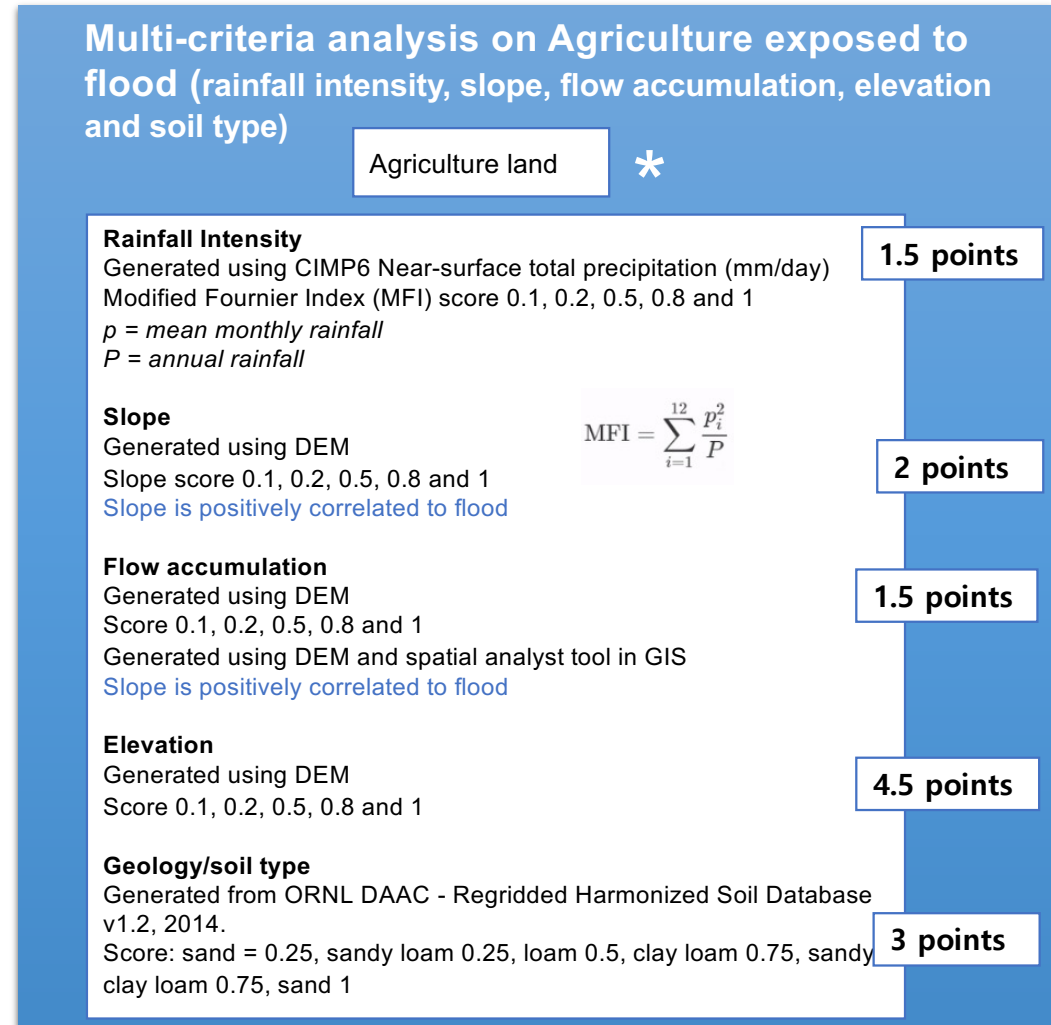# Multi-criteria analysis on agriculture exposure to flood

Our analysis on flood focuses on agriculture exposure to climate-related indicators in arid areas. This method uses the following multi-criteria indicators: 1) rainfall intensity, 2) elevation, 3) slope, 3) flow accumulation, 4) soil type and 5) agriculture land as exposure indicators. The selection and method of the first four indicators were modified from a study on flood risk mapping on crops by M. Mohammadi and others in 2021.
The exposure indicator used in this analysis is agriculture land, similar to the one used in drought calculation of the previous section.

After being processed with spatial analysis in GIS, all of these datasets were scored. Based on Mohammadi and others, we weighed rainfall intensity 1.5, elevation 4.5, slope 2, flow accumulation 1.5 and soil types 3. Lastly, these layers were then combined to get the total flood risk hazard. This total flood risk hazard was then overlaid with agriculture land layers to quantify the exposure of agriculture land to flood.

Multi-criteria analysis on Agriculture exposed to flood (rainfall intensity, slope, flow accumulation, elevation and soil type)

Agriculture land *

Rainfall Intensity
Generated using CIMP6 Near-surface total precipitation (mm/day)
Modified Fournier Index (MFI) score 0.1, 0.2, 0.5, 0.8 and 1
p = mean monthly rainfall
P = annual rainfall

1.5 points

$$MFI = \sum_{i=1}^{12} \frac{p_i^2}{P}$$

Slope
Generated using DEM
Slope score 0.1, 0.2, 0.5, 0.8 and 1
Slope is positively correlated to flood

2 points

Flow accumulation
Generated using DEM
Score 0.1, 0.2, 0.5, 0.8 and 1
Generated using DEM and spatial analyst tool in GIS
Slope is positively correlated to flood

1.5 points

Elevation
Generated using DEM
Score 0.1, 0.2, 0.5, 0.8 and 1

4.5 points

Geology/soil type
Generated from ORNL DAAC - Regridded Harmonized Soil Database v1.2, 2014.
Score: sand = 0.25, sandy loam 0.25, loam 0.5, clay loam 0.75, sandy clay loam 0.75, sand 1

3 points

ESCAP modified from "Flood risk mapping and crop-water loss modeling using water footprint analysis in agricultural watershed" by M. Mohammadi, 2021.

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

OVERAL GOAL	INDICATORS	SUB-INDICATORS	INDICES	SCENARIO

Hazard/climate

Rainfall intensity — Precipitation
- CIMP6 Near-surface total precipitation (mm/day) – monthly
- CIMP6 Near-surface total precipitation (mm/day) – annual

Agriculture land exposure in countries surrounding the Aral Sea basins

Slope — Digital Elevation Model — ASTER Global Digital Elevation Model Version 3 (GDEM 003). 2018

Flow accumulation — Digital Elevation Model — ASTER Global Digital Elevation Model Version 3 (GDEM 003). 2018

Elevation — Digital Elevation Model — ASTER Global Digital Elevation Model Version 3 (GDEM 003). 2018

Geology (soil type) — Soil data — ORNL DAAC - Regridded Harmonized Soil Database v1.2, 2014.

Landcover: Agriculture — 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)

Worst-case Scenario (D) SSP3 – 7.0 Long-term 2081-2100

Hyperlink to the Methodology landing page.