INTEGRATED WATER RESOURCES MANAGEMENT AND THE WATER-ENERGY-FOOD NEXUS

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The Blue Nile Basin Basin

ABOUT ME

Rotary Youth Exchange Student to Idar-Oberstein, Germany in 2012/2013

Environmental Sustainability at MSU and Freiburg, Germany

Worked for Clean Water Action and The Watershed Center Grand Traverse Bay

Master's at the Institute of Technology in Cologne in Integrated Water Resources Management with a focus on the MENA region

Research Assistant at the German Agency for International Development for the project Water and Energy for Food

ITT
Institute for Technology and Resources Management in the Tropics and Subtropics

Technology Arts Sciences TH Köln

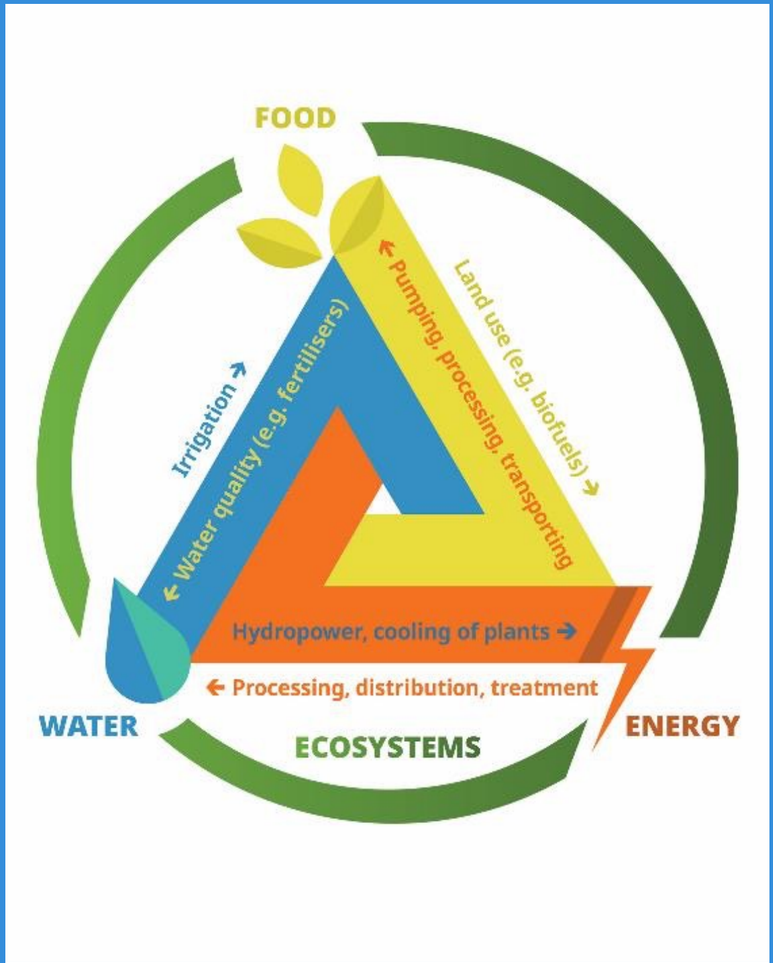
GJU
الجامعة الألمانية الأردنية
German Jordanian University

"Current global trends such as population and economic growth as well as climate change exert increasing pressure on water resources worldwide, which are the basis for food production, urban and industrial water supplies and hydropower."

A bilateral program between ITT and the German Jordanian University in Amman, Jordan– focus on water scarcity

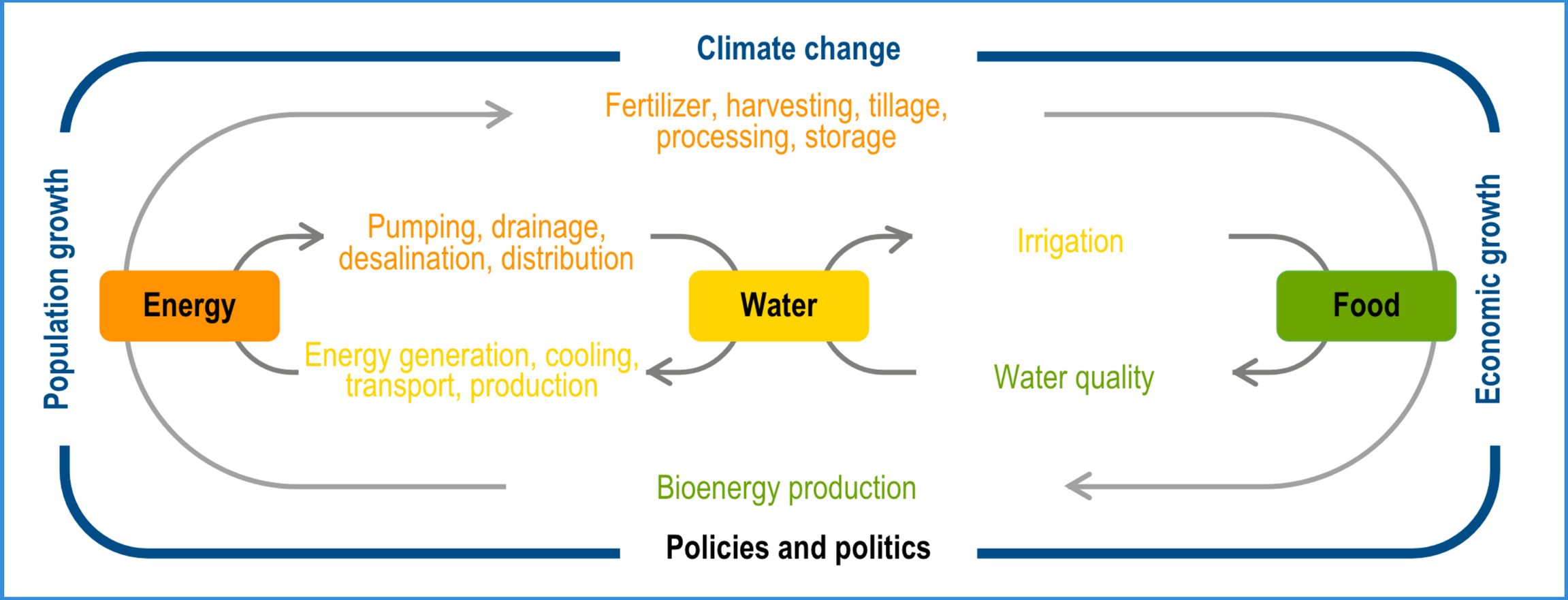
WHAT IS THE IMPORTANCE OF INTEGRATED WATER RESOURCES MANAGEMENT?

The Water-Energy-Food NEXUS



- Agriculture accounts for 70% of total global freshwater withdrawals
- The energy sector accounts for about 10- 15% of the global freshwater withdrawal
- Agriculture & food chain account for 33% of global energy demand

The Water-Energy-Food NEXUS



Case Study:

The Blue Nile Basin

The Blue Nile Basin lies on the border of Ethiopia and Sudan, a region of Sub-Saharan African frequently afflicted by droughts. Characterized by the Ethiopian highlands and Sudanese lowlands, the Blue Nile Rivers run through the basin area and provide the water for the region before emptying into the Nile in Khartoum, providing 60% of the flow of the Nile.

WATER-ENERGY-FOOD IN THE BLUE NILE BASIN

WATER SECURITY

Adequate Resources- insufficient management

ENERGY SECURITY

Only 38.5% of the total population was connected to the national grid

FOOD SECURITY

Limited by water allocation

BASIN CHALLENGES

SUDAN AND ETHIOPIA

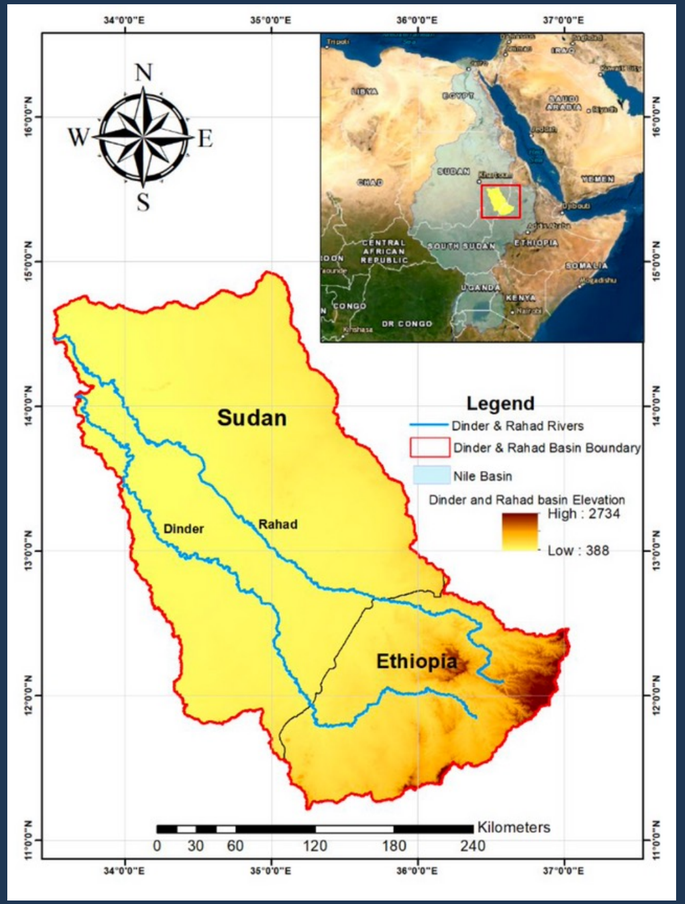
- Political Instability
  - Unrest in Sudan- no legitimate government recognized
  - Ongoing protests
  - Limited governmental capacities
- Regional instability
  - Lack of fundamental cooperation between the basin countries
- Climate change
  - Extreme weather events
  - Reduction in precipitation over time


MINISTRY OF IRRIGATION
AND WATER RESOURCES
وزارة الري والموارد المائية

DINDER BASIN

Drought Analysis

The Dinder and Rahad Basin lies on the border of Ethiopia and Sudan, a region of Sub-Saharan African frequently afflicted by droughts. Characterized by the Ethiopian highlands and Sudanese lowlands, the Dinder and Rahad rivers run through the basin area and provide much of the seasonal water for the region.



ASSESSMENT OF THE BASIN

WATER SCARCITY ANALYSIS

Measure the human and infrastructural impacts on water avilability

DROUGHT ANALYSIS

Measures the natural flow and environmental water availability

VULNERABILITY ANALYSIS

Measures the anthropogenic effects and quantifies loss

RISK ASSESSMENT

$$Risk = (Vulnerability \times Hazard \times Exposure) - Adaptive\ Capacity$$

REMOTE SENSING

Used to determine the hazard and exposure of drought risk

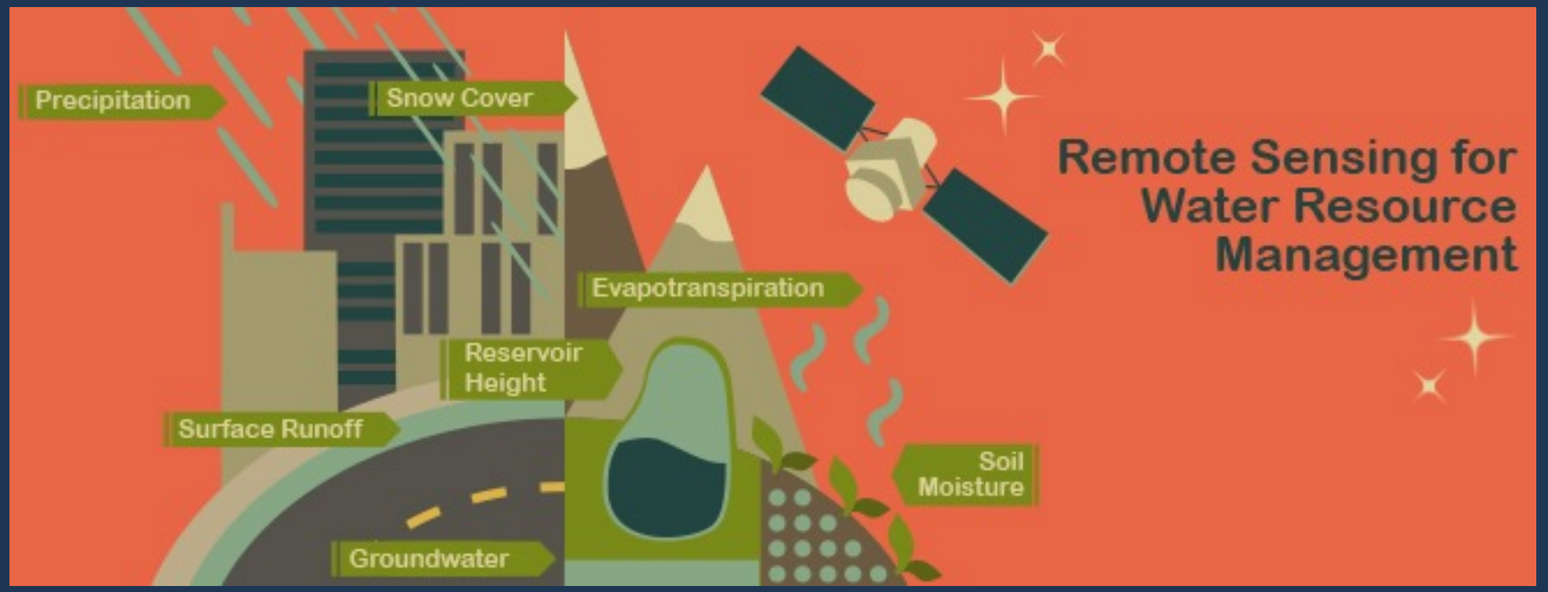
GROUND DATA COLLECTION

Mostly field surveys- used to determine vulnerability parameters and collect data to be weighted

NATIONAL DATA

National scale data is used for validation and for data scare regions

REMOTE SENSING FOR HAZARD QUANITFICATION

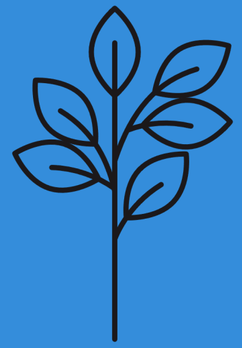


"Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). " (NASA, 2016)

Drought Analysis

METEOROLOGICAL DROUGHT

"The magnitude and duration of a precipitation shortfall" Meteorological droughts refer to a lack of precipitation over a defined amount of time and impacts can include agricultural loss, reduction in soil moisture, and compounding water deficits



AGRICULTURAL DROUGHT

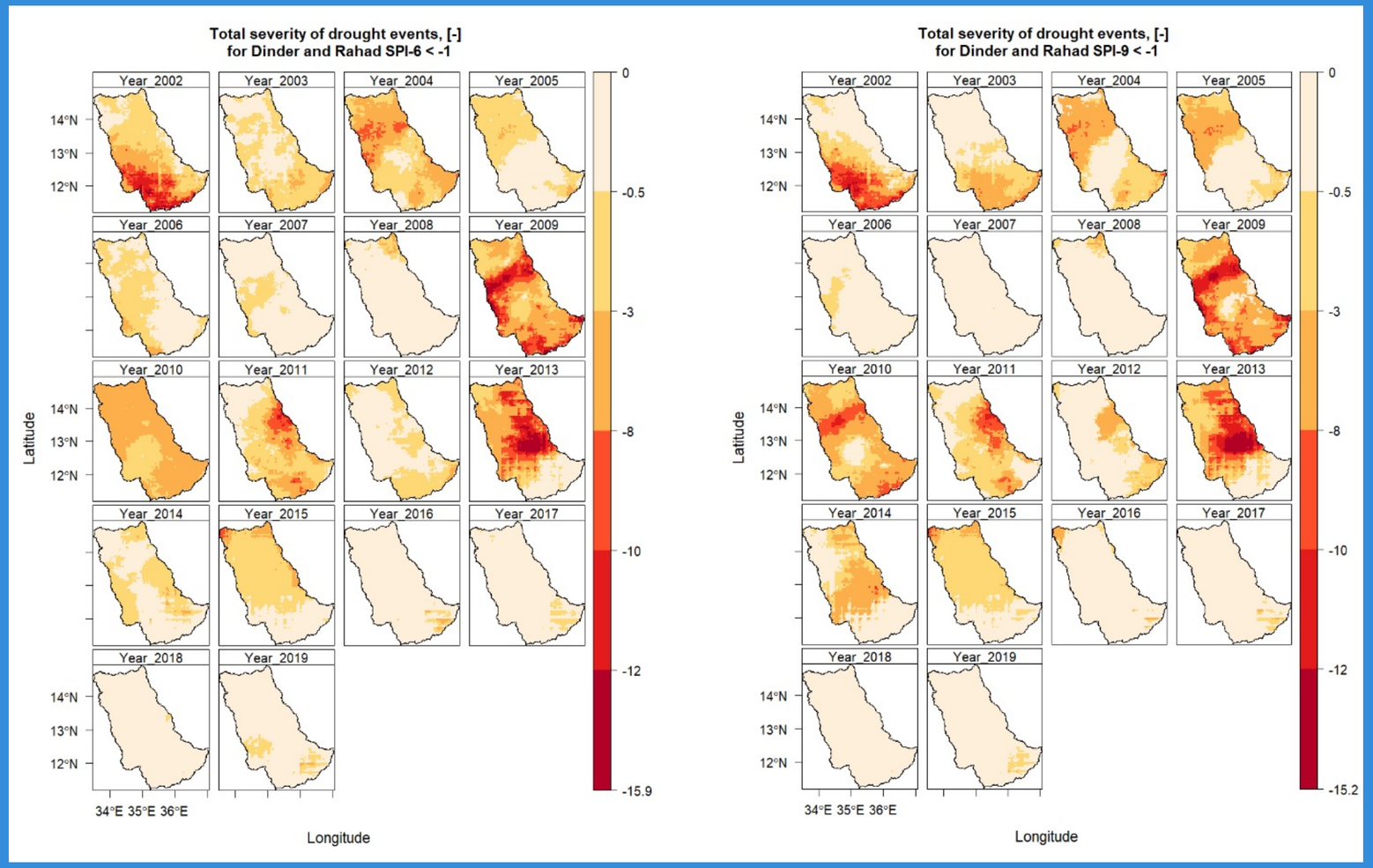
Agricultural drought is defined by a period of decreasing soil moisture that results in crop failure without any relation with surface water. Agricultural drought usually happens when the available amount of water goes below the optimal level of water for the proper growth of the plants during the growing season.

HYDROLOGICAL DROUGHT

Further propagation of drought conditions results in a hydrological drought. Low levels of surface water bodies, such as rivers and lakes, but also groundwater indicate a lack of water in the system. Hydrological droughts, lasting for months to years, can negatively affect the health of ecosystems as well as the economic sector, including drinking water supply, agriculture, and hydropower

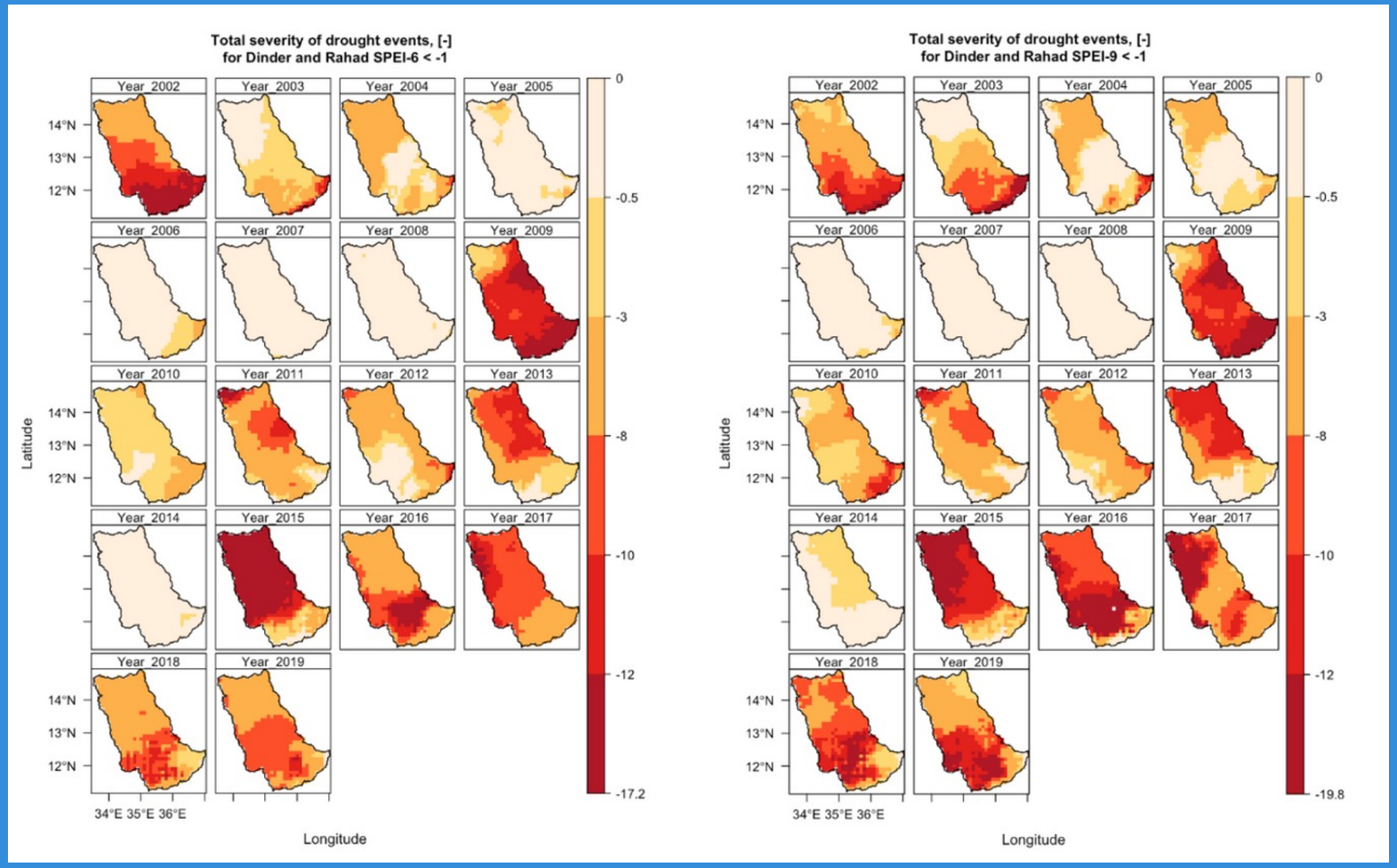
The Standardised Precipitation Index

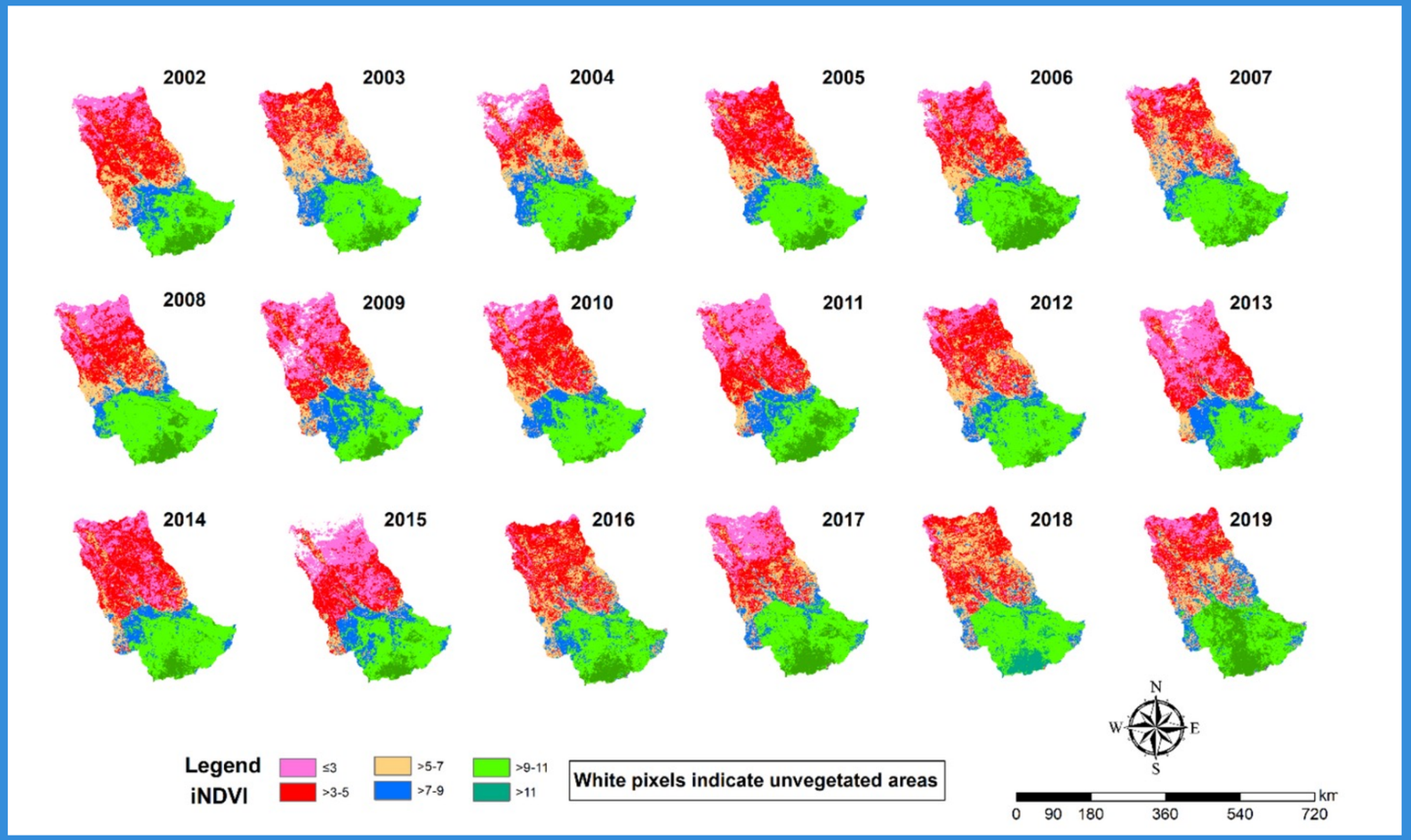
SPI measures the amount of precipitation in a given area during a defined period compared as standard deviations above or below the historical mean.



The Standardised Precipitation-Evapotranspiration Index

The calculation for SPEI is derived from this calculation of SPI and uses the difference in precipitation data and potential-evapotranspiration (PET) which results in the simplified water balance which is then calculated at the different time scales.





The Normalized Difference Vegetation Indexmalized

Uses global vegetation data derived from remote sensing satellites. It uses the reflectance in visible and near-infrared spectrems to measure the greenness of vegetation which can show the relative wet or dryness of an area.

PROPOSED SOLUTIONS

Farm level			**Policy level**
No-cost / low cost	*Unsure about investment costs*	*Moderate to high investments*	
Adapted sowing dates	Use of agro-chemicals	Rain water harvesting	Drought risk mapping
Zero/reduced tillage	Tree shelterbelts	Irrigation	Management plans
Leavging crop residues on cropland + cover crops	Agro-forestry		Enhancing access to capital and credits
Crop rotation	Drought-resilient crops		Improvement of infrastructure
High crop variety			Crop insurance
Counter ridging			Climate information

Next Steps

ADDITIONAL STUDIES

SMALL SCALE SOLUTIONS FOR CLIMATE CHANGE ADAPTATION

INTEGRATION OF STUDY OUTCOMES INTO REGIONAL POLICY

FACILITATION OF COOPERATION BETWEEN RIPARIAN PARTNERS

UPDATED POLITICAL FRAMEWORK

Questions?