Economic and Social Commission for Western Asia

Increasing Watershed Resilience to Climate Change Nahr El Kalb Watershed

Maya Atie,

May 31, 2023

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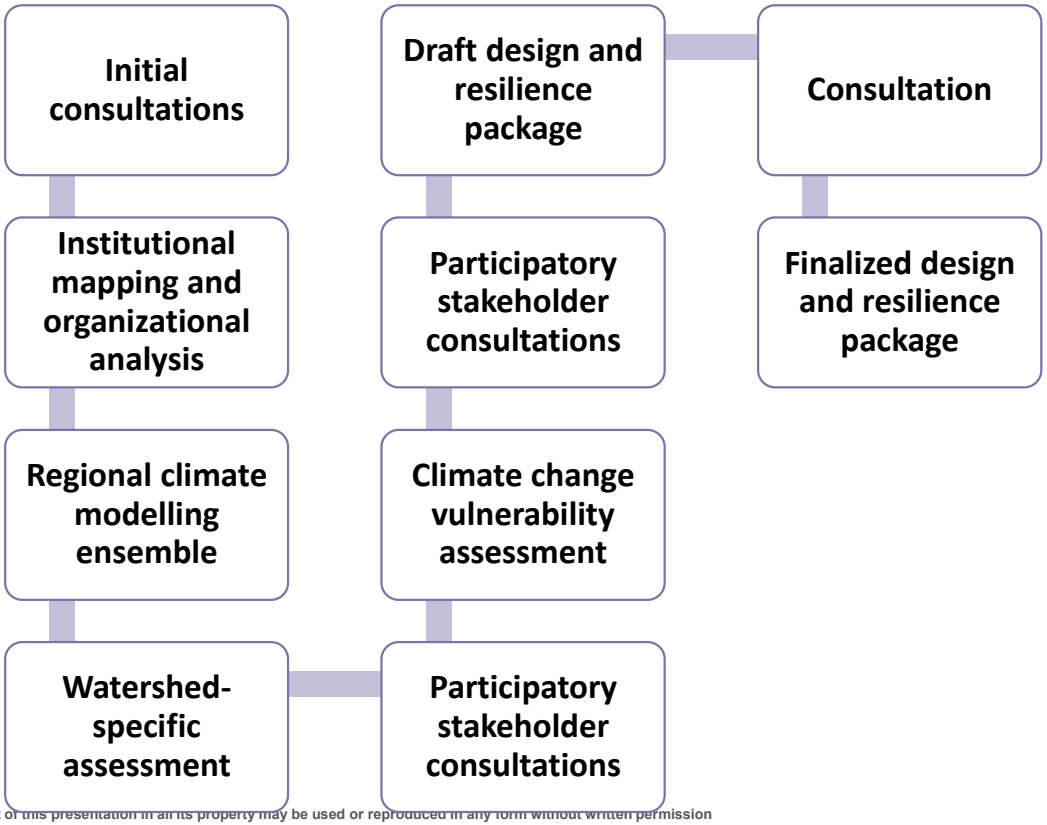
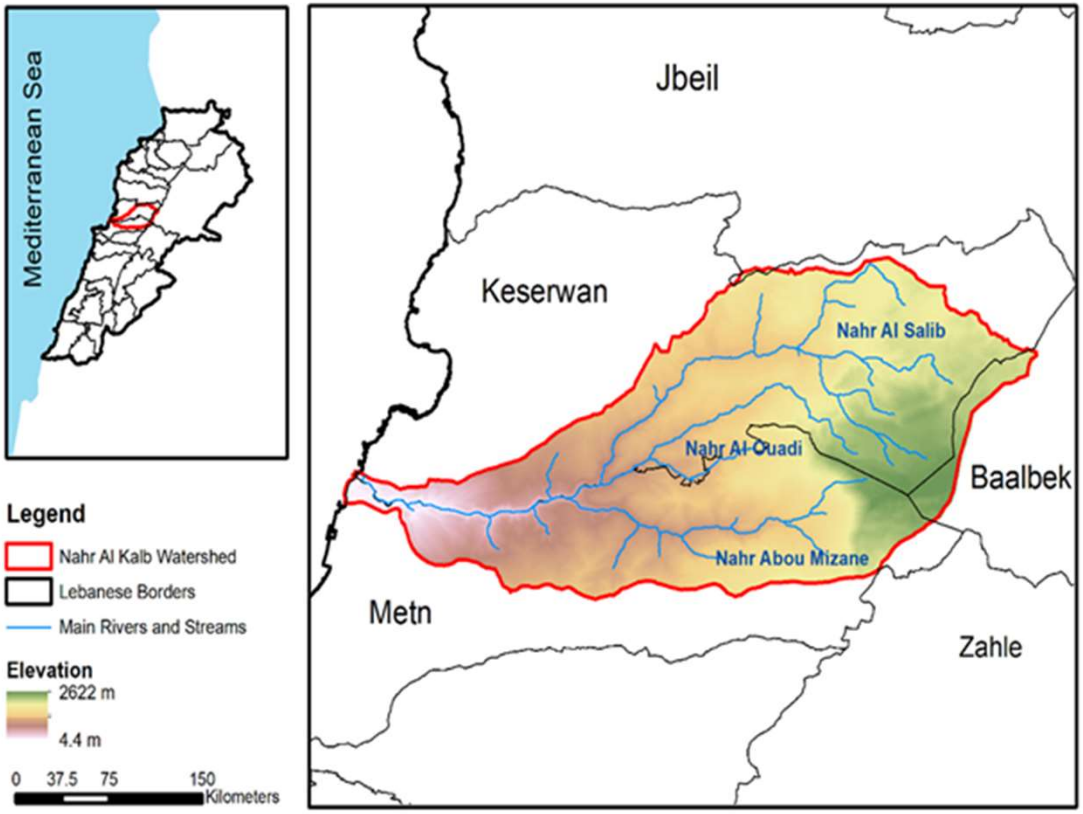
Increasing Watershed Resilience to Climate Change

10-Point Methodology



Nahr El Kalb Watershed-Lebanon



- Area: 291 km^2
- Elevation variation: coast to 2622 masl
- Connects Lebanon's two districts, Keserwan and Metn
- Semi-arid climate, rainy season (October-February).
- Water allocation multiple sectors
- Arable pervious lands have been replaced by impervious urban surfaces which has reduced agriculture activities and impacted the area's hydrology.
- No wastewater treatment plants yet exist

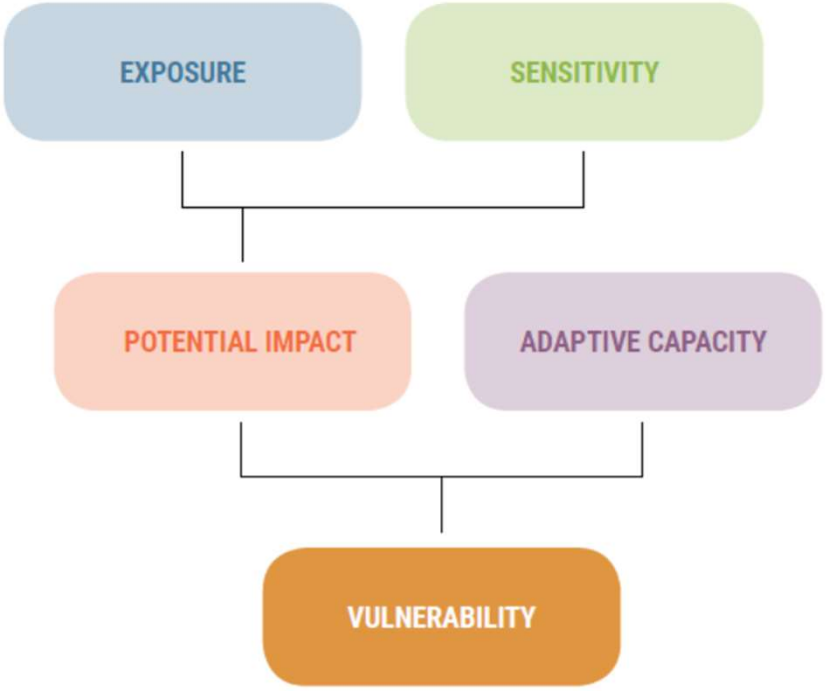
First Participatory Stakeholder Consultation
Thursday 24 February, 2022 at NDU

(1) Introduce the project and discuss community-based challenges and capacities affecting the ability to cope with climate change;

(2) Identify key crops in the watershed that may be impacted by climate change;

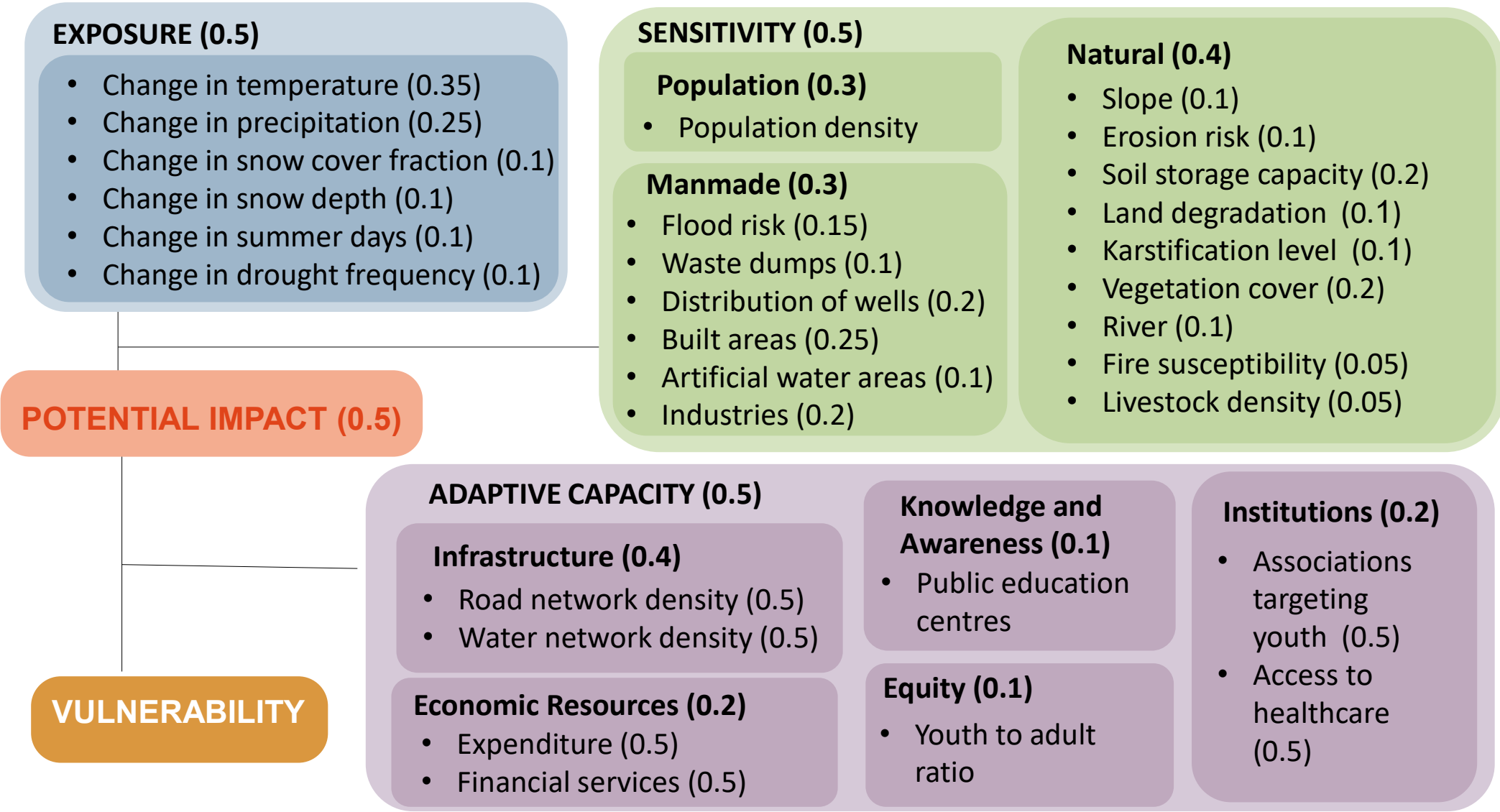
(3) Prioritize indicators for use in the vulnerability assessment study.

The Integrated Vulnerability Assessment



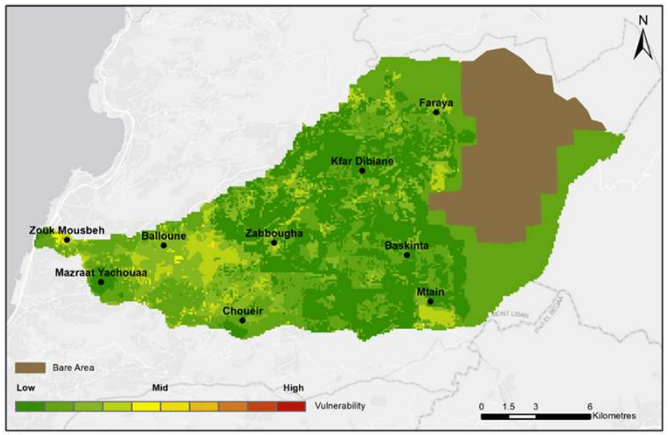
Vulnerability is defined as the degree to which a system, in this case the water resources in Nahr El Kalb watershed, is susceptible to the adverse impacts of climate change

- Exposure: quantifiable climate change parameters such as change in temperature and change in precipitation.
- Sensitivity: describes the natural and physical environment as well as differing population groups that are most susceptible to climate change.
- Potential Impact: coupling both exposure and sensitivity
- Adaptive capacity: describes the ability to cope, mitigate and adapt to climate change.
- The net difference between potential impact and adaptive capacity defines vulnerability

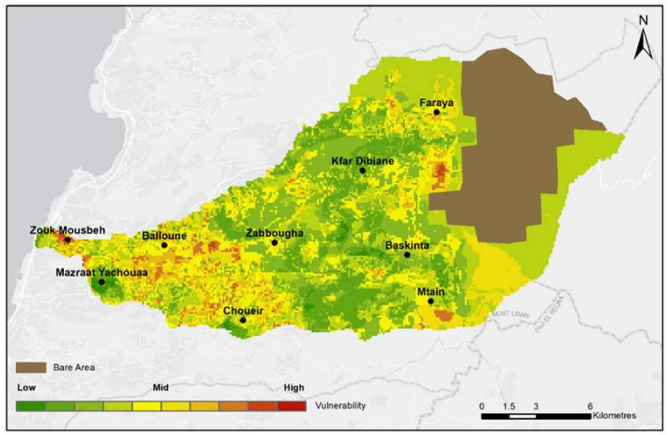

EXPOSURE (0.5)
Change in temperature (0.35)
Change in precipitation (0.25)
Change in snow cover fraction (0.1)
Change in snow depth (0.1)
Change in summer days (0.1)
Change in drought frequency (0.1)
SENSITIVITY (0.5)
Population (0.3)
Population density
Manmade (0.3)
Flood risk (0.15)
Waste dumps (0.1)
Distribution of wells (0.2)
Built areas (0.25)
Artificial water areas (0.1)
Industries (0.2)
Natural (0.4)
Slope (0.1)
Erosion risk (0.1)
Soil storage capacity (0.2)
Land degradation (0.1)
Karstification level (0.1)
Vegetation cover (0.2)
River (0.1)
Fire susceptibility (0.05)
Livestock density (0.05)
POTENTIAL IMPACT (0.5)
ADAPTIVE CAPACITY (0.5)
Infrastructure (0.4)
Road network density (0.5)
Water network density (0.5)
Economic Resources (0.2)
Expenditure (0.5)
Financial services (0.5)
Knowledge and Awareness (0.1)
Public education centres
Equity (0.1)
Youth to adult ratio
Institutions (0.2)
Associations targeting youth (0.5)
Access to healthcare (0.5)
VULNERABILITY

Climate change vulnerability assessment – Annual Vulnerability

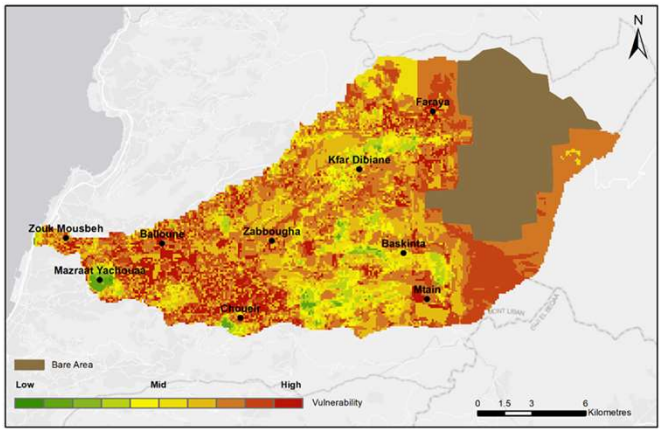
Reference Period (1995-2014)



Near-term (2021-2040)



Mid-term (2041-2060)



By Mid-term:

- ❑80% of the watershed area is projected to exhibit moderate & high vulnerability
- ❑94% of the total cropped area will exhibit moderate & high vulnerability
- ❑92% of population will be living in areas that will exhibit moderate & high vulnerability

10 Interventions

4 Shortlisted interventions

Development of Climate-Proofed Watershed Management Design and Resilience Package

Nahr El Kalb Watershed

Shortlisted Intervention Measures

Intervention Measure 1:
Enhancing agriculture sector resilience

Intervention Measure 2:
Improving Industrial Water Use

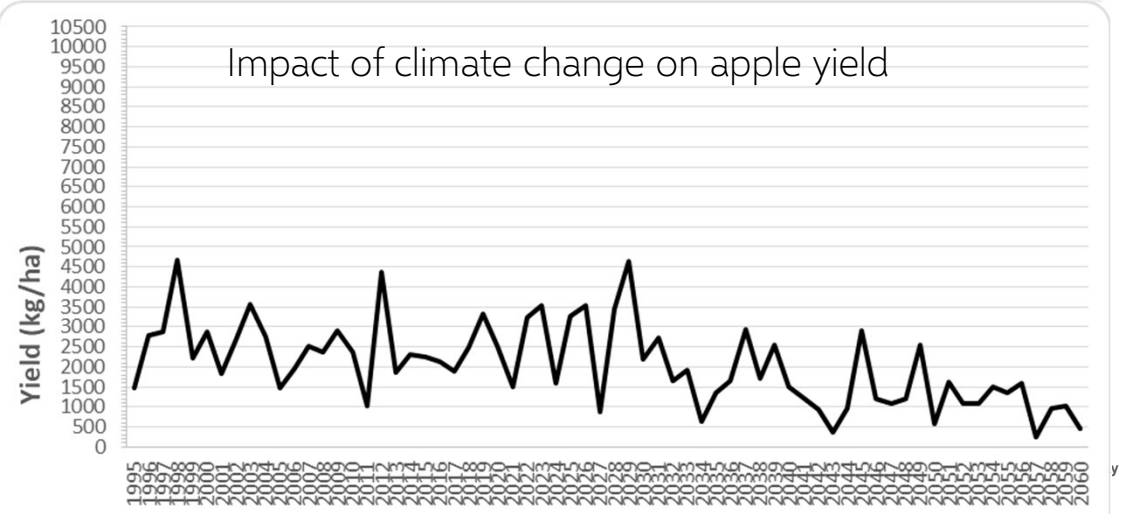
Intervention Measure 3:
Livelihood Diversification through Sustainable Tourism

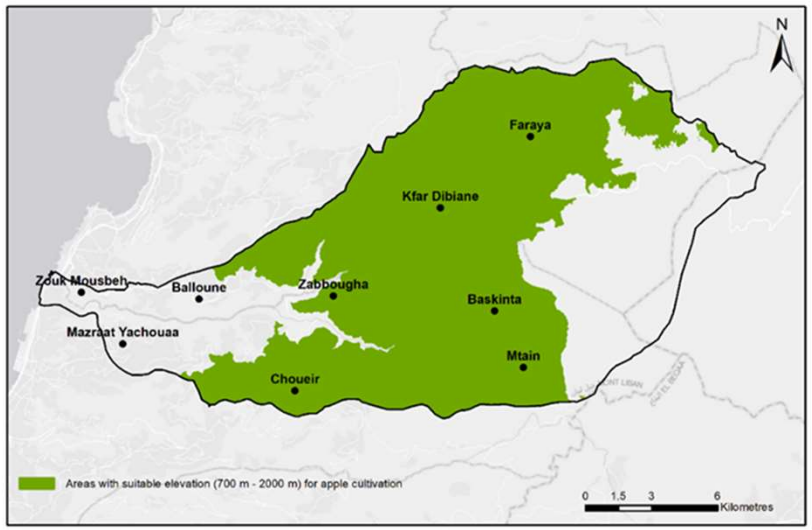
Intervention Measure 4:
Reforestation and Risk Reduction of Forest Fires

Intervention 1: Enhancing Agriculture Sector Resilience

Assessment of CC impact using CropSyst model:

- ❑Apple tree yield could be reduced by 48 % in the mid-term period compared to reference period.
- ❑Growing cycle of apple fruit is projected to be reduced by 24 days
- ❑Seasonal AET of apple trees is projected to increase by 66 mm (24%) for the same period
- ❑Increase in apple tree water consumption by about 24 %.





Areas with suitable altitude for apple cultivation (700 - 2000 masl)

Necessary to minimize CC impact by adopting sustainable agricultural practices & by providing additional water resources to meet the increased water requirement

Intervention 1: Enhancing Agriculture Sector Resilience
Estimated Duration: 3 Yrs Estimated Cost: 15,750,000$

No.	Activity	Time period											
		Year 1				Year 2				Year 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Assessing & proposing a restoration plan for irrigation canals including considering the possibility of installing solar panels on open canals												
2	Promoting good & sustainable agricultural practices through capacity development for farmers												
3	Increasing the water-use efficiency of irrigation systems through the implementation of three drip irrigation pilot projects for smallholders in three major apple producing municipalities & assessing the suitability of using renewable energy for the irrigation systems												
4	Implementing three pilot project of eyebrow micro-catchment rainwater harvesting systems												
5.1	Implement hill lakes planned in the updated National Water Sector Strategy												
5.2	Implement three pilot small hill lakes or water ponds in 3 major apple producing municipalities												

Economic and Social Commission for Western Asia

Increasing Watershed Resilience to Climate Change Algerois Watershed

Sara Hess

May 31, 2023

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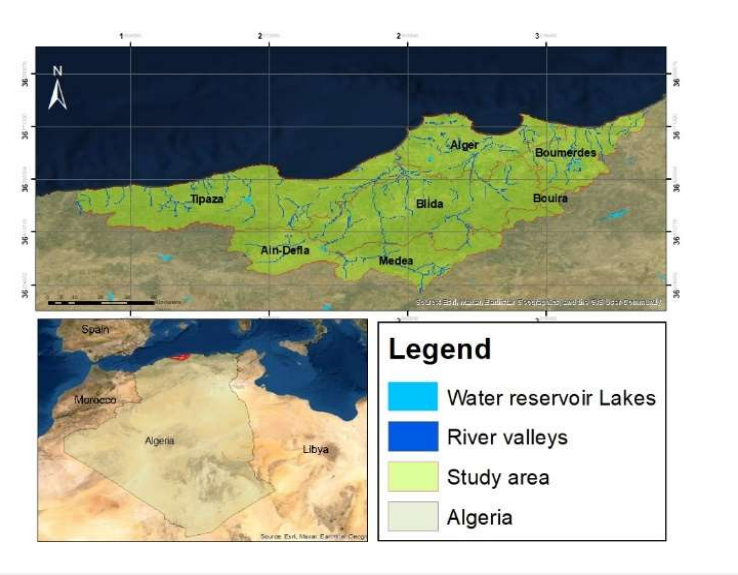
Algerois Watershed-Algeria



Total area: 4,570 km²

Mitidja is the main aquifer covering an area of 1,450 km²

The watershed includes six large dams with a cumulative capacity of 540 million m^3.

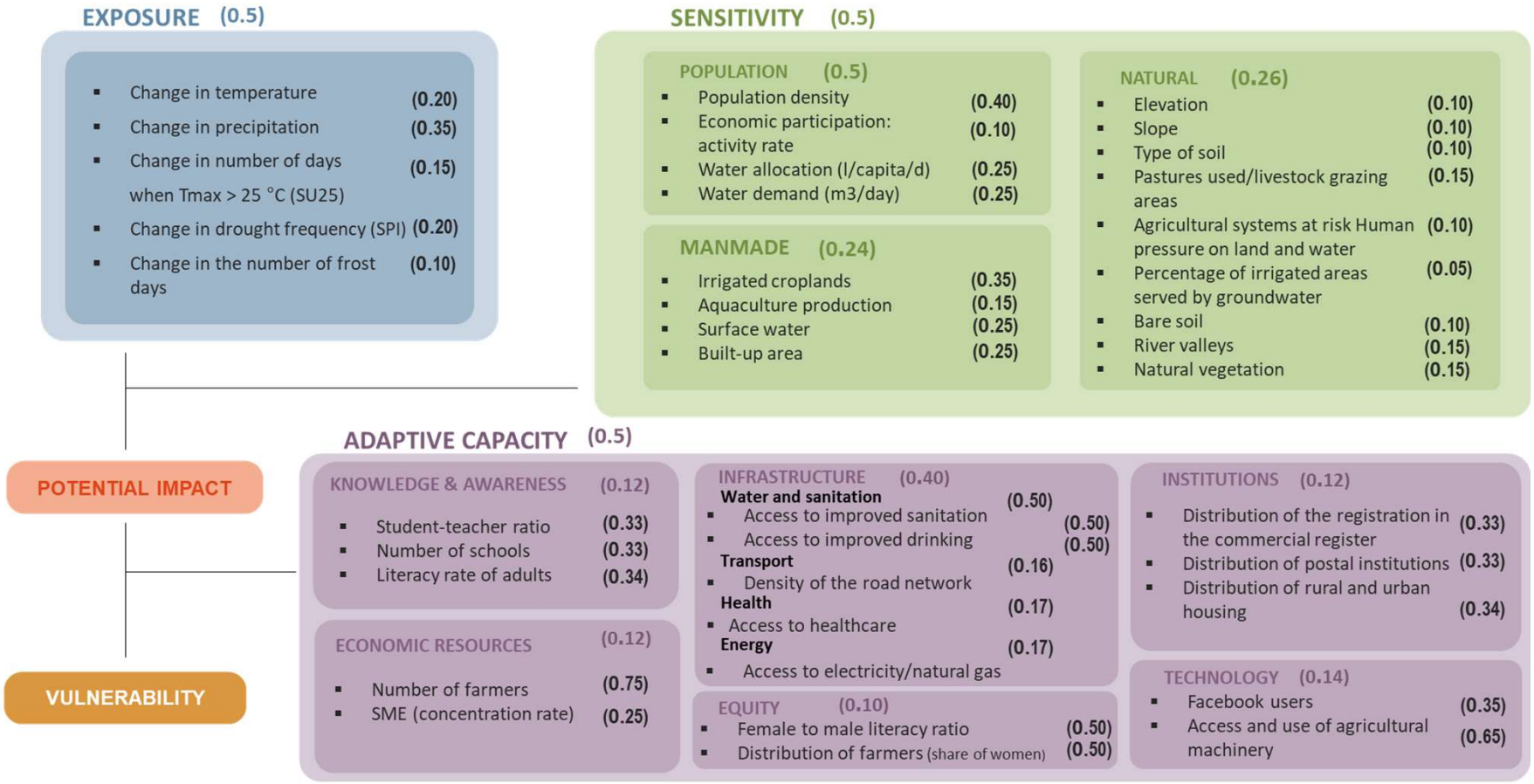
The southern part of the basin is dominated by the mountainous region of the Tell Atlas, where some mountains rise to more than 1,000 m in altitude. The Mitidja plain is less than 100 m above sea level.

The Algerois watershed is a center of agricultural production: citrus fruit trees, grapes, potatoes and various cereals, including wheat.

Two climate zones are present: the temperate coastal climate and the continental climate of the Atlas mountains with humid to sub-humid conditions.

Drought is a recurring problem in northern Algeria and has increased over the past 50 years, leading to pressure between different water sectors, including agriculture.

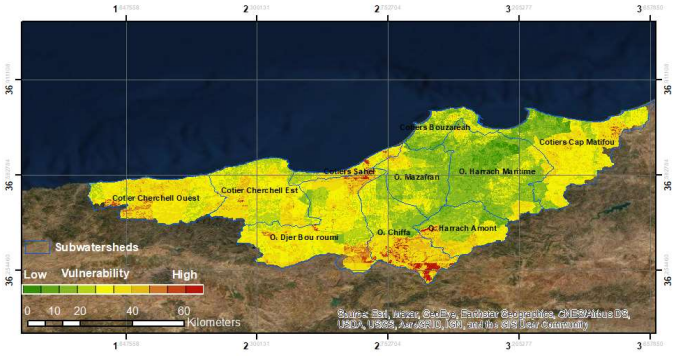
Vulnerability assessment impact chain - Agriculture Sector



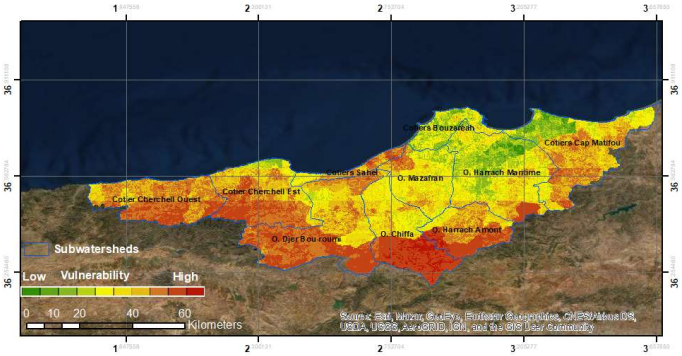
Annual vulnerability of the agricultural sector to climate change- Algerois watershed, Algeria

Due to low adaptative capacity, areas with high vulnerability will significantly increase, from **58%** in the near century to **94%** in the mid - century.

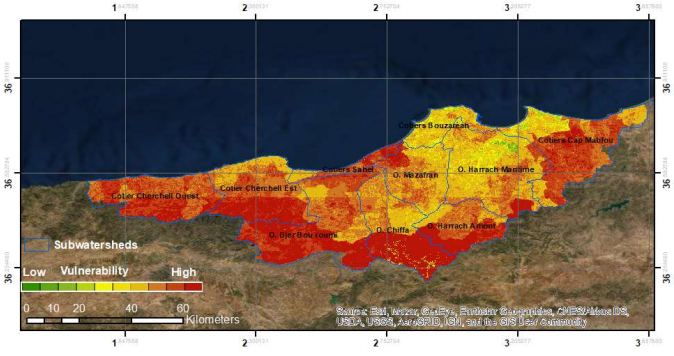
Vulnerability at the reference period
1986-2005



Vulnerability at near-term
2021-2040



Vulnerability at midterm
2041-2060



Change in precipitation

Précipitations (mm/month)	Average change in precipitation (mm/month)	
Reference period (1986 – 2005)	Near-century (2021 – 2040)	Mid-century (2041 – 2060)
54	-4.8	-8.5

Change in temperature

Temperature (°C)	Average temperature change(°C)	
Reference period (1986 – 2005)	Near-century (2021 – 2040)	Mid-century (2041 – 2060)
16.7	0.9	1.8

Sweden Sverige

Climate Change impact on Agricultural Production - Citrus

Projections using **multiple regression analysis** to assess climate change impacts on Citrus in Algérois watershed - Algeria

Change in citrus yield

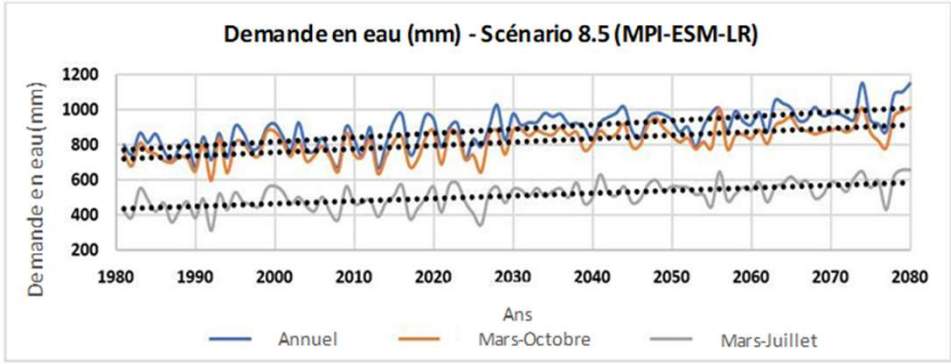
- The analysis based on five climate models **indicates a decline in yields after 2020**
- In the medium term (2041-2060), the **average decline is expected to be around 51%**
  - This drop will be caused by less rain and higher temperatures.
- To ensure a **satisfactory yield** in the short and medium term, **adequate irrigation water must be provided to compensate for rainfall deficits**.

Change in citrus water demand

- Projections show that by 2060, average water demand will increase by 13%
  - **This is linked to a decrease in precipitation and higher temperatures, which will increase evapotranspiration.**

Yield trends for the five climate models - Scenario 8.5 in the short term (2021-2040) and in the medium term (2041-2060)

	Model	CNRM-CM5	CE-TERRE	HadGEM2-ES	MPI-ESM-LR	IPSL-CM5A-MR	Average
Yield (Qx/ha)	1983 - 2002	239,0	307,9	265,0	249,8	272,8	266,9
	2021 - 2040	209,6	219,4	208,1	238,8	261,0	227,4
	2041 - 2060	148,2	144,4	100,4	111,4	145,7	130,0
	2021 - 2060	178,9	181,9	154,3	175,1	203,4	178,7
Yield Change (Qx /ha) In %	2021 - 2040	-12,3	-28,7	-21,5	-4,4	-4,3	-14,8
	2041 - 2060	-38,0	-53,1	-62,1	-55,4	-46,6	-51,3
	2021 - 2060	-25,1	-40,9	-41,8	-29,9	-25,5	-33,0



10 Interventions

5 Shortlisted interventions

Development of Climate-Proofed Watershed Management Design and Resilience Package

Algerois Watershed

Shortlisted Intervention Measures

Intervention Measure 1:

Assessment of surface and groundwater resources subject to anthropogenic pressure and climate change

Intervention Measure 2:

Management and collection of rainwater and wastewater

Intervention Measure 3:

Sustainable land management to improve agricultural productivity and increase ecosystem integrity

Intervention Measure 4:

The promotion of conservation agriculture for sustainable and rural development through knowledge exchange

Intervention Measure 5:

Improve incomes and increase resilience of low-income rural households in the watershed

Intervention 2: Management and collection of rainwater and wastewater

Justification: This intervention is necessary for better mobilization of additional water resources and to ensure optimal irrigation of the agricultural lands of the watershed. Due to low energy and transportation costs, rainwater harvesting is one of the cleanest methods to increase water supply. Expansion of sewage treatment plants is another adaptation measure that can alleviate the shortage of water in the watershed over the next few years.

Activities: Improve the capacity of existing wastewater treatment facilities in the catchment area and encourage the use of treated wastewater for irrigation, assess the unconventional water resources that can be mobilized for agricultural and urban uses, reuse treated wastewater with tertiary treatment for agriculture and artificial recharge of the Mitidja aquifer.

Budget: $3.1 million

Timeline: 36 months

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Thank you

Increasing Watershed Resilience to Climate Change
Implementing the 2030 Agenda for water efficiency/productivity and Water Sustainability in the NENA countries