Vulnerability to Extreme Events due to Climate Change in Egypt

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

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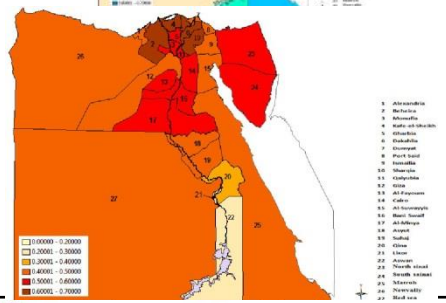
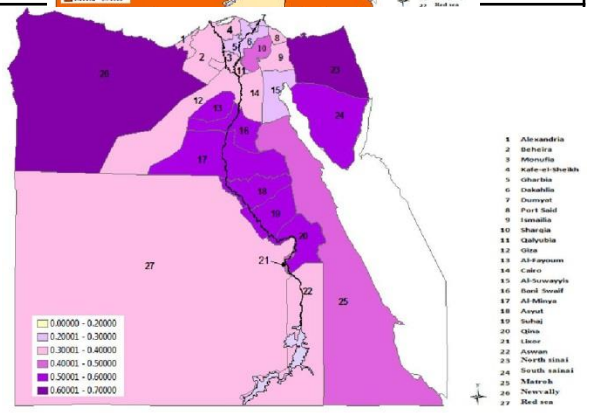
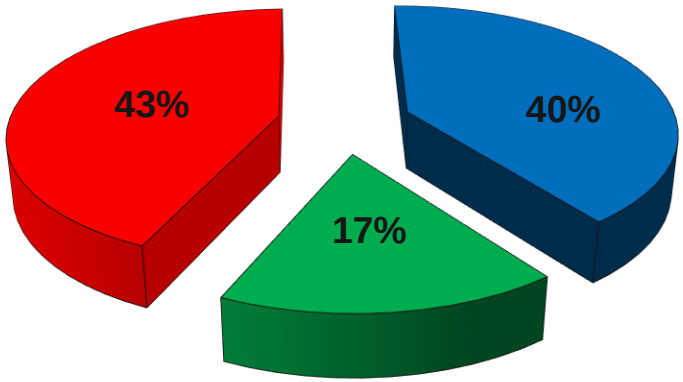
Projection of Vulnerability Components for Egypt Governorates

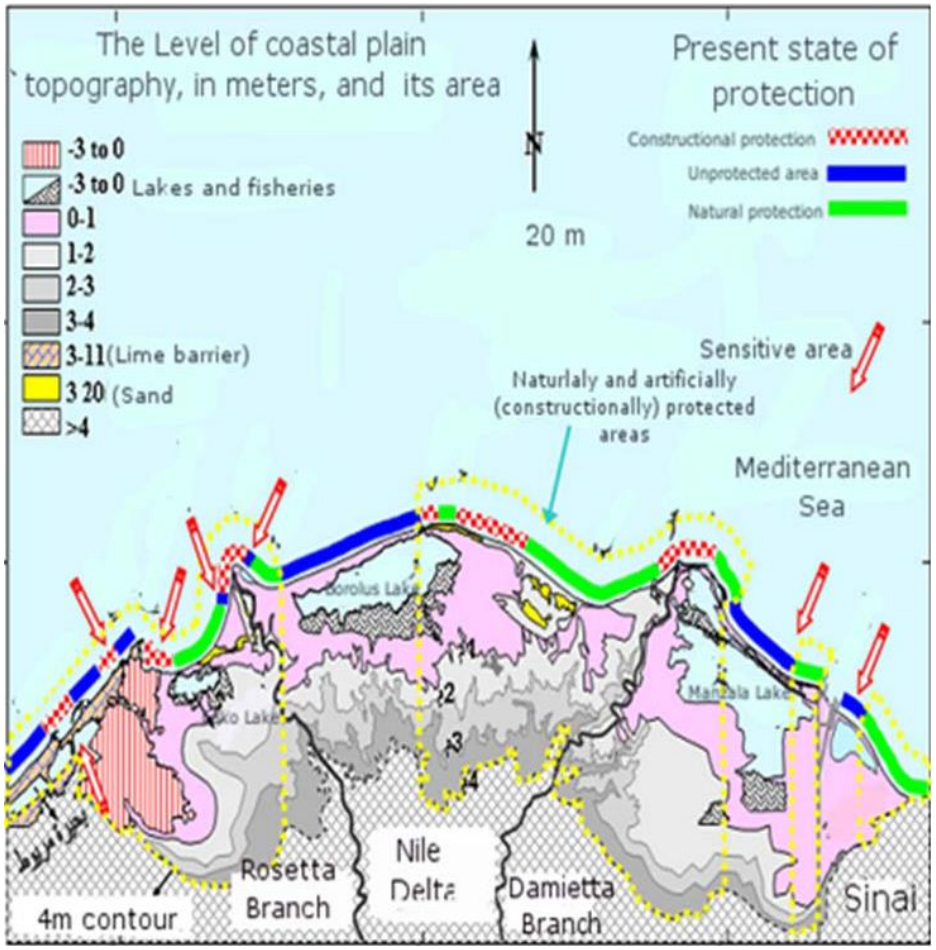
Vulnerability components	Resources	Indicators	Results
Exposure	Extreme Events	No of flash Floods	
	Change in Climate Variables	Max. Temperature	
		Min. Temperature	
Sensitivity	Human	Population density	
		Rural area	
		Distance from sea	
	Ecology	Protected area	
	Water	Water poverty index	
	Energy	Available energy for consumption	
	Agriculture	evapotranspiration	
		Area under major crop	
Capacity adaptation	Socio-economic	Human development index	
		Gender development index	
		GDP	
		Share of Agriculture GDP	
	Infrastructures	Drainage covered area/total cultivated area	
		Paved roads (% of total roads)	
		% of households with access to sanitation	
		% of households with access to piped water	
	Technology	Per capita consumption of Electricity	

Source, Inas El Gafy and Neil Grigg, 2016, Journal of American Science 2016;12(8)

Examples of Vulnerable Sectors in Egypt

1. Coastal Zone





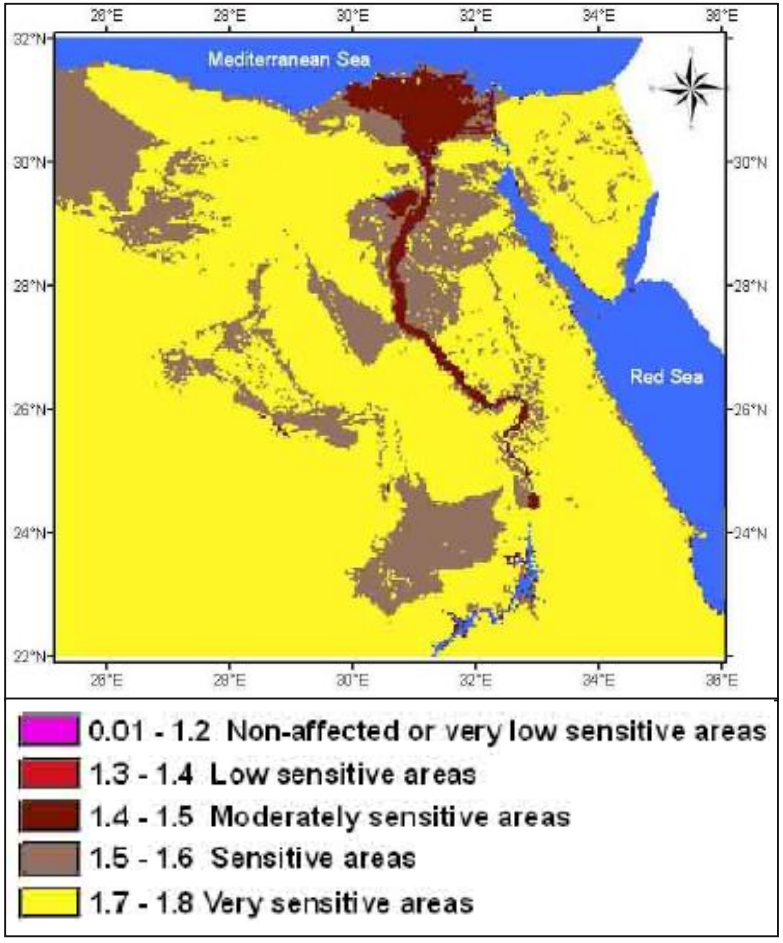
Source: *Egyptian Aut hority for Coastal protection Information and Decision Support Center– Advisory Committee for Crisis/ Disaster Management and Disaster Risk Reduction.*

Examples of Vulnerable Sectors in Egypt

2. Agriculture Sector

Crop	Productivity	Increase of Temperature Degree	Water Consumption
Wheat	-9%	+2	+6.2%
		+4	+18%
Maize	-19%	+3.5	+8%
Cotton	+17%	+2	+4.1---5.2%
	+31%	+4	+10%
Rice	-11%		+16%
Tomato	-14%	+2	+4.2----5.7%
	-51%	+3.5	
Sugar Cane	-24.5%		+2.3%

Crop	Change %		Reference
	2050s	2100s	
Wheat	-15*	-36**	(Abou- Hadid ,2006)
Rice	-11		(Eid and El-Marsafawy,2002)
Maize	-19		(Eid, El-Marsafawy, Ainer, El-Mowelhi, El-Kholi, 1997)
	-14	-20	(Hassanein and Medany, 2007)
Soybeans	-28		(Eid and EL-Marsafawy, 2002)
Barley	-20		(Eid, El-Marsafawy, Ainer, El-Mowelhi, El-Kholi, 1997)
Cotton	+17*	+31**	(Eid, El-Marsafawy, Ainer, El-Mowelhi, El-Kholi, 1997)
Potato	-0.9 to -2.3	+0.2 to +2.3	(Medany and Hassanein, 2006)



Environmentally sensitive areas (ESA's) for desertification in Egypt. (Gad and Lotfy, 2008)

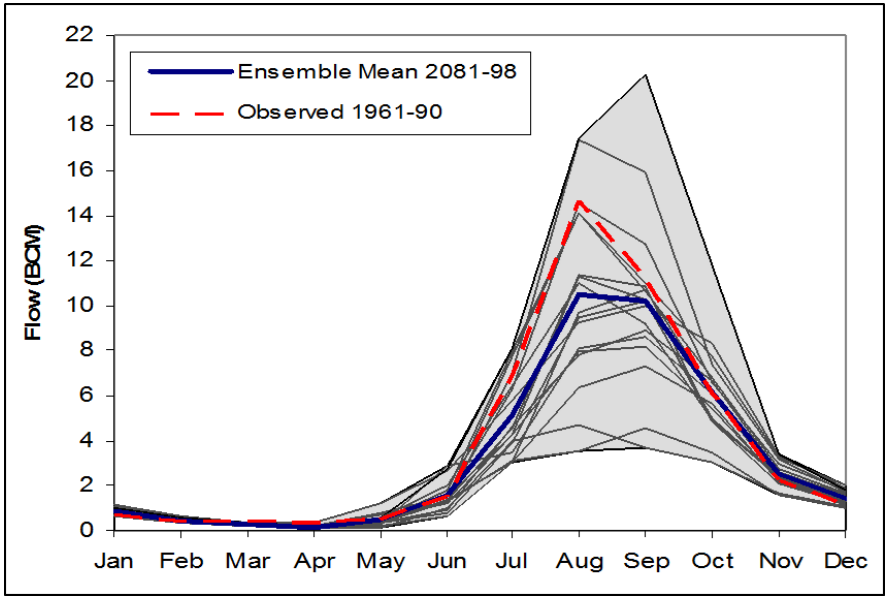
Examples of Vulnerable Sectors in Egypt

3. Water Resources

3.1 Nile River

The vulnerability of Egypt's water resources to climate change entails those affecting Nile flows:

- hypersensitivity to Ethiopian rain;
- sensitivity to temperature increase and evapotranspiration in equatorial lakes and Bahr El Ghazal, and
- uncertainty due to significant differences in the Global Circulation Models output of water flow into the Nile,
  - Elshamy et al. (2009b): -62% to +43%
  - Beyene et al. (2010): -29% to +26% by 2040-2069.



Elshamy et al, 2009b

Examples of Vulnerable Sectors in Egypt

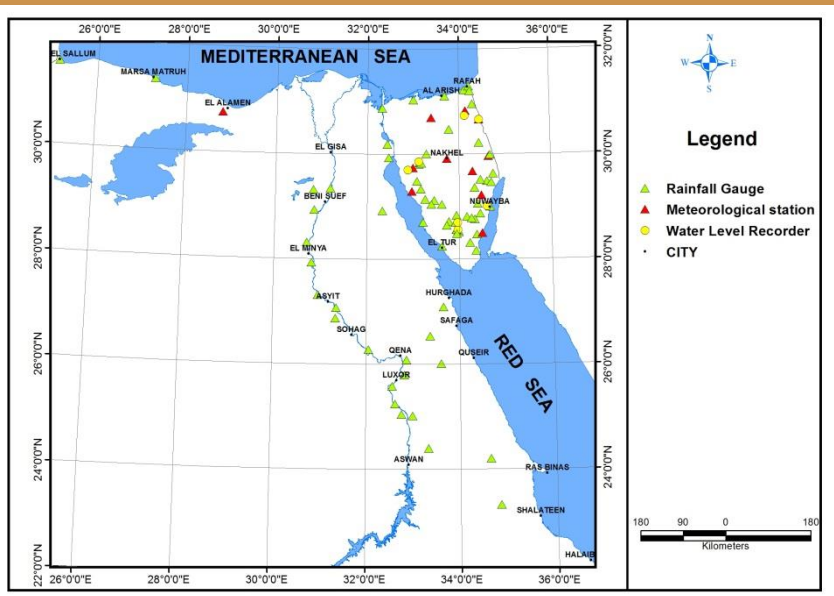
3.2 Ground Water

- Groundwater in Sinai may be sensitive to changes in rainfall,
- Groundwater in the Nile Delta is more sensitive to climate change, as its sources are the water leaking from the Nile and its branches, as well as the irrigation network and agricultural land which is mostly irrigated by basin irrigation methods,
- The anticipated elevation of groundwater in the north coast – as an impact of the probable sea level rise,
- The aquifer extending west of Alexandria, is facing the threats of seawater intrusion, reduced rainfall as well as increased temperature i.e. more evaporation.

Examples of Vulnerable Sectors in Egypt

3.3 Rainfall

- The rain gauge stations record length is too short
- There is a need to use reference data (Reanalysis, statistical or estimated data from satellite images)
- Three reference data are evaluated during the period (2004-2014) comparing with available observed data for the same period:
  - Climate Research Unit Data (CRU)
  - Global Precipitation Climate Center Data (GPCC)
  - European Centre for Medium-Range Weather Forecasts (ECMWF) interim reanalysis (ERA-Interim)

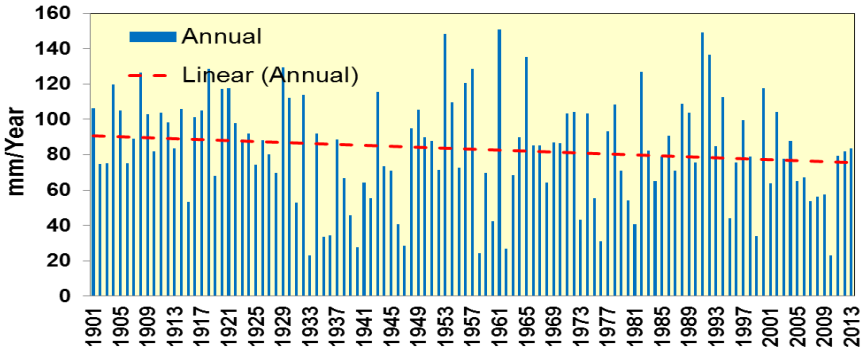


Stations	RMSE (mm)	R^2	MAE (mm)
El_Tour	0.70	0.90	0.25
Abo_erdies	0.99	0.82	0.33
Sueiz	1.06	0.74	0.52
Gardaqa	0.95	0.70	0.23
El_Qusser	0.69	0.75	0.16
Dahab	1.64	0.40	0.47

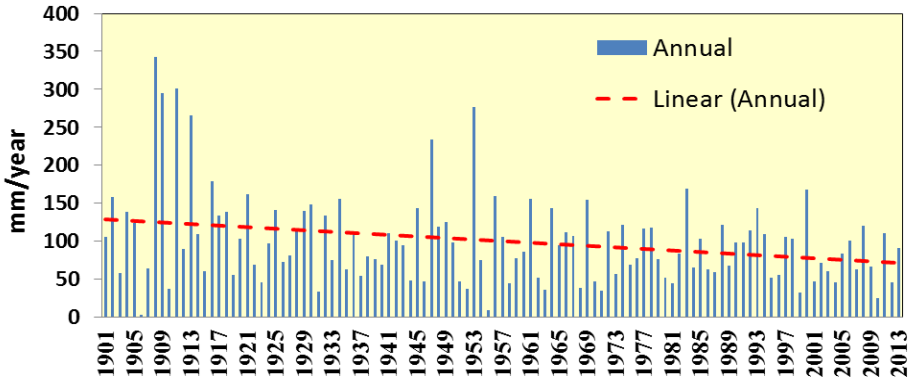
Water Resources Research Institute (WRRI). 2017

Examples of Vulnerable Sectors in Egypt

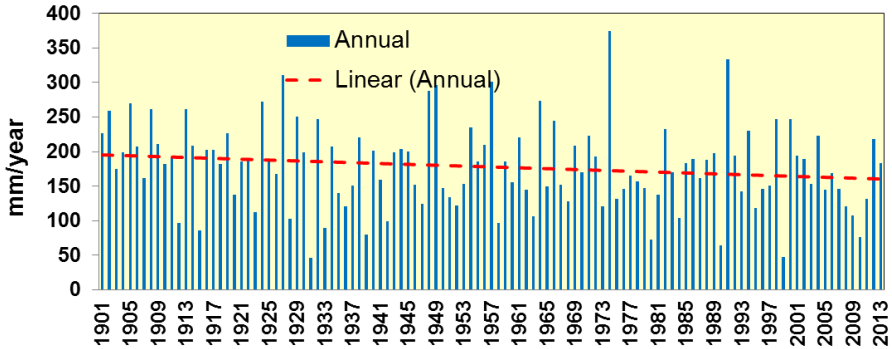
3.3 Rainfall



Damietta (Delta North Coast)



Salloum (West North Coast)



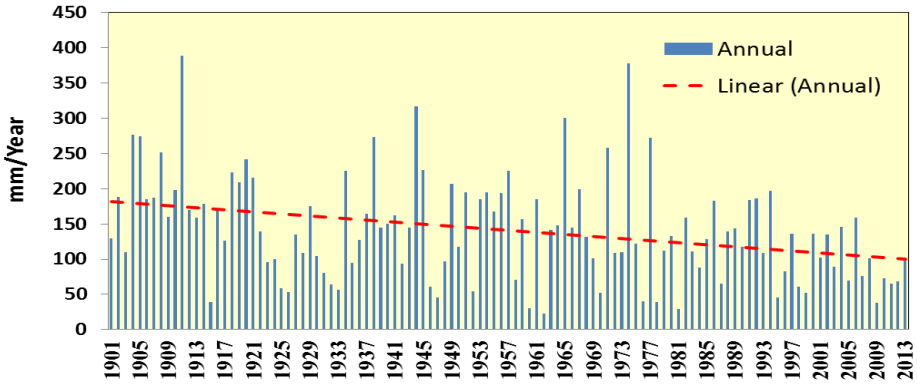
Alexandria (North Coast)

Data Source: GPCC (https://www.esrl.noaa.gov/psd/data/gridded/data.gpcc.html)

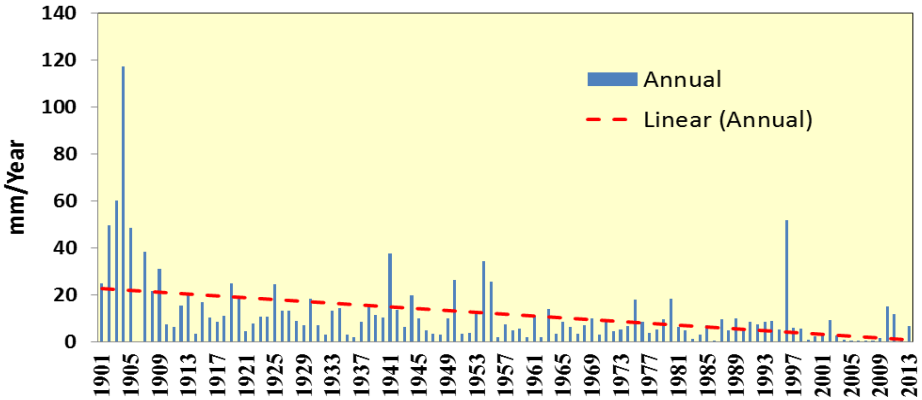
Water Resources Research Institute (WRRI). 2017

Examples of Vulnerable Sectors in Egypt

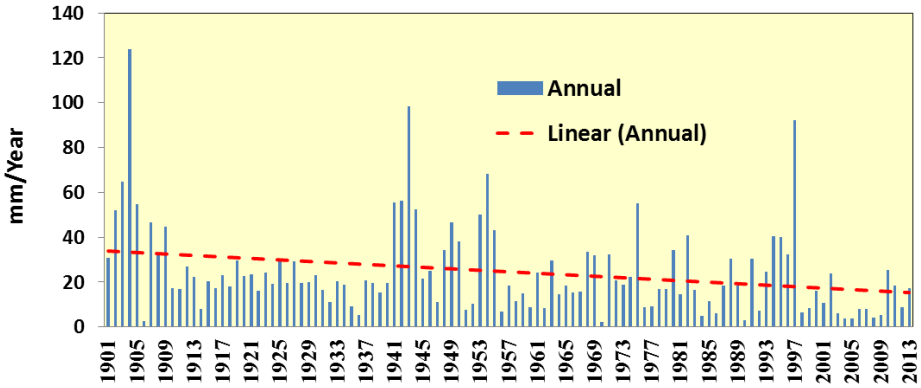
3.3 Rainfall



Al Arish (North Sinai)



Sharm ElShaik (South Sinai)

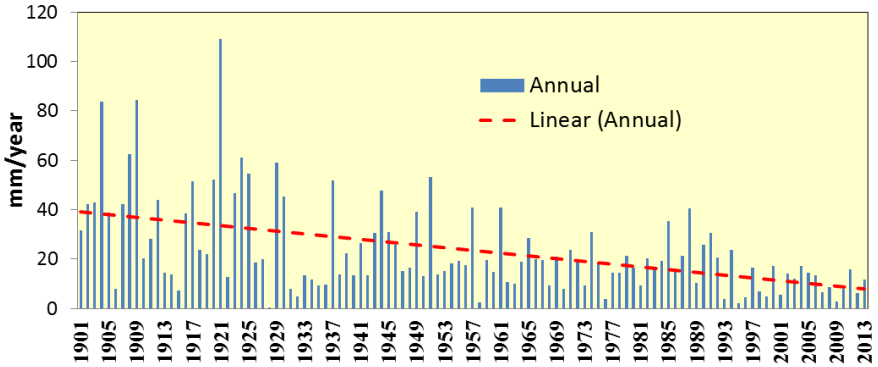


Sant. Katrina (Middle Sinai)

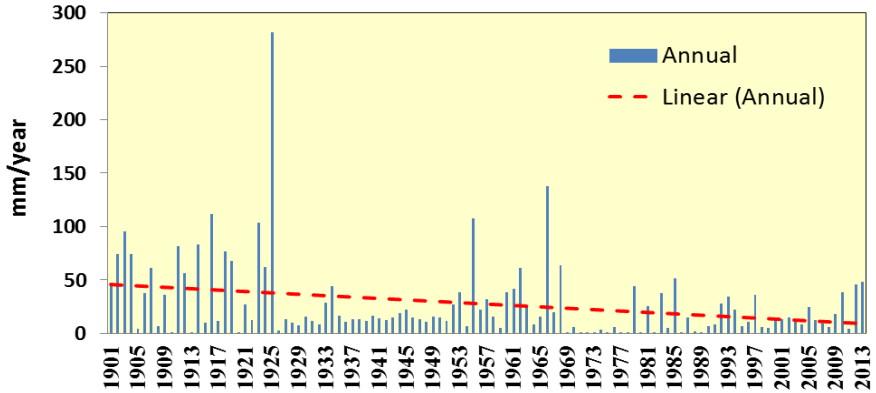
Data Source: GPCC (https://www.esrl.noaa.gov/psd/data/gridded/data.gpcc.html)

Examples of Vulnerable Sectors in Egypt

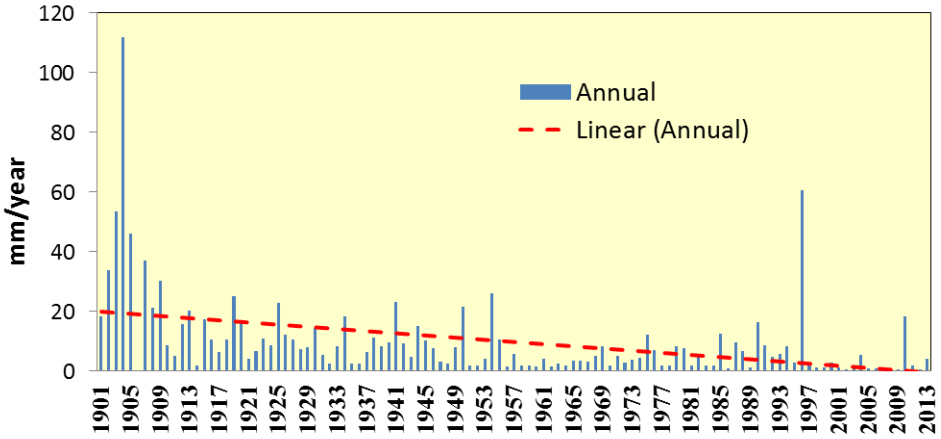
3.3 Rainfall



Elsuez (North Red Sea)



Shalateen (South Red Sea)



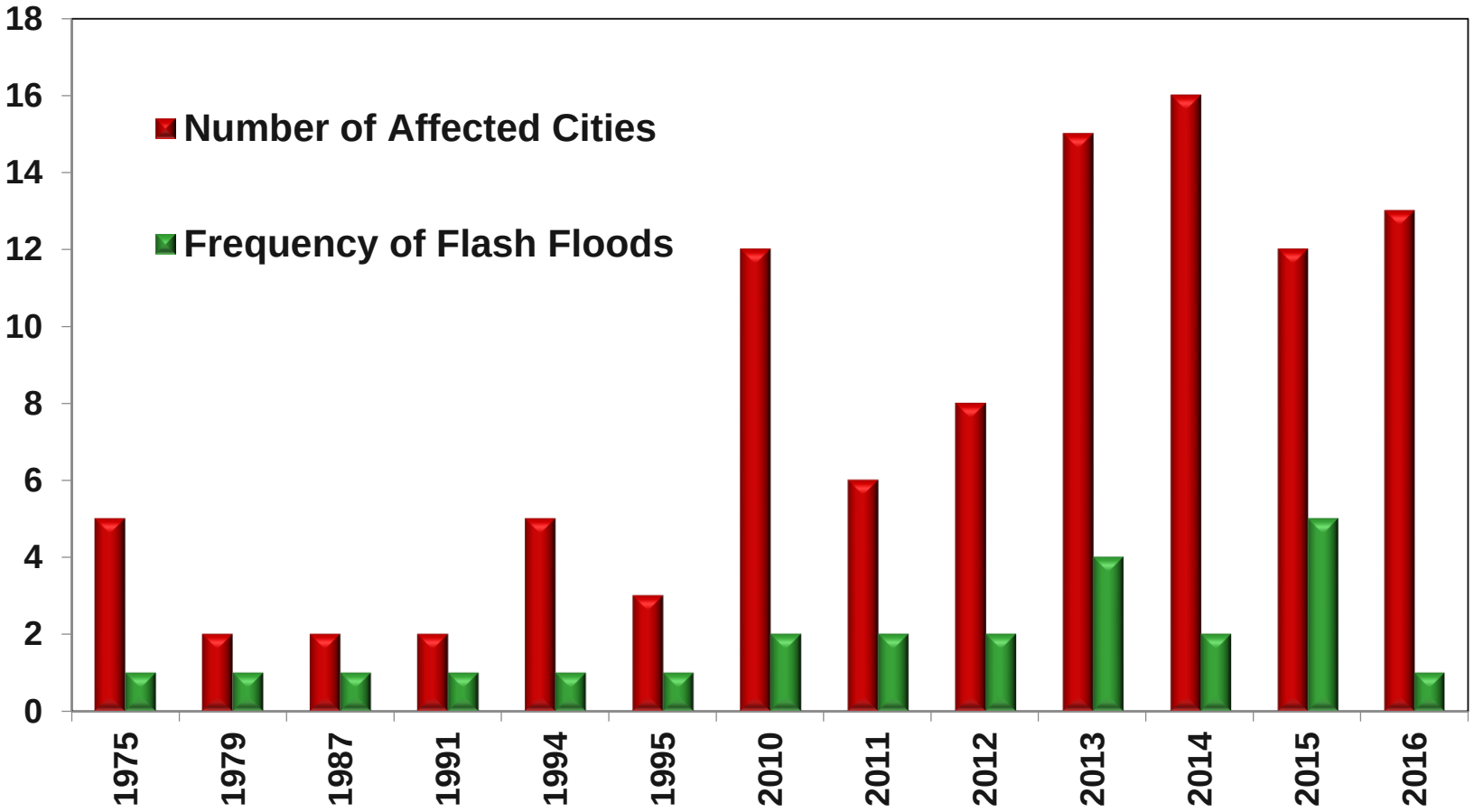
Hurgada (Red Sea)

Data Source: GPCC (https://www.esrl.noaa.gov/psd/data/gridded/data.gpcc.html)

Water Resources Research Institute (WRRI). 2017

Vulnerability to Extreme Events due to Climate Change

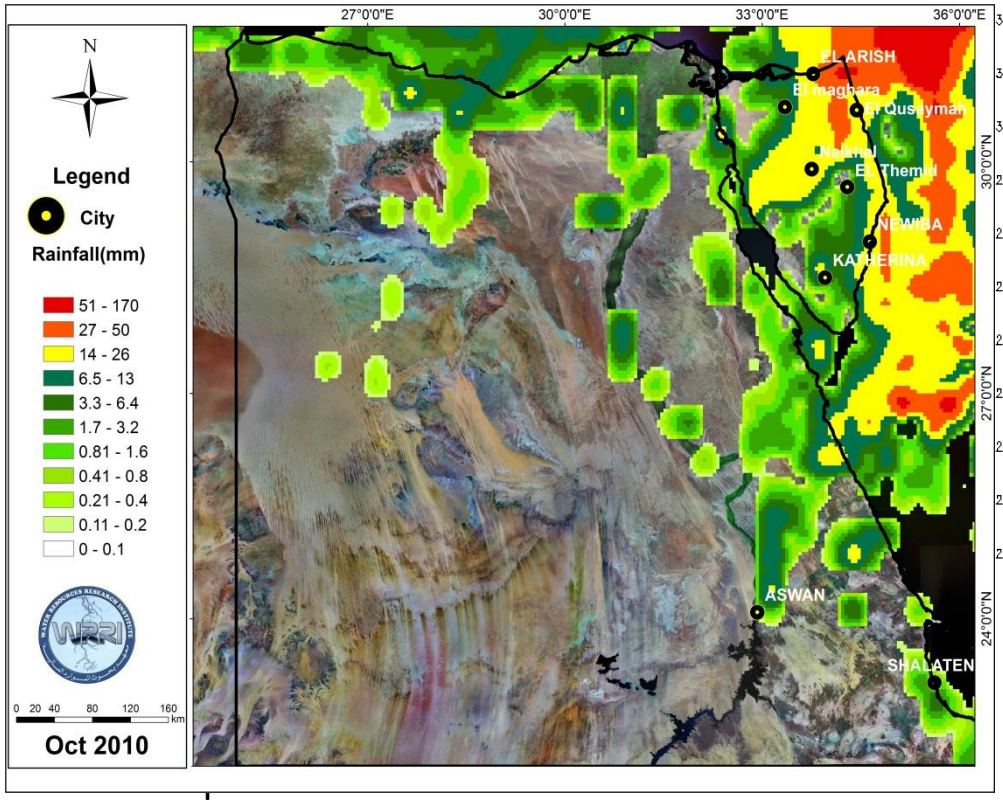
Frequency of the Storms

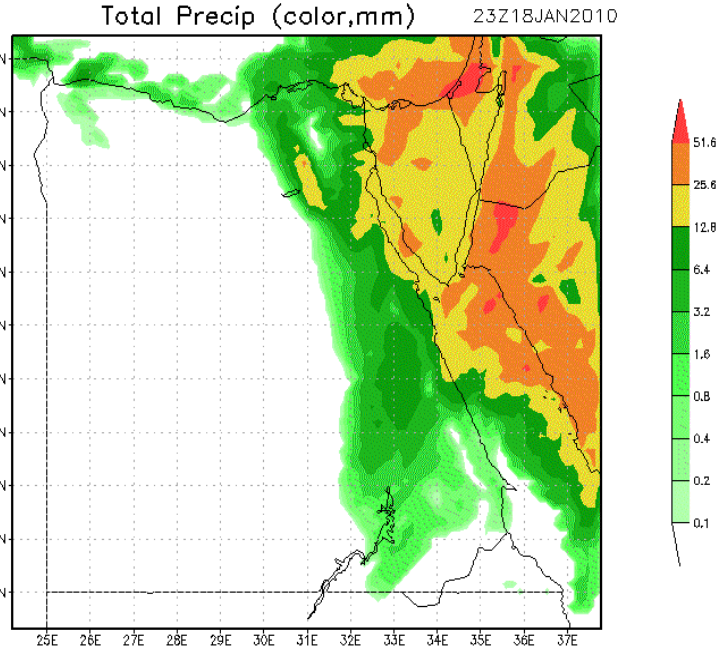


Vulnerability to Extreme Events due to Climate Change

Observed and forecasted distributions of the storms

Event of Jan 2010





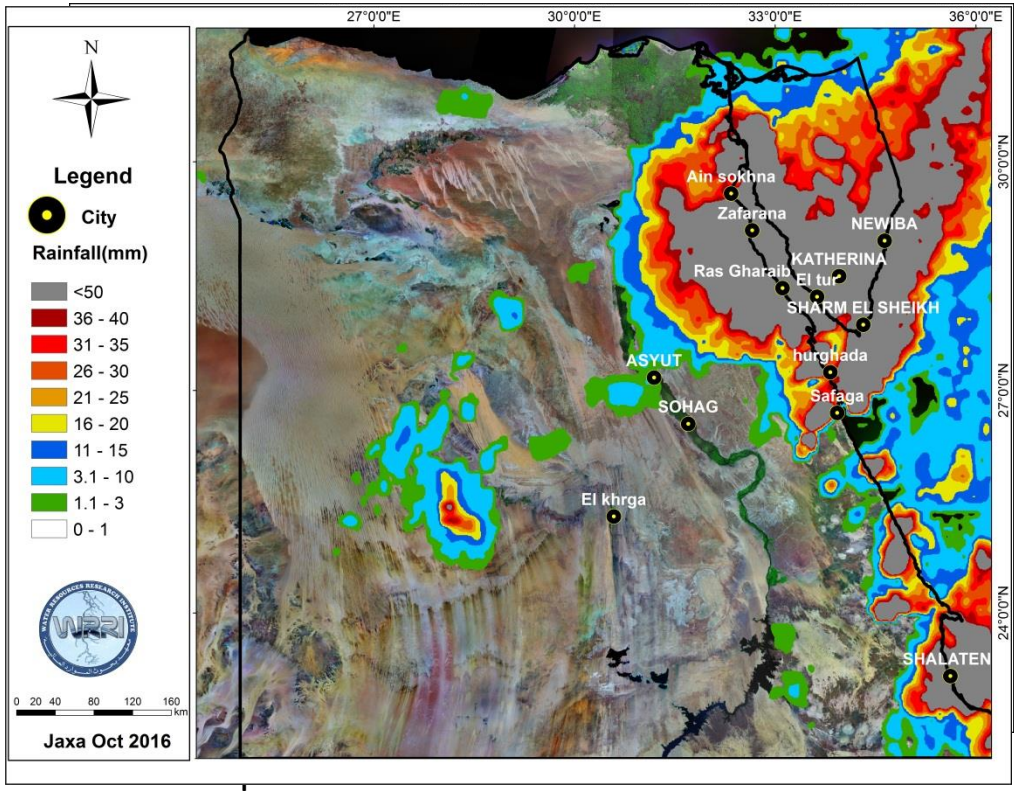
Source: WRF Output, WRRI

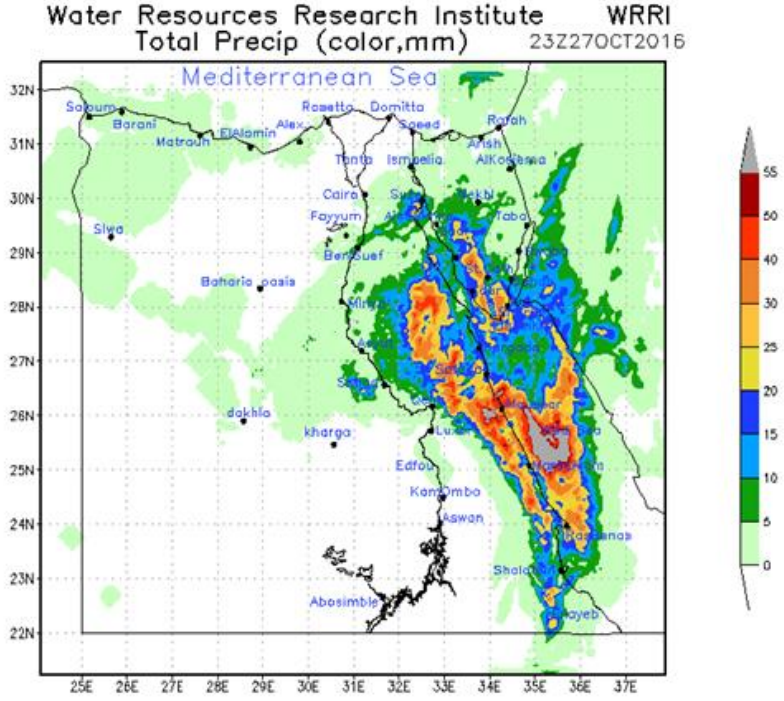
Rainfall data source: TRMM

Vulnerability to Extreme Events due to Climate Change

Observed and forecasted distributions of the storms

Event of Oct **2016**





Source: WRF Output, WRRI

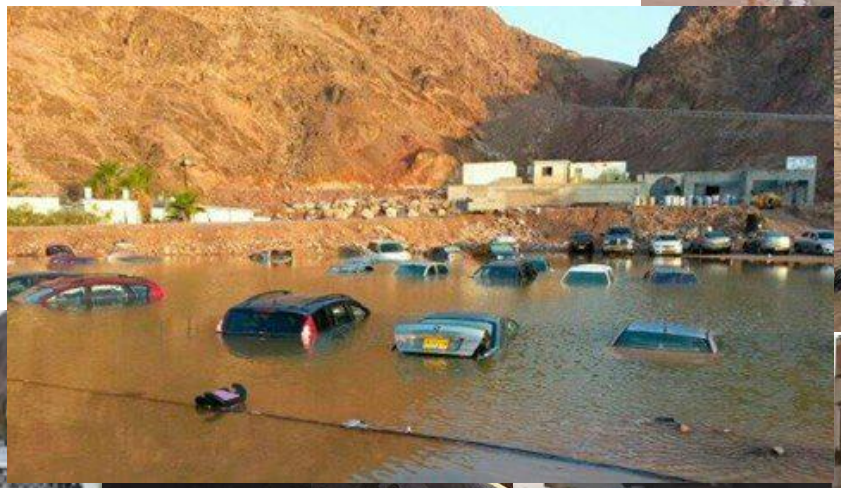
Rainfall data source: GSMaP (JAXA)

Vulnerability to Extreme Events due to Climate Change

Cases of events damage

Alexandria. 2015

Taba. 2014



Al - Arish. 2010

RasGhareb. 2016

Vulnerability to Extreme Events due to Climate Change

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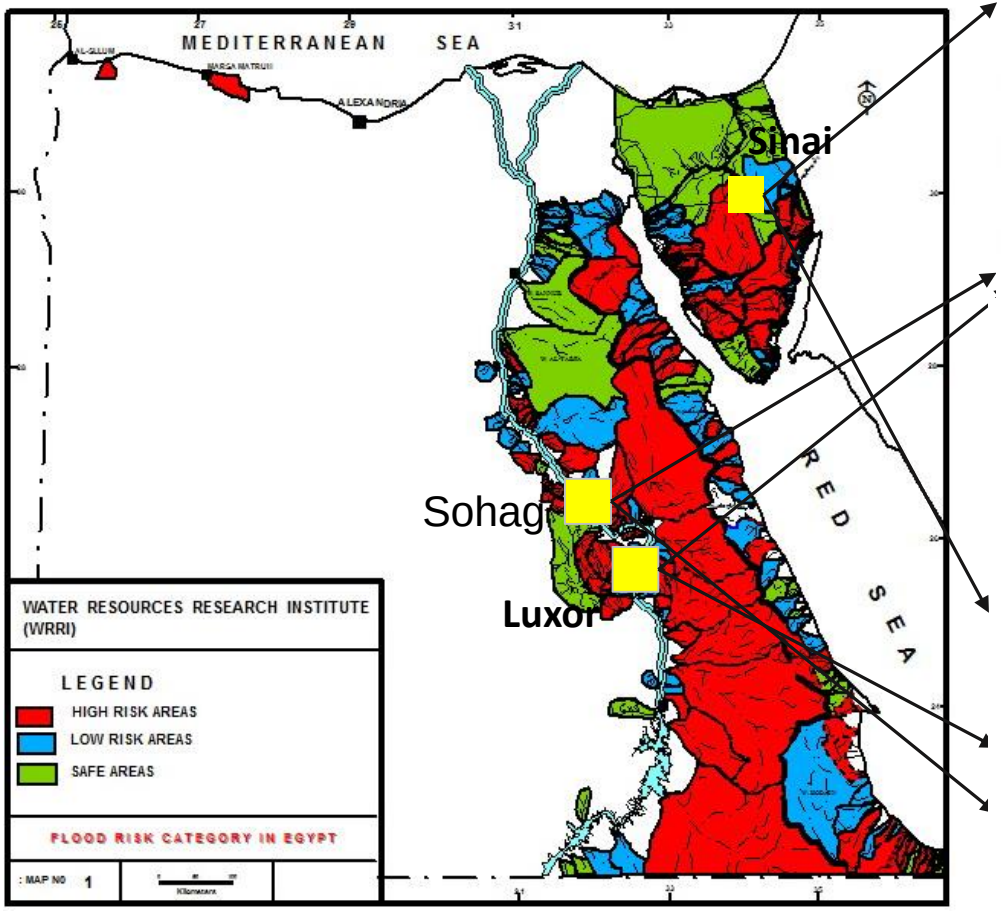
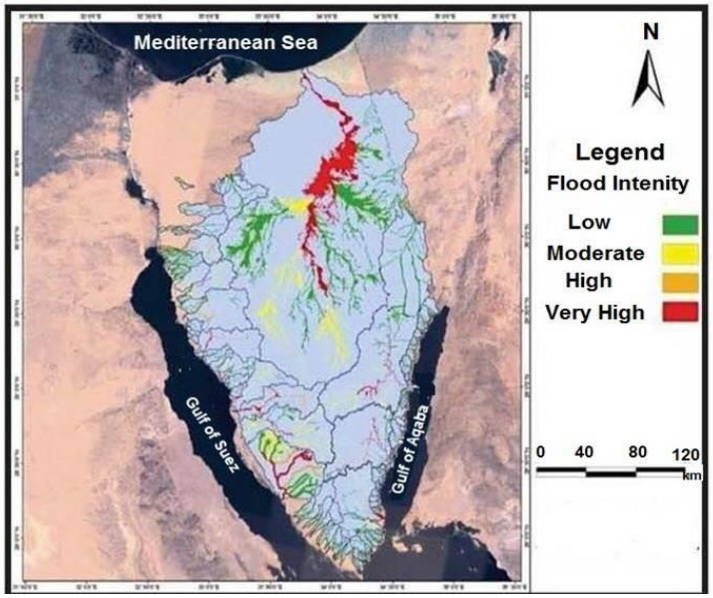
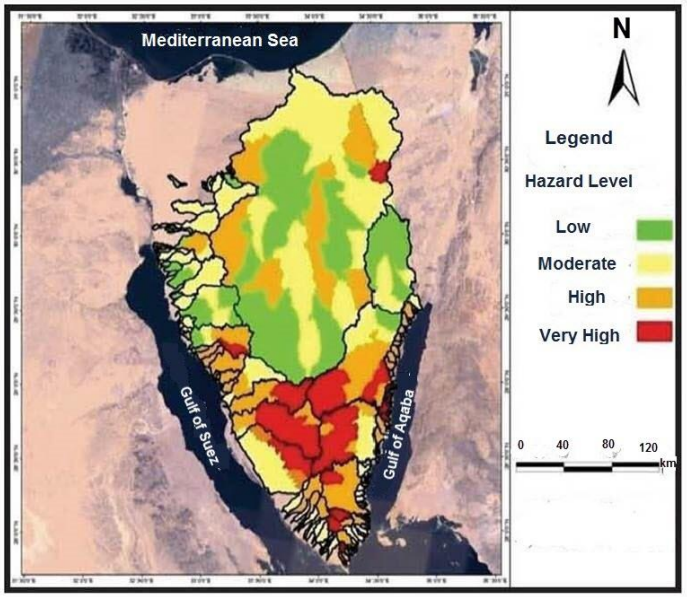
Areas vulnerable to flash floods in Egypt

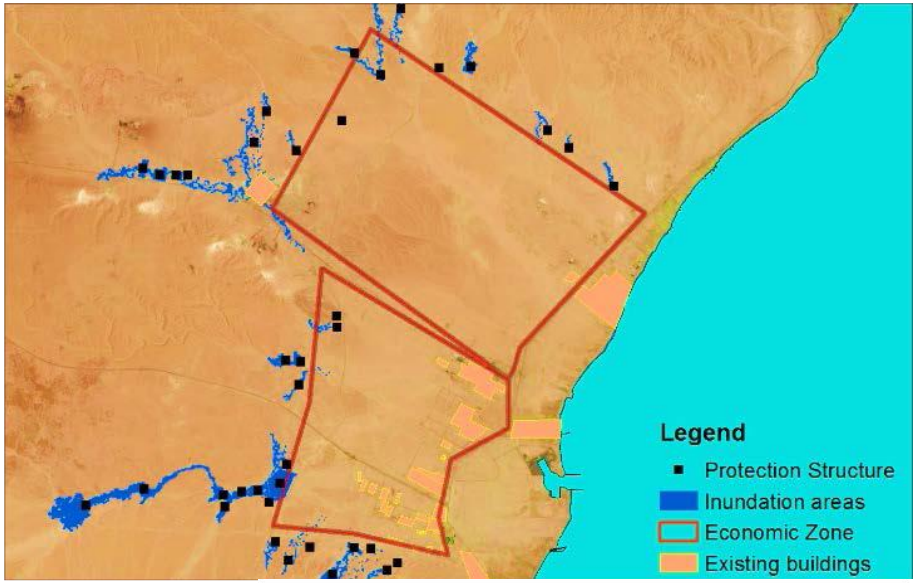




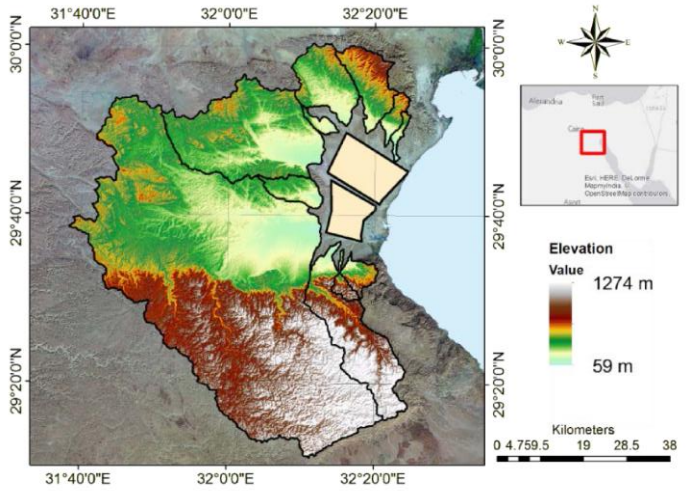


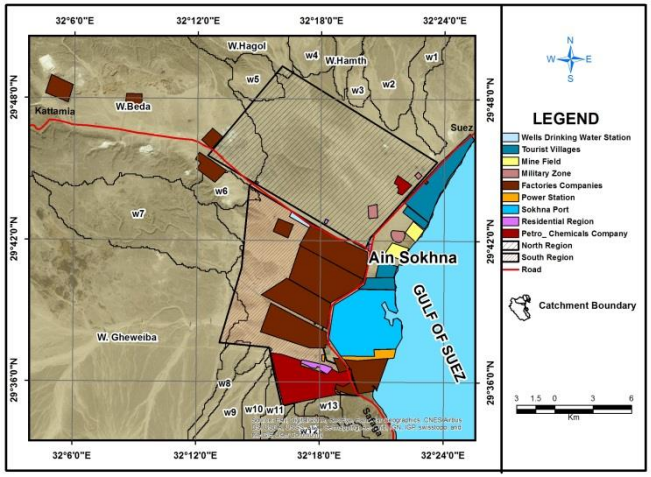
Flash Flood Risk Assessment

1- Economic zone

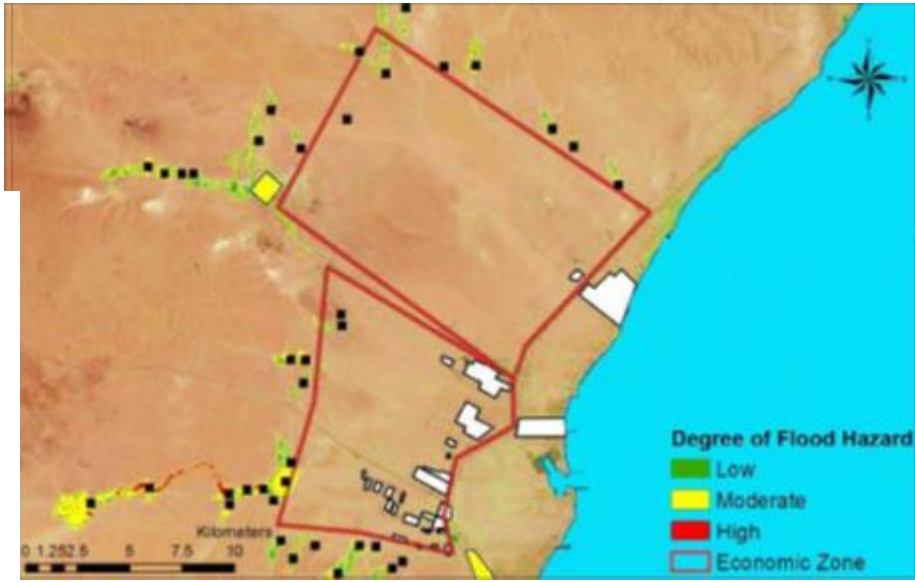


Inundation map





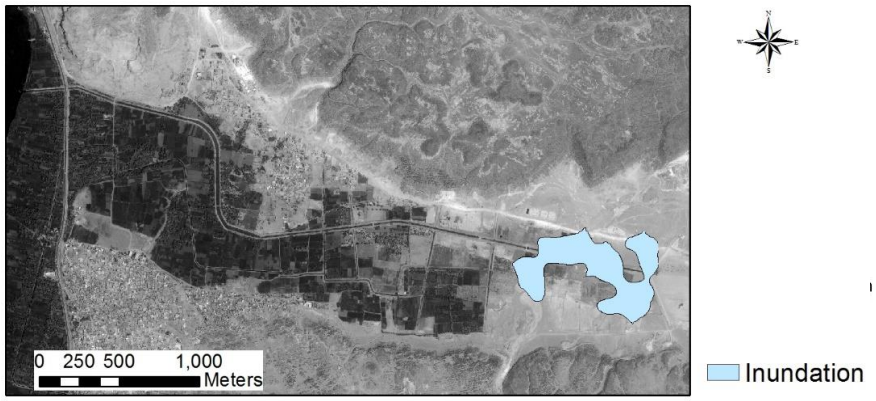
Infrastructures



Hazard degrees

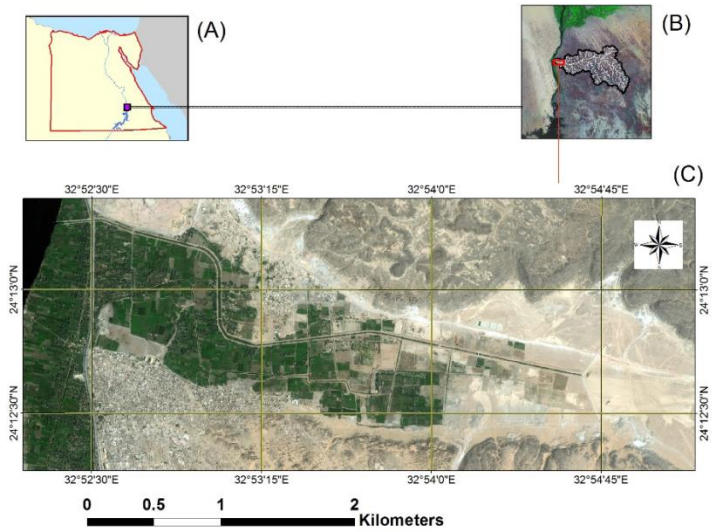
Flash Flood Risk Assessment

2- AboSbera Valley



Inundation map

Hazard degrees



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Conclusions and Recommendations

- Most of Egypt sectors are vulnerable to climate change
- Although rainfall is declining, the events of Flash Flood (storms) are changed in their frequency, intensity and distribution
- Early warning system is useful in decreasing the damage process however, a complete warning system is still required
- Public awareness of climate change and the adaptation measures should be given high priorities.
- The safety of different monitoring equipment and adaptation measures should be grantee by local governorates and stakeholders.

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National Water Research Center
المركز القومي لبحوث المياه

WATER RESOURCES RESEARCH INSTITUTE
WRRI
معهد بحوث الموارد المائية

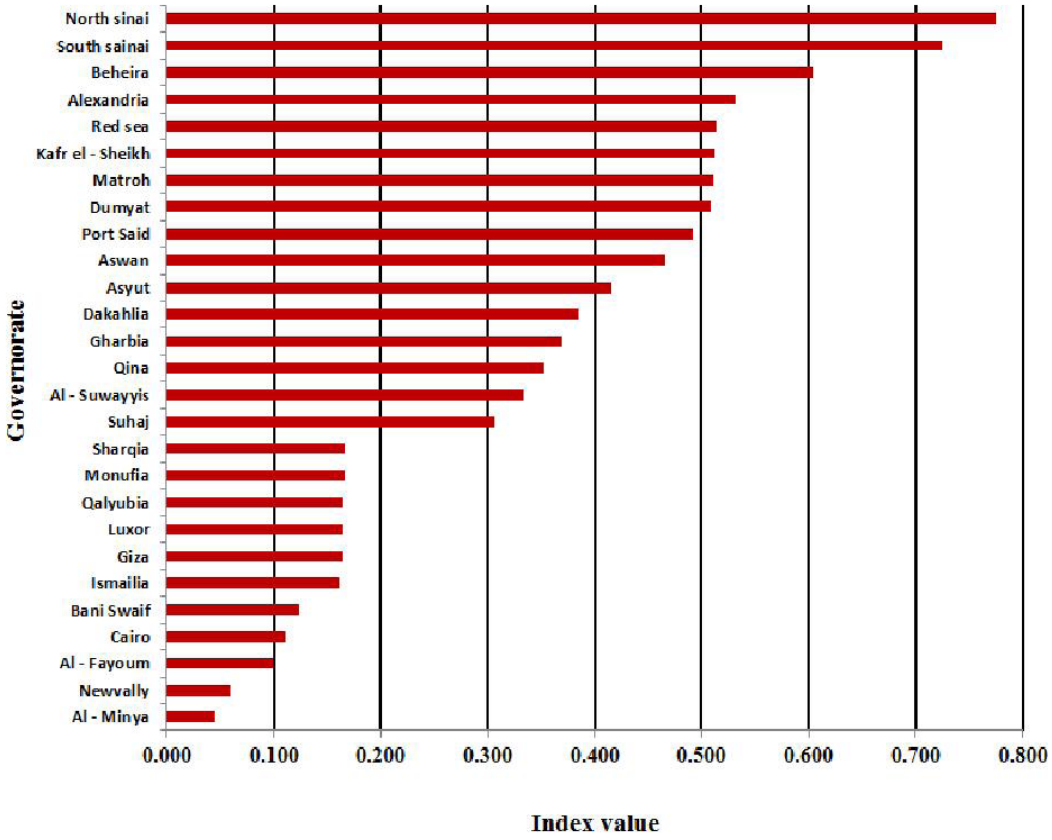
وزارة الموارد المائية والرى

Thanks for Your Attention

Prof. Karima Attia
Director of Water Resources Research Institute (WRRI)
Egypt

High Exposure: North Sinai

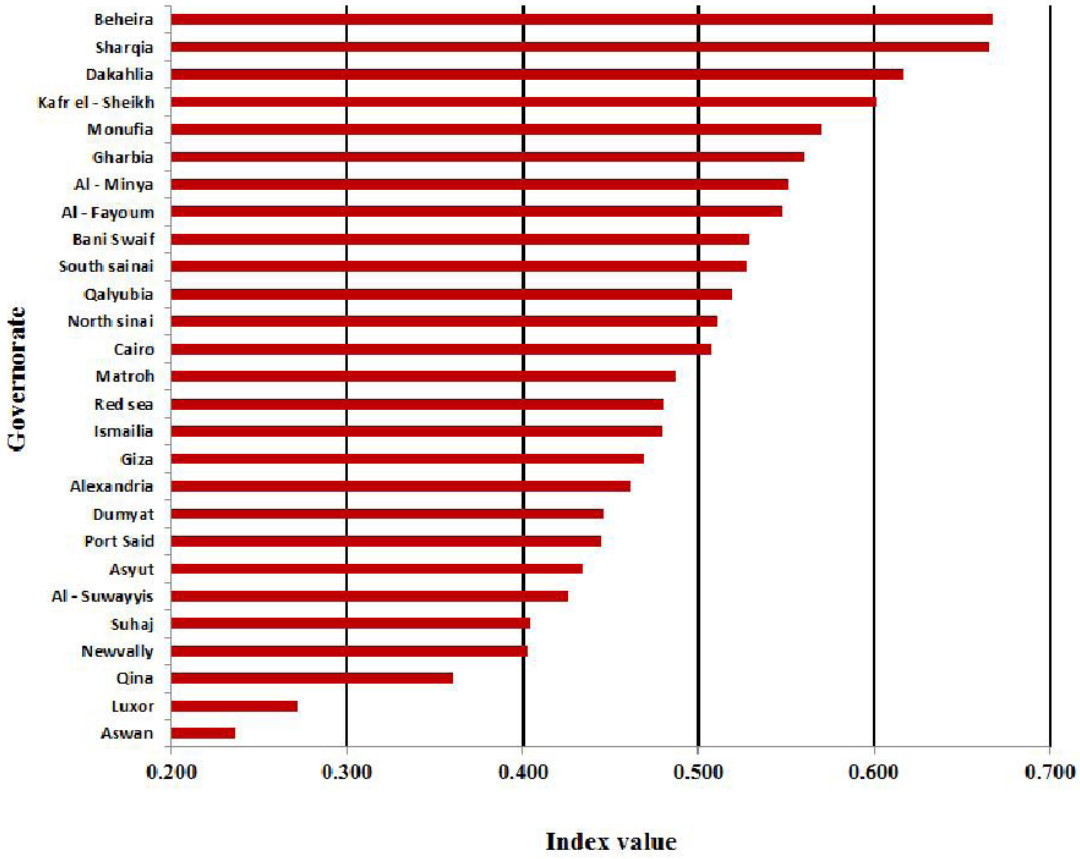
Low Exposure: Al-Minya



Exposure index of the Egyptian governorates

High Sensitive:
Beheira

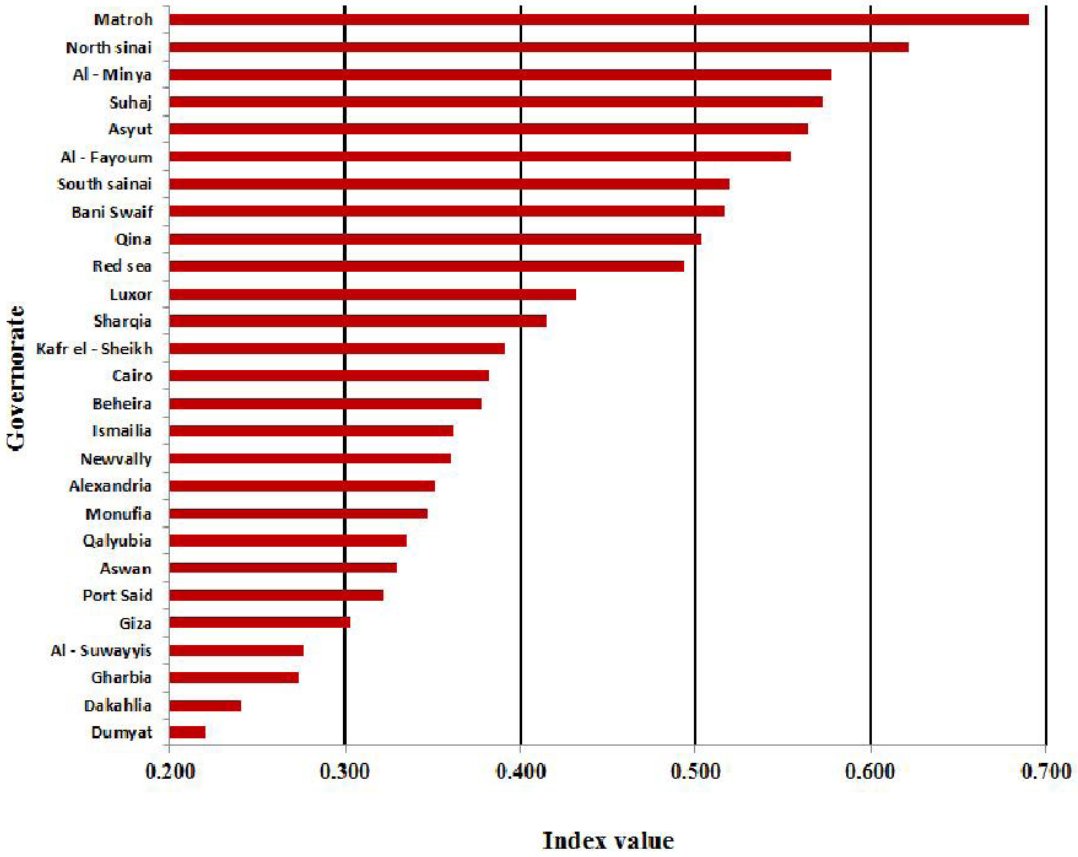
Low Sensitive:
Aswan



Sensitivity index of the Egyptian governorates

High Adaptation Capacity:
Matrouh

Low Adaptation Capacity:
Dumyate



Adaptation capacity index of the Egyptian governorates

Al-Arish, 2010

Taba, 2014

Ras_Ghareb