Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

ACSAD

ESCWA

Integrated Vulnerability Assessment of Climate Change in the Arab Region

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Methodology

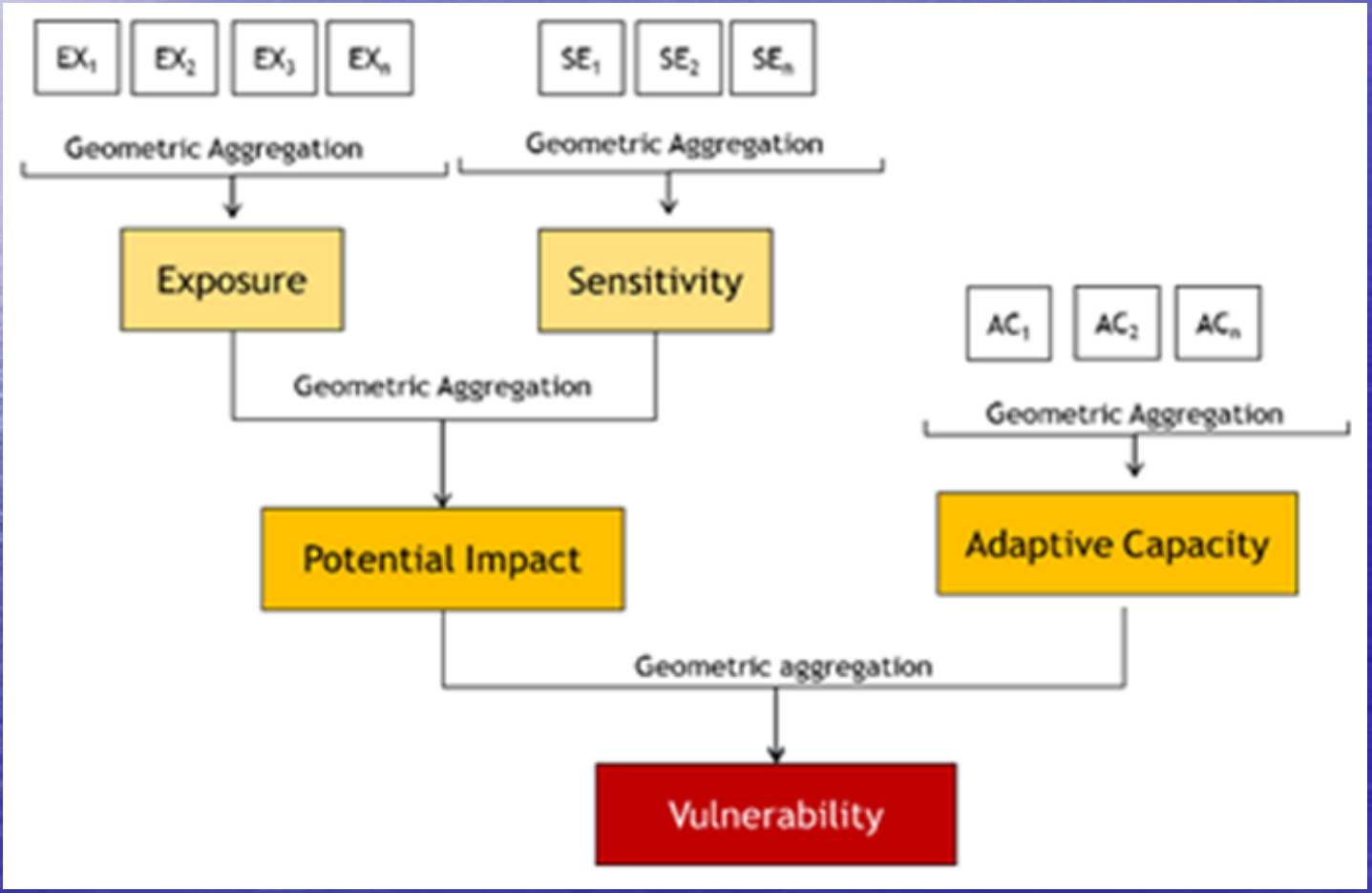
- Definition of sectors and impacts
- Identification of indicators
- Data acquisition and quality check of the data
- Aggregation of the data and mapping
- Evaluation

Sectors and potential climate change impacts

Sectors	Impacts	(Sub-)Vulnerability
 Water	Change in water availability	V0
 Biodiversity & Ecosystems	Change in area coveredby forests	V1
	Change in area of wetlands/marshes	V2
 Agriculture	Change of water available for crops	V3
	Change of rangeland for livestock	V4
 Infrastructure & Human Settlements	Change in inland flooding area	V5
	Change in coastal flooding area	V6
 People	Change of water available for drinking	V7
	Change in health due to heat stress	V8
	Change of employment rate in the agricultural sector	V9

Source: VA-WG, adapted from adelphi, 2013.

Components of the Vulnerability



Identifying and Selecting Indicators

Exposure Indicators Matrix

Indicators in light grey text are proposed to be dropped

TOTAL NUMBER OF EXPOSURE INDICATORS: 5 INDICATORS

RKH	VA	Indicator / Index	Source	Spatial resolution	Unit	Sector	Potential Impact	STATUS	CLASS REPS.	NOTES
✓		**Change in Temperature:** Indicates (projected/future) trends and changes in temperature	BMHI / ACSAD	50x50km	°C or % change	• **Sector Biodiversity and Ecosystems** – Vulnerability towards changing water availability • **Sector Agriculture** – Vulnerability towards changing water availability • **Sector Agriculture** – Vulnerability towards changing water availability • **Sector People** – Vulnerability towards changing water availability • **Sector People** – Vulnerability towards heat waves NOTE that the water sector is not included in the training manual	**PI1:** Change in area covered by forests **PI2:** Change in area covered by wetlands **PI3:** Change in available water for agriculture/crops **PI4:** Change in available water for livestock **PI7:** Change in available water for people **PI8:** Change in employment in agriculture **PI9:** Change health conditions	DRAFT	ACSAD	• Baseline period layer: 1986-2005 • Absolute change in comparison with 2016-2035 • Absolute change in comparison with 2046-2065 • Absolute change in comparison with 2081-2100 • Completed by classes and colors need to be adjusted.
✓		**Change in Precipitation:** Indicates (projected/future) trends and changes in temperature	BMHI / ACSAD	50x50km	Mm or % change	• **Sector Biodiversity and Ecosystems** – Vulnerability towards changing water availability • **Sector Agriculture** – Vulnerability towards changing water availability	**PI2:** Change in area covered by wetlands **PI3:** Change in available water for agriculture/crops	DRAFT	ACSAD	• Baseline period layer: 1986-2005 • Absolute change in comparison with 2016-2035 • Absolute change in comparison with 2046-2065 • Absolute change in comparison with 2081-2100 • Completed by classes and colors need to be adjusted.
✓		**Change in run-off:** Indicates (projected/future) trends and changes in run-off	BMHI / ACSAD	50x50km	mm/a	• **Sector Water** – Vulnerability towards changing water availability • **Sector Biodiversity and Ecosystems** – Vulnerability towards changing water availability • **Sector Agriculture** – Vulnerability towards changing water availability • **Sector People** – Vulnerability towards changing water availability	**PI0:** Water availability **PI1:** Change in area covered by forests **PI2:** Change in area covered by wetlands **PI3:** Change in available water for agriculture/crops **PI4:** Change in available water for livestock **PI7:** Change in available water for people **PI8:** Change in employment in agriculture	DRAFT	ACSAD	• Baseline period layer: 1986-2005 • Absolute change in comparison with 2016-2035 • Absolute change in comparison with 2046-2065 • Absolute change in comparison with 2081-2100 • Accounts for the water balance: runoff, infiltration, temperature, precipitation (to generated ET) • Completed by classes and colors need to be adjusted.

Sensitivity Indicators Matrix

Indicators in light grey text are proposed to be dropped

TOTAL NUMBER OF SENSITIVITY INDICATORS: 18 INDICATORS

RKH	VA	Indicator / Index	Source	Spatial resolution	Unit	Sector/PI	Potential Impact	STATUS	CLSF REPS.	NOTES
POPULATION										
✓×	✓×	**Population density:** Indicates number of people potentially affected by Climate Change.	SEDAC / CIESIN	30 arc seconds (~1*1km)	inhabitats/km²	• **Sector Infrastructure and Settlements** – Vulnerability towards damage from flooding • **Sector People** – Vulnerability towards changing water availability • **Sector People** – Vulnerability towards heat waves	**PI5:** Damage from inland flooding **PI7:** Change in available water for people **PI10:** Change health conditions	**DRAFT OPTIONS**	NM, DC	Several data sources for population available, and differs approaches to geospatially distribute them at the country-level: • regarding population in rural areas (e.g., even in desert areas, population concentrations will be noted).
		Share of population employed in agriculture: Indicates the amount of people working in agricultural sector and potentially affected by Climate Change.	World Bank WDI AQAD	national level (one value per country)	%	• **Sector People** – Vulnerability towards changing water availability	**PI8:** Change in employment in agriculture	**DRAFT**	DC	• ESCWA/Mapor work with the labour force value from the population density raster map with national-level information about the agriculture sector employment •
✓		**Share of children and elderly of the population:** Indicates the share of population most sensitive towards heat waves	World Bank WDI	national level (one value per country)	% of population	• **Sector People** – Vulnerability towards heat waves	**PI10:** Change health conditions	**DRAFT**	NM-DC	• Population below 14 and above 6 (Represented by 2 different layers by age group for the RKH Maps)
✓		**Total renewable water available per capita (TARWR):** Indicates human pressure on renewable but finite resources.	Aquastat	national level (one value per country)	m³/inhabitant/yr	• **Sector Water** – Vulnerability towards changing water availability • **Sector Biodiversity and Ecosystems** – Vulnerability towards changing water availability • **Sector Agriculture** – Vulnerability towards changing water availability • **Sector People** – Vulnerability towards changing water availability	**PI0:** Water availability **PI1:** Change in area covered by forests **PI2:** Change in area covered by wetlands **PI3:** Change in available water for agriculture/crops **PI4:** Change in available water for livestock **PI7:** Change in available water for people **PI8:** Change in employment in agriculture	**DRAFT**	DC-NM	•

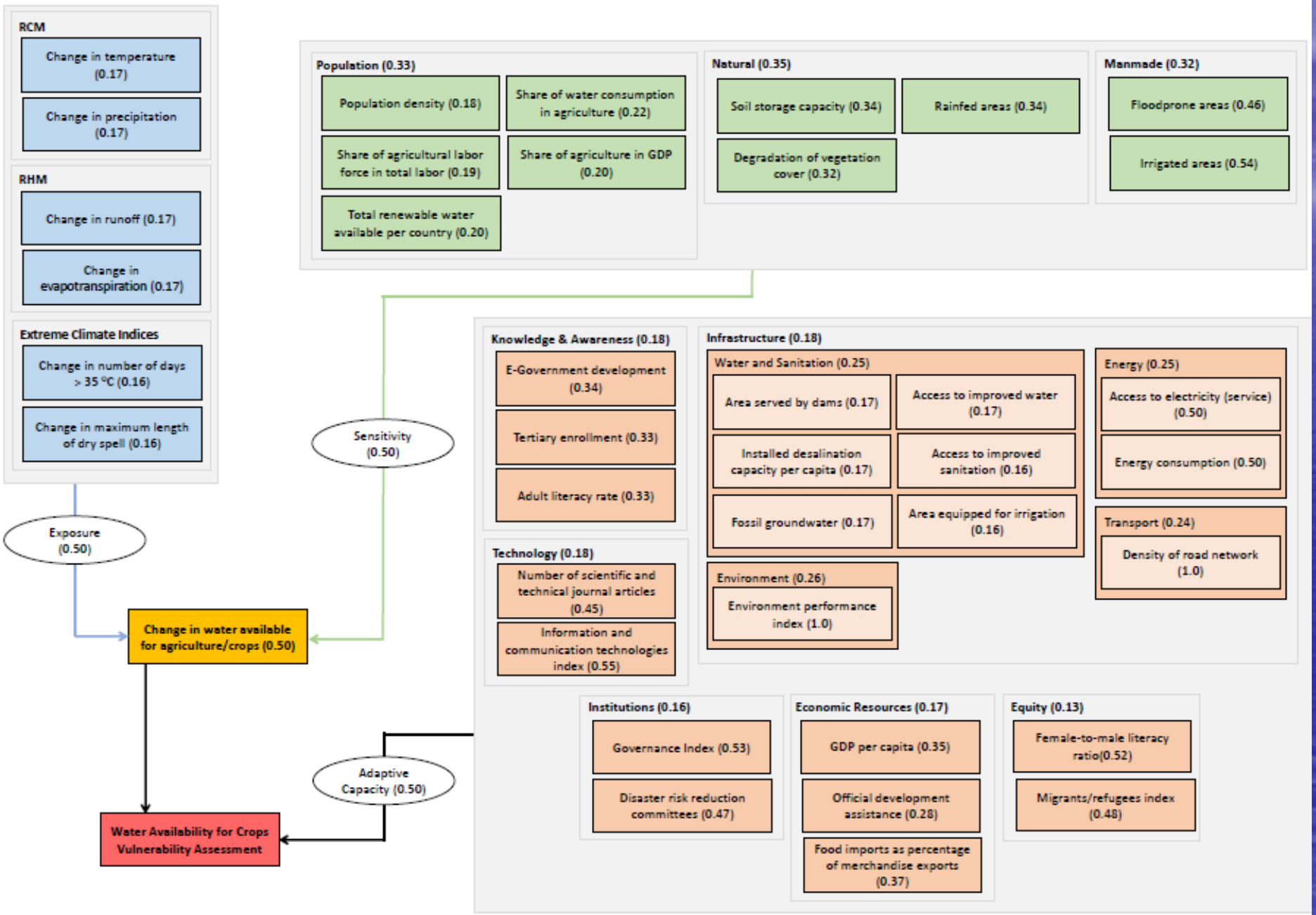
Adaptive Capacity Indicators Matrix

Indicators in light grey text are proposed to be dropped

TOTAL NUMBER OF ADAPTIVE CAPACITY INDICATORS: (4+3+ 16+11+6+3) 43 INDICATORS

RKH	VA	Indicator / Index	Source	Spatial resolution	Unit	Sector/PI	Potential Impact	STATUS	CLSF REPS.	NOTES
KNOWLEDGE & AWARENESS										
		Number of University Graduates		national level	%	• All			DC	
		Literacy Rate – Total Literacy Rate				• All			DC	
		Indicator on the Knowledge Society	Oxford Economics & Tim Berners-Lee's World Wide Web Foundation	national level		• All			DC	Annual Global Web Index Project. Potential use of subcomponents of the indicator: • Communications and institutional infrastructure score; • Web Content and Web use score; • Sub-Index 3: Political, economic and Social impact score
		Access to E-Government strategies and systems				• All			DC	
		Education programs, TV programs emissions				• All		DROP		No available datasets
TECHNOLOGY										
		Share of GDP expenditures on R&D	World Bank World Development Indicators	%		• All		PROPOSED	DC	Difficulty with indicator: Data only available for about half of the Arab countries from WDI
		Technological Development Indicator:	World	national		• All		PROPOSED	DC	World Bank Knowledge Economy Index – Technological

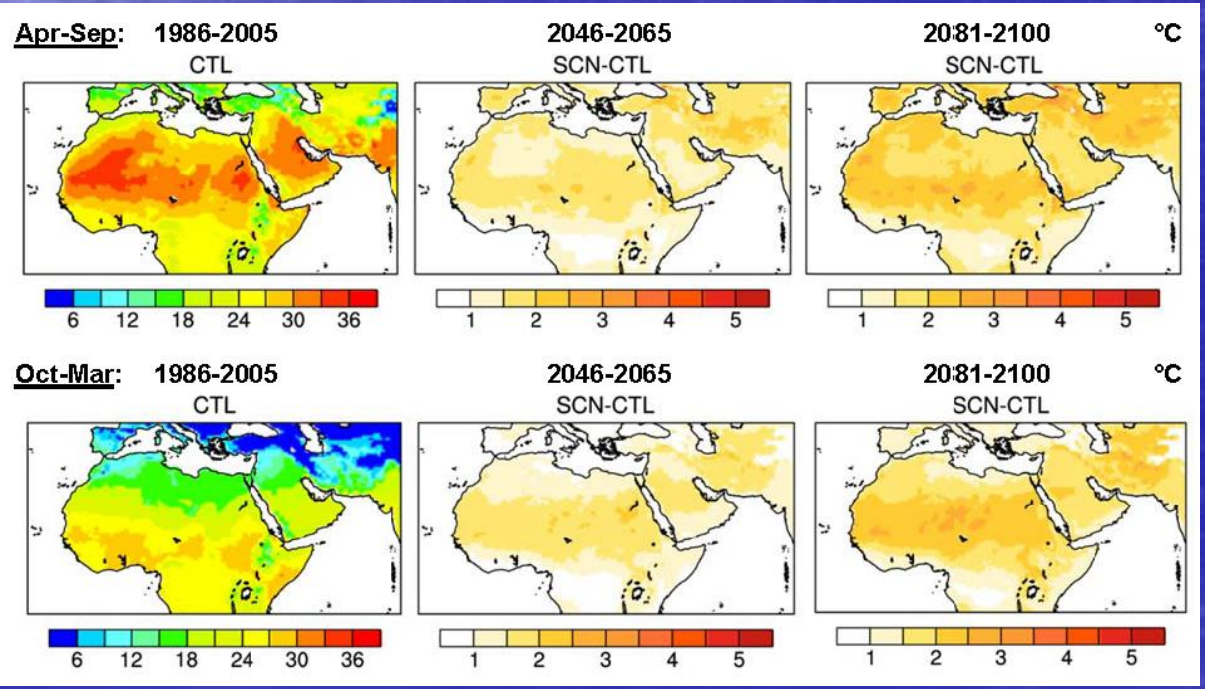
Impact Chain and Weights for Agriculture Sector - Change in water available for agriculture/crops



Identifying Data Sets to Quantify Indicators

- Once indicators are identified, sources which can quantify these indicators have to be selected.

- The data for exposure indicators were mainly developed as one output of RICCAR:



- For sensitivity indicators, data was mainly used from **international organisations** providing regional or global maps covering the Arab Domain as well as statistical data for all of the selected 21 countries in the Arab region.

Data collection and preperation

- Digital Soil Map of the World " FAO-UNESCO : http://www.fao.org/geonetowrk/srv/en/metadata.show
- World bank : http://data.worldbank.org/indicator/EN.POP.DNST

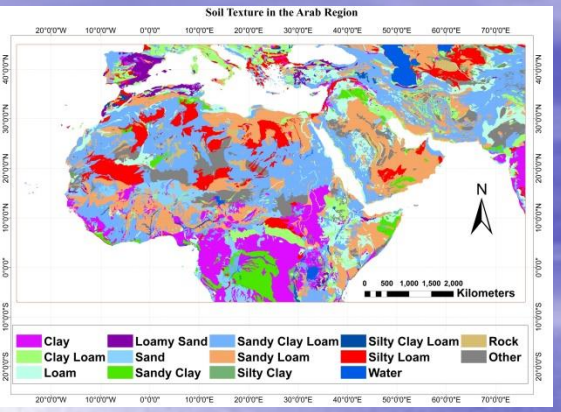
World Health Organization
REGIONAL OFFICE FOR THE Eastern Mediterranean

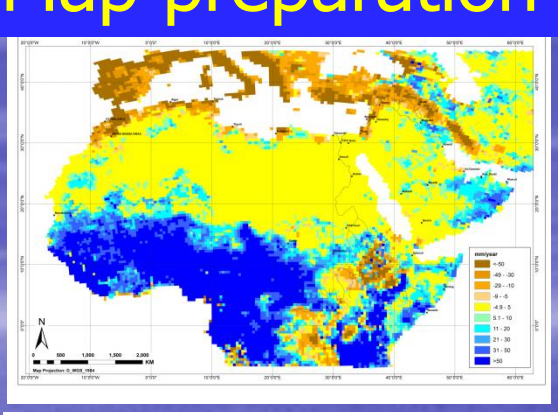
- **Aquastate :http://www.fao.org/nr/water/aquastat/dams/index.stm**
- FAO Global Land Cover Share (GLC-SHARE)
- **Population density :** http://sedac.ciesin.columbia.edu/data/set/grump-v1-population-count/data-download

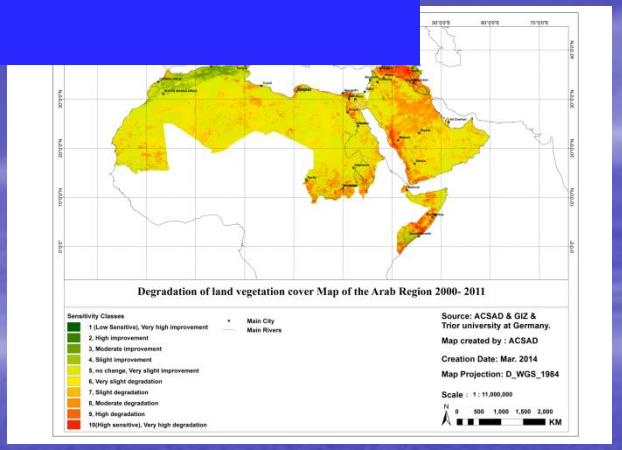
- ACSAD :
  - Degradation of vegetation cover
  - Groundwater

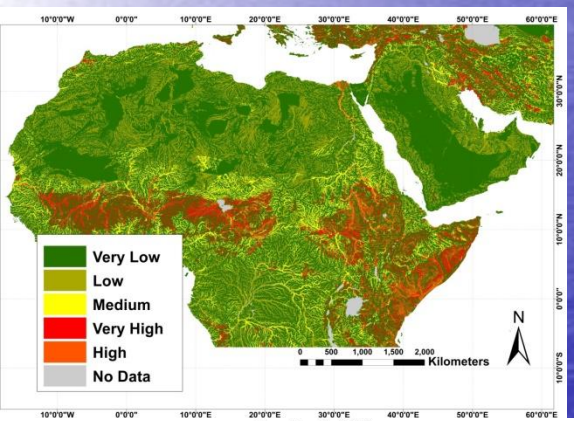
- For adaptive capacity, **statistics**, for the most part from the United Nations system were used. The data is only available for the national scale,.

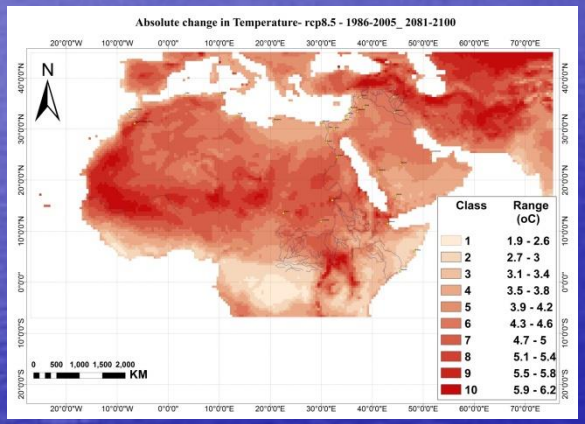
Map preparation

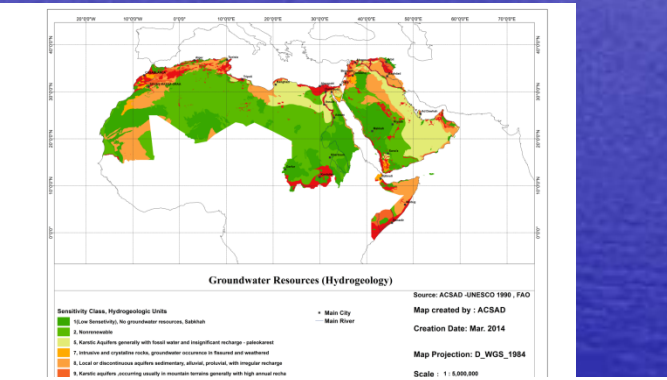


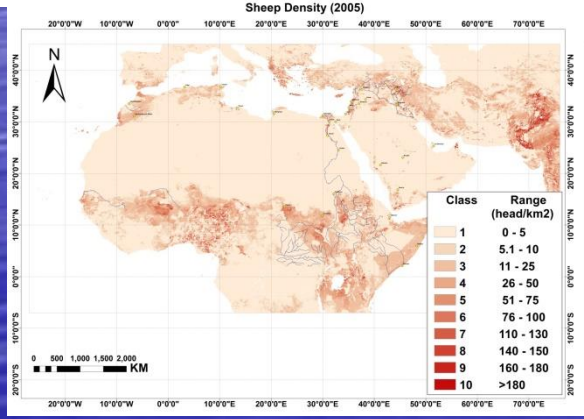


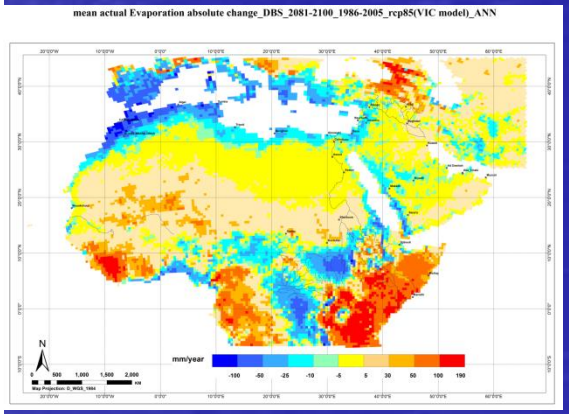


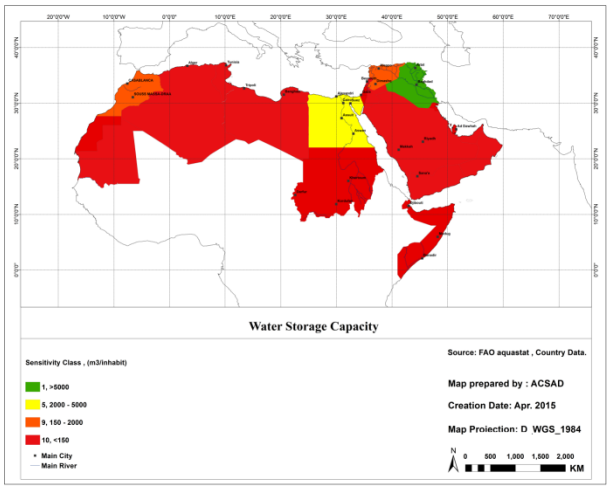












VA Indicator Fact Sheets

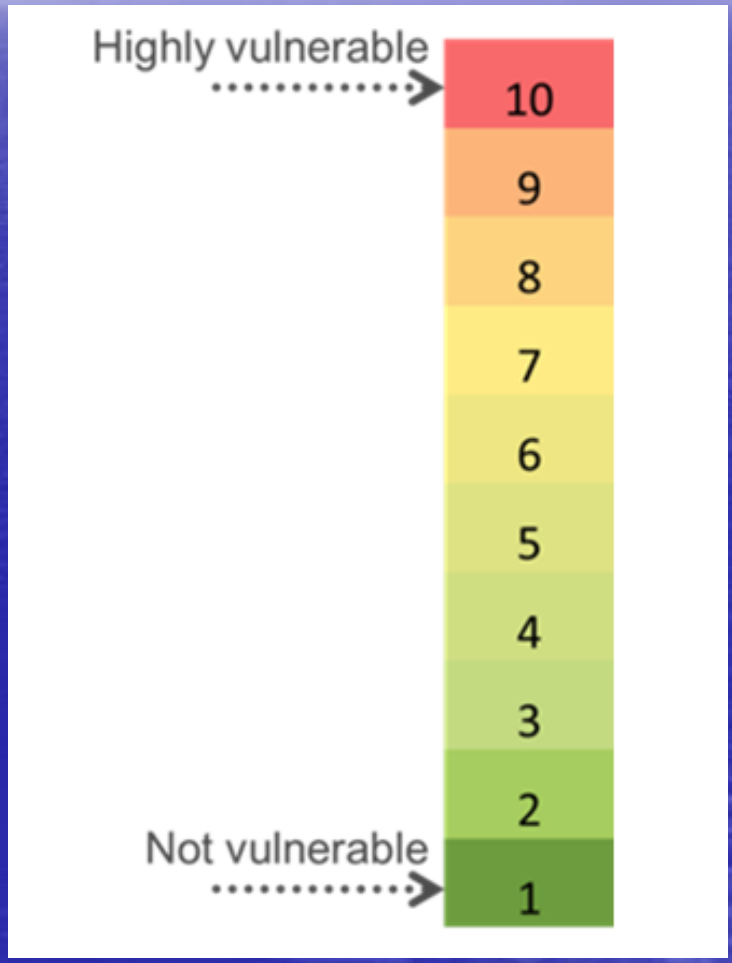
Population density

Population Density

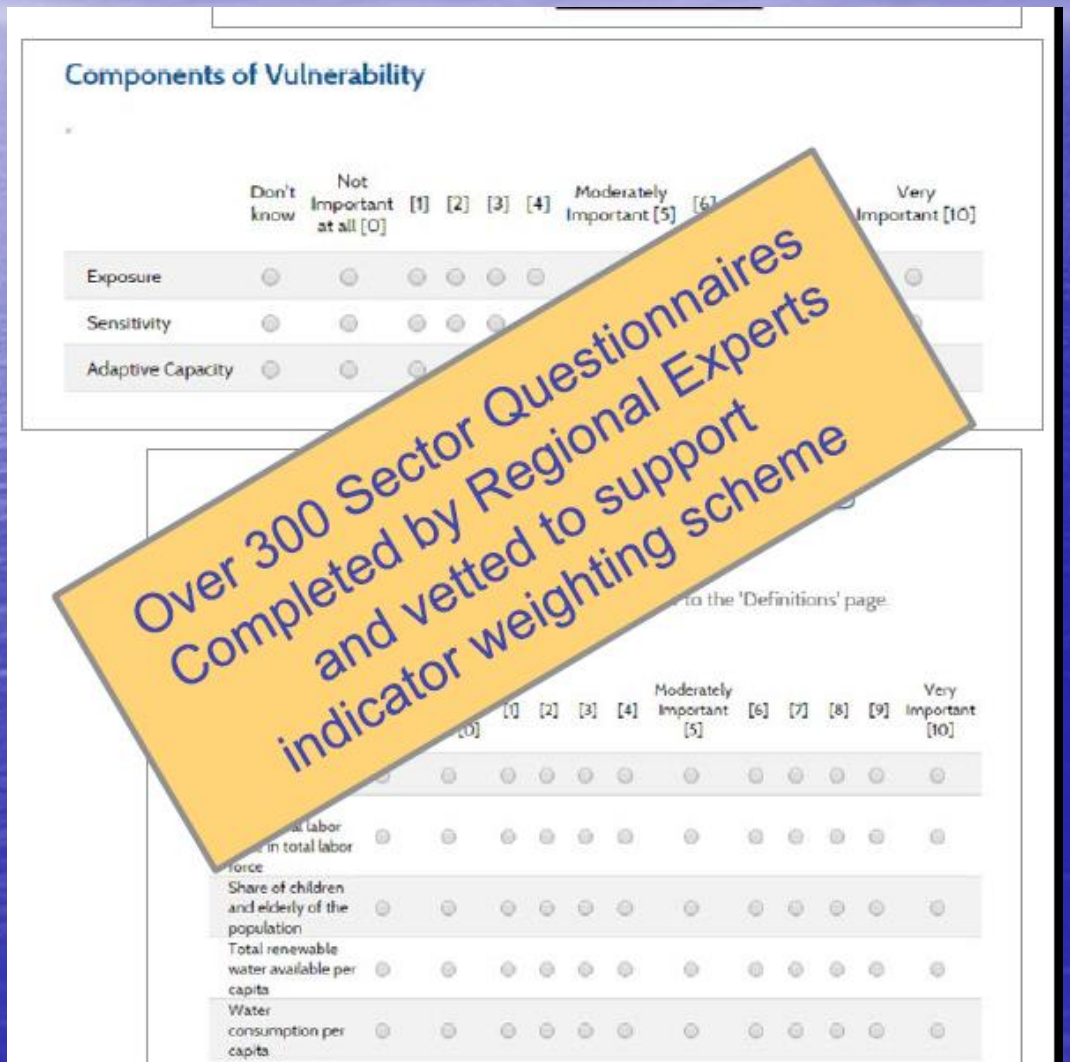
Indicator fact sheet		
Indicator	**Population Density**	
Vulnerability component and dimension	Sensitivity	Population
Description (position in the impact chain)	Number of Inhabitants per km²	
Applicable subsectors and impacts with corresponding weight of indicator for VA	**Water Availability**	0.21
	Biodiversity & Ecosystem: *Forests*	0.60
	Biodiversity & Ecosystem: *Wetlands*	1.00
	Agriculture: *Water available for agricultural production*	0.18
	Agriculture: *Water available for rangeland areas for livestock*	0.23
	Infrastructure & Human Settlements: *Inland flooding*	0.21
	People: *Water available for drinking*	0.15
	People: *Health due to heat stress*	0.20
	People: *Employment rate in agricultural sector* *	0.16
Classes and ranges/thresholds for Regional Knowledge Hub and Vulnerability Assessment	**Manual Classification (for RKH and VA)**	
	Sensitivity 1 =	0 – 2
	Sensitivity 2 =	2 – 5
	Sensitivity 3 =	5 – 10
	Sensitivity 4 =	10 – 50
	Sensitivity 5 =	50 – 100
	Sensitivity 6 =	100 – 500
	Sensitivity 7 =	500 – 1,000
	Sensitivity 8 =	1,000 – 5,000
	Sensitivity 9 =	5,000 – 10,000
	Sensitivity 10 =	10,000 – 92,139
	Manual Classification (for VA)- * *Employment in Agriculture VA only*	
	Sensitivity 1 =	0 – 2 and Urban Areas
	Sensitivity 2 =	2 – 5
	Sensitivity 3 =	5 – 10
	Sensitivity 4 =	10 – 50
	Sensitivity 5 =	50 – 100
	Sensitivity 6 =	100 – 500
	Sensitivity 7 =	500 – 1,000
	Sensitivity 8 =	1,000 – 5,000
	Sensitivity 9 =	5,000 – 10,000
	Sensitivity 10 =	10,000 – 92,139
Influence on vulnerability	The higher the population density the higher the sensitivity. For *Employment in Agriculture sector*, urban areas are less sensitive because it is expected that people will not work in agriculture.	
Citation (source of data)	LandScan 2014 Global Population Database	
Data information		
Type of data	Raster	
Spatial coverage	Only Arab States and the Arab Domain	
Resolution	1 x 1 km pixel	
Time reference	Updated based on 2010-2014 census data adjusted with to account refugees and internally displaced people in 2015	
Unit of measurement	Inhabitants per square kilometer	
Methodology for general data calculation	The data is available in the used unit and resolution	
Methodology for classification and transformation of values	The chosen classification method was done manually by experts for both the RKH and VA	
Input-indicators needed	-	
Data supply and acquisition		
Date of processing and publication	2015	
Availability and costs	Not available for external use	
Right to use / disseminate the data	All rights reserved to LandScan Global Population Database	
Contact	ESCWA	
Download-link	N/A	
Date of acquirement	2015	

Normalisation and Evaluation of Data

- In order to aggregate these datasets into the course of the vulnerability assessment, the data first need to be transformed into a unit-less score on a common scale. This process is called **normalisation**



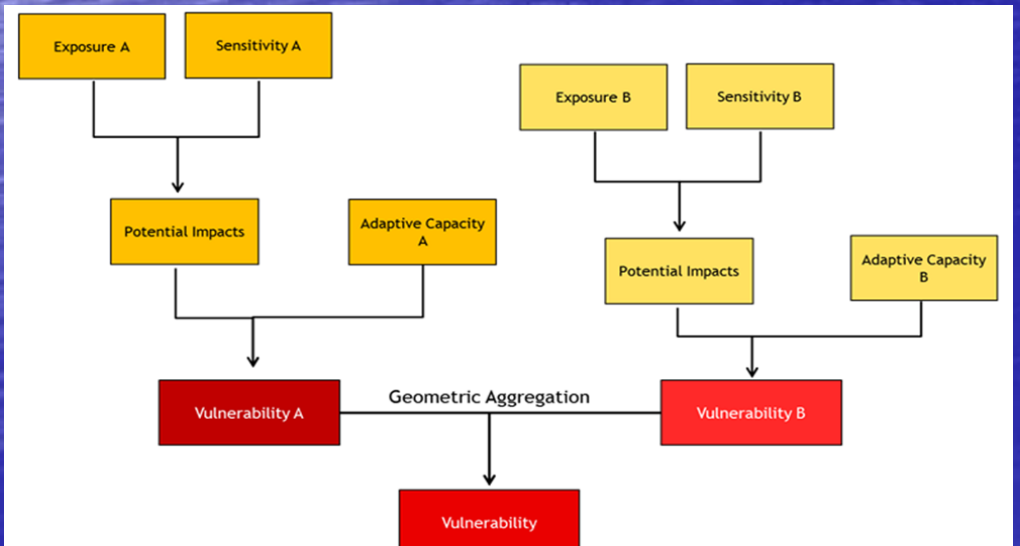
Indicator weighting

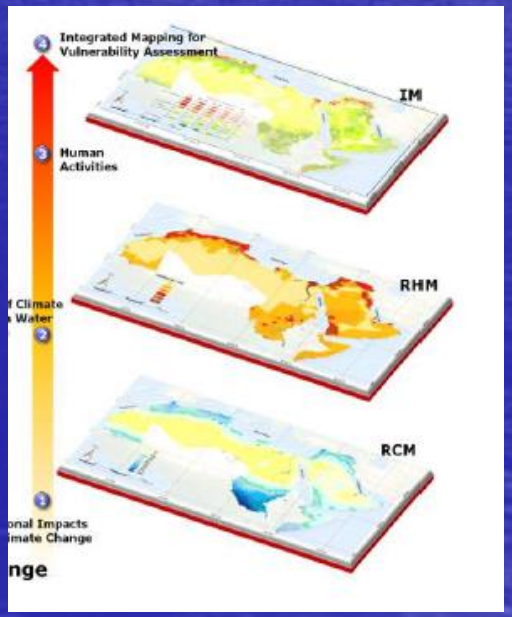


Aggregation

- Geometric aggregation approach was selected to aggregate individual indicators to a composite indicator.

CIExposure = (EX1 * EX2 * EX3 * … * EXn) 1/n



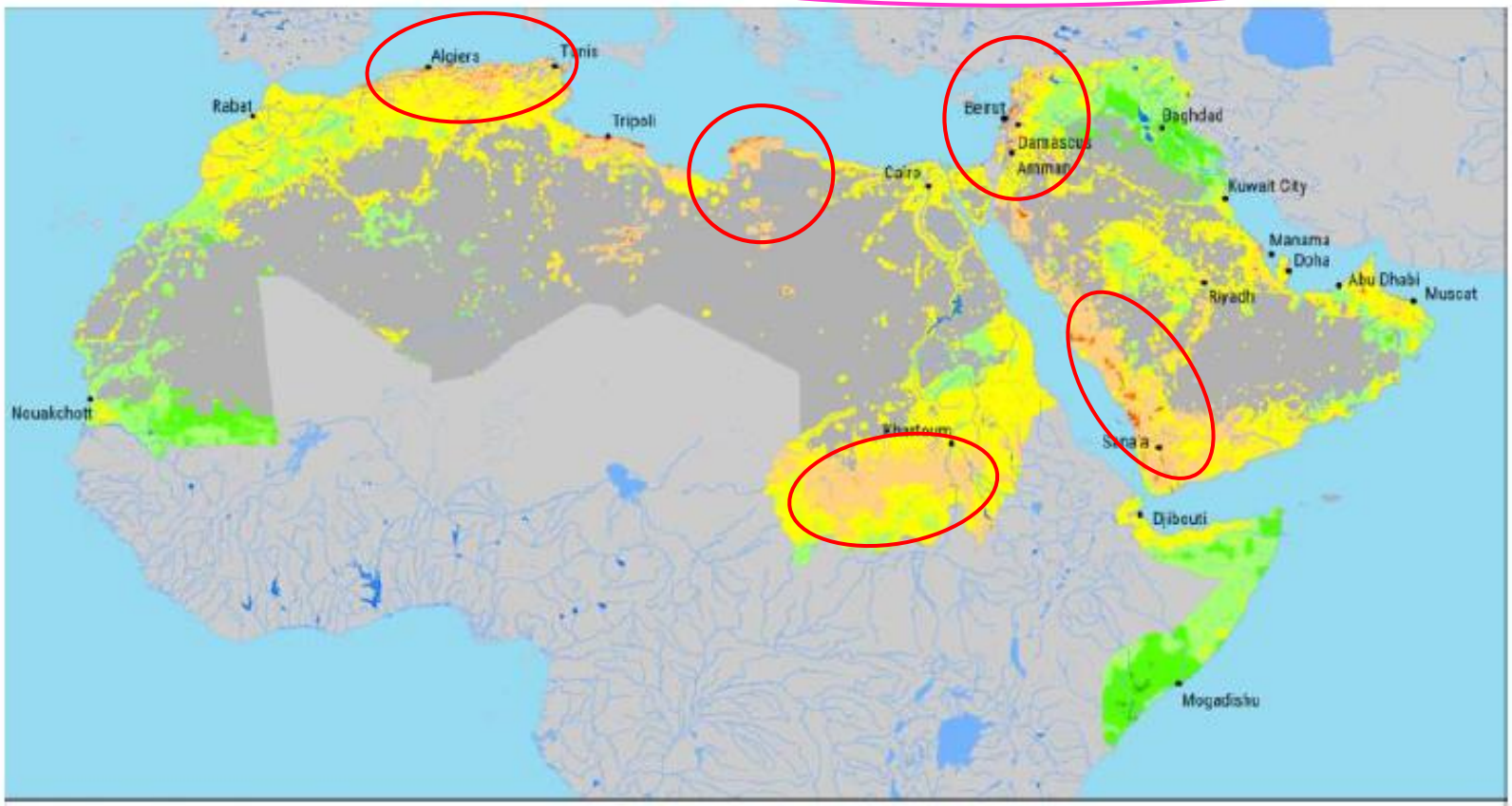


results

Water sector

Potential impact

Figure 9: Water availability – End-century – Potential Impact – RCP 8.5



WATER: WATER AVAILABILTY

POTENTIAL IMPACT: RCP8.5 END-CENTURY (2081-2100)

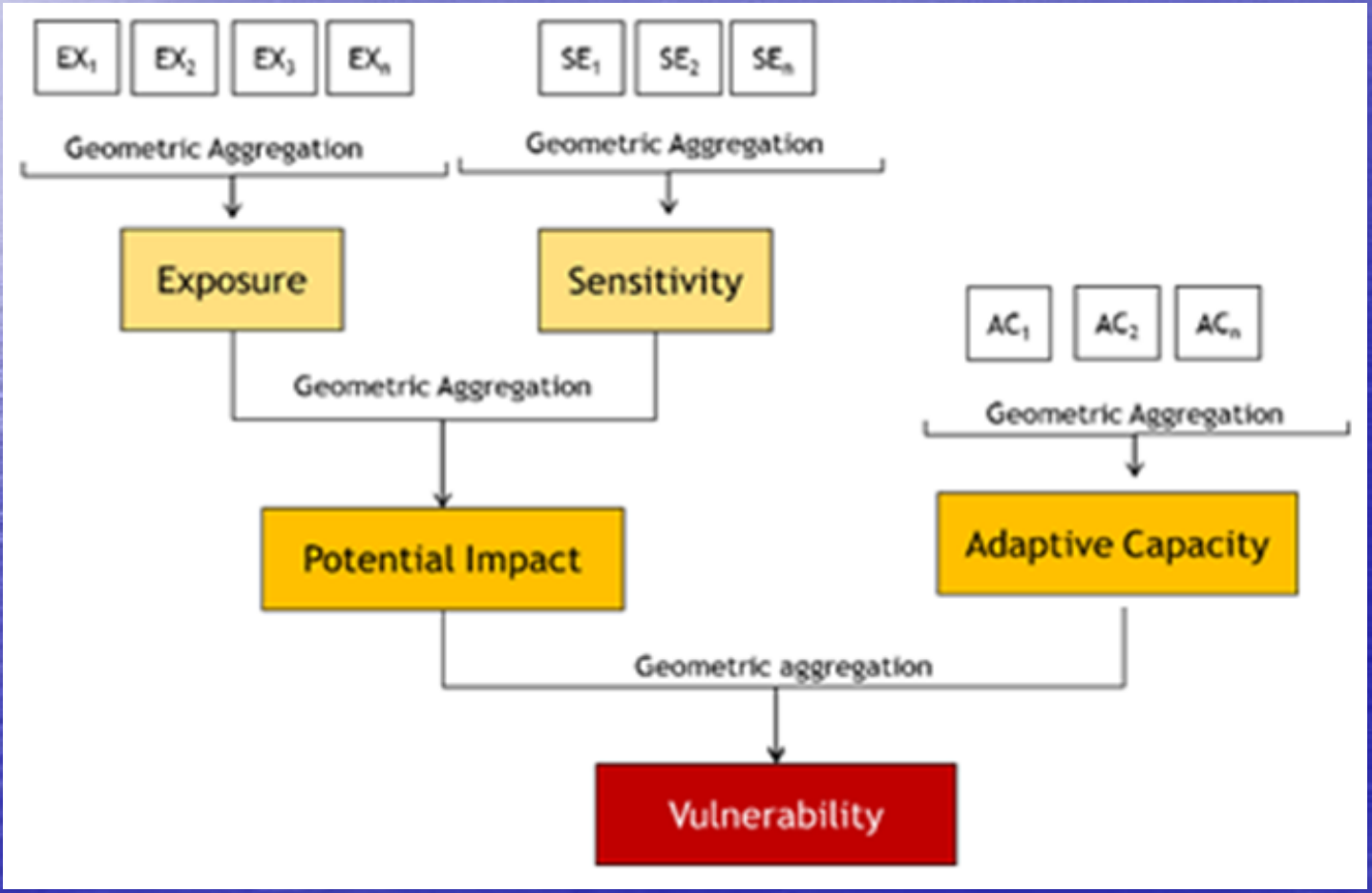
Legend

Lakes
Reservoirs
Rivers
Intermittent rivers
Major cities
Study area not relevant to subsector

Low Potential Impact — High Potential Impact

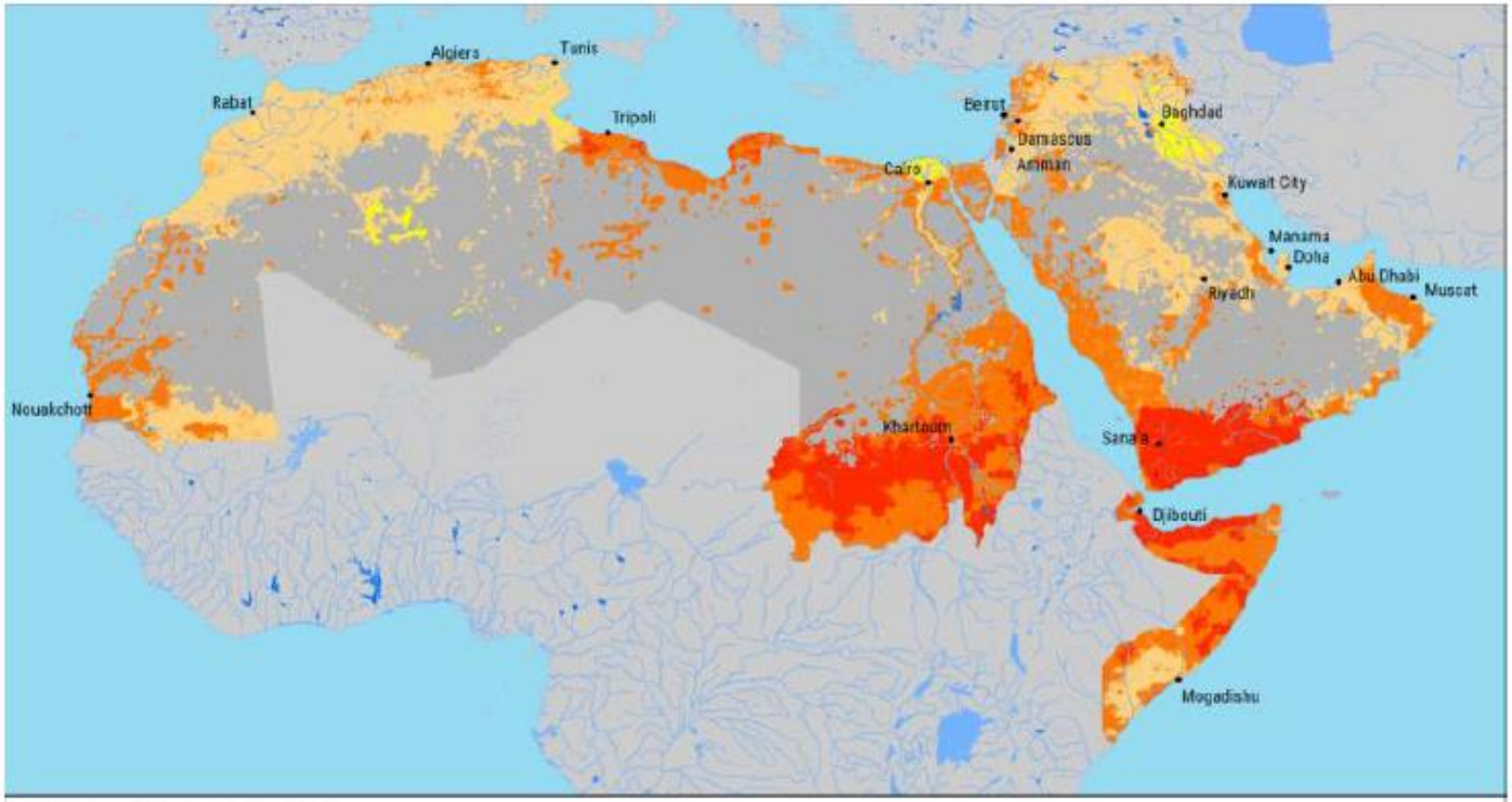
RICCAR

Components of the Vulnerability



Vulnerability

Figure 13: Water availability – End-century –Vulnerability – RCP 8.5



WATER: WATER AVAILABILTY

VULNERABILITY: RCP8.5 END-CENTURY (2081-2100)

Legend

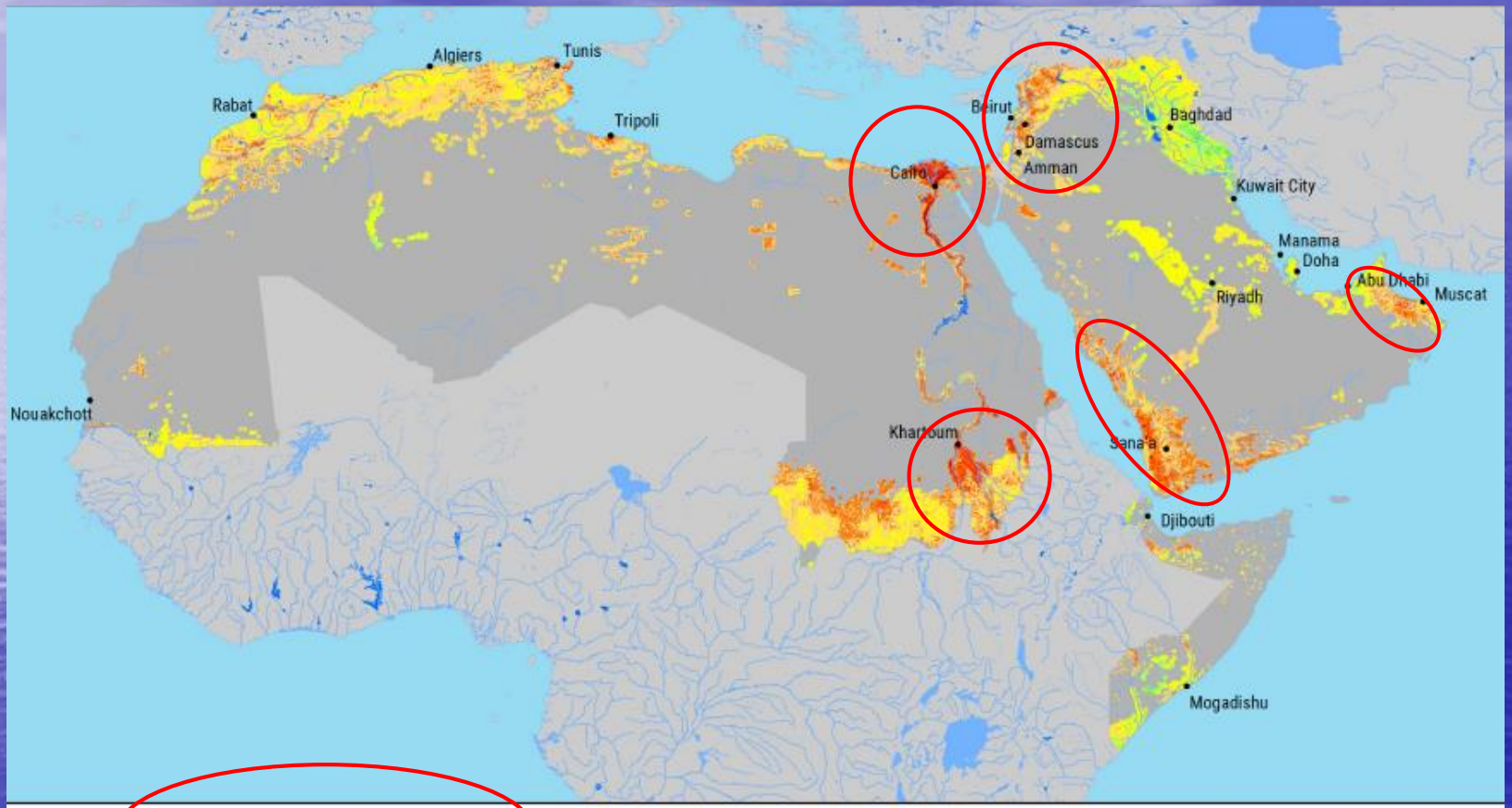
Lakes
Reservoirs
Rivers
Intermittent rivers
Major cities
Study area not relevant to subsector

Low Vulnerability — High Vulnerability

RICCAR

Water Available for Crops

Potential impact



AGRICULTURE: WATER AVAILABLE FOR CROPS

POTENTIAL IMPACT: RCP8.5 END-CENTURY (2081-2100)

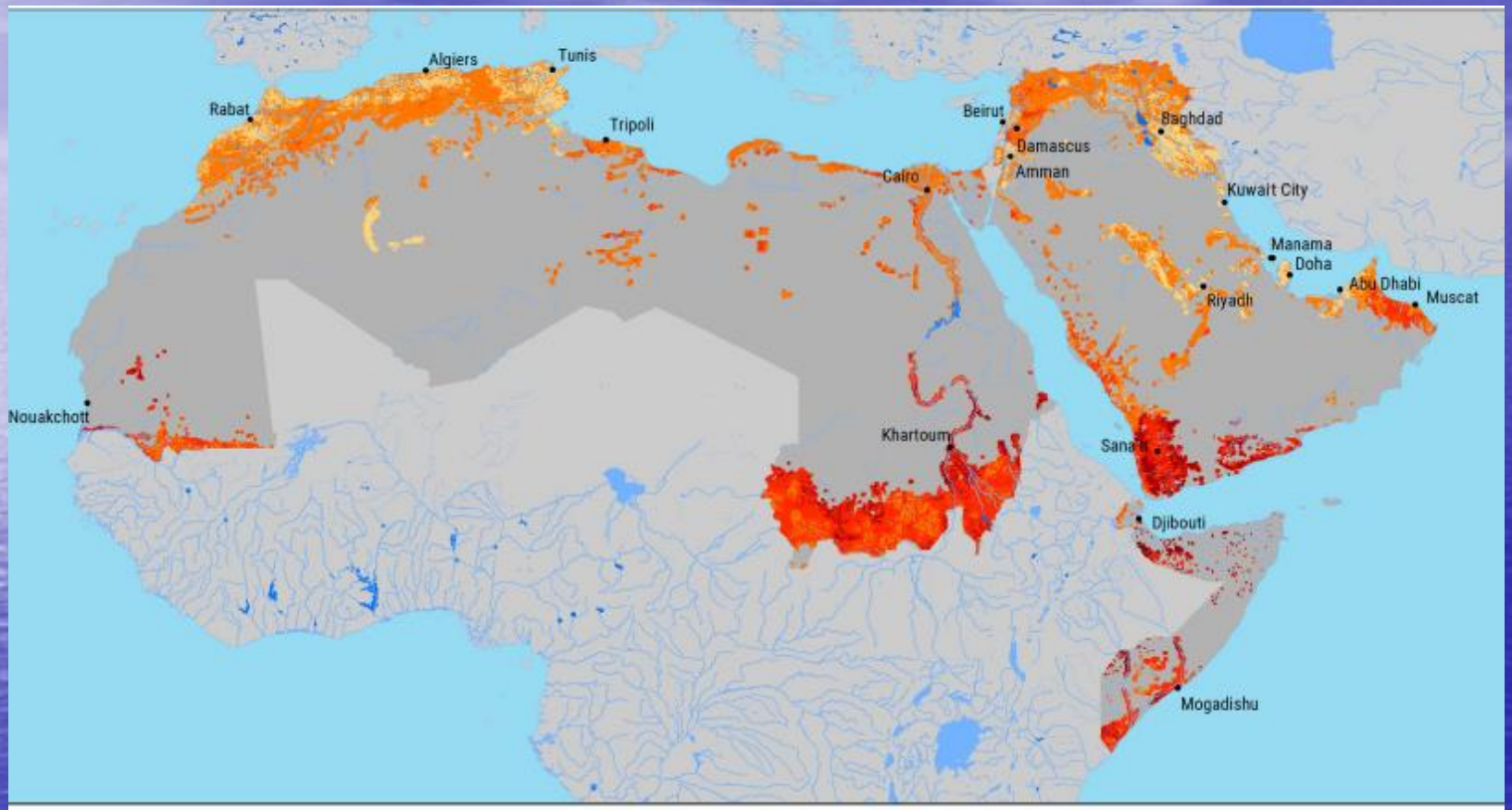
Legend

- Lakes
- Reservoirs
- Rivers
- Intermittent rivers
- Major cities
- Study area not relevant to subsector

Low Potential Impact — High Potential Impact

RICCAR

vulnerability



AGRICULTURE: WATER AVAILABLE FOR CROPS

VULNERABILITY: RCP8.5 END-CENTURY (2081-2100)

Legend

- Lakes
- Reservoirs
- Rivers
- Intermittent rivers
- Major cities
- Study area not relevant to subsector

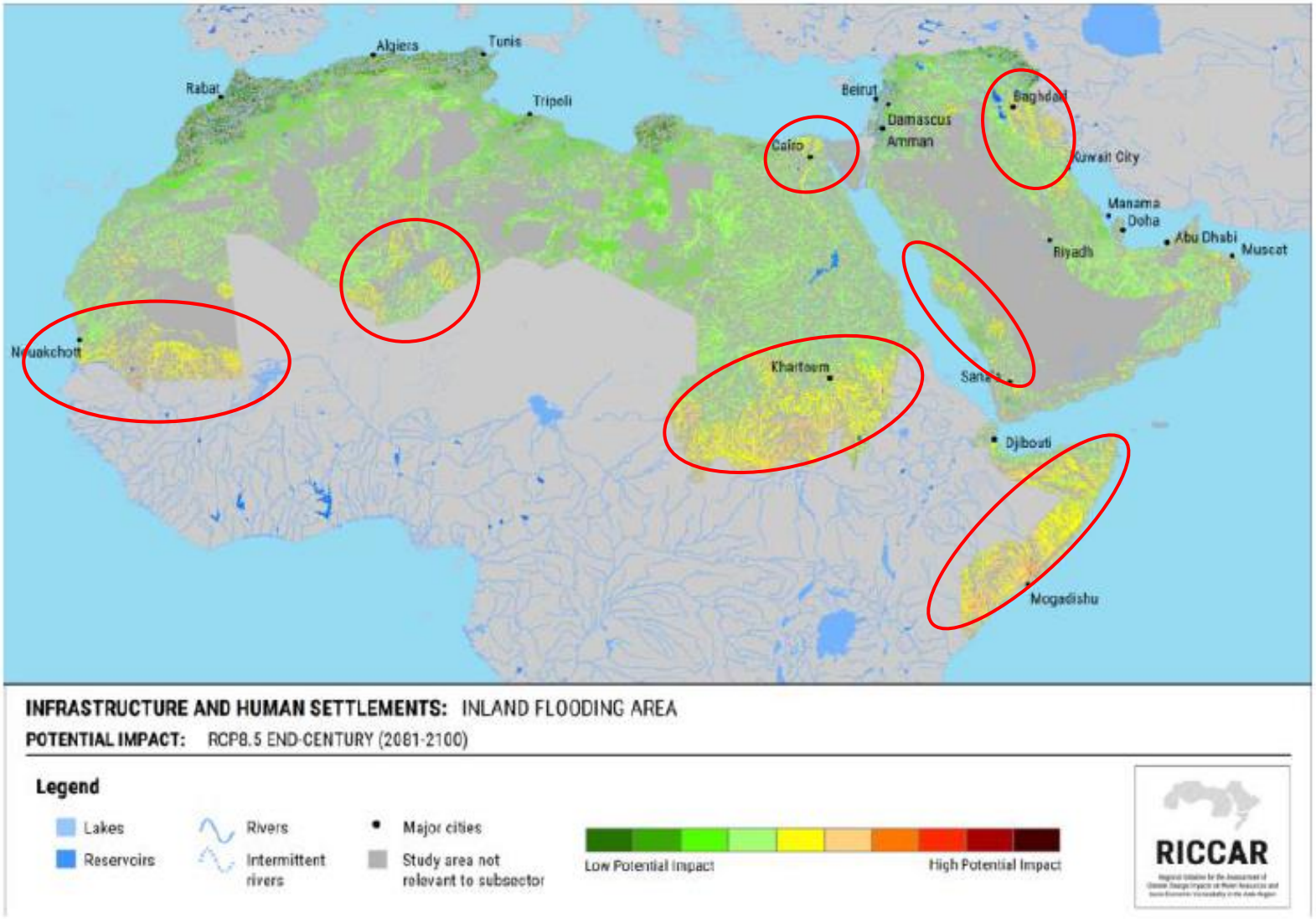
Low Vulnerability — High Vulnerability

RICCAR

Inland flooding area

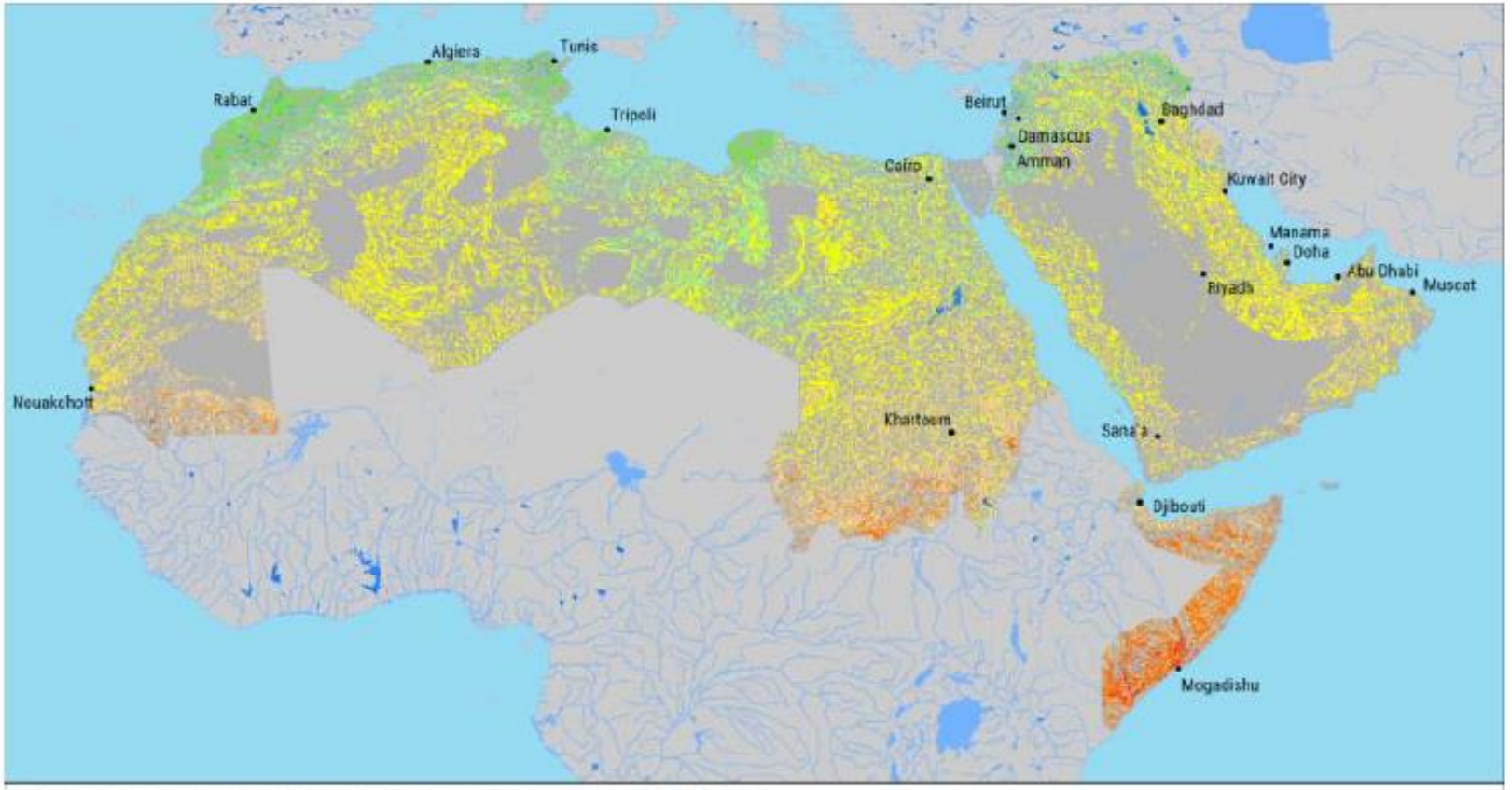
Potential impact

Figure 74: Inland flooding area – End-century – Potential Impact – RCP 8.5



vulnerability

Figure 78: Inland flooding area – End-century –Vulnerability – RCP 8.5



INFRASTRUCTURE AND HUMAN SETTLEMENTS: INLAND FLOODING AREA

VULNERABILITY: RCP8.5 END-CENTURY (2081-2100)

Legend

Lakes
Reservoirs
Rivers
Intermittent rivers
Major cities
Study area not relevant to subsector

Low Vulnerability — High Vulnerability

RICCAR

Key results

- Of the three components, adaptive capacity is most likely to influence vulnerability suggesting the ability of mankind is stronger than climate change and environmental stressors.
- Areas with the highest vulnerability, which have been defined as hotspots, generally occur in the Horn of Africa, the Sahel, and the southwestern Arabian Peninsula, irrespective of sector, subsector, or projected climate scenario.

Key results

- Areas with the lowest vulnerability relative to the region include the western Mediterranean, coastal Maghreb, and the coastal Levant due to increased adaptive capacity.
- The Euphrates and Tigris river basins, the lower Nile Basin, the central Mediterranean coast and the Gulf region are area exhibit moderate projected vulnerability due to high adaptive capacity.

Thanks