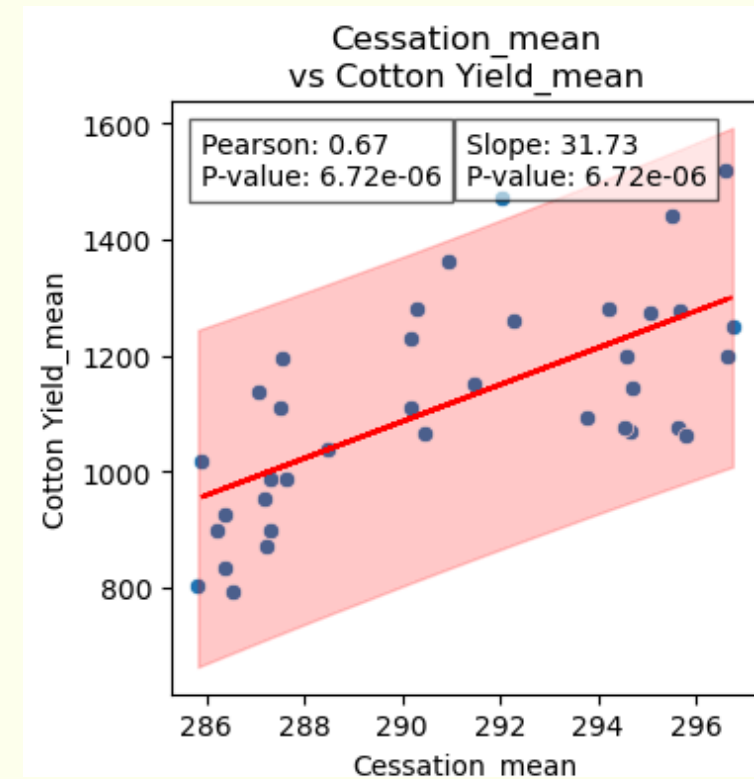
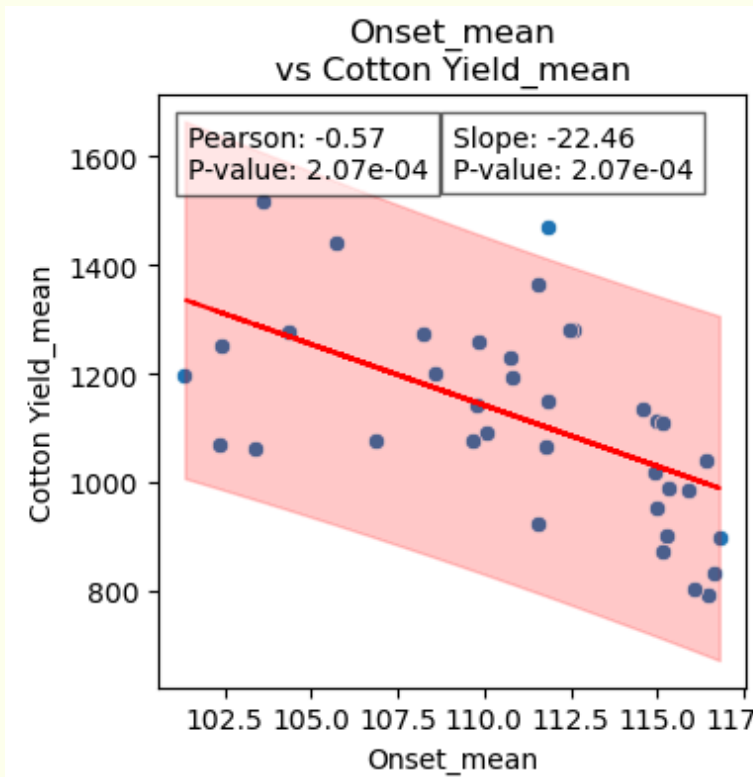
- Analyzing rainfall indices against yields while considering the effects of both years and sectors

CORRIGENDUM

Faulty results:



Correct results:



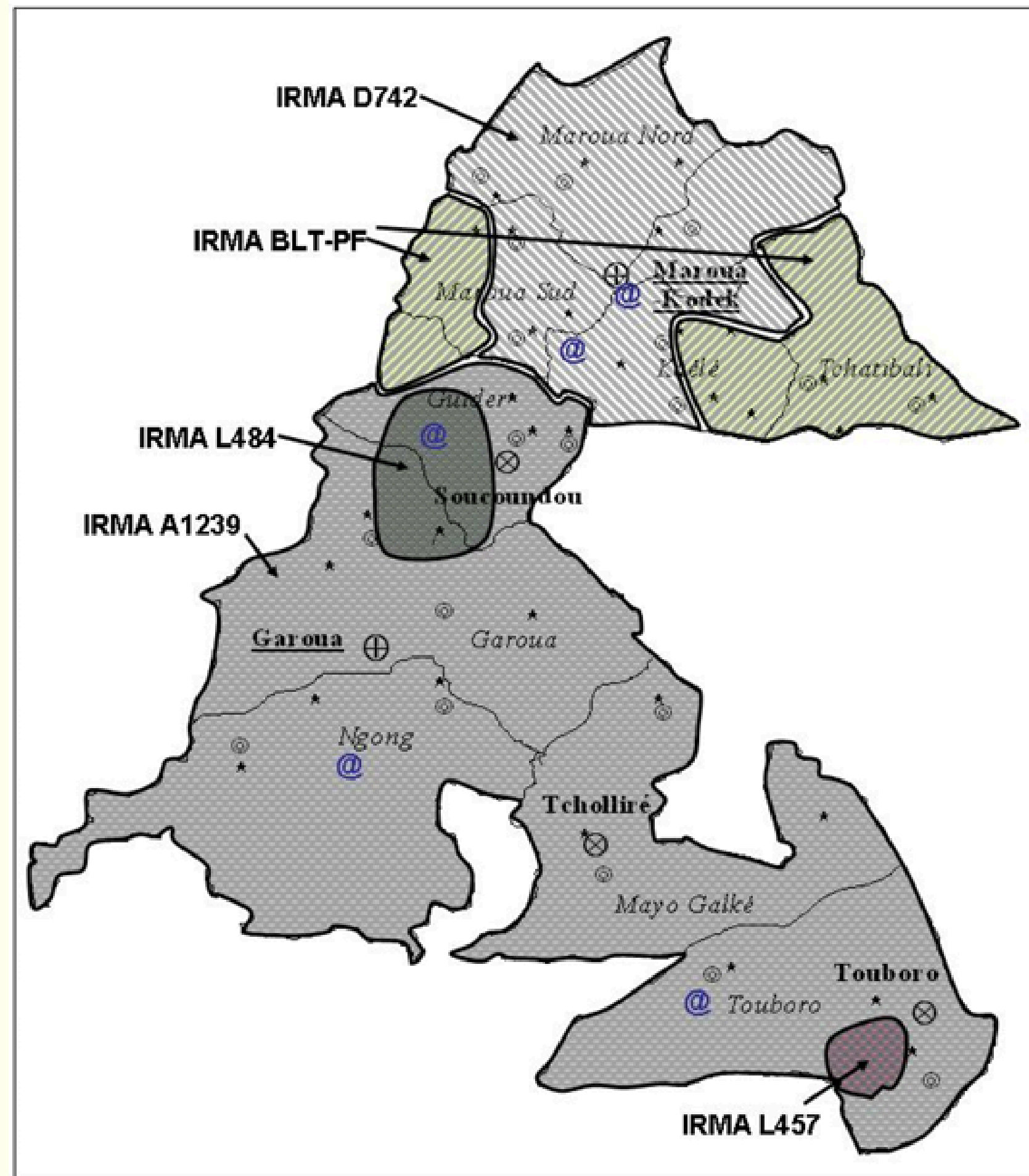
CONCLUSION

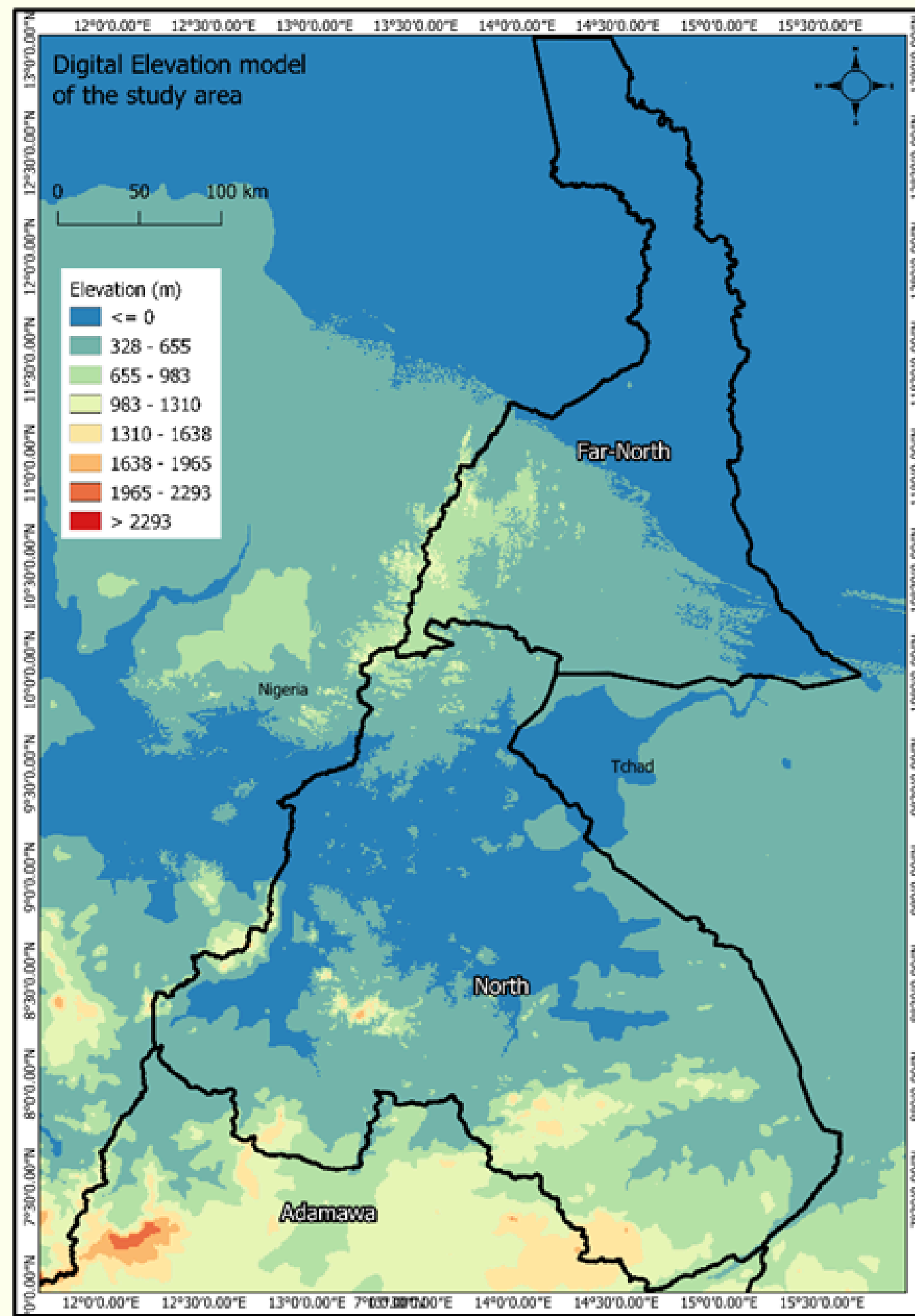
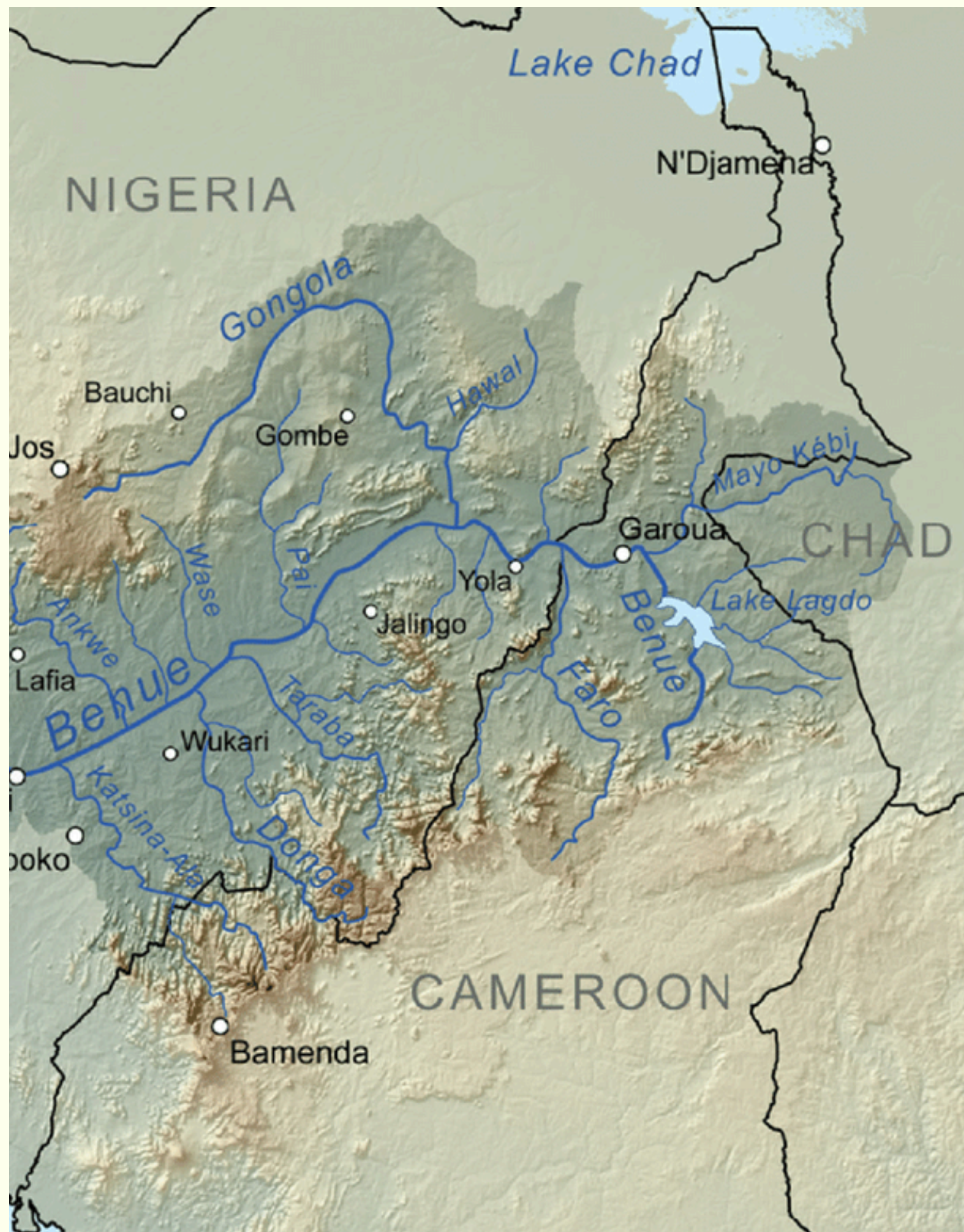
- Cotton is the main cash crop for northern Cameroon, but suffering under climate change and interannual rainfall variability
- Analysis of the statistical relationship between 25 seasonal rainfall indices and cotton yields
- Seasonal rainfall amount, rain and wet days, dry days and spells, as well as seasonal parameters display strong impacts on cotton yields
- Importance of regional characteristics and year-to-year changes in rainfall
- Influence of cotton varieties and natural hazards
- Foresight into the potential scenarios of cotton yield variability
- Support for strategic planning and resilience-building



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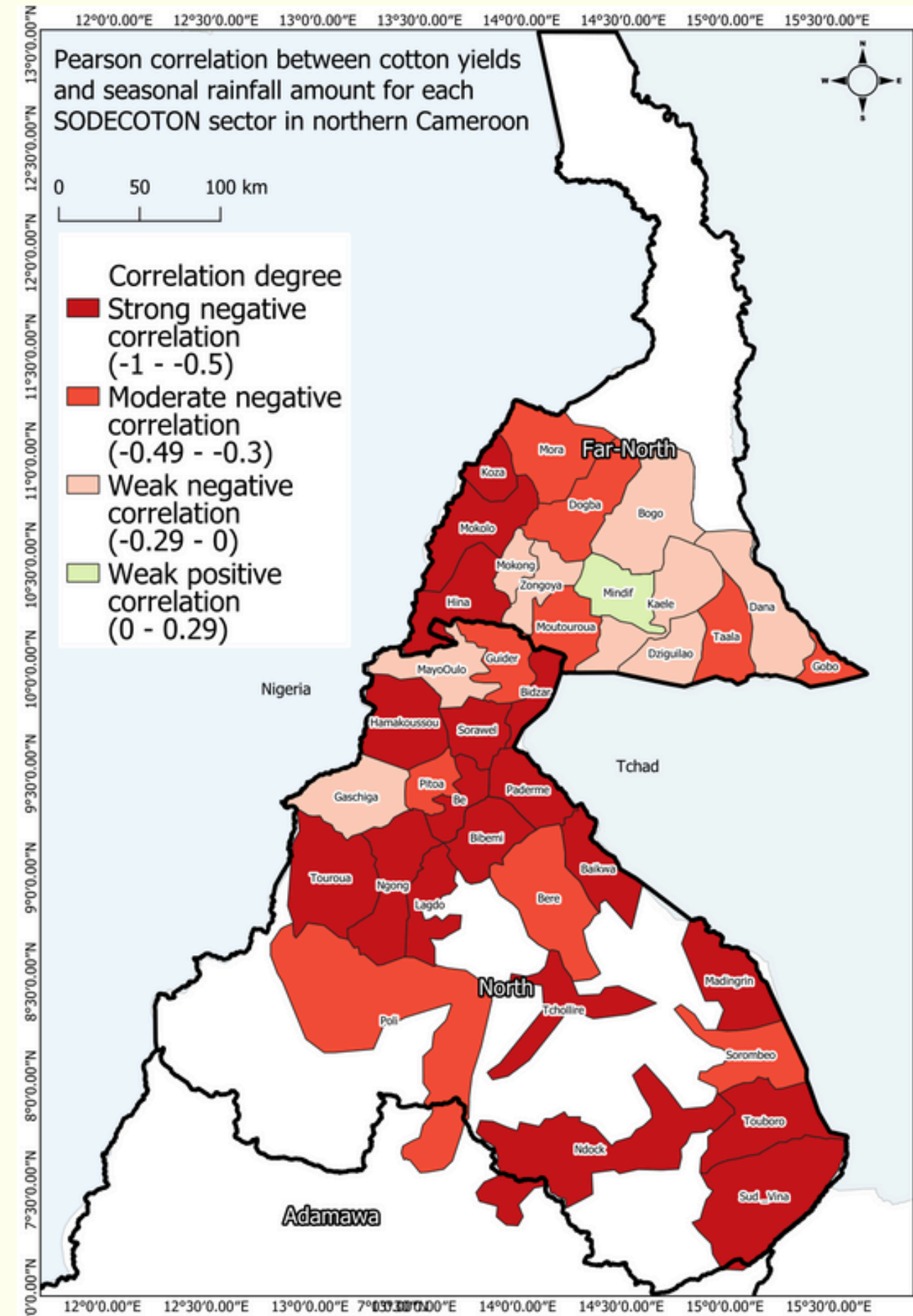
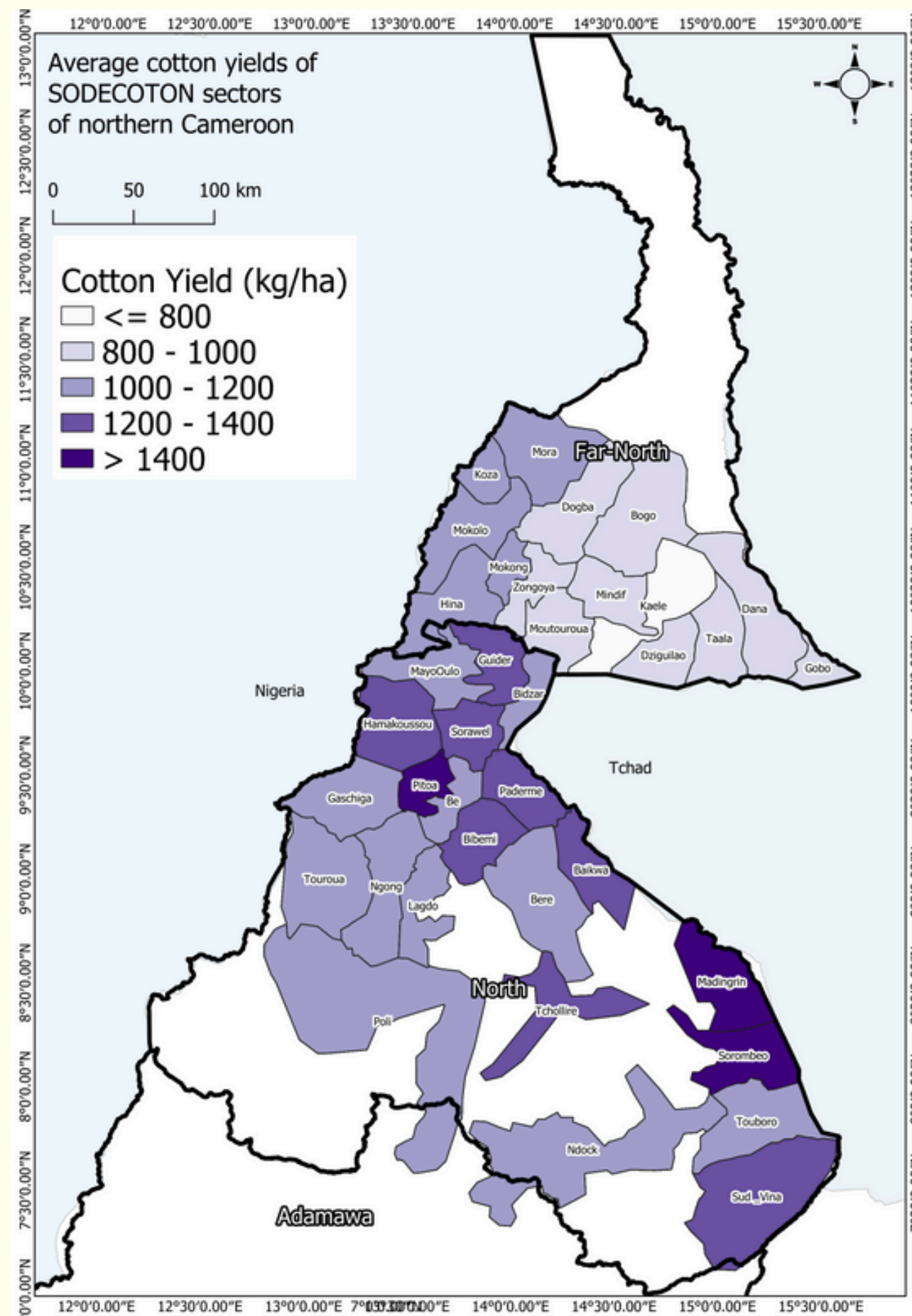


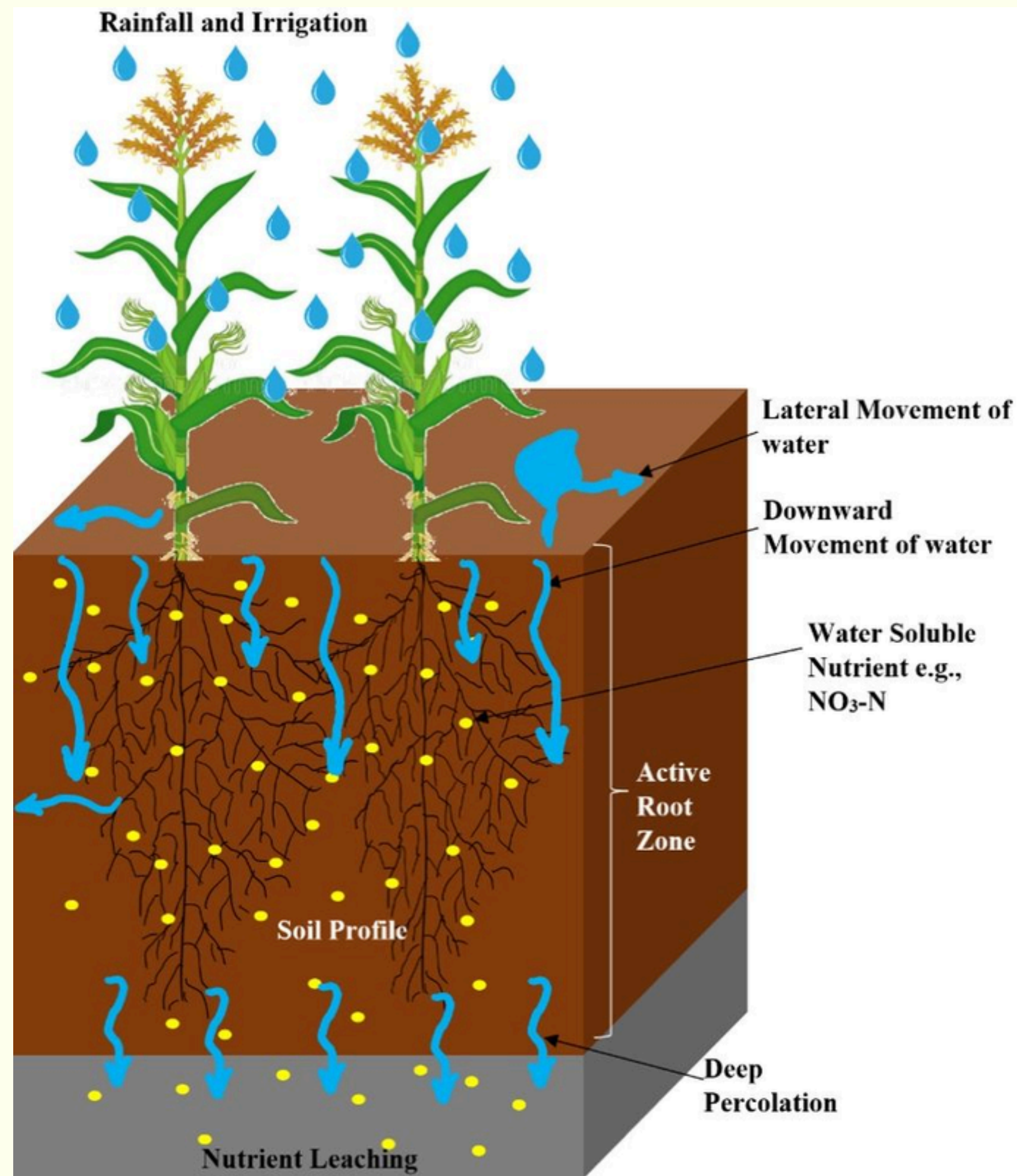


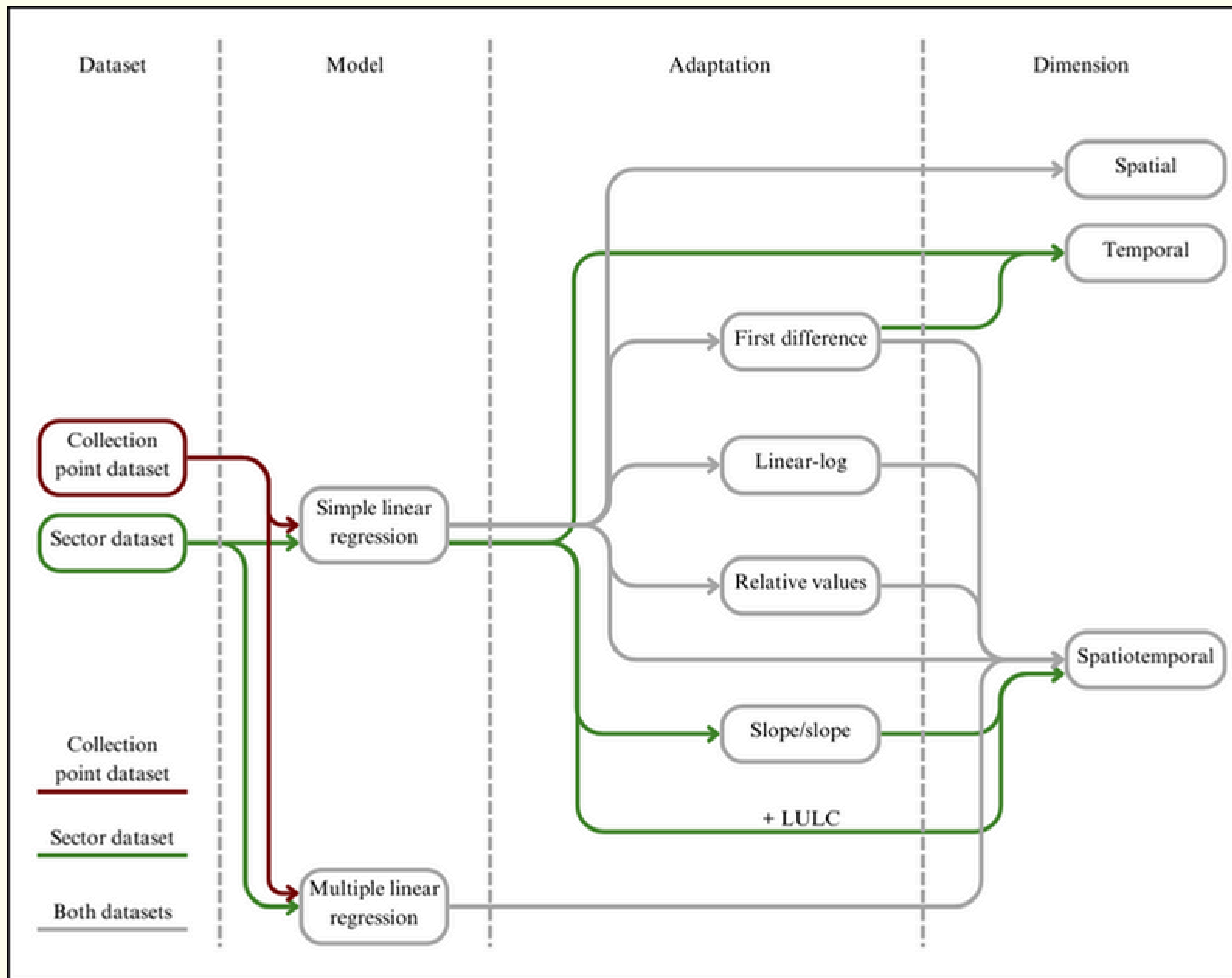
Years with important floods:

- 1997
- 1999
- 2010

-> Benoue river







Indices	Simple linear regression - Pearson																																
Adaptation	-												First Difference						Linear-Log			Relative values			Slope/slope								
Dimension	Spatial				Spatiotemporal				Spatiotemporal with LULC mask		Temporal				Spatiotemporal			Temporal			Spatiotemporal			Spatiotemporal			Spatiotemporal						
Yield value	mean				median				observed value				observed value		mean				median			observed value			observed value			observed value					
Index value	mean		median		mean		median		mean	median	interp. value	mean	median	mean	median	mean	median	mean	median	interp. value	mean	median	mean	median	mean	median	interp. value	mean	median	interp. value	mean	median	
Cessation	0.67	0.03	0.66	0.03	0.62	0.04	0.62	0.04	0.01	0.02	0.08	-0.06	-0.02	-0.54	-0.47	-0.54	-0.52	0.24	0.22	0.05	-0.31	-0.21	-0.55	-0.53	0.02	-0.02	0.08	0.01	0.02	0.08	0.52	0.55	
Dry days	-0.35	-0.13	-0.34	-0.12	-0.28	-0.12	-0.27	-0.12	0.12	0.12	-0.12	0.14	0.13	0.54	0.52	0.54	0.53	-0.06	-0.06	-0.17	-0.3	-0.23	-0.23	-0.16	0.14	0.13	-0.12	0.12	0.12	-0.12	-0.27	-0.23	
DSC10	-0.49	-0.17	-0.5	-0.16	-0.43	-0.17	-0.46	-0.16	0.05	0.05	-0.15	0.07	0.06	0.51	0.51	0.53	0.53	-0.16	-0.14	-0.21	0.51	0.52	0.49	0.51	0.01	0.06	-0.1	0.05	0.05	-0.15	-0.28	-0.12	
DSC15	-0.47	-0.12	-0.47	-0.11	-0.61	-0.15	-0.58	-0.14	-0.12	-0.12	-0.07	-0.12	-0.13	0.03	0.01	0.01	-0.02	-0.11	-0.1	-0.14	0.13	0.05	-0.02	-0.08	-0.1	-0.13	-0.08	-0.12	-0.12	-0.07	0.19	0.31	
DSC20	-0.36	-0.24	-0.39	-0.23	-0.41	-0.26	-0.43	-0.24	-0.09	-0.11	-0.1	-0.08	-0.07	-0.02	-0.04	-0.17	-0.19	-0.05	-0.06	-0.17	-0.39	-0.41	-0.5	-0.52	-0.06	-0.07	-0.13	-0.09	-0.11	-0.1	0.36	0.38	
DSI	-0.18	-0.24	-0.15	-0.23	nan	-0.26	nan	-0.24	0.02	0.04	-0.1	0.04	0.04	0.17	0.13	-0.06	-0.07	0.05	0.08	-0.17	-0.4	-0.43	-0.23	-0.22	0.12	0.04	-0.13	0.02	0.04	-0.1	0.31	0.11	
DSxI	0.46	-0.24	0.44	-0.23	nan	-0.26	nan	-0.24	-0.02	-0.01	-0.1	-0.03	-0.01	-0.01	-0.06	nan	nan	-0.05	-0.04	-0.17	-0.43	-0.48	nan	nan	-0.21	-0.01	-0.13	-0.02	-0.01	-0.1	-0.18	-0.24	
Onset	-0.57	-0.09	-0.57	-0.09	-0.53	-0.05	-0.54	-0.05	-0.05	-0.07	-0.01	-0.06	-0.04	0.2	0.15	0.05	0	-0.18	-0.18	-0.06	0.16	0.08	-0.19	-0.27	-0.05	-0.04	-0.01	-0.05	-0.07	-0.01	0.15	0.1	
Rain days	0.54	0.14	0.53	0.14	0.55	0.15	0.53	0.15	-0.06	-0.05	0.13	-0.1	-0.08	-0.72	-0.66	-0.7	-0.63	0.24	0.23	0.17	-0.21	-0.12	-0.15	-0.08	-0.03	-0.08	0.13	-0.06	-0.05	0.13	0.42	0.41	
Relative dry days	-0.45	-0.13	-0.44	-0.13	-0.42	-0.12	-0.4	-0.12	0.09	0.09	-0.13	0.13	0.11	0.61	0.58	0.62	0.58	-0.14	-0.14	-0.17	-0.3	-0.26	-0.25	-0.23	0.12	0.11	-0.13	0.09	0.09	-0.13	-0.41	-0.42	
Relative rain days	0.45	0.13	0.44	0.13	0.42	0.12	0.4	0.11	-0.1	-0.1	0.15	-0.13	-0.11	-0.62	-0.59	-0.62	-0.58	0.14	0.14	0.17	0.12	0.1	0.09	0.1	-0.09	-0.11	0.15	-0.1	-0.1	0.15	0.43	0.44	
Relative wet days 20	0.53	0.26	0.54	0.25	0.55	0.27	0.56	0.25	0.05	0.04	0.19	0.06	0.06	-0.49	-0.44	-0.5	-0.45	0.2	0.18	0.27	-0.59	-0.51	-0.63	-0.54	-0.02	0.06	0.17	0.05	0.04	0.19	-0.38	-0.36	
Relative wet days 30	0.5	0.23	0.52	0.21	0.47	0.21	0.5	0.19	0.2	0.19	0.14	0.17	0.17	-0.09	-0.09	-0.22	-0.24	0.21	0.21	0.23	-0.32	-0.34	-0.43	-0.48	0.11	0.17	0.13	0.2	0.19	0.14	-0.38	-0.37	
Relative wet days 40	0.48	0.15	0.51	0.14	0.45	0.15	0.49	0.13	0.2	0.18	0.07	0.16	0.16	0.07	0.09	0.05	0.03	0.17	0.15	0.18	0.07	0.09	-0.07	-0.12	0.16	0.16	0.06	0.2	0.18	0.07	-0.27	-0.19	
Relative wet days 50	0.49	0.09	0.51	0.08	0.34	0.14	0.34	0.13	0.16	0.13	0.03	0.13	0.14	0.12	0.13	nan	nan	0.12	0.1	0.1	0.05	0.07	nan	nan	0.13	0.14	-0.14	0.16	0.13	0.03	-0.06	-0.02	
Season length	0.63	0.07	0.63	0.07	0.54	0.05	0.54	0.05	0.05	0.06	0.05	0.01	0.02	-0.44	-0.37	-0.29	-0.23	0.25	0.25	0.07	-0.29	-0.18	-0.1	0	0.06	0.02	0.05	0.05	0.06	0.05	0.21	0.28	
Seasonal rainfall amount	0.53	0.25	0.54	0.24	0.52	0.23	0.52	0.22	-0.05	-0.05	0.2	-0.07	-0.07	-0.69	-0.63	-0.69	-0.63	0.23	0.22	0.27	-0.46	-0.37	-0.46	-0.38	-0.02	-0.07	0.2	-0.05	-0.05	0.2	-0.17	-0.17	
Wet days 20	0.53	0.26	0.54	0.24	0.54	0.25	0.55	0.24	0.04	0.04	0.19	0.05	0.05	-0.51	-0.45	-0.54	-0.48	0.2	0.18	0.28	-0.6	-0.49	-0.63	-0.52	-0.01	0.05	0.17	0.04	0.04	0.19	-0.36	-0.35	
Wet days 30	0.5	0.22	0.52	0.21	0.48	0.21	0.51	0.19	0.19	0.19	0.15	0.16	0.16	-0.13	-0.11	-0.27	-0.28	0.21	0.21	0.23	-0.35	-0.35	-0.45	-0.49	0.11	0.16	0.14	0.19	0.19	0.15	-0.36	-0.35	
Wet days 40	0.48	0.16	0.51	0.15	0.45	0.15	0.49	0.13	0.19	0.18	0.08	0.16	0.15	0.07	0.09	0.06	0.04	0.16	0.15	0.19	0.07	0.1	-0.08	-0.13	0.16	0.15	0.09	0.19	0.18	0.08	-0.25	-0.17	
Wet days 50	0.5	0.1	0.52	0.1	0.34	0.15	0.34	0.14	0.16	0.13	0.03	0.14	0.15	0.12	0.13	nan	nan	0.11	0.09	0.1	0.05	0.08	nan	nan	0.13	0.15	-0.08	0.16	0.13	0.03	-0.06	-0.01	
WSI	0.59	0.17	0.59	0.16	0.53	0.18	0.52	0.17	0.32	0.31	0.1	0.28	0.28	0.27	0.28	0.19	0.2	0.21	0.22	0.2	-0.04	0.01	0.1	0.15	0.32	0.28	0.1	0.32	0.31	0.1	-0.47	-0.46	
WSC10	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan
WSC15	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan
WSC20	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan

Sector dataset
 Collection point dataset

