Integrated Vulnerability Assessment

Ihab Jnad

The Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD)

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 covered by 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
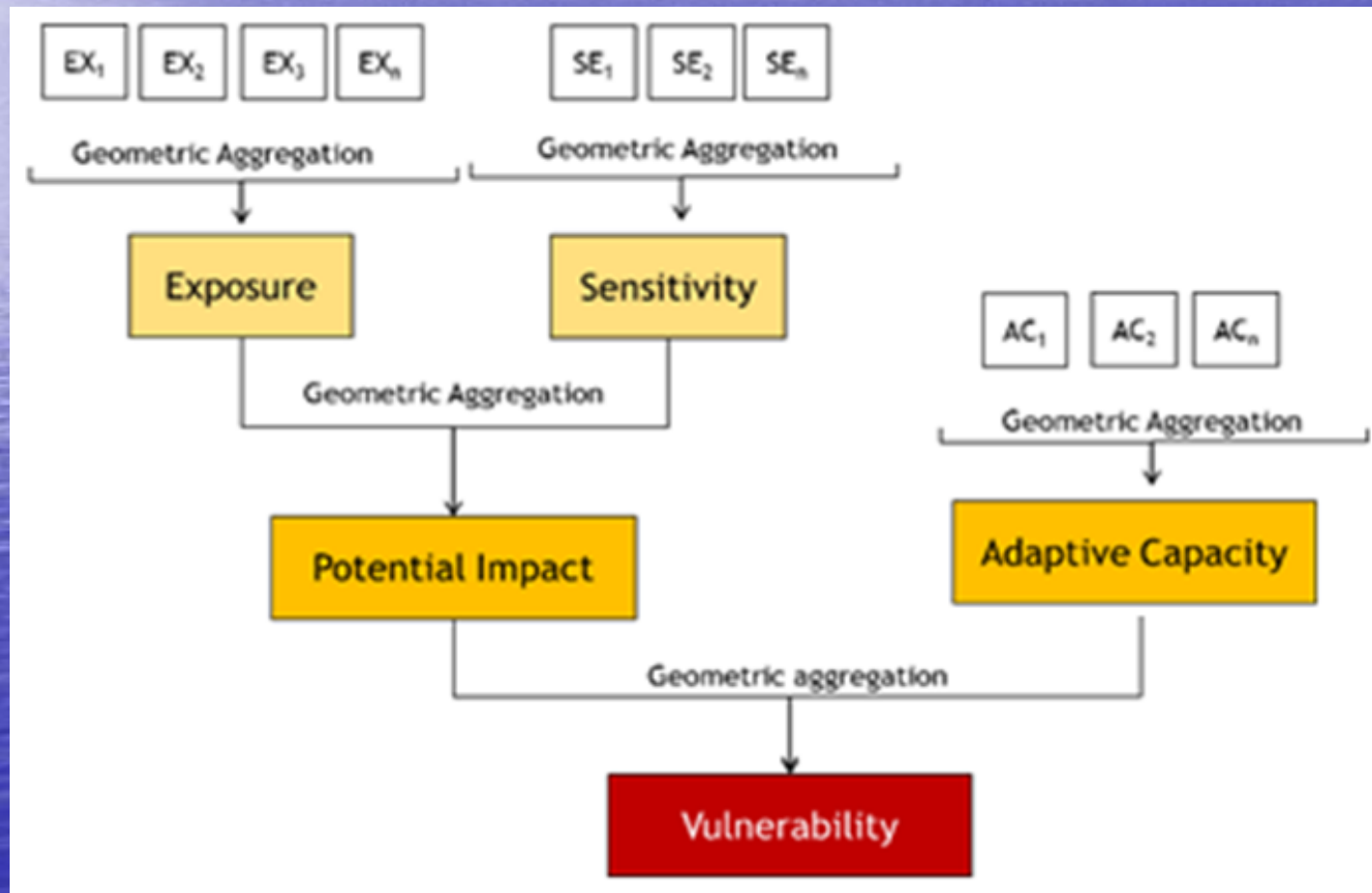
Identifying and Selecting Indicators

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	CLSF REPS.	NOTES
✔		**Change in Temperature:** Indicates (projected/future) trends and changes in temperature	SMHI / 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	SMHI / 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	SMHI / ACSAD	50x50km	mm/s	• 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

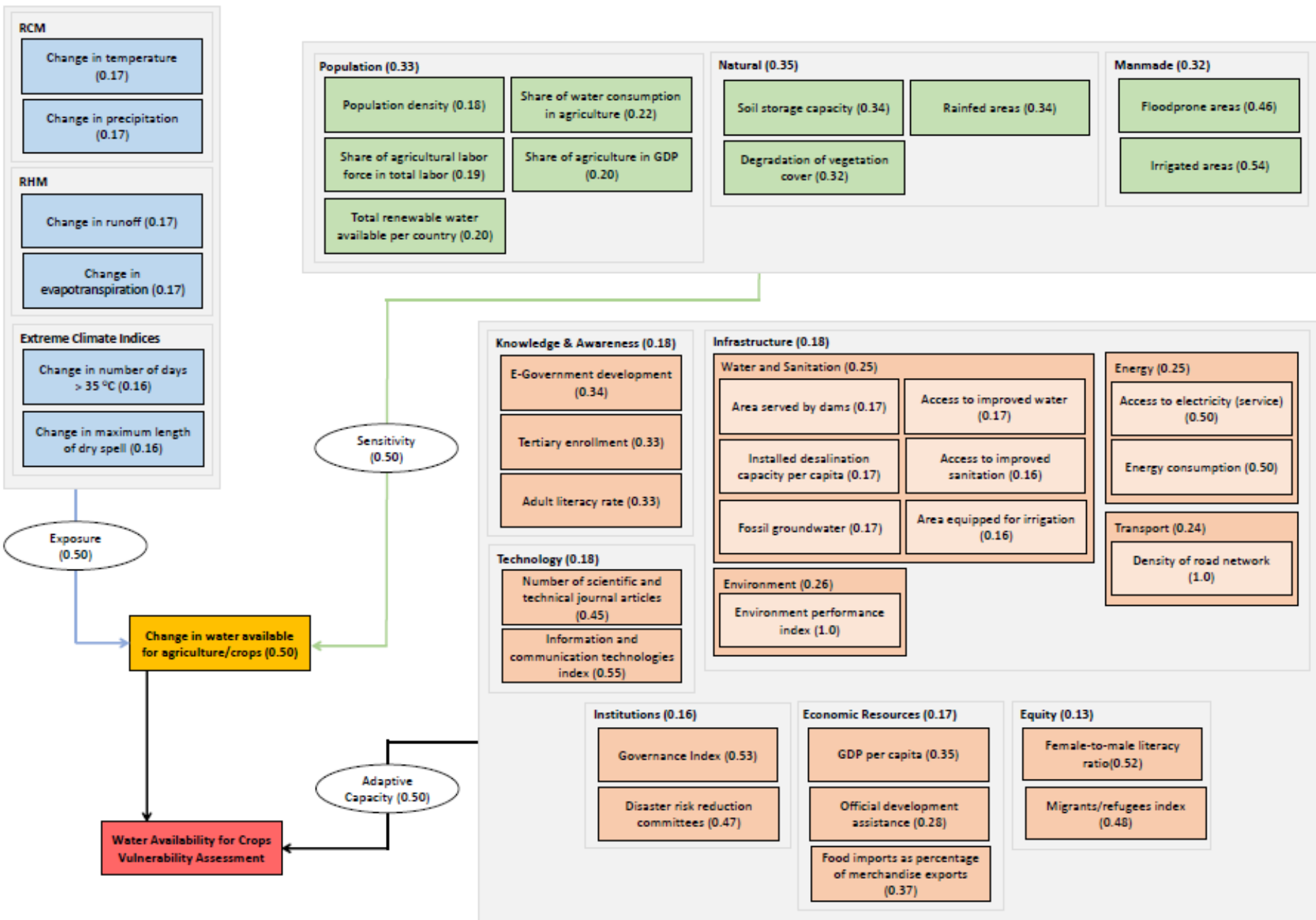| RKH	VA	Indicator / Index	Source	Spatial resolution	Unit	Sector/PI	Potential Impact	STATUS	CLSF REPS.	NOTES
										POPULATION
✓×	✓×	Population density: Indicates number of people potentially affected by Climate Change.	SEDAC / CIESIN	30 arc seconds (~1*1km)	Inhabitats/km²	• Sector Infrastructure 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 AOAD	national level (one value per country)	%	• Sector People – Vulnerability towards changing water availability	PI8: Change in employment in agriculture	DRAFT	DC	• ESCWA/Manos 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/inhabitat/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

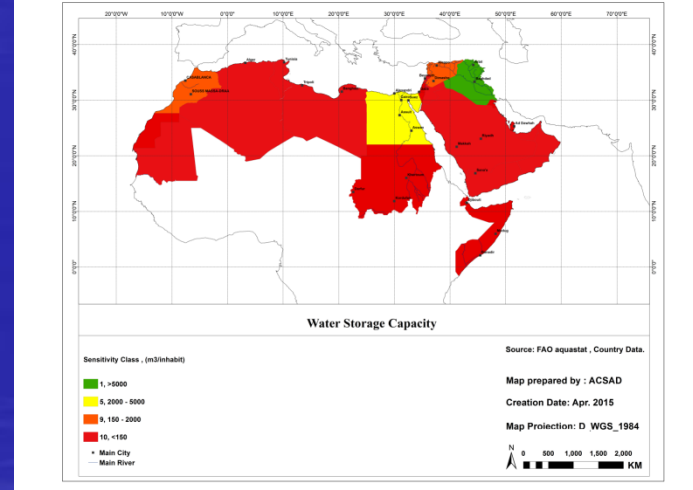TOTAL NUMBER OF ADAPTIVE CAPACITY INDICATORS: (4+3+ 16+11+6+3) 43 INDICATORS
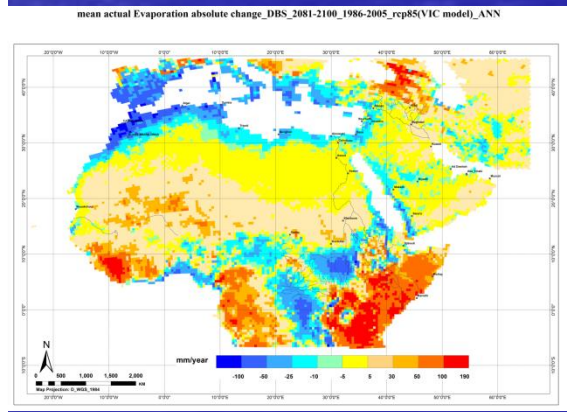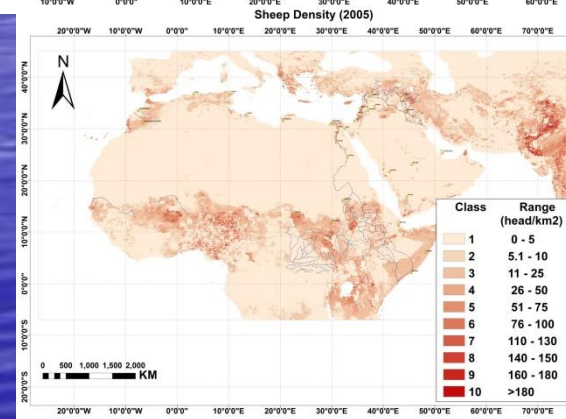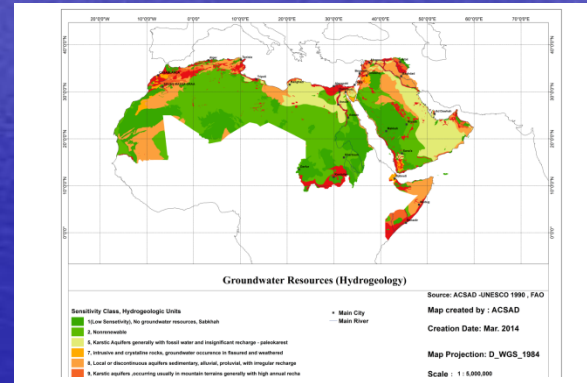
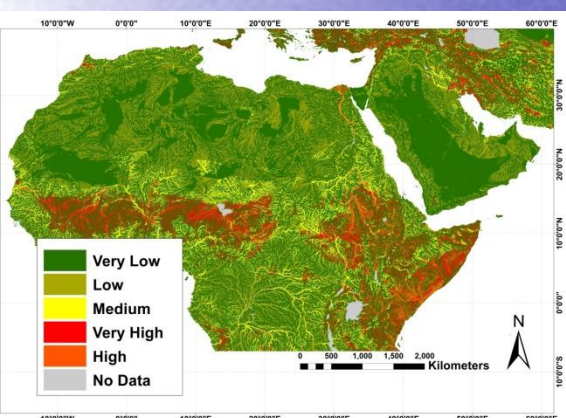| RKH	VA	Indicator / Index	Source	Spatial resolution	Unit	Sector/PI	Potential Impact	STATUS	CLSF REPS.	NOTES
		KNOWLEDGE & AWARENESS								
		Number of University Graduates		national level	%	• All			DC	
		Literacy Rate – Total Literacy Rate				• All			DC	
		Indicator on the Knowledge Society	Oxford 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 Index

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

RCM

- Change in temperature (0.17)
- Change in precipitation (0.17)

RHM

- Change in runoff (0.17)
- Change in evapotranspiration (0.17)

Extreme Climate Indices

- Change in number of days > 35 °C (0.16)
- Change in maximum length of dry spell (0.16)

Exposure (0.50)

Population (0.33)

- Population density (0.18)
- Share of water consumption in agriculture (0.22)
- Share of agricultural labor force in total labor (0.19)
- Share of agriculture in GDP (0.20)
- Total renewable water available per country (0.20)

Natural (0.35)

- Soil storage capacity (0.34)
- Rainfed areas (0.34)
- Degradation of vegetation cover (0.32)

Manmade (0.32)

- Floodprone areas (0.46)
- Irrigated areas (0.54)

Sensitivity (0.50)

Knowledge & Awareness (0.18)

- E-Government development (0.34)
- Tertiary enrollment (0.33)
- Adult literacy rate (0.33)

Technology (0.18)

- Number of scientific and technical journal articles (0.45)
- Information and communication technologies index (0.55)

Infrastructure (0.18)

Water and Sanitation (0.25)

- Area served by dams (0.17)
- Access to improved water (0.17)
- Installed desalination capacity per capita (0.17)
- Access to improved sanitation (0.16)
- Fossil groundwater (0.17)
- Area equipped for irrigation (0.16)

Environment (0.26)

- Environment performance index (1.0)

Energy (0.25)

- Access to electricity (service) (0.50)
- Energy consumption (0.50)

Transport (0.24)

- Density of road network (1.0)

Institutions (0.16)

- Governance Index (0.53)
- Disaster risk reduction committees (0.47)

Economic Resources (0.17)

- GDP per capita (0.35)
- Official development assistance (0.28)
- Food imports as percentage of merchandise exports (0.37)

Equity (0.13)

- Female-to-male literacy ratio (0.52)
- Migrants/refugees index (0.48)

Change in water available for agriculture/crops (0.50)

Adaptive Capacity (0.50)

**Water Availability for Crops Vulnerability Assessment**

Map preparation

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**

Highly vulnerable ·······> 10

9

8

7

6

5

4

3

2

Not vulnerable ·······> 1
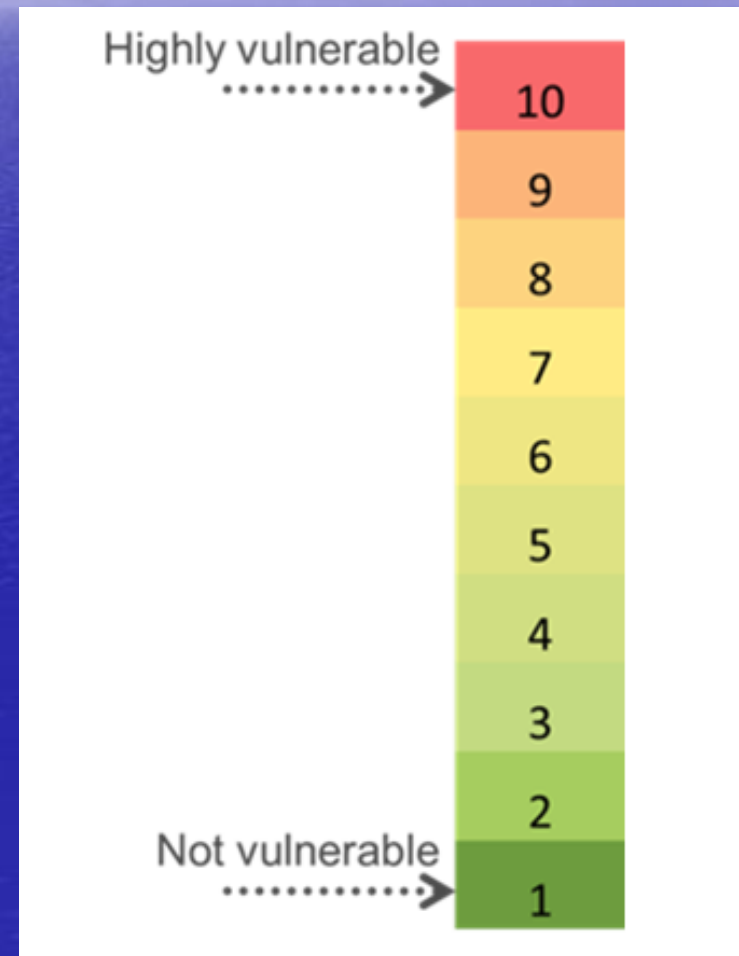
Aggregation

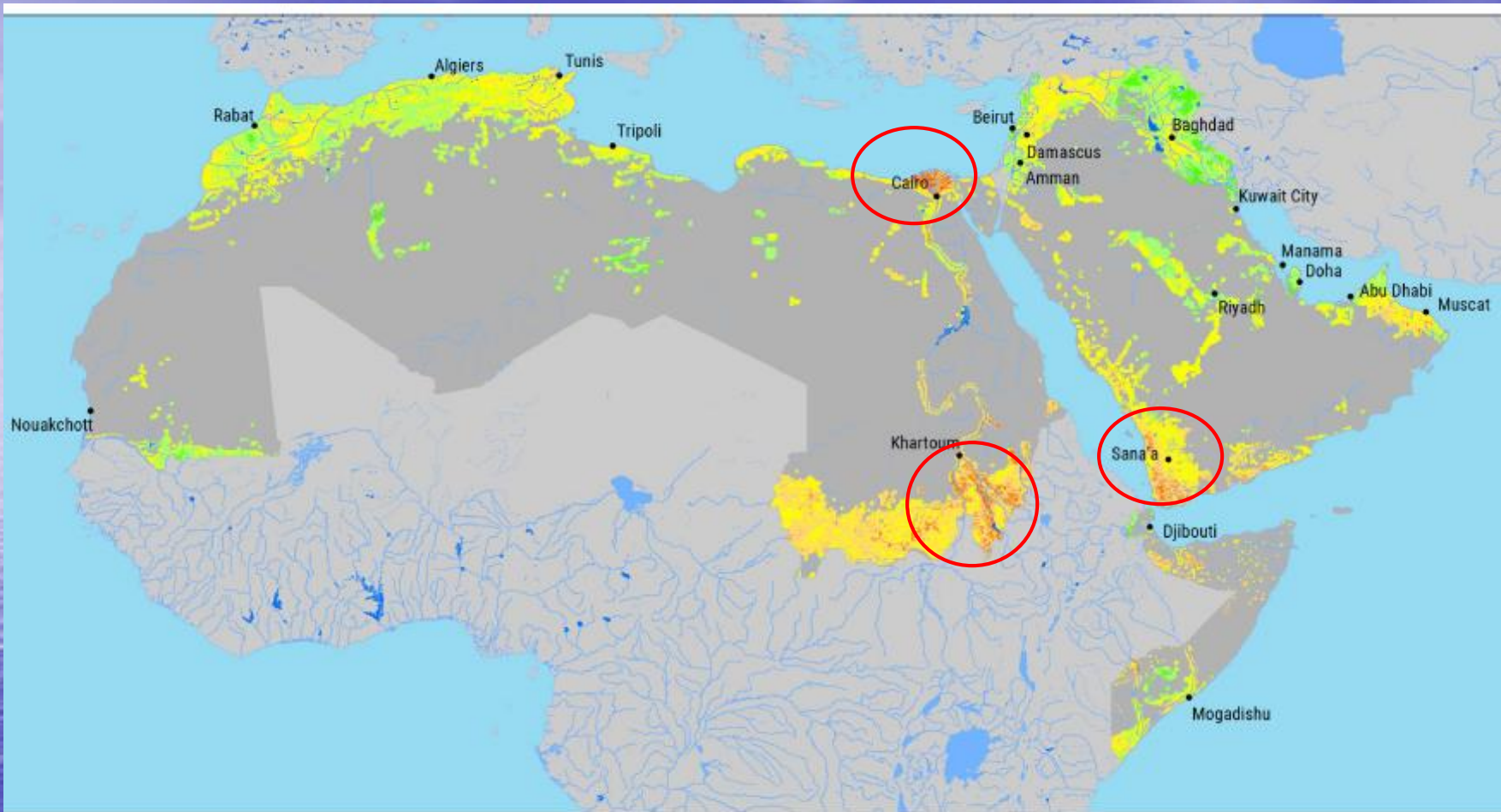- Geometric aggregation approach was selected to aggregate individual indicators to a composite indicator.
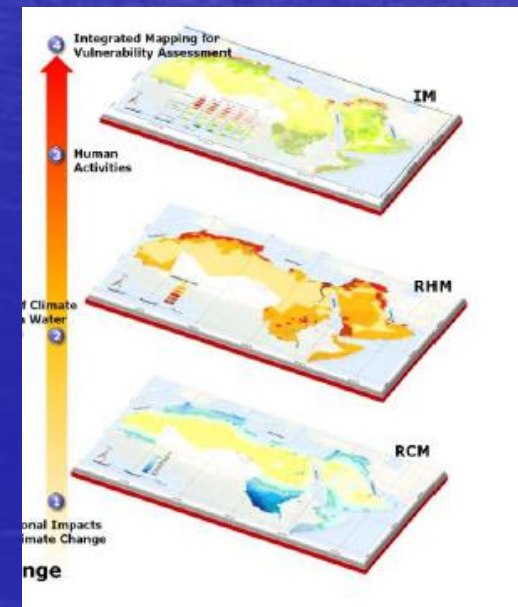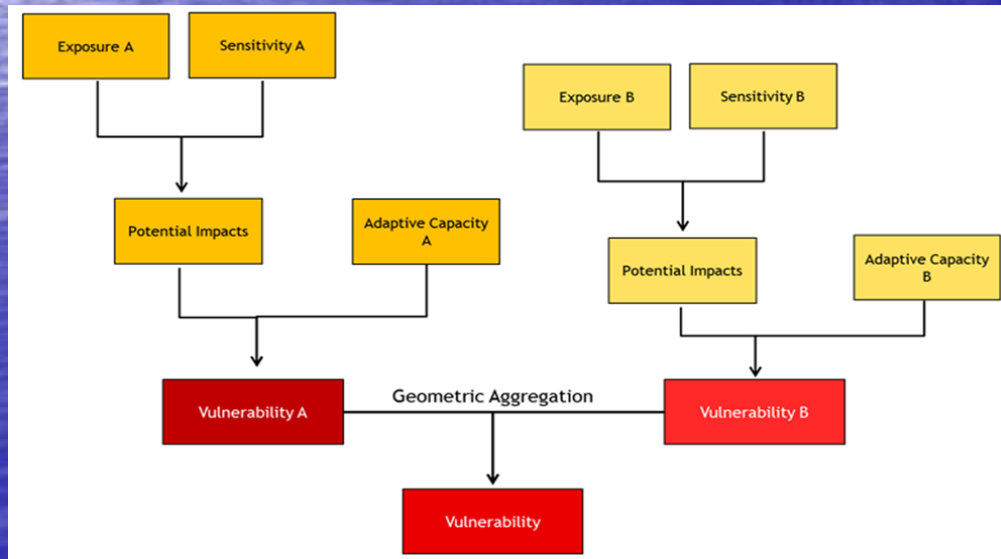
results

Potential impact

AGRICULTURE: WATER AVAILABLE FOR CROPS

POTENTIAL IMPACT: RCP4.5 MID-CENTURY (2046-2065)

Legend

Lakes

Reservoirs

Rivers

Intermittent rivers
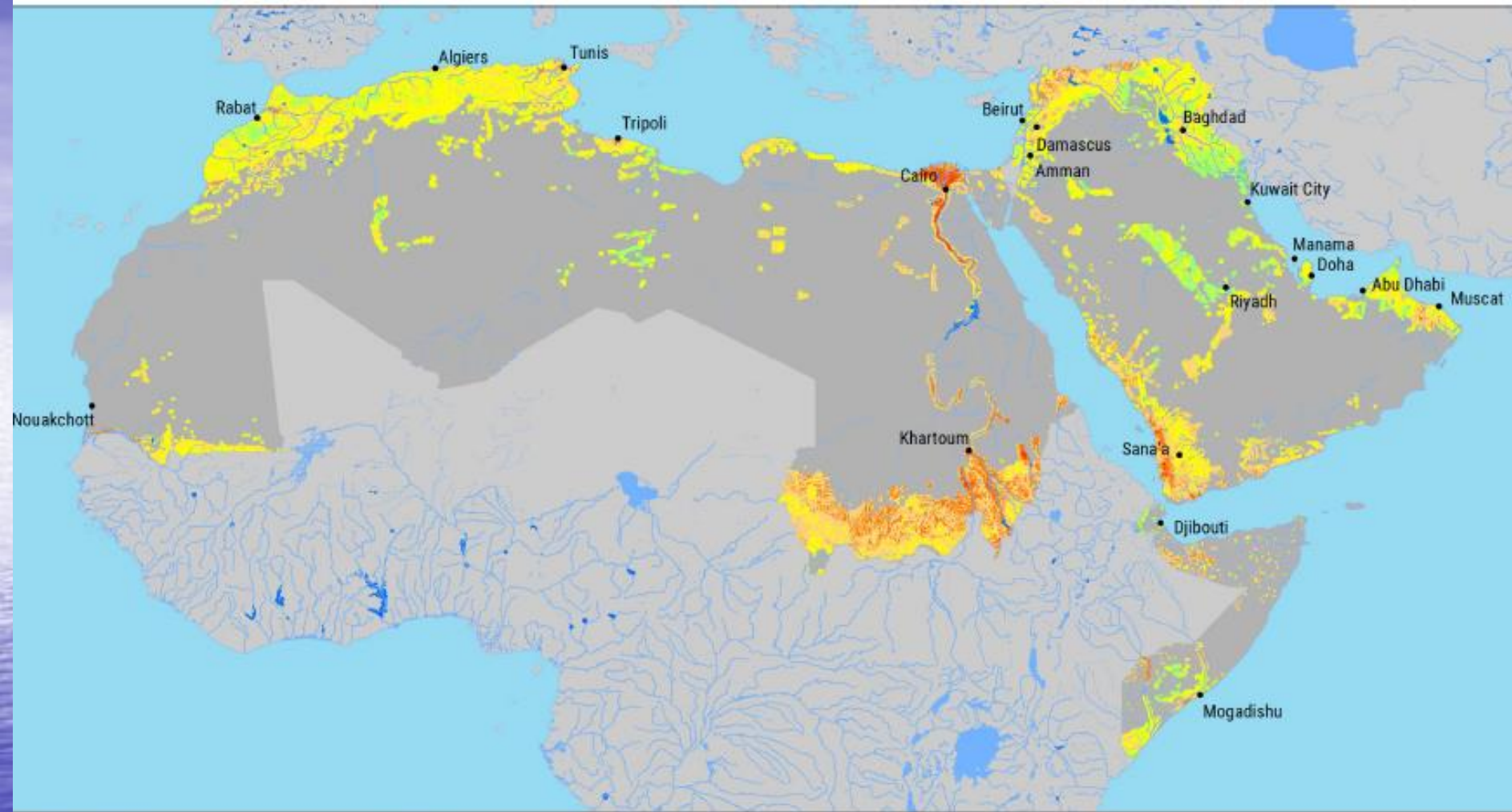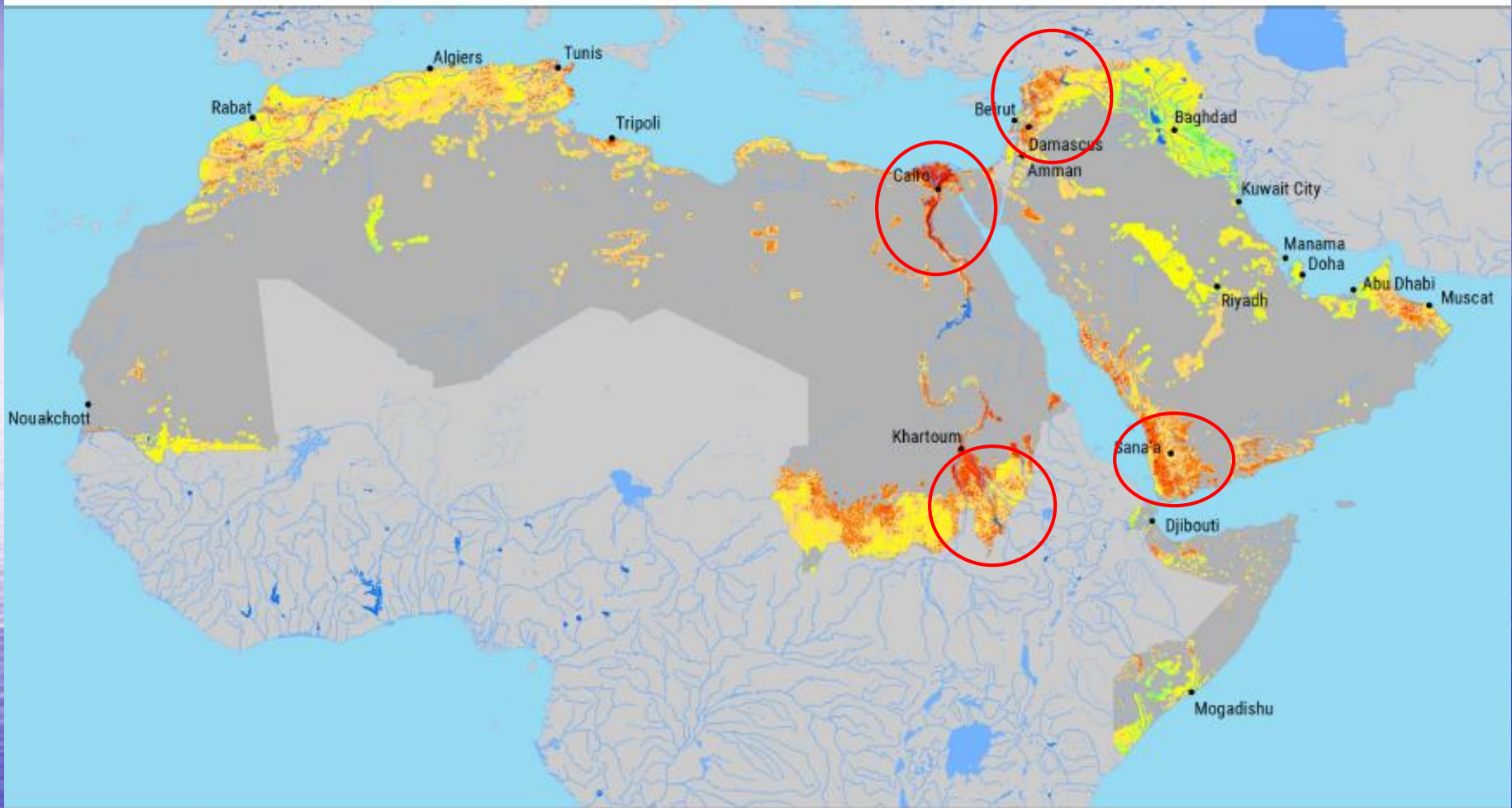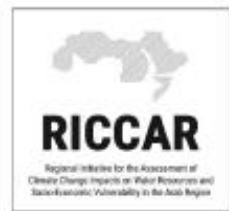
Major cities

Study area not relevant to subsector

Low Potential Impact — High Potential Impact

RICCAR

Regional Initiative for the Assessment of Climatic Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
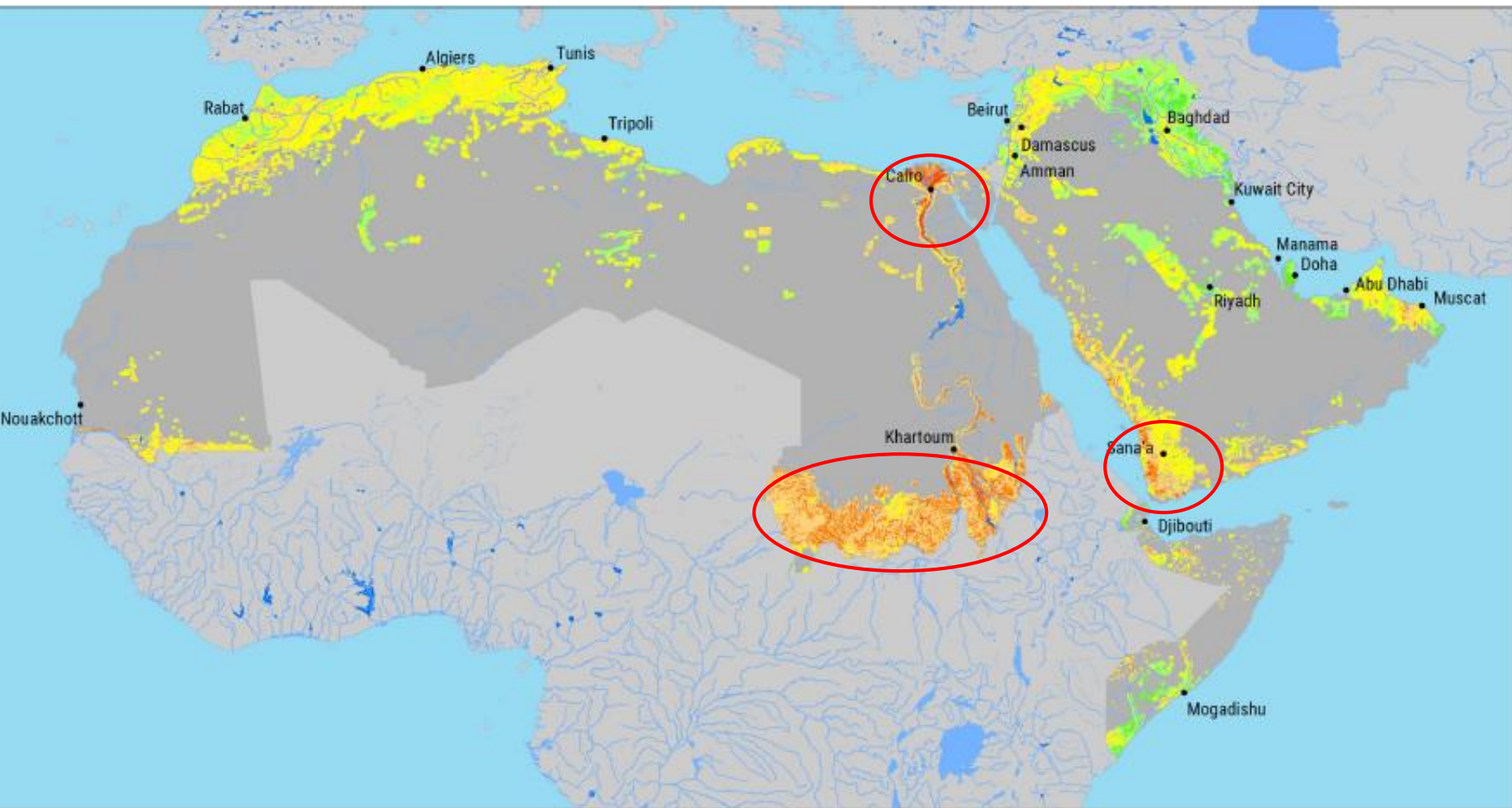
AGRICULTURE: WATER AVAILABLE FOR CROPS

POTENTIAL IMPACT: RCP4.5 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

Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region

AGRICULTURE: WATER AVAILABLE FOR CROPS

POTENTIAL IMPACT: RCP8.5 MID-CENTURY (2046-2065)

Legend

- Lakes
- Reservoirs
- Rivers
- Intermittent rivers
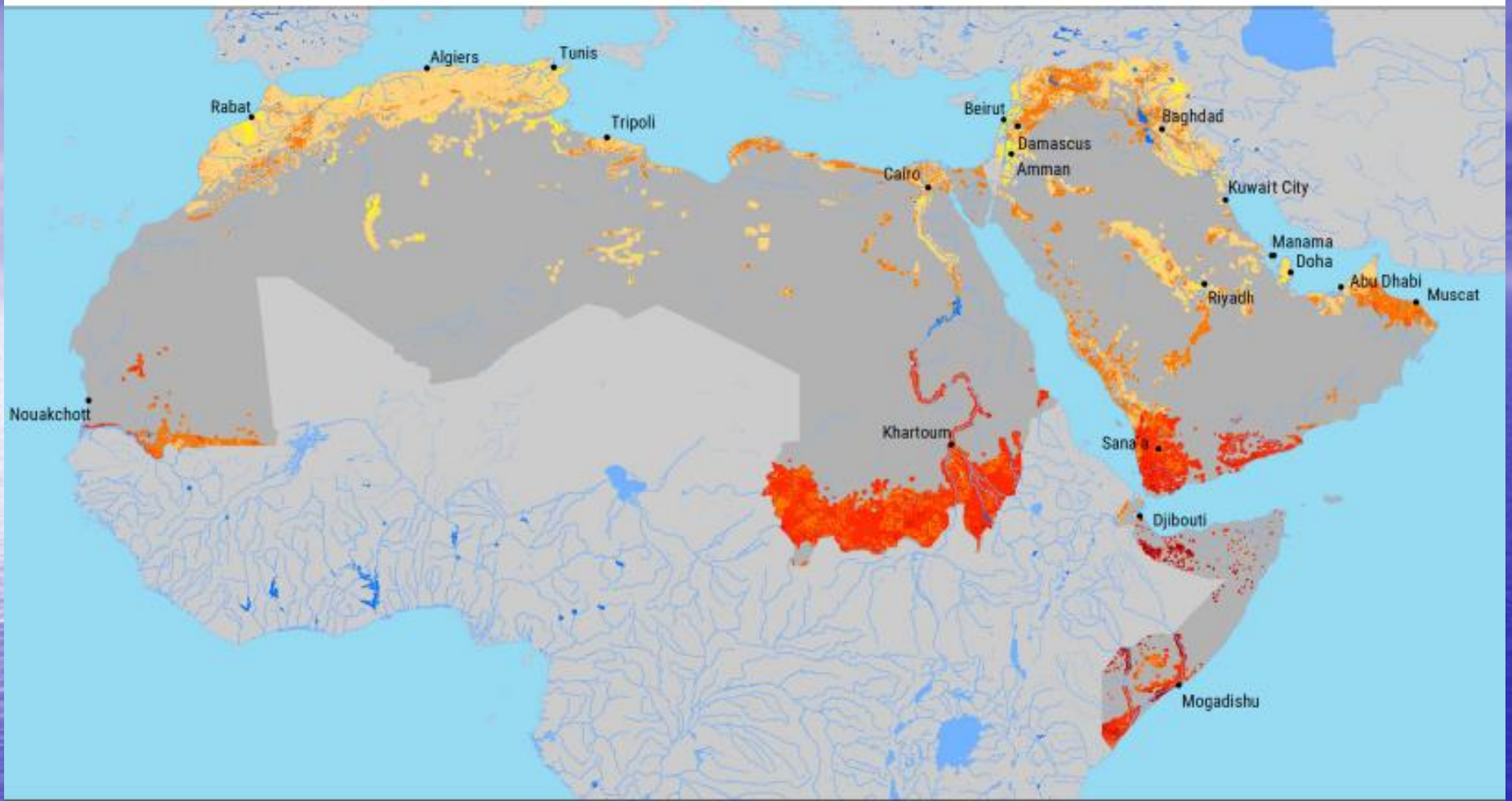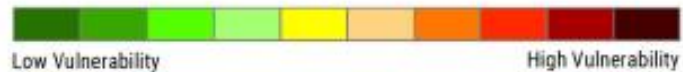- Major cities
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Low Potential Impact · High Potential Impact

RICCAR

Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region

AGRICULTURE: WATER AVAILABLE FOR CROPS

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

Legend

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

Low Potential Impact ··· High Potential Impact

RICCAR

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vulnerability

Components of the Vulnerability
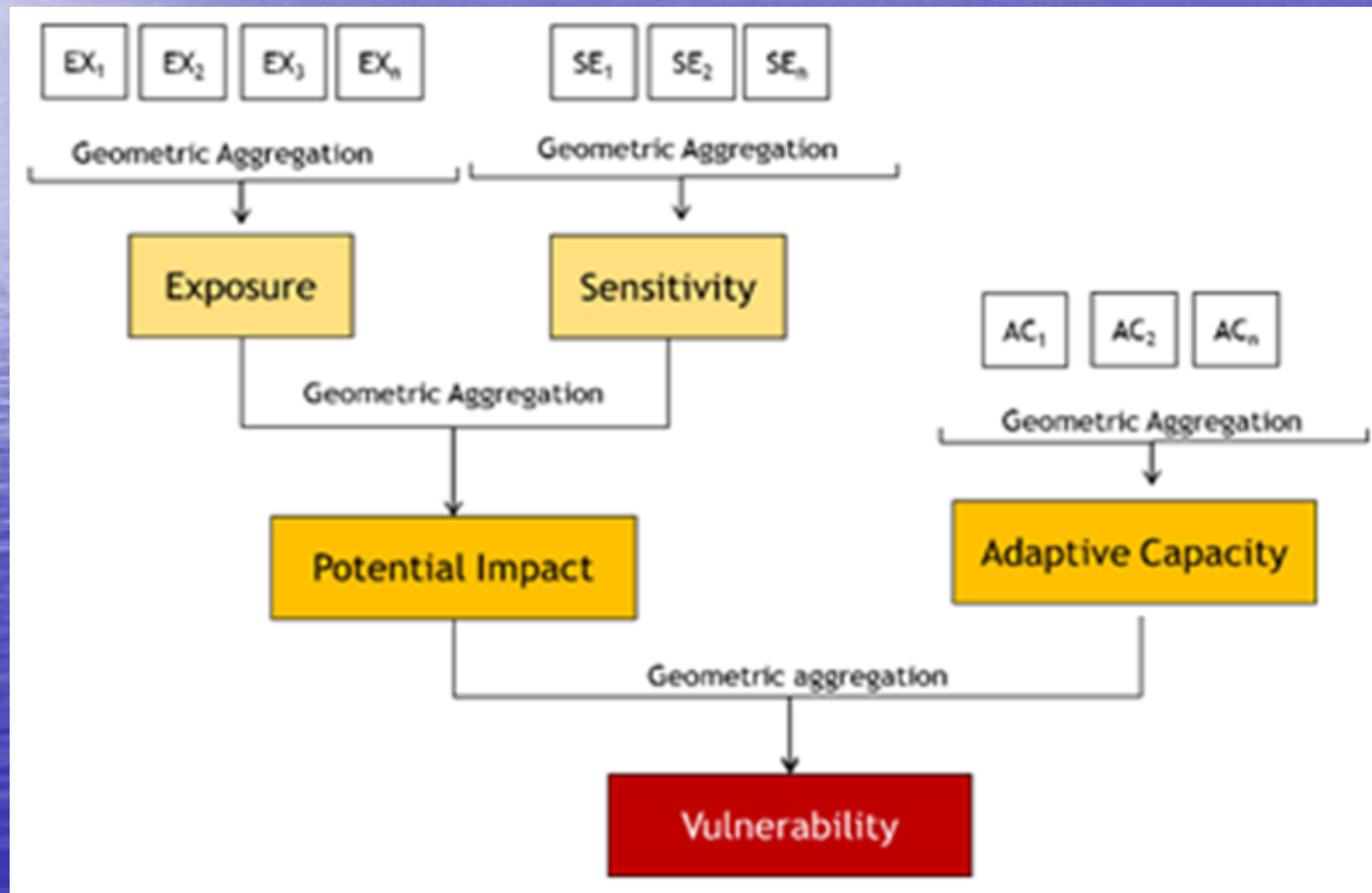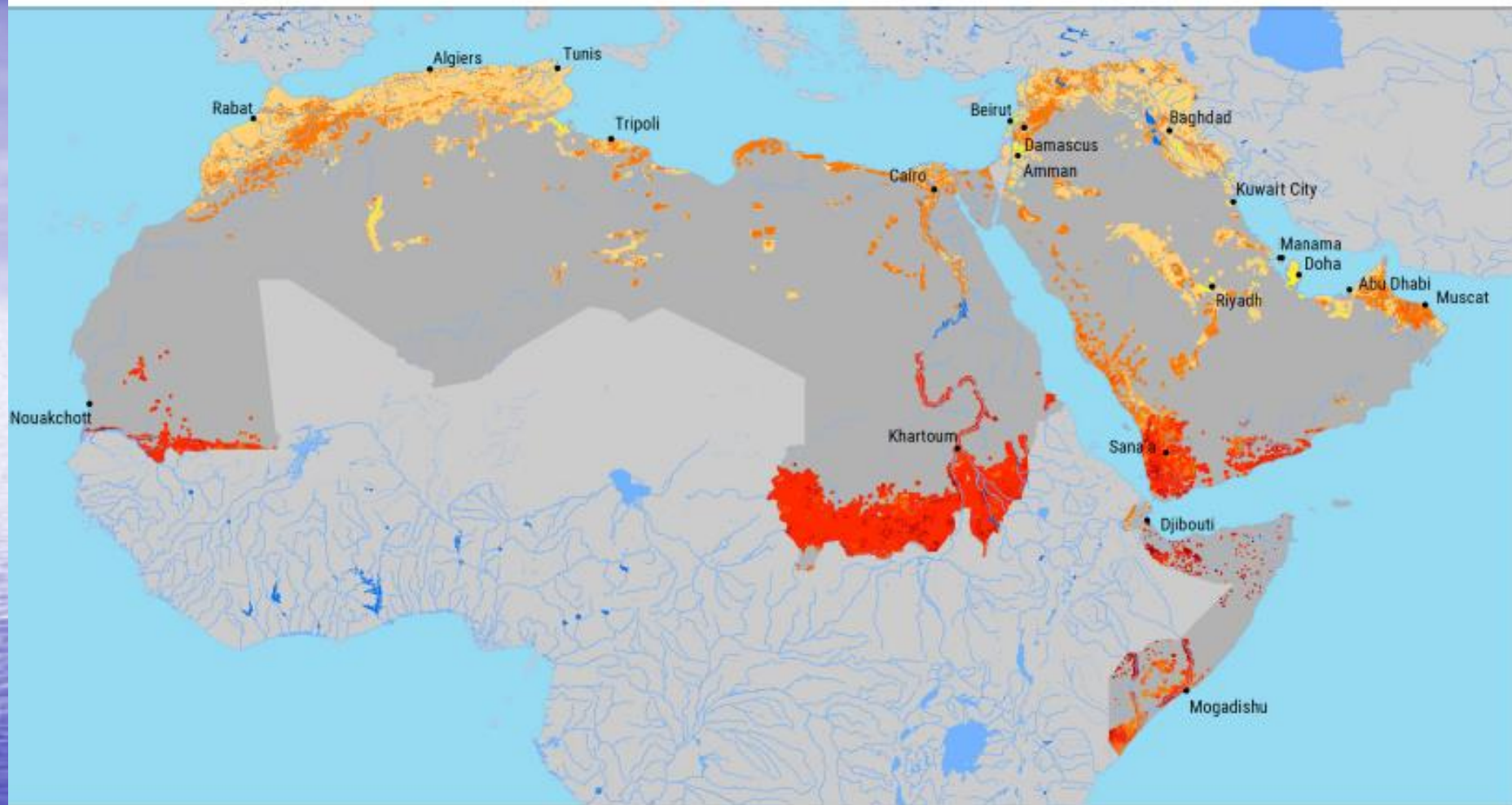
AGRICULTURE: WATER AVAILABLE FOR CROPS
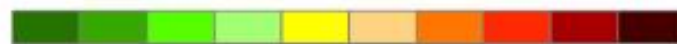VULNERABILITY: RCP4.5 MID-CENTURY (2046-2065)

Legend

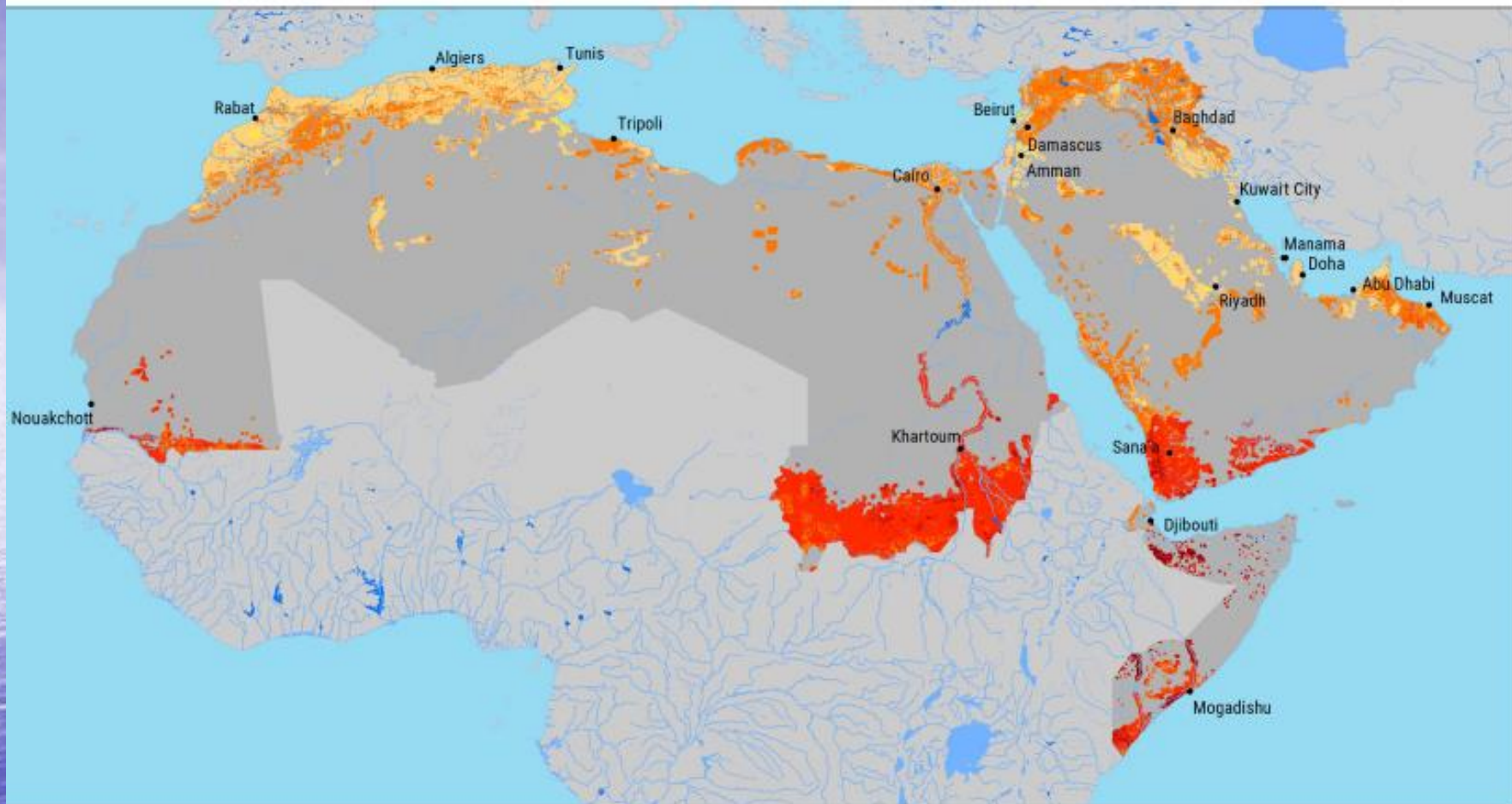Lakes

Reservoirs

Rivers

Intermittent rivers
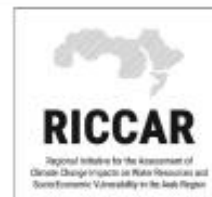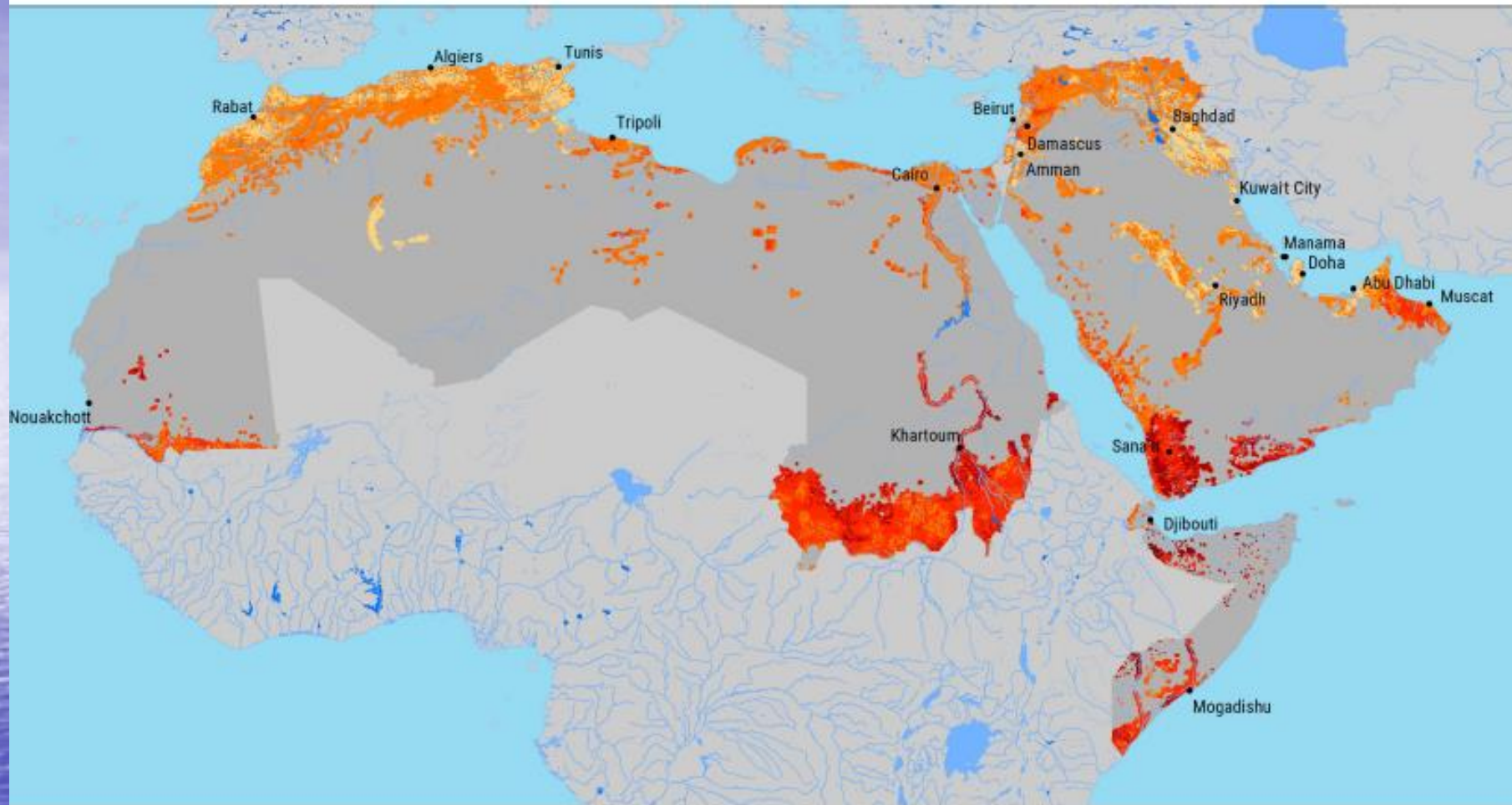
Major cities

Study area not relevant to subsector

Low Vulnerability   High Vulnerability

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Climate Change Impacts on Water Resources and
Socio-Economic Vulnerability in the Arab Region

AGRICULTURE: WATER AVAILABLE FOR CROPS

VULNERABILITY: RCP4.5 END-CENTURY (2081-2100)

Legend

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

Low Vulnerability — High Vulnerability

RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region

AGRICULTURE: WATER AVAILABLE FOR CROPS

VULNERABILITY: RCP8.5 MID-CENTURY (2046-2065)

Legend

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

Low Vulnerability — High Vulnerability

RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region

AGRICULTURE: WATER AVAILABLE FOR CROPS

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

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Low Vulnerability — High Vulnerability

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Training manual

Thanks