UN-SPIDER International Workshop

Space-based Technologies for Disaster Risk Reduction - Assessing the Unseen Risks

7-9 December 2022

Bangkok, UN-ESCAP Conference Centre

Drought Risk Evaluation in Iran Using Geospatial Technologies

Abdolreza Ansari Amoli

Remote Sensing Researcher

Remote Sensing Department

Iranian Space Agency

Outline:

- The outcomes of a systematic literature review
- Two wrong imaginations about drought risk assessment
- Disaster Risk Assessment Process
- Drought Risk Mapping Methodology
- Results & Conclusions

The outcomes of a systematic literature review about drought risk assessment

IOP Publishing

Environ. Res. Lett. **14** (2019) 083002

https://doi.org/10.1088/1748-9326/ab225d

Environmental Research Letters

TOPICAL REVIEW

Drought vulnerability and risk assessments: state of the art, persistent gaps, and research agenda

Michael Hagenlocher[1], Isabel Meza[1], Carl C Anderson[2], Annika Min[1], Fabrice G Renaud[2], Yvonne Walz[1], Stefan Siebert[3] and Zita Sebesvari[1]

[1] United Nations University, Institute for Environment and Human Security (UNU-EHS), UN Campus, Platz der Vereinten Nationen 1, 53113 Bonn, Germany

[2] University of Glasgow, School of Interdisciplinary Studies, Dumfries Campus, Rutherford/McCowan Building, Dumfries DG1 4ZL, United Kingdom

[3] Department of Crop Sciences, University of Göttingen, Von-Siebold-Strasse 8, D-37075 Göttingen, Germany

E-mail: hagenlocher@ehs.unu.edu

Keywords: drought, risk assessment, review, human dimension, research gaps

Supplementary material for this article is available online

OPEN ACCESS

RECEIVED
12 December 2018

REVISED
14 March 2019

ACCEPTED FOR PUBLICATION
17 May 2019

PUBLISHED
22 July 2019

- **Web of Science**
- **Scopus**

(1970-2018)

The outcomes of the systematic literature

Their analysis shows that, of the reviewed assessments

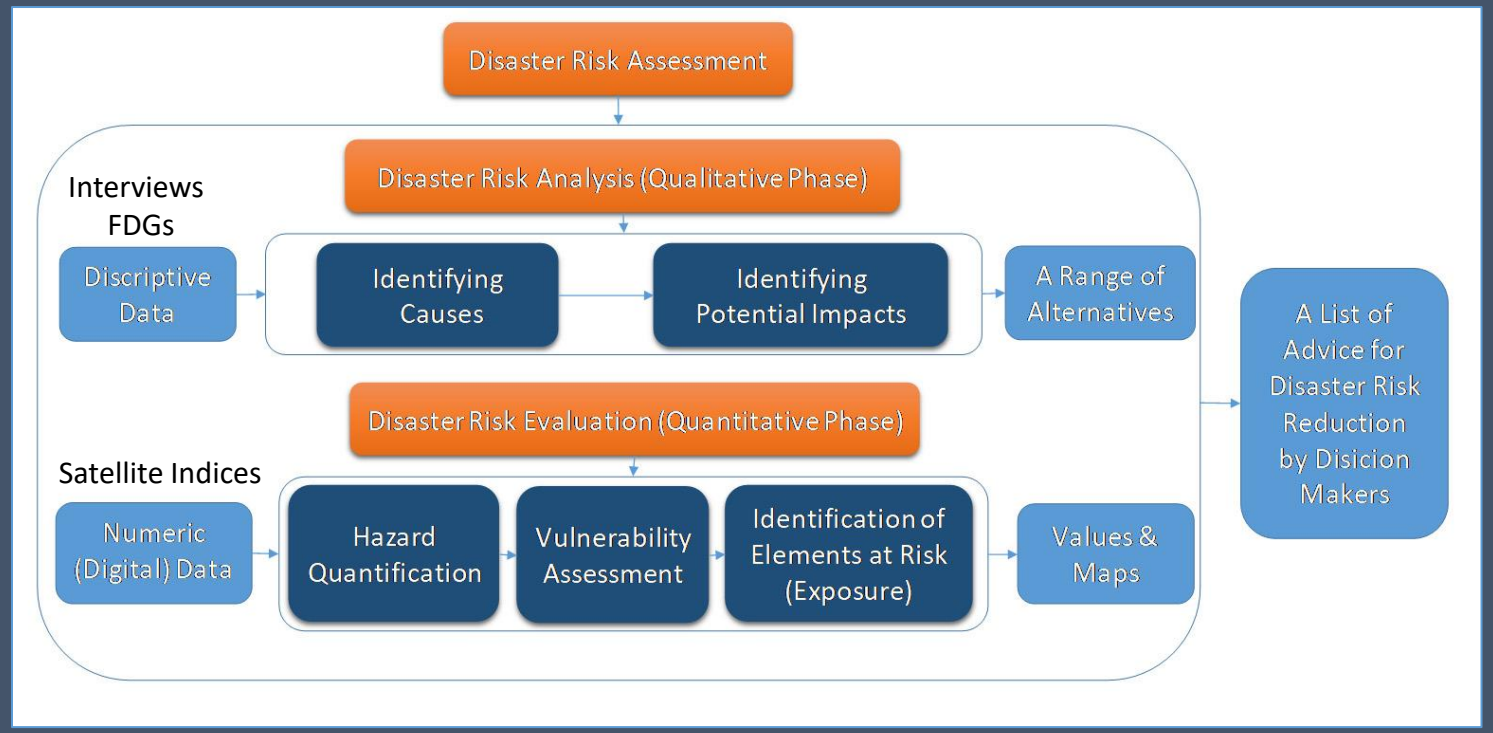
- 42% do not provide a clear definition of drought risk
- more than 60% do not explicitly specify the type of drought hazard that is addressed.(Meteorological,Agricultural,Hydrological,Combined)
- 57% of the indicator based assessments do not specify their weighting methods.
- Only ten percent develop future scenarios of drought risk
- 14% include exposure as part of vulnerability.
- Only about 40% of the assessments establish a direct link to drought risk reduction or adaptation strategies, i.e. consider solutions
- About 60 percent of researchers have mostly used one or two components, at most, in their risk-assessment procedure, and rarely quantify all three components (i.e.Hazard,Vulnerability and Exposure).

Two wrong imaginations about drought risk

- 1.**Drought damage assessment** is the same **drought risk assessment**.

- 2.**Drought risk assessment** is the same **drought prediction**.

Disaster Risk Assessment Process



For Drought Risk Analysis

Causes:

- Lack of Precipitation
- Increase in Temperature

Potential Impacts:

- Agricultural crops losses,
- Losing farmers money ,
- Bankruptcy of agricultural machinery industry

A range of Alternatives:

- Developing a pressurized or drop irrigated system
- planting water-resistant or dry-compatible crops and vegetation
- Using rain water collection systems for optimum usage of rainfall

Disaster Risk Evaluation (Quantitative Phase)

(Hazard Quantification,Vulnerability Assessment,Exposure Assessment)

- Hazard Quantification (HQ)

- According to the description given by the Canadian Center for Occupational Health and Safety website a *hazard* is: *"Any source of potential damage, harm or adverse health effects on something or someone*".

- But, the mathematical concept of '*hazard*" implies a probability or likelihood of a hazard event occurrence based on the number of times it happens in a specific period of time.

Disaster Risk Evaluation (Quantitative Phase)

- Vulnerability Assessment:
- The United Nations Office for Disaster Risk Reduction (UNDRR) defines vulnerability as "***The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard***"
- Exposure (Elements at Risk)

- Based on the exact definition of UNDRR terminology, exposure to some natural hazards may be described as "***being in the wrong place at the wrong time***" .**In the case of drought**, exposure usually focuses on several factors, such as **population** and **livestock density**, **utilization of land for agriculture** (percentage of irrigated farms), as well as water extraction, especially for the industrial sector .

Risk Calculation:

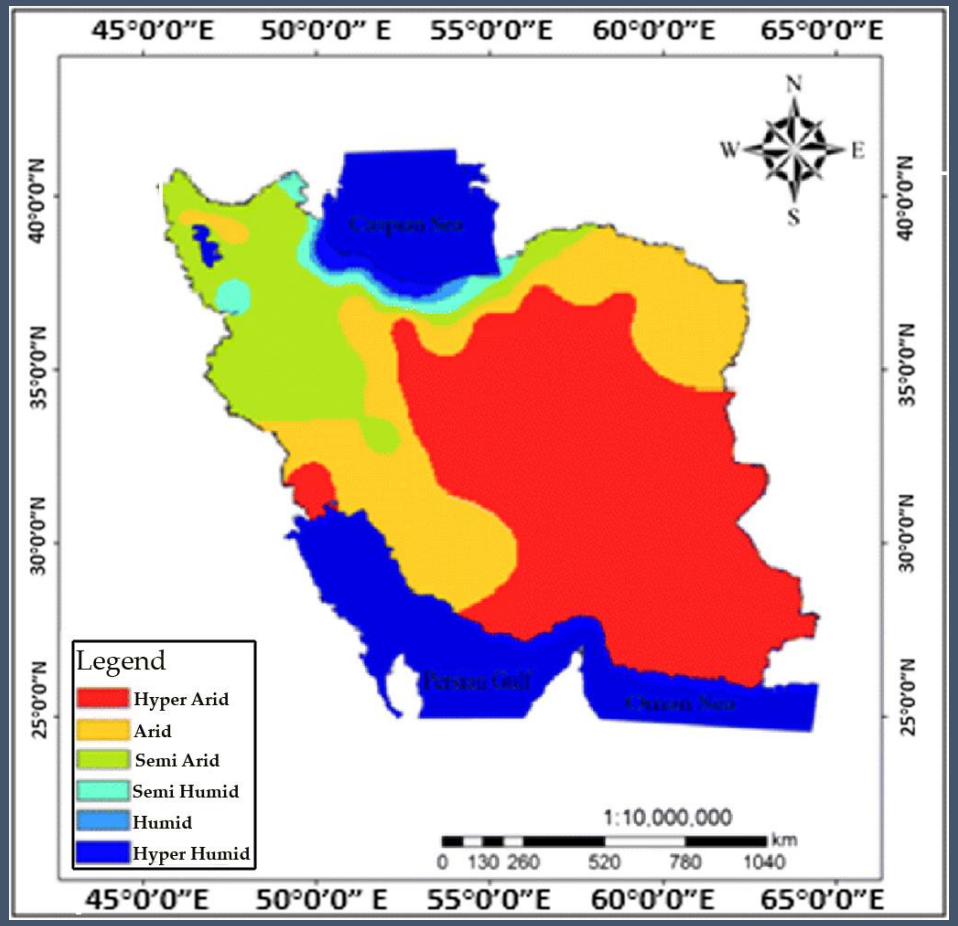
- Risk = Hazard X Vulnerability X Exposure

Drought Risk Mapping Methodology

(Drought Risk Evaluation in Iran Using Geospatial Technologies)

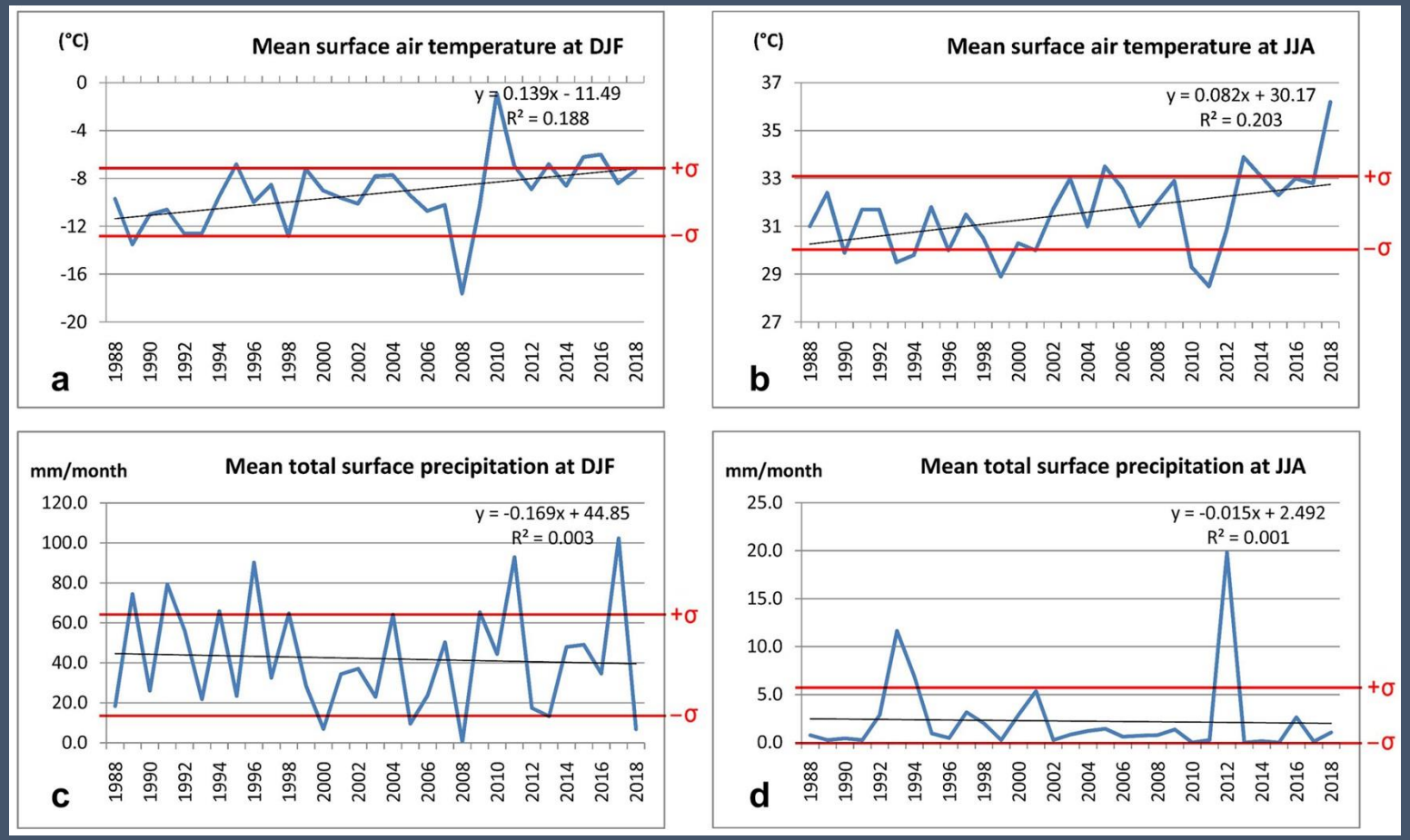
Iran and its neighborhood countries

Iran Aridity Map



Iranian Meteorological Organization (2016)

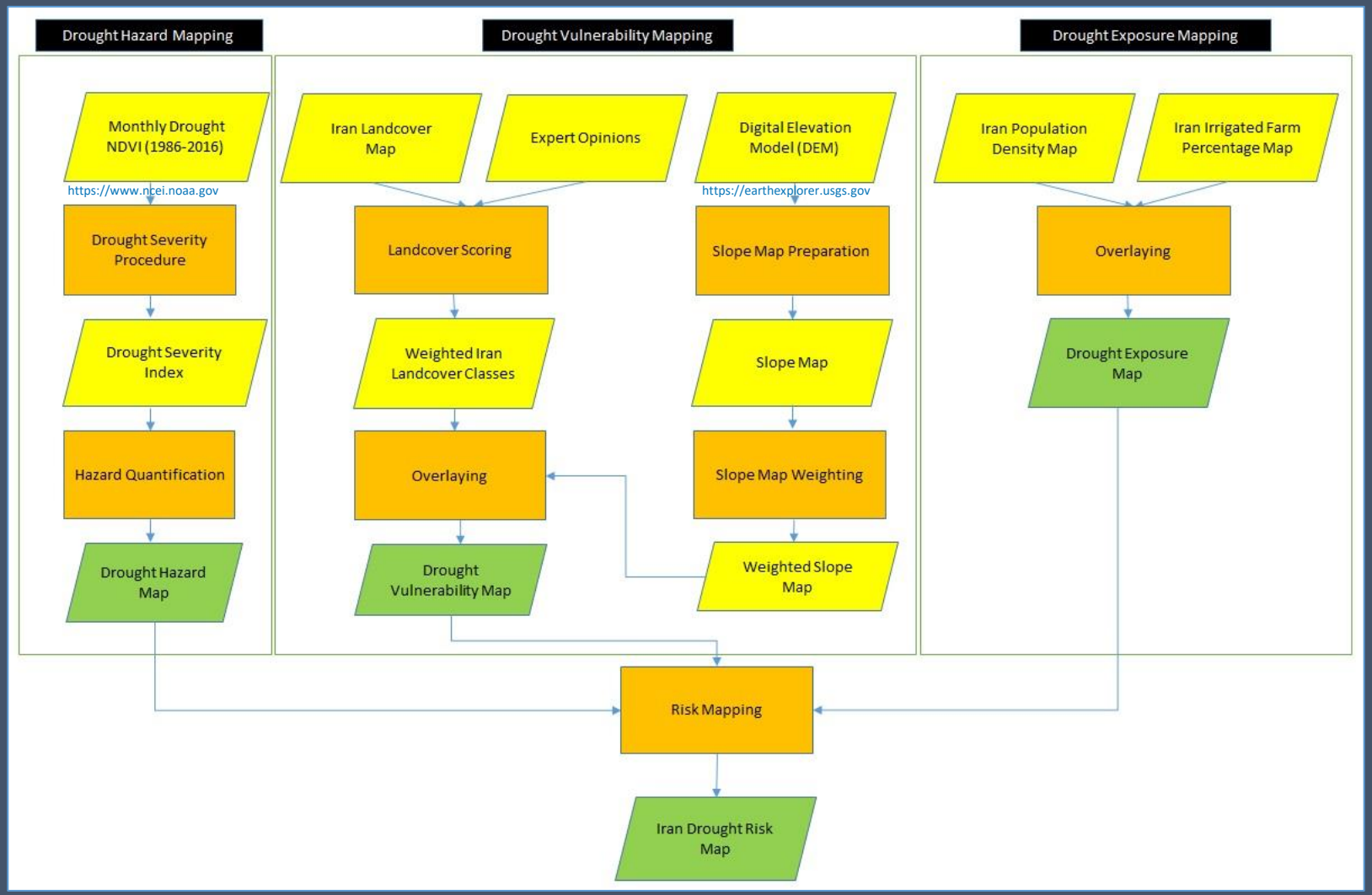
Iran Air Temperature & Precipitation Changes (1988-2018)



Intergovernmental Panel on Climate Change (IPCC) reports

	2020-2040	
	Middle East	Iran
Air temperature	2 Degree Centigrade Increase	2.6 Degree Centigrade Increase
Precipitation	20% Decline	35% Decline

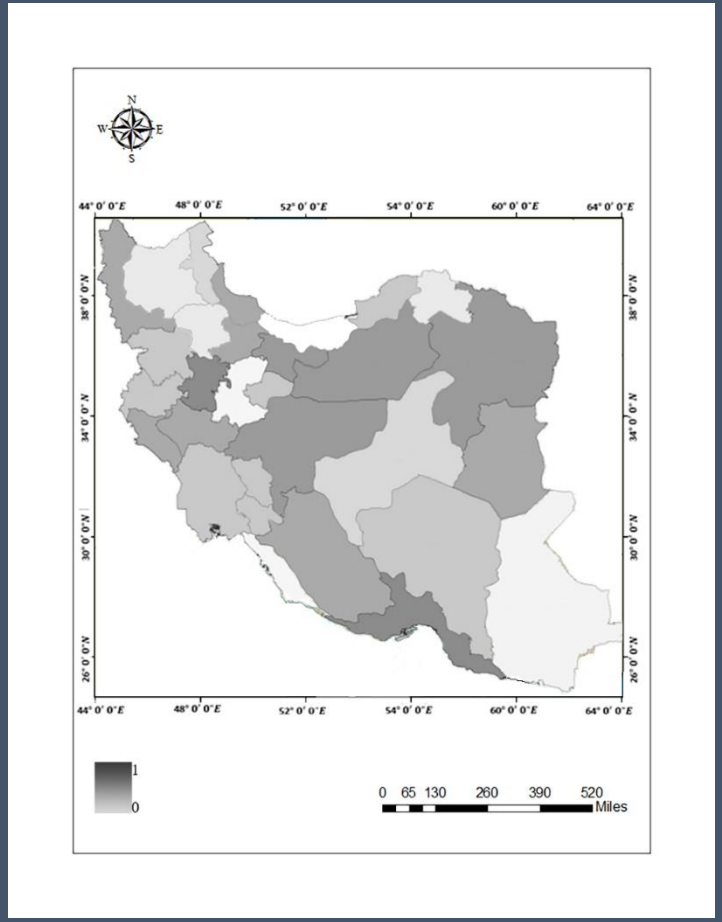
Research Methodology



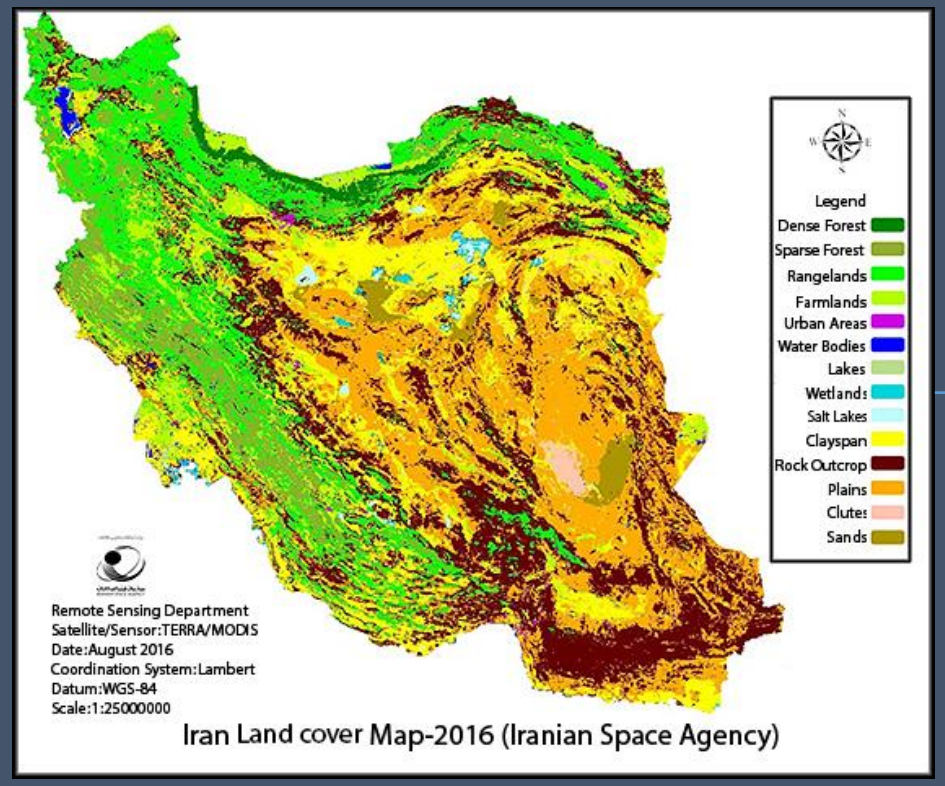
Iran Hazard Map

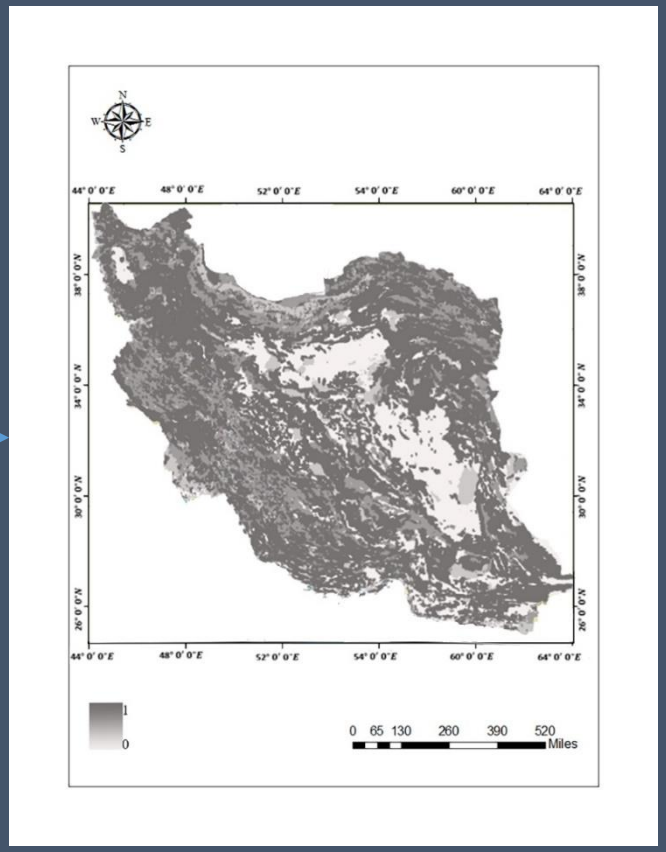
NDVI=(NIR-R)/(NIR+R)

Drought Severity Index=$(NDVI-\overline{NDVI})/\sigma$

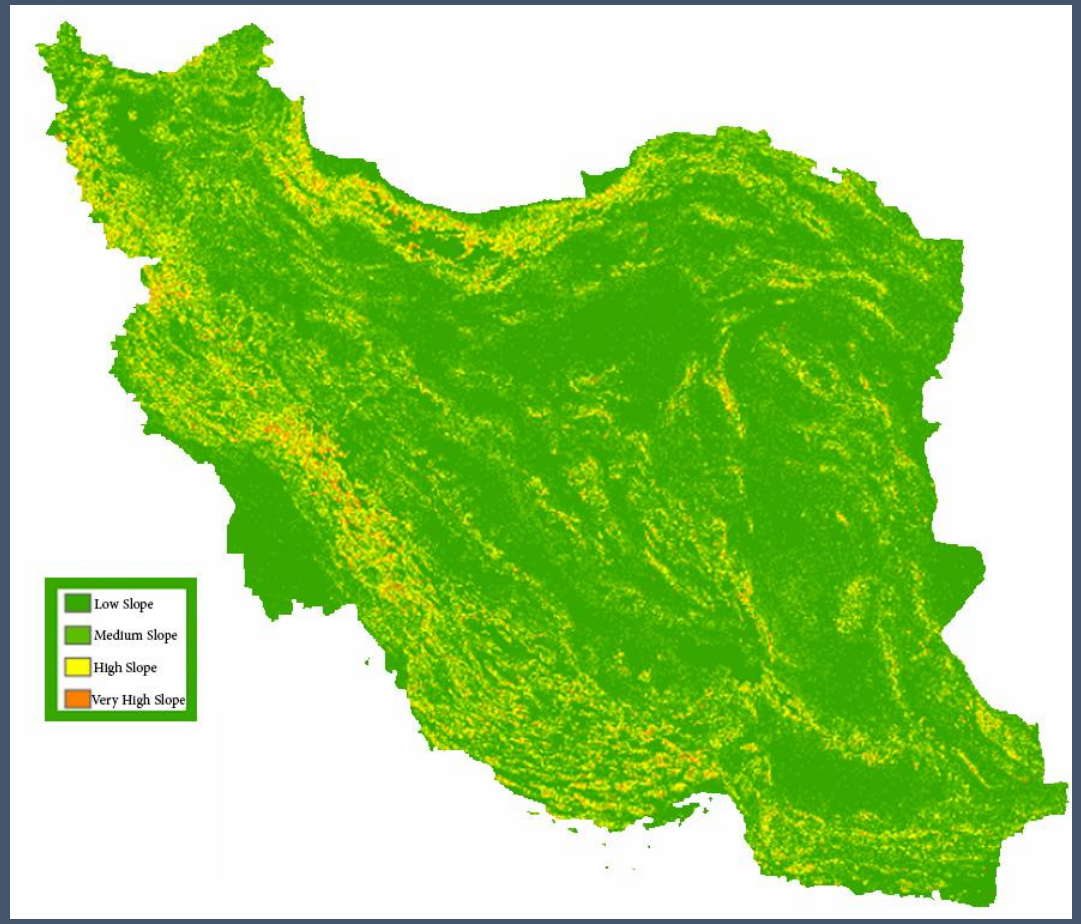


Iran Vulnerability Map Based on Land cover

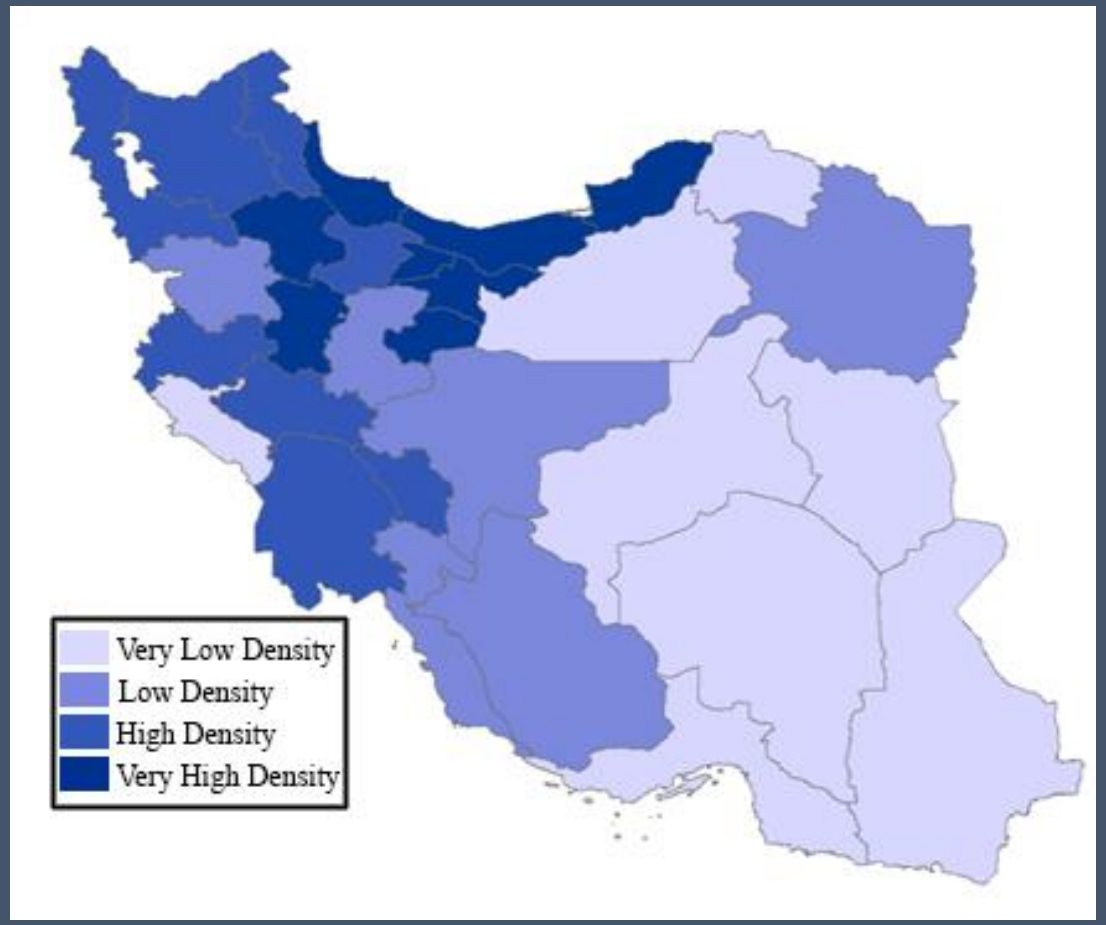




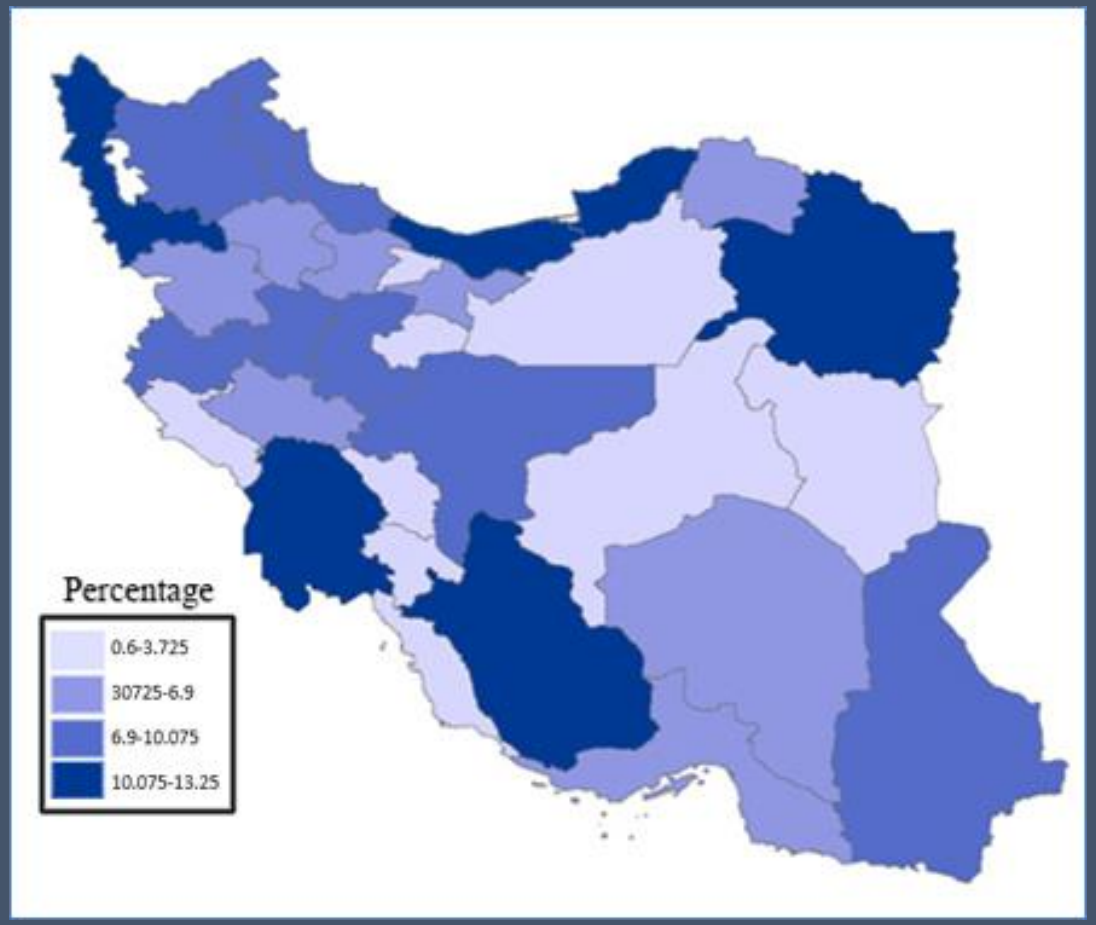
Iran Vulnerability Map Based on Slope



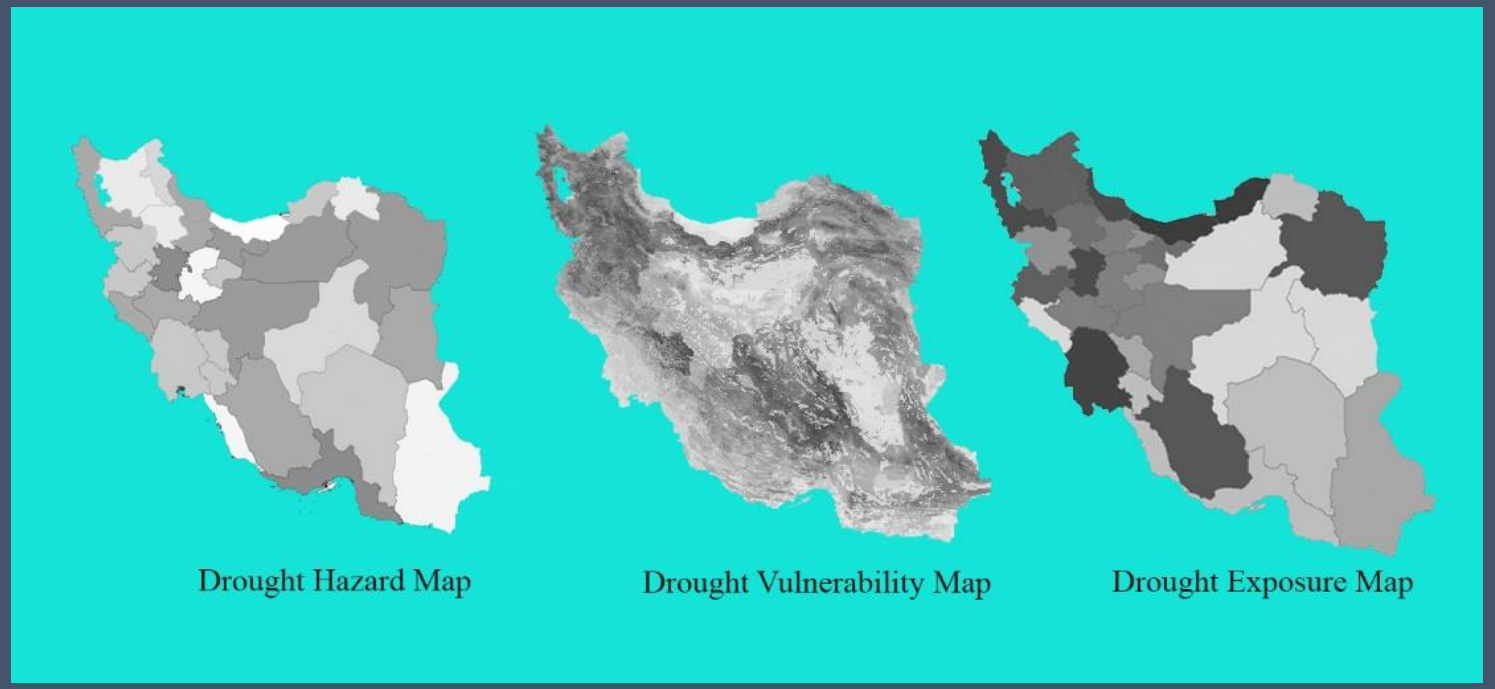
Iran Exposure Map Based on Population Density

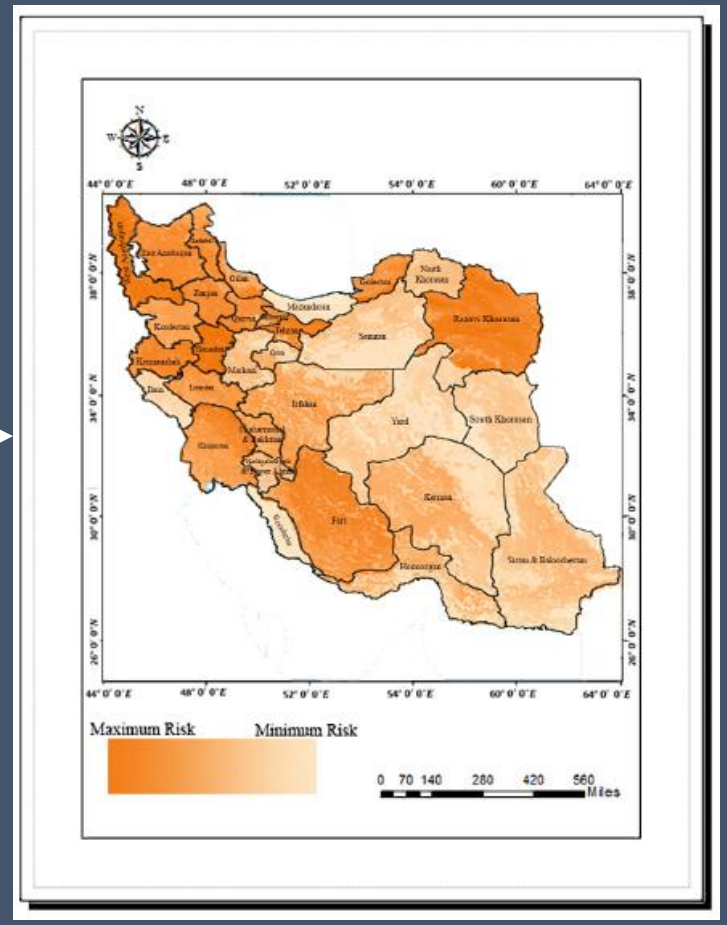


Iran Exposure Map Based on Irrigation Percentage

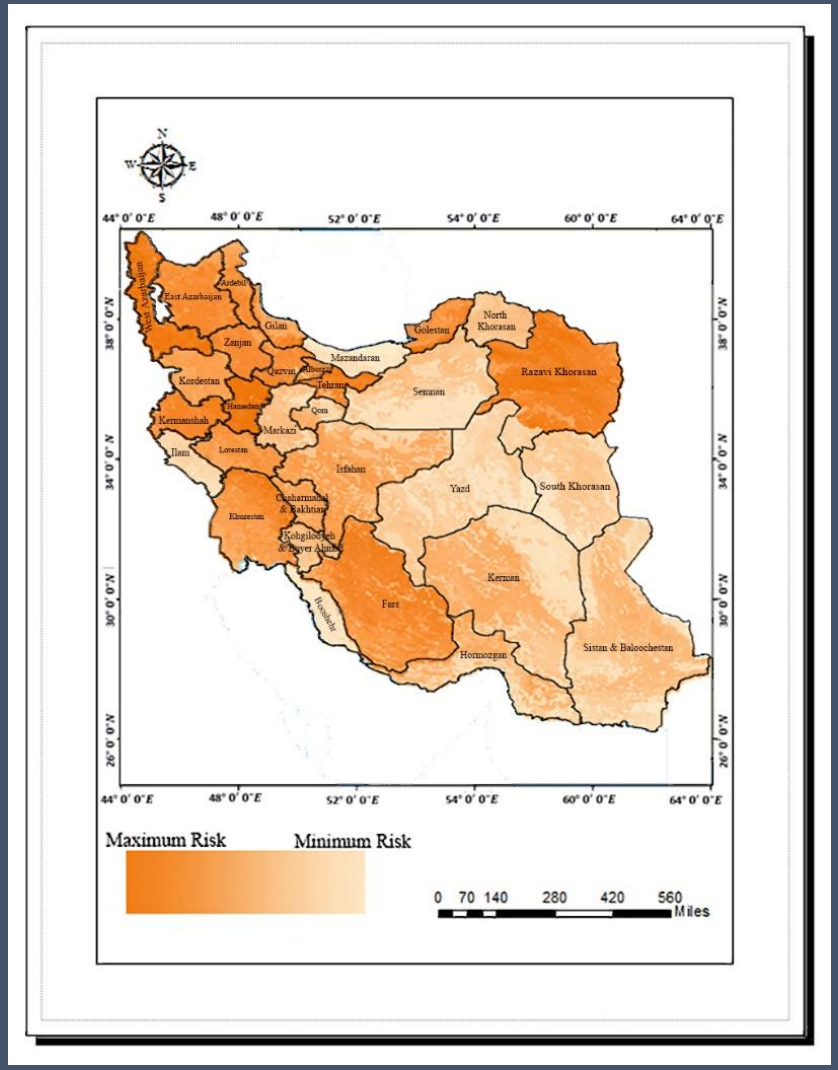


Iran Risk Mapping Procedure





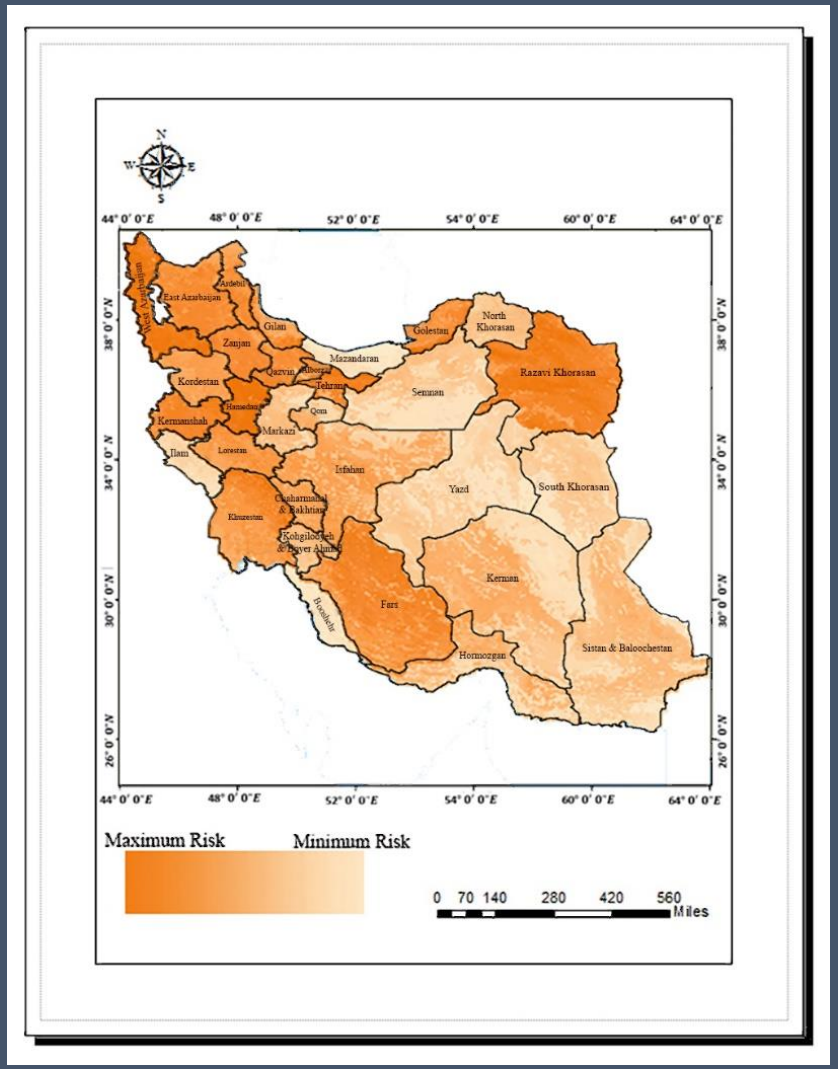
Iran Risk Map



Discussion

Discussion

- Based on the results obtained, **the middle part of Iran**, with desert and semi-desert terrain, experiences the least drought risk. The lack of factors such as population, agricultural farms, and any other types of vegetation classes like forests, rangelands etc., moves the overall risk value to near zero in this area.
- In contrast, **the northwest of Iran**, with a climate that corresponds to central European weather conditions (Northwest of Iran, with a climate that corresponds to central European weather conditions (cold, wet and a few enjoyable summer months), suffers from a high drought risk value.

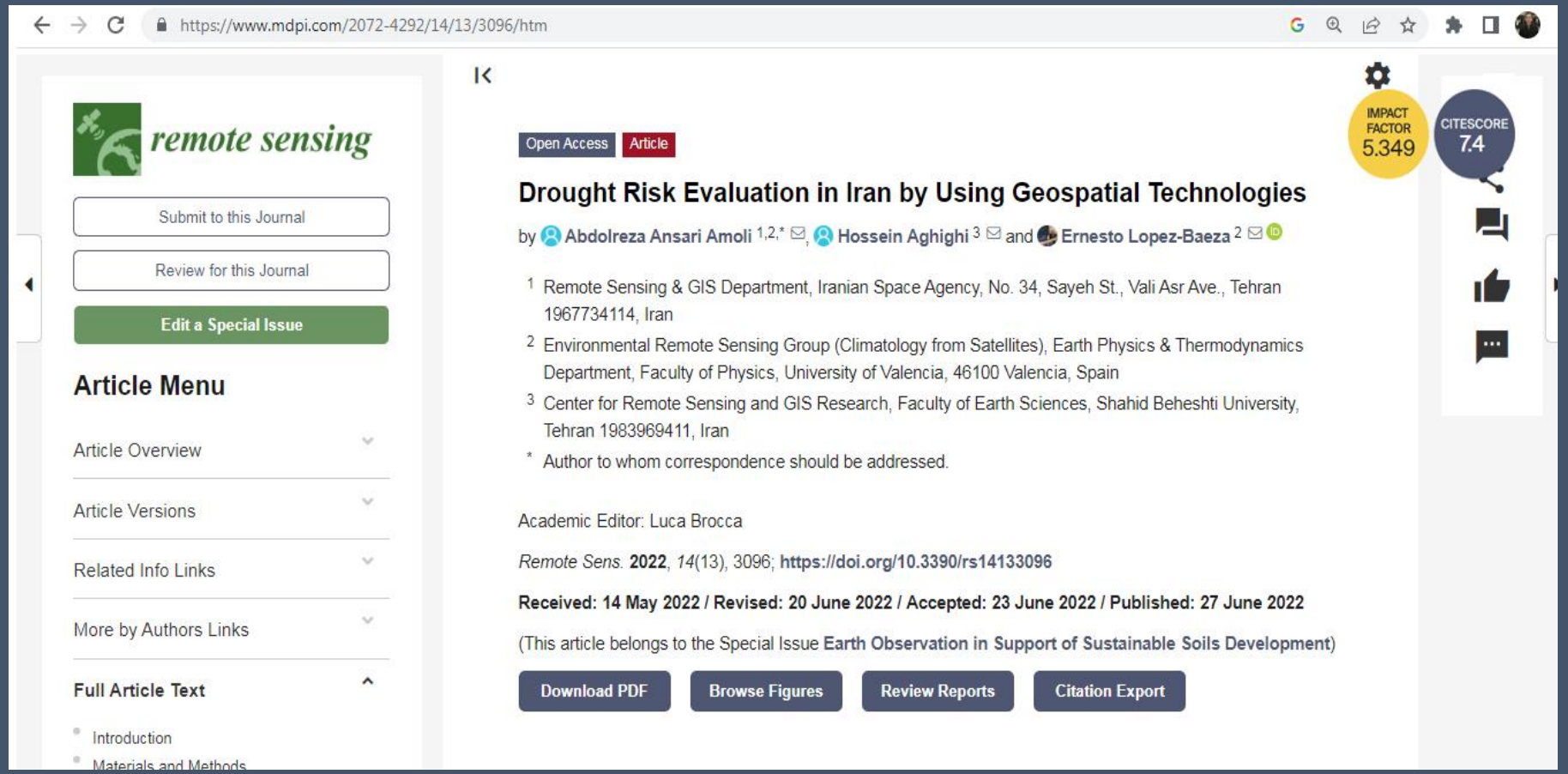


Conclusions:

- The results show that the main areas of the country, in the west and northwest, and a small part in the northeast of Iran are highly threatened by the high risk of drought.

Decision Makers:

- In conclusion, the output drought risk map in this research shows that decision makers should allocate more money in their **budget** to the **provinces located in the west, northwest, and small parts of the northeast of Iran** (with valuable factors such as millions of inhabitants, vast agricultural and vegetated areas) than the areas located in the deserts (central parts of Iran) without any population, vegetation, or human elements.



https://www.mdpi.com/2072-4292/14/13/3096/htm

Future Works

- In future work, the addition of other significant data provided by remote sensing and GIS techniques, such as soil moisture, drainage density, ground water table,…
- The Enhanced Vegetation Index (EVI) is more sensitive to drought stressors and may provide more precise drought risk evaluation maps and is therefore recommended for future work.

Thank you for your attention!