Multi-criteria analysis on agriculture exposure to drought in arid areas

ESCAP developed a methodology to assess the agriculture land exposure to drought-related climate risk using aridity and projections for environmental risk. The agriculture exposure to multi-criteria indicators for drought was modified based on the Land suitability assessment method for agriculture in arid land developed by Marieme Seif-Ennasr and others (2020). There are 3 main variables used in this analysis, namely 1) Aridity, 2) Climate-related data, 3) Slope, and 4) Agriculture data as exposure.

Once the aridity, climate and slope indicators were spatially analyzed through scoring and normalization; these were then combined. Afterwards, the output was overlaid with agriculture exposure and the exposure of agriculture to certain level of drought risks was quantified.

Multi-criteria analysis on Agriculture exposed to drought in arid areas (aridity, decrease of rainfall, increasing number of dry days and temperature and slope)

Agriculture land

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Aridity
Normalized score of aridity for arid & semi arid
(Low score of aridity → more arid)

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Drought
Normalized % Change in Maximum 5-day precipitation amount during dry days (in June-August)
Threshold → only the negative percentages
Higher precipitation → less drought-risk possibility

Temperature change
Normalized Increasing Temperature **change** (unit: deg C). Threshold >0.
USAID, 2018: Increased temperature change → more damage to crops in Central Asia

Number of dry days
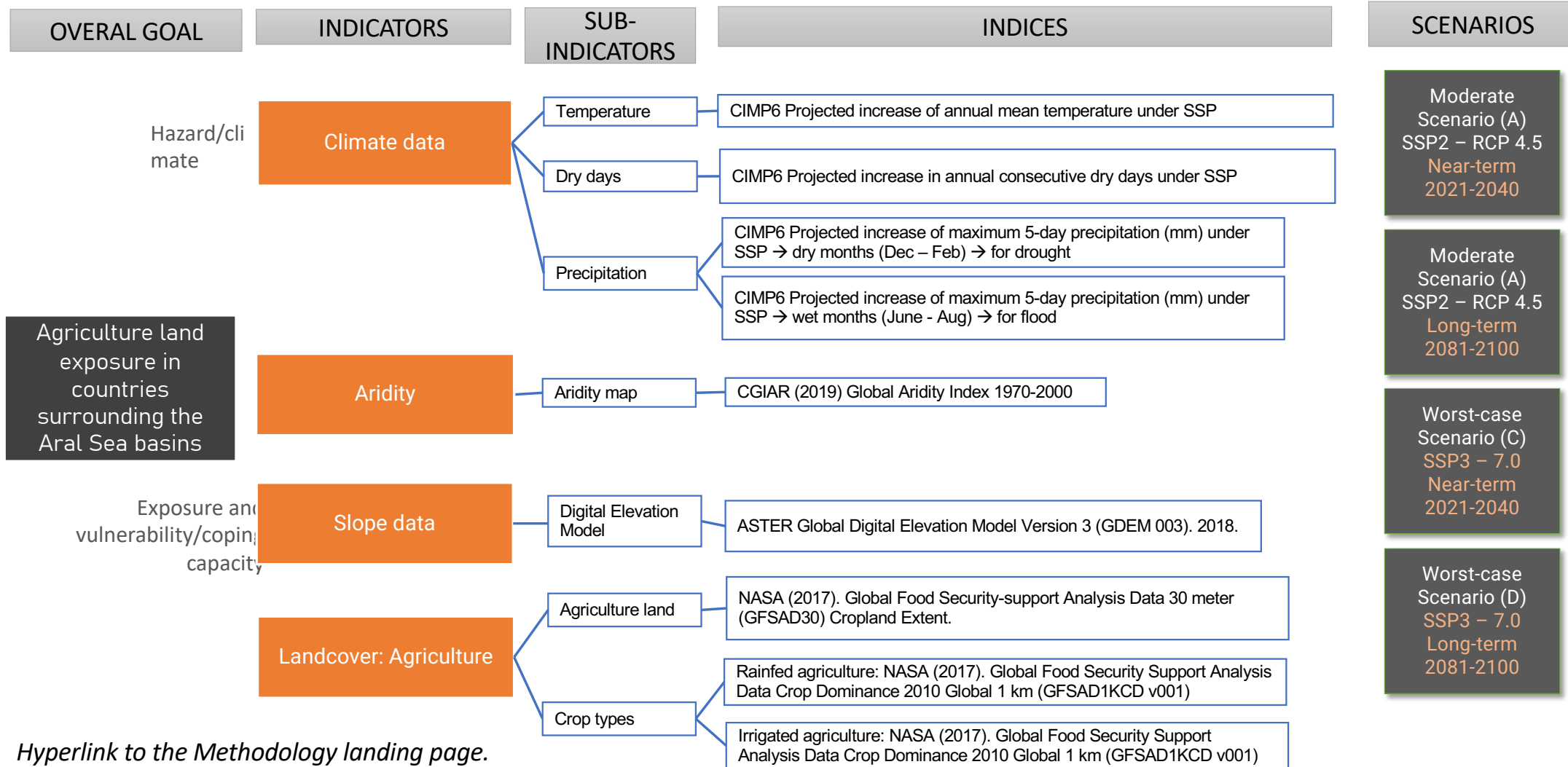Normalized Increasing Number of consecutive dry days (unit: days, pr<1mm). Threshold **>0**

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Slope from DEM (0.1, 0.3, 0.6, and 1)
Seif-Ennasr et al, 2020: degree slope → better land suitability → less risk

ESCAP modified from "Land suitability assessment for agriculture method" by Marieme Seif-Ennasr et al, 2020.

The following diagram shows the indicators and datasets used in our analysis.

OVERAL GOAL	INDICATORS	SUB-INDICATORS	INDICES	SCENARIOS
Agriculture land exposure in countries surrounding the Aral Sea basins	Climate data	Temperature	CIMP6 Projected increase of annual mean temperature under SSP	Moderate Scenario (A) SSP2 – RCP 4.5 Near-term 2021-2040
		Dry days	CIMP6 Projected increase in annual consecutive dry days under SSP	Moderate Scenario (A) SSP2 – RCP 4.5 Long-term 2081-2100
		Precipitation	CIMP6 Projected increase of maximum 5-day precipitation (mm) under SSP → dry months (Dec – Feb) → for drought	
			CIMP6 Projected increase of maximum 5-day precipitation (mm) under SSP → wet months (June - Aug) → for flood	
	Aridity	Aridity map	CGIAR (2019) Global Aridity Index 1970-2000	Worst-case Scenario (C) SSP3 – 7.0 Near-term 2021-2040
	Slope data	Digital Elevation Model	ASTER Global Digital Elevation Model Version 3 (GDEM 003). 2018.	Worst-case Scenario (D) SSP3 – 7.0 Long-term 2081-2100
	Landcover: Agriculture	Agriculture land	NASA (2017). Global Food Security-support Analysis Data 30 meter (GFSAD30) Cropland Extent.	
		Crop types	Rainfed agriculture: NASA (2017). Global Food Security Support Analysis Data Crop Dominance 2010 Global 1 km (GFSAD1KCD v001)	
			Irrigated agriculture: NASA (2017). Global Food Security Support Analysis Data Crop Dominance 2010 Global 1 km (GFSAD1KCD v001)	

Hazard/climate

Exposure and vulnerability/coping capacity

Hyperlink to the Methodology landing page.