Gender-sensitive Climate Risk Assessment of the Tangier-Tétouan-Al Hoceima Region Morocco

GEF MedProgramme – Enhancing Environmental Security
SCCF Project

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Table of contents

Table of contents 3

Table of illustrations 5

Figures 5

Tables 6

List of acronyms 7

Introduction 9

A. Overview of the GEF MedProgramme and the SCCF Project 9

B. Methodology of the gender-sensitive climate risk assessment in TTA 10

I. Legislative and strategic framework 11

A. Climate change and ICZM initiatives in Morocco 11

1. Legislative framework 11

2. Strategic frameworks and initiatives in Morocco 12

B. Gender in Morocco 14

1. Institutional and Policy Frameworks 14

II. Climate Risk in Morocco – national context 17

A. Climate evolution observed during the last decades and projections at the national level 17

1. Evolution of precipitation and temperature 17

2. Climate projections 17

B. Climate evolution observed during the last decades and projections in the TTA REGION 19

III. Gender: general considerations 20

A. Methodological considerations 21

B. Gender-based differentiation in disasters and vulnerability 22

C. Socioeconomic and gender baseline in Morocco 25

IV. TTA: an overview 28

A. Geography and geomorphology 28

B. Climate and precipitation 29

C. Hydrographic resources 30

D. Forest coverage 33

E. Infrastructure 34

F. Economic activities 35

1. Agriculture 35

2. Livestock breeding 35

3. Fishing sector 36

4. Extractive industries 36

5. Industry 36

6. Tertiary sector activities 36

G. Population and demography 37

H. Natural resources and environmental challenges 41

I. Women in Moroccan Society 42

1. Employment and Economic Activities 42

2. Agriculture 42

3. Education 43

4. Entrepreneurship 43

5. Water Supply and Sanitation 44

6. Energy 44

7. Rural Development 44

V. Application of the Multi-Scale Coastal Risk Index at the Local Scale (CRI-LS) in TTA 45
A. CRI-LS: concepts and steps 45
1. Step 1: Definition of the coastal hazard zone 47
2. Step 2: Variable selection and ranking 47
3. Step 3: Assignation of weights to risk variables 50
4. Step 4: Aggregation of variables, sub-indices, and final index calculation 50
5. Step 5: Elaboration of the risk maps 50
B. Gender-sensitive CRI-LS: variables considerations 50
1. Climate-related variables 51
2. Gender-related variables 57
3. Final variable selection and ranking 65
C. Assignation of weights to risk variables 68
D. Construction of the risk map 68
1. Coastal Forcing Index map 69
2. Coastal Vulnerability Index map 73
3. Coastal Exposure Index map 89
4. Coastal Risk Index map 91
Final considerations 93
Bibliography 95
Web bibliography 97
Annexes 98
ANNEX 1: Inventory of stakeholders to engage in the participatory process of the Regional Coastal Scheme (SRL) of the Tangier-Tétouan-Al Hoceima Region 98
ANNEX 2: Online questionnaire: Expert's assignation of weights to risk variables 100

Table of illustrations

FIGURES

Figure 1. Precipitation and temperature anomalies between 1971-1980 and 1998-2007 in Morocco 17
Figure 2. Geographical distribution of projected precipitation by 2050 according to the RCP 4.5 and 8.5 scenarios 18
Figure 3. Geographical distribution of average annual temperatures projected by 2050, according to the RCP 4.5 and 8.5 scenarios 18
Figure 4. Observed and projected precipitations and temperatures by 2050 for TTA region.....19
Figure 5. Provinces and Prefectures of TTA.....28
Figure 6. Soil types in TTA 29
Figure 7. Average annual rainfall.....30
Figure 8. Regional water resources 31
Figure 9. Cumulative monthly rainfall in Chefchaouen (2009-2010) and cumulative daily rainfall in Tétouan.....32
Figure 10. Flood sites in TTA.....32
Figure 11. Landslide density in TTA 33
Figure 12. Forest cover of the region 34
Figure 13. Municipal population density in 2014 38
Figure 14. Urbanisation rate in 2014.....39
Figure 15. Protected areas of TTA 41
Figure 16. The interaction among the physical climate system, exposure, and vulnerability producing risk 45
Figure 17. A multi-dimensional Mediterranean region 47
Figure 18. Map of the Coastal Forcing Index.....69
Figure 19. Multi-mission Sea Level Trends (Zooms on TTA and the Mediterranean basin). Period: January 1993-October 2019...70
Figure 20. Significant wave height (SWH) (zooms on TTA and the Mediterranean basin) - 100-year return period. Experiment: RCP4.5, Period: 2071-2100.....71
Figure 21. Aridity Index (AI).....72
Figure 22. Daily precipitation concentration index (CI).....72
Figure 23. Population growth.....73
Figure 24. Trend of tourism arrivals 73
Figure 25. Map of the Coastal Vulnerability Index 74
Figure 26. Map of the Coastal Vulnerability index considering only environmental variables 75
Figure 27. Map of the Elevation of TTA.....75
Figure 28. Map of the Coastal slope.....76
Figure 29. Map of land roughness.....77
Figure 30. Map of the Distance from the shoreline. 77
Figure 31. Map of the Ecosystem health.....78
Figure 32. Map of the Coastal Vulnerability index considering only gender variables.....79
Figure 33. Illiteracy rate: gender gap map for TTA, by Province 80
Figure 34. Map of the tertiary education gender gap related for TTA, by Province.....82
Figure 35. Map of the activity rate gender gap for TTA, by Province 83
Figure 36. Average Life Expectancy at birth gender map in TTA, by Province.....85
Figure 37. Overall poverty rate gender map in TTA, by Province.....86
Figure 38. Poverty distribution gender map in TTA, by Province 88
Figure 39. Multidimensional poverty gender map in TTA, by Province.....89
Figure 40. Map of the Coastal Exposure index.....89
Figure 41. Land cover map 90
Figure 42. Population density map (MEDSEA, based on Columbia University data).....91
Figure 43. Map of the Coastal Risk index 92

TABLES

Table 1. Status of Morocco regarding the 7 Protocols of the Barcelona Convention 11
Table 2. Gender-based differentiation in disasters and vulnerability: implications for women 22
Table 3. Composite statistical indices....25
Table 4. Poverty indices 26
Table 5. Labour statistics....26
Table 6. Selected socio-economic indicators according to gender in TTA....40
Table 7. Employment and Economic Activities....42
Table 8. Choice and ranking of the variables used for the CRI-LS index for the Tétouan case study 48
Table 9. Consideration on variables to be used for the CRI-LS index for TTA and first data analysis 53
Table 10. Amplification of pre-existing gender inequalities 57
Table 11. Potential gendered coping skills 59
Table 12. Gender variables: considerations and final selection 61
Table 13. Illiteracy Rate (2014)....65
Table 14. Final list of variable and related ranking value to be used for the gender sensitive CRI-LS for TTA 66
Table 15. Final weights to be used for the gender-sensitive CRI-LS for TTA....68
Table 16. Climate classification and dryland subtypes based on the Aridity Index 71
Table 17. Illiteracy rate: gender data for TTA, by Province and by Rural and Urban area 80
Table 18. Share of population with tertiary education gender data for TTA, by Province and rural and urban area 81
Table 19. Activity rate gender data for TTA, by Province and Rural and Urban area 83
Table 20. Average Life Expectancy at birth gender data in TTA, by Province....84
Table 21. Average Life Expectancy at birth gender data for Morocco's Regions 85
Table 22. Overall poverty rate gender data in TTA, by Province and rural and urban area 86
Table 23. Poverty distribution or monetary poverty gender data in TTA, by Province and rural and urban area 87
Table 24. Multidimensional poverty gender data for TTA, by Province and rural and urban area 88
Table 25. Moroccan stakeholders who participated in the online questionnaire....105

List of acronyms

ACTR	Activity Rate by Gender and Age
AI	Aridity Index
BD	Biodiversity
CW	Chemicals and Waste
CC	Climate Change
CE	Coastal Exposure
CH	Coastal Hazards
CI	Daily Precipitation Concentration Index
CRI-LS	Coastal Risk Index – Local Scale
CRI-MED	Coastal Risk Index – Mediterranean Scale
CV	Coastal Vulnerability
CVI	Coastal Vulnerability Index
D	Distance from shoreline
DEM	Digital Elevation Model
E	Exposure
EH	Ecosystems health
ELE	Elevation
ESA	European Space Agency
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GEF	Global Environment Facility
GII	Gender Inequality Index
GDI	Gender Development Index
GIS	Geographic Information System
H	Hazard
HDI	Human Development Index
ICZM	Integrated Coastal Zone Management
ILR	Illiteracy rate
IPCC	Intergovernmental Panel on Climate Change
LEB	Average Life Expectancy at birth by gender
LR	Land Roughness
MENA	Middle East and North Africa
MS-CRI	Multi-scale Coastal Risk Index
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NSSD	National Strategy for Sustainable Development
OECD	Organisation for Economic Co-operation and Development
PAP/RAC	Priority Actions Programme Regional Activity Centre
PD	Poverty distribution
PDE	Population density
PGR	Population growth
PM	Multidimensional poverty
PPP	Public-Private Partnerships
PR	Overall poverty rate

R	Risk
SCCF	Special Climate Change Fund
SLO	Coastal Slope
SLR	Sea Level Rise
SWH	Significant Wave Height
TTA	Tangier-Tétouan-Al Hoceima region
TOUR	Tourism arrivals
UAA	Useful Agricultural Area
UNDAF	United Nations Development Assistance Framework
UNDP	United Nation Development Programme
UNEP	United Nation Environmental Programme
UNEP/MAP	United Nations Environment Programme / Mediterranean Action Plan
UNFCCC	United Nations Framework Convention on Climate Change
V	Vulnerability
WHO	World Health Organization

Introduction

A. OVERVIEW OF THE GEF MEDPROGRAMME AND THE SCCF PROJECT

The Mediterranean area is particularly affected by adverse consequences of climate variability and change, coupled with existing socio-economic processes associated with growing bio-geographical vulnerability and exposure in the coastal areas of the region. As a result, Mediterranean coastal communities, ecosystems and assets are increasingly at risk.

The Global Environment Facility's "Mediterranean Sea Programme (MedProgramme): Enhancing Environmental Security" (2019-2024) is GEF's first programmatic multi-focal area initiative in the Mediterranean Sea. It aims to operationalise priority actions to reduce major transboundary environmental stresses in the Mediterranean's coastal areas, while strengthening climate resilience and water security and improving the health and livelihoods of coastal populations. The MedProgramme is currently being implemented in nine beneficiary countries: Albania, Algeria, Bosnia and Herzegovina, Egypt, Lebanon, Libya, Montenegro, Morocco and Tunisia.

Its Child Projects cut across four different GEF Focal Areas (International Waters [IW], Biodiversity [BD], Chemicals and Waste [CW], and Climate Change [CC]) and involve a wide spectrum of developmental and societal sectors, ranging from banking institutions, the private sector, governmental and non-governmental bodies, industry, research, media, and various other organisations. The eight Child Projects will deliver a set of complementary results embracing three categories of priorities identified by the Transboundary Diagnostic Analysis for the Mediterranean Sea, which are translated into three programme components:

I. Reduction of Land-Based Pollution in Priority Coastal Hotspots;
II. Enhancing Sustainability and Climate Resilience in the Coastal Zone;
III. Protecting Marine Biodiversity.

In this context, the Special Climate Change Fund (SCCF) Project "Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas" contributes to MedProgramme Component II). As the latter's only project devoted specifically to climate change adaptation, the SCCF seeks to build the capacity of people and institutions to adapt to the impacts of climate change in coastal areas, which are especially vulnerable to these impacts. Technical assistance in this project focuses on mainstreaming climate change adaptation strategies into coastal plans and facilitating access to climate financing to scale up adaptation measures in the region.

It is important to note that the activities of the SCCF Project are fully integrated with those of MedProgramme Child Project (CP) 2.1 "Mediterranean Coastal Zones Climate Resilience Water Security and Habitat Protection". CP 2.1's main goal is to support Mediterranean countries in the implementation of the Protocol on Integrated Coastal Zone Management (ICZM Protocol) in order to reduce major transboundary environmental stresses affecting the Mediterranean Sea and its coastal areas, taking into account climate change by building climate resilience and water security, and ultimately improving the health and livelihoods of coastal populations. Indeed, coastal planning processes represent a natural entry point for the implementation of climate change adaptation strategies in the Mediterranean. Amongst other activities, CP 2.1 is producing coastal plans in two areas identified as highly vulnerable to climate change in Montenegro (Kotor Bay) and in the Tangier-Tétouan-Al Hoceima (TTA) region of Morocco.

To enhance climate resilience in this coastal area, national stakeholders have requested the development of recommendations to mainstream adaptation into the Coastal Plan (the *Schéma régional du littoral*) for TTA. These recommendations are also relevant to the regional development plan (*Plan Régional de Développement* – PRD) for the region. This PRD has already been developed and is currently implemented with a broader focus on both coastal and inland areas.

B. METHODOLOGY OF THE GENDER-SENSITIVE CLIMATE RISK ASSESSMENT IN TTA

MEDSEA's overarching approach is designed to mainstream climate change within the existing processes in place to develop coastal plans. This gender-sensitive climate risk assessment supports efforts to enhance coastal resilience to climate change in a sustainable and inclusive manner, identifying how women and men are differently affected by climate risks and how they can enhance their resilience to climate change. To this end, MEDSEA has built upon existing methods and tools that have been previously used in the Mediterranean and in Morocco, and are recognised as appropriate and beneficial.

More specifically, the methodology of this assessment is based on the **multi-scale coastal risk index (MS-CRI)**, developed by Satta et al. (2015) and implemented and tested within the framework of the ClimVar & ICZM Project: "Integration of climatic variability and change into national strategies to implement the Integrated Coastal Zone Management (ICZM) Protocol in the Mediterranean" (2017), which aimed at assessing the risks of climate change impacts on coastal ecosystems and local communities in the Mediterranean regions. To this end, a test of the MS-CRI's application at the Local Scale (CRI-LS) was performed on the coastal zone of Tétouan (Satta, 2016).

The same method will be applied for the development of this study, including the integration of a gender perspective. Overall, it will assess how women and men are differently affected by climate risks and how they can participate in and benefit from project activities. Indeed, MEDSEA carried out a thorough review of available studies and data for the development of the gender-sensitive aspect of the study to:

1. Assess the availability of existing climate risk assessments for TTA, and collect data required for the replication of the CRI-LS methods already applied for the Tétouan case study to the entire region;
2. Identify the links between climate change impacts and gender, and define how to integrate gender aspects into the CRI-LS.

Indeed, a gender lens is necessary for the MedProgramme to achieve its climate targets and contribute to the implementation of its regional Gender Mainstreaming Strategy. By mainstreaming gender-responsive actions into regional climate change adaptation strategies, thereby creating the impetus towards the formulation of gender data-driven policies to manage climate risks and environmental resources in the region, while engaging stakeholders on the gender and socioeconomic aspects of adaptation solutions, the programme can ensure both environmental and social co-benefits.

Gender-sensitive approaches and tools for understanding and assessing impacts, vulnerability and adaptation to climate change refer to methodologies and practices applied to ensure that both men's and women's concerns, aspirations, opportunities and capacities are taken into account. Leadership on gender-sensitive climate adaptation, as well as an enabling environment, are essential for gender-sensitive tools and approaches to be applied beyond the design phase of the adaptation planning process. In this sense, MEDSEA's method includes a gender analysis, a gender-responsive vulnerability assessment and sex-disaggregated information systems, as well as comprehensive gender guidelines and toolkits to promote gender sensitivity in climate change adaptation.

I. Legislative and strategic framework

A. CLIMATE CHANGE AND ICZM INITIATIVES IN MOROCCO

1. Legislative framework

Morocco is a signatory to the main international conventions on the marine and coastal environment and on climate change, namely: the United Nations Convention on the Law of the Sea (UNCLOS); the Convention on Biological Diversity (CBD), especially target 11, which stipulates that "Parties commit to protect 10% of marine and coastal areas"; and the UN Framework Convention on Climate Change (UNFCCC). At the Mediterranean level, Morocco is a Contracting Party to the Barcelona Convention.

Table 1. Status of Morocco regarding the 7 Protocols of the Barcelona Convention

Protocols of the Barcelona Convention	Signature	Ratification, Acceptance, Approval or Membership	Entry into force
1. Immersion Protocol Protocol relating to the prevention and elimination of pollution of the Mediterranean Sea by dumping operations carried out by ships and aircraft or by incineration at sea (adopted on June 10, 1995, in Barcelona).	16/02/1976	05/12/1997 Acceptance	-
2. Prevention and Critical Situations Protocol Protocol relating to cooperation in preventing pollution from ships and, in case of emergency, combating pollution of the Mediterranean Sea (adopted on January 25, 2002, in Malta).	25/01/2002	26/04/2011 Ratification	26/05/2011
3. Land Sources Protocol The objective of this Protocol is to take all appropriate measures to prevent, reduce and eliminate to the greatest extent possible pollution of the Mediterranean Sea from land-based sources and activities, through the reduction and progressive elimination of toxic, persistent and bioaccumulative substances listed in the Protocol (adopted on March 7, 1996 in Syracuse, Italy).	17/05/1980	02/10/1996 Acceptance	11/05/2008
4. Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean The SPA/BD Protocol provides the regional framework for the conservation and sustainable use of biological diversity in the Mediterranean (adopted on June 10, 1995, in Barcelona, Spain).	10/06/1995	24/04/2009 Ratification	25/05/2009
5. Offshore Protocol This Protocol deals with all aspects of offshore oil and gas activities in the Mediterranean. It provides measures relating to the reduction of pollution from all phases of offshore activities, the response to offshore pollution incidents, and liability and compensation (adopted in 1994 and entered into force in 2011).	-	01/07/1999 Membership	24/03/2011
6. Hazardous Wastes Protocol The general objective of the "Hazardous Wastes" Protocol is to protect human health and the marine environment against the harmful effects of hazardous wastes. It was adopted in 1996 and entered into force in 2008.	20/03/1997	01/07/1999 Ratification	19/12/2007

Protocols of the Barcelona Convention	Signature	Ratification, Acceptance, Approval or Membership	Entry into force
7. Protocol on Integrated Coastal Zone Management (ICZM) The ICZM Protocol provides the legal framework for the integrated management of coastal zones in the Mediterranean Sea. It requests the Parties to take the necessary measures to strengthen regional cooperation and achieve the objectives of integrated coastal zone management. It aims, among other things, to protect the characteristics of specific coastal ecosystems, to ensure the sustainable use of the coastal zone, and to adapt the coastal and maritime economy to the fragile nature of coastal areas.	21/01/2008	21/09/2012 Ratification	21/10/2012

At the national level, Morocco has committed to reconciling environmental protection and socio-economic development over the past decades. Several laws and reforms were initiated at the national and regional levels, several of which are specific to coastal areas:

- ***The Law 11-03 for the Protection and Enhancement of the Environment*** (2015) establishes the general framework and principles for environmental protection in Morocco.
- ***The Framework Law No. 99-12*** (2014) on the National Charter for the Environment and Sustainable Development sets the fundamental objectives of state actions in terms of environmental protection, sustainable development and the promotion of environmentally-friendly economic activities. It explicitly mentions the fight against climate change and calls for strengthening capacities to promote adaptation.
- ***The Coastal Law (Law No. 81-12)*** (2015): this is the main legislative and regulatory framework for the protection and sustainable development of the coastal zones. It aims, among other things, to preserve biological and ecological balances, natural and cultural heritage, historical and archaeological sites, natural landscapes and to fight against coastal erosion. This law requires the development of a national plan for integrated coastal management, the "National Coastal Plan (PNL)", as well as "Regional Coastal Schemes (SRL)", considering the limit of the non-constructible area and by "adopting an integrated management approach that takes into account the coastal ecosystem and climate change".
- ***Law No. 77-15*** (2015) prohibits the manufacture, import, export, marketing and use of plastic bags. Article 2 stipulates that: "As of July 1, 2016, the manufacture of plastic bags, ..., as well as their import, export, possession for sale, sale, their sale or distribution, even free of charge, are prohibited".
- ***Law 36-15 relating to water*** (2016): Morocco adopted a new water law which defines the rules for the integrated, decentralised and participatory management of water resources, targeting the sustainable use of water resources and risk prevention. This law strengthens the legal framework of 1995 by introducing new provisions for the reuse of wastewater and rainwater and for better protection of water resources against climate change.

Several other legal and regulatory instruments in the various sectors related to coastal areas (fishing, aquaculture, tourism and seaside activities, energy, extractive industries, management of the maritime public domain and port activities) have also been adopted. They concern waste management (Law 28-00 of 2006), quarries (Law 27-13 of 2015), protected areas (Law 22-07) and environmental impact studies (Law 12-03).

2. Strategic frameworks and initiatives in Morocco

Over the last decade, Morocco launched or took part in several initiatives concerning climate change adaptation measures and enhancing climate resilience in its coastal areas, such as:

- In 2009, the National Plan against Global Warming set out to reduce greenhouse gas emissions through the development and diversification of clean energy sources and the implementation of adaptation measures that rely mainly on its Strategy for Water and the Green Morocco Plan for Agriculture. A wide range of adaptation tools have been incorporated into Morocco's sectoral adaptation strategies, such as coastal planning, housing, health, water, agriculture and fisheries, forestry, biodiversity protection and tourism.
- In 2012, the adoption of the National Charter for Environment and Sustainable Development allowed the country to redouble its efforts to protect the environment and promote sustainable development.

- In November 2016, Morocco hosted the UNFCCC COP22 in Marrakesh and secured high visibility of its national endeavours in terms of climate change mitigation and adaptation. These actions demonstrated a remarkable political will, and placed the country in a favourable position to benefit from the support of international partners to progress towards adaptation.

By ratifying the UNFCCC, Morocco adopted an institutional framework responsible for monitoring and implementing its commitments by ensuring consultations and coordination of actions. This framework includes a set of entities responsible for several aspects of climate policy, including:

- The *State Secretariat for Sustainable Development* as National Focal Point of the UNFCCC, it is responsible for coordinating Morocco's efforts to fulfill commitments to the UNFCCC.
- The *National Committee on Climate Change* includes representatives of the main public actors involved in the issue of climate change in Morocco, in addition to representatives of the private sector and civil society.
- The National Scientific and Technical Committee – Climate Change (CNST-CC) composed of national experts (public establishments, universities, consulting firms), covers the main themes of climate change.
- A Designated National Authority in charge of the Green Climate Fund, for the examination of projects submitted for financing by the latter (in the process of being set up).
- An Interministerial Monitoring Committee (CIS) responsible for monitoring and validating the technical studies conducted by Morocco in the context of its commitments to the UNFCCC (National Communications, INDCs, NAMAs, etc.).
- The National Meteorological Directorate (DMN), Focal Point of the Intergovernmental Panel on Climate Change (IPCC).
- A National Committee, as well as Regional Committees for Monitoring and Air Quality Surveillance.
- The National Competence Centre for Climate Change Mitigation and Adaptation (4C Maroc): is a national platform for dialogue and capacity building for the various actors and a hub for climate change information.

In 2016, a National Plan for Climate Change Adaptation began its implementation in three regions: Souss-Massa, Béni Mellal-Khénifra and Drâa Tafilalet. The same year, Morocco submitted its Nationally Determined Contribution (NDC), in which it pledged a 42% reduction in emissions by 2030. At the end of 2016, the country also launched its National Adaptation Plan (NAP) process with support from the GIZ. In this context, a NAP Road Map has been prepared and validated by the Government. It provides details on the next steps to be undertaken by the Government of Morocco (GoM) to finalise and implement its NAP. In 2017, Morocco adopted its National Strategy on Sustainable Development to move towards a green and inclusive economy, recognizing climate change and adaptation as priority considerations of the Strategy.

In its United Nations Development Assistance Framework (UNDAF, 2017-2021), Morocco designated “Inclusive Sustainable Development” as one of its six expected results, and expressed specific outcomes related to climate change adaptation that could be enhanced through collaboration with the United Nations system, including:

- Territorial planning that integrates the principles of sustainable development and the preservation of natural and cultural heritage;
- Reinforced resilience to climate change and natural risks, especially for vulnerable populations;
- Cities that are more sustainable and inclusive;
- Increased equitable access to natural resources and ecosystem services.

Morocco has established a solid institutional, policy and legal framework for ICZM, and hence has the capacity to effectively implement climate change adaptation strategies in coastal planning and management activities**.** In addition, Morocco has already carried out several ICZM projects, including a Coastal Area Management Programme for the Central Rif with the support of PAP/RAC (2008-2010), the ICZM project of the Eastern Mediterranean coast, with the support of GEF and the World Bank (2015-2020), the National Coastal Plan and Regional Coastal Plans, in accordance with the Coastal Law, and an extensive database is now available that can be used for future studies. As a response to the needs assessment performed during the finalisation of the ClimVar & ICZM project, Moroccan representatives requested support in several activities including the development of the Coastal Plans for the Tangier, Tétouan and Oriental Rif areas.

During the GEF ClimVar & ICZM project (2013-2015), two areas were identified as the most at risk (considering coastal hazards, vulnerability and forcing) due to climate change: the province of Tétouan and the areas of Nador and of Berkane in the Oriental Region. It should be recalled that the World Bank launched a €5 million project in 2012 for the implementation of pilot ICZM actions for the Oriental Region, which includes the Nador and Saïdia areas. As for the Tétouan area, it was the subject of the application of a coastal risk index at the local scale (CRI-LS) (Satta et al, 2016).

Baseline planning processes in Morocco

- Morocco's **National Strategy for Sustainable Development** (2016-2030) aims at transforming the country's sustainable development policy into concrete actions. The Strategy recognizes climate change as a transversal challenge to be considered in actions regarding economic development, infrastructure, sectoral plans. For instance, the Green Morocco Plan on agriculture includes a number of measures to facilitate women's access to income-generating activities through the promotion of cooperatives for agricultural products and services. Economic empowerment is expected to unfold through access to and control of productive assets, an increase in household wealth, poverty reduction and a reduction of social and territorial inequalities, among others. Morocco has estimated the global cost of a five-year implementation plan of the NSSD at nearly US$ 10 million, and has committed US$ 3 million to implement this plan.
- Morocco's **Nationally Determined Contribution (NDC)** was adopted by the Government of Morocco in 2016 and outlines the country's planned contribution to climate change mitigation and adaptation. Regarding coastal areas, the strategy underlines their high vulnerability to sea level rise, floods and erosion and defines a set of adaptation measures to be implemented by 2020 and 2030 in order to increase climate resilience. In addition to sectoral adaptation solutions, the strategy highlights cross-cutting needs, including the necessity to improve knowledge on climate change and its impacts, and to strengthen existing institutional frameworks to finance and implement adaptation. There are no specific gender targets in the NDC, nor references to gender in the document.
- The **National Adaptation Plan (NAP)** process was launched in 2016 with support from the GIZ. Based on initial stakeholder consultations and a gap analysis to identify capacity building needs for the implementation of the NAP process in the country, a Roadmap was prepared. This Roadmap was approved by the GoM and highlights four strategic objectives: i) identify and address gaps in current information on climate change impacts and vulnerabilities; ii) assess and enhance national capacities to mainstream adaptation into development and financial plans; iii) build national and local capacities to mainstream climate change adaptation into development plans and regulations; and iv) develop a strategy to implement and finance the NAP process. In addition, several training sessions on climate change adaptation have been organised in April 2017 for sectoral Focal Points.
- The **2030 National Climate Plan (PCN)** aims to establish the fundamentals of low-carbon and climate-resilient development. As part of its territorial implementation, the Department of Sustainable Development is in the process of providing all regions with Regional Climate Plans. In 2020, studies for the development of 7 such Plans, including TTA, were launched. Climate risks are now factored into investment decisions and development planning. The PCN2030 Priorities are included in the NAP, which now constitutes a roadmap for implementing a coordinated national adaptation policy at the national and regional levels.
- The operational plan for implementing the **National Risk Management Strategy 2021-2031** spans the 2021-2026 period, and identified 2 projects relating to coastal areas in its Strategic Axis 2 (Improvement of knowledge and assessment of natural hazards):
  - P. 7: Tsunami risk studies and scenarios for priority territories;
  - P. 8: Studies and scenarios of marine flooding and coastal erosion and mitigation measures for priority territories (2021-2023).
- The **National Flood Protection Plan**: to implement its policy on natural disaster risk prevention, the Ministry of the Interior, in partnership with the various actors concerned, launched an effort to support flood risk management. National Drought Plan is also in place,

B. GENDER IN MOROCCO

1. Institutional and Policy Frameworks

The GoM ratified the **Convention on the Elimination of all forms of Discrimination Against Women** (CEDAW) in 1993 and in 1995. It also committed to developing a national gender strategy (USAID, 2003: 4), submitting six periodic reports to the CEDAW Committee from 1994 to 2014. In 1999, the Plan of Action for the Integration of Women in Development (PAIWD) was presented to Parliament for approval by the Prime Minister. Even though the PAIWD was not adopted by Parliament, it served as a working document for women's empowerment in Morocco for development partners and civil society actors in the development sector and related Ministries (USAID, 2003). At the institutional level, the measures are mainly aimed at strengthening the capacities of the main actors and developing analytical methods and tools for the

integration of the gender approach into public policies for climate change mitigation and adaptation. They are based on a set of programmes and strategies aimed at preserving natural balances and reducing the effects of climate change on vulnerable groups, especially women.

Gender-responsive budgeting (GRB) was adopted in 2002 and piloted in the Ministries of Health, Education, Finance, followed by Agriculture in 2005. The Centre of Excellence for Gender-Responsive Budgeting in Morocco (CE-GRB) was established in 2013, to support line ministries and local authorities in the effective implementation and monitoring of the GRB process. Moreover, a 'Committee for Gender Cooperation' was established to monitor the yearly gender report (Haddad, 2016). A testimony to Morocco's commitment to GRB, a gender budget statement and report has been drafted yearly in the country since 2006, and presented as an annex to the finance report (Castilleja and Tilley, 2015: 14). It sprung from partnership between UNIFEM (a UN Women's predecessor organisation) and the GoM to incorporate a gender perspective into the national budget reform process, and reinforce accountability to meet the GoM'S commitments on gender equality. Ongoing efforts have resulted in the progressive mainstreaming of GRB Morocco's budget reform process. Five pilot line ministries apply GRB programming, and 27 Ministries take part in the preparation of the gender report. Indeed, more than 10 years of experience with results-based and gender-responsive public finance management led to the adoption of a new organic finance law that which legally institutionalised gender equality throughout the budget processes Akin to a financial constitution, it was approved in January 2014 by the Council of Government. Taking the GRB processes a step forward, this new legislation explicitly mentions that gender equality must be taken into account in line budget objectives, results and performance indicators. The new organic law also institutionalised the gender report as an official part of the annual Finance Bill - an important achievement.

During the 12th June 2009 elections, 20,458 women contested, 3,406 were elected - 3, 200 in seats reserved by quota and the remaining 206 seats in open competition. The local council quota thus increased from 12% to 27% in 2011. In the 2015 elections, the first under the new constitution and gender quota provision, two women were elected presidents of the provincial municipal councils, but none of the 12 elected presidents of regional councils was a woman.

The first national framework devoted to gender equality, the **National Strategy for Gender Equity and Equality 2006-2012/ICRAM** was adopted in 2006. It provides a comprehensive vision for the reduction of disparities between the sexes across various sectors of the society. Key objectives include guaranteeing the physical and psychological integrity of girls and women, strengthening their voices and participation in decision-making, ensuring and expanding civil and socioeconomic rights, individual and collective awareness-raising, underpinned by institutional and political consolidation (European Parliament, 2017). It is now in its second phase, ICRAM 2 (2017-2021). ICRAM was further strengthened in 2007 with a Circular from the Prime Minister to ministries, *walis* and governors to mainstream gender into all policies, sector, and regional development (GoM, 2016). The Inter-Ministerial Equality Commission, established in 2014, recommended the creation of two National Observatories on violence against women (VAW), the development of legislation to implement constitutional provisions, as well as a bill to fight against VAW. The creation of *Espaces Multifonctionnels Dédiés* aux Femmes, multi-purpose community centres for women that provide counselling, shelter, training, and other services, is also of note (USAID, 2018).

Following the Arab Spring protests, a **new Constitution** that strengthened and institutionalised women's rights was adopted in 2011. Its provisions assert the equal political, civil, social, and economic rights of women and men, prohibiting all forms of discrimination, with specific mention of gender-based discrimination. It further granted the National Human Rights Commission (NHRC) constitutional status, independence and a judicial mandate to monitor the observance of human rights. Moreover, it made provisions for the creation of a specific authority to promote equality and fight all forms of discrimination, to be established by the NHRC, recognizing the supremacy of international gender-related laws over national law and paving the way for lifting the reservations on CEDAW. The reservations on CEDAW were lifted in 2011, and the Bill approving Morocco's assent to the Optional Protocol of CEDAW was passed by Parliament in October 2015 (Islamic Development Bank, 2019).

Organic Law No. 27-11 (14 October, 2011) sets a gender quota of 60 out of 395 seats (15%) to increase women's representation in the House of Representatives. It also established a quota of 30 seats for men under 40 years of age. Gender quotas to increase women's representation in Moroccan politics were first introduced in 2002 at the national level, and were extended to local level elections in 2009. Until the adoption of the Electoral Law in 2011, quotas were a voluntary agreement between political parties. Initially, 30 seats out of 325 seats were guaranteed to women in the Lower Chamber. Women's representation in Parliament has increased since the adoption of the 2011 law, rising from 10.5% in 2007 to 17% in 2011, and 20.5% in 2016.

Established in 2012, the **Ministry of Solidarity, Women, Family and Social Development** is responsible for promoting and protecting women's rights in the country. It transitioned from the State Secretariat for Family, Children and the Handicapped (SEFEPH), created in 1998 to a department in the newly established Ministry for Social Development, Family and Solidarity in 2007 (GoM, 2016; UNDP, 2012: 21). One of its priorities is to establish a platform for gender equality between ministerial departments, NGOs and other organisations (Haddad, 2016).

With particular reference to climate and gender, Morocco launched a reform process to reconcile sustainable development and the fight against gender inequalities. At the institutional level, the measures are mainly aimed at strengthening the capacities of the main actors and developing analytical methods and tools for the integration of the gender approach into public policies for climate change mitigation and adaptation. They are based on a set of programmes and strategies aimed at preserving natural balances and reducing the effects of climate change on vulnerable groups, especially women. This process was also accelerated by the 2011 Constitution, which calls for the mobilisation of all the means at the disposal of the State, public institutions and local authorities to ensure a healthy environment and equal water access rights to all citizens (Article 31). Gender is therefore both pervasive, but also most often implicit, in public policies relating to climate change. In addition, several pieces of legislation relating to natural resources were promulgated, which implicitly guarantee women equal rights with men. These include the Water Act, the Waste Management and Disposal Act and the Air Pollution Control Act. In addition, the revision of the Family Code, the Labour Code, the Commercial Code and the Penal Code are major steps forward in terms of strengthening gender equality and reducing discrimination against women in Moroccan society.

The **National Strategy for Equity and Gender Equality** and its Government Plan (adopted in 2013) mark a decisive turning point on the road to gender equality in Morocco, by establishing an institutional framework covering all the programs and actions undertaken by the various ministerial departments for the promotion of gender equality. These include the axis: "Development of basic infrastructure to improve the living conditions of women and girls", comprising Goal 15 "Development of renewable energies to alleviate the drudgery of women in rural areas" and Goal 16 "Drinking water supply and preservation of the environment". The **Communal Charter** contributes to the integration of the gender approach into public policies. Article 14 calls for the establishment of an ad hoc committee on parity and equal opportunities within the municipal council, as well as the elaboration of Communal Development Plans (PCD). The latter must take gender into account, both from a perspective of sustainable development and in a participatory approach for the actions and projects carried out on the territory of the municipality (Article 36)

The **National Initiative for Human Development (INDH)**, launched in 2005, is a cross-cutting strategy in the fight against poverty and social exclusion, and includes, among others, gender equality in terms of climate change mitigation and adaptation. For instance, it promotes the use resource-efficient wood stoves, the adoption of solar energy, green entrepreneurship for women, water-saving measures such as rainwater harvesting. The **Green Morocco Plan** seeks to steer the agricultural sector towards more ecological practices while supporting small precarious farmers, composed largely of women. The aim is to improve their capacity to adapt to climate change through the dissemination of appropriate technologies, notably mobilising Morocco's significant agricultural knowledge developed over the centuries. In the fisheries **sector**, a UN Women project focused on improving the capacities of 650 women fisheries in terms of leadership, entrepreneurial spirit and knowledge on sustainable fisheries management practices, and their financial resilience. Gender is a cross-cutting component of the **National Strategy for the Development of the Social and Solidarity Economy** (2010-2020), which has led to an increase in the number of women's cooperatives.

Morocco's women NGOs are fully engaged in various activities in the country to protect and promote women's rights in all spheres of society. They advocate for women quotas in politics and decision-making, for the reform of the Family Law and educating the public on the law. Indeed, they have been submitting Shadow Reports to the CEDAW Committee in response to the GoM's reports to the body. Several projects highlight the importance of connecting gender to climate. For instance, "Towards Equality" is an international collaborative initiative that, brings together 15 international newspapers to highlight the challenges and solutions to achieve gender equality. Toward Equality includes FAREDEIC (Argan and Rural Women Committed to Inclusive Economic Development and Climate). On the territory. A further noteworthy 2019 project is "Women Engage for a Common Future", an international network of feminist and environmental organizations and its local partners: the Association for renewable energies and sustainable development (AERDD), the Mohammed VI Foundation for research on and conservation of argan and the Moroccan Network for the social and solidarity economy (REMESS). Their goal is to develop the renewable energy sector in the relevant arears, creating energy cooperatives led by women who manufacture simple and affordable solar energy products, such as solar cookers, dryers and ovens.

II. Climate Risk in Morocco – national context

Morocco is located between two climatic zones, temperate in the North, and subtropical in the South, which makes it possible to distinguish four types of climates: humid, sub-humid, semi-arid and arid. Climate change is already underway in Morocco in view of the climatic trends observed over the last decades, which attest to the progression of the semi-arid climate towards the north of the country.

A. CLIMATE EVOLUTION OBSERVED DURING THE LAST DECADES AND PROJECTIONS AT THE NATIONAL LEVEL

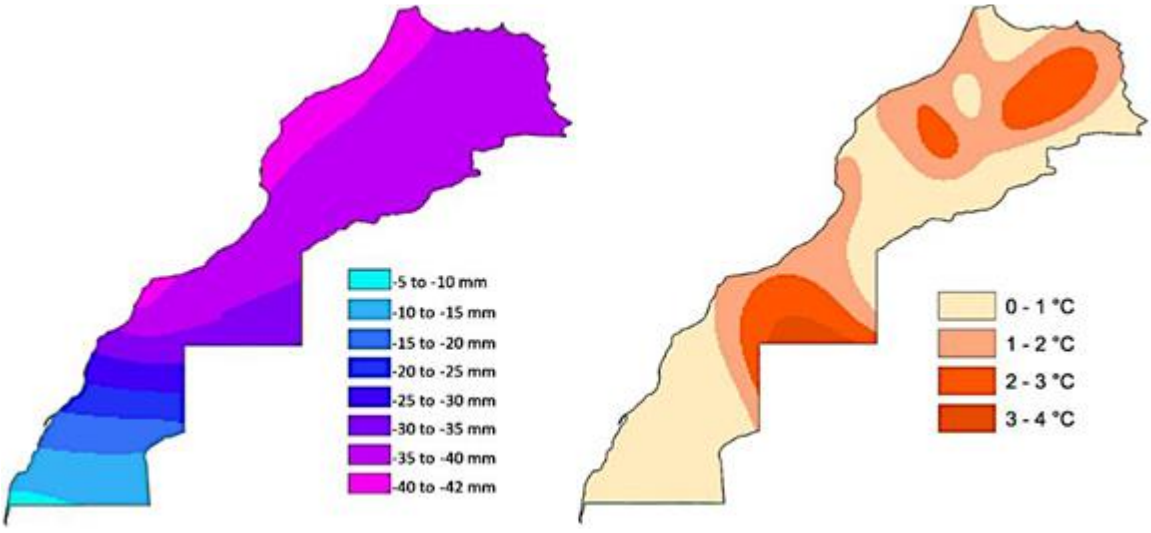
1. Evolution of precipitation and temperature

An analysis of the rainfall index recorded during the period 1900-1901 to 2006-2007 in three regions of Morocco (Knippertz P. et al, 2003), reveals the following information:

- In the Mediterranean region (MED), rainfall has fallen below the average value for the period 1900-2007 since the end of the 1970s;
- In the Atlantic region (ATL), precipitation decreased from the end of the 1970s to the beginning of the 1990s. Rainy years reappeared at the end of the 1990s;
- In the southern Atlas region (SOA), precipitation has generally been above the average value since the mid-1980s.

The analysis of the average annual temperatures observed during the period 1961-2008 shows a warming throughout the territory of Morocco (Ait Brahim et al., 2011). Warming varies between +0.1°C per decade in the far North, +0.3°C per decade in ATL, with the exception of Essaouira (a microclimate influenced by the cold ocean currents of the region), and +0.4°C per decade in the mountains over the SOA. On average, warming varied between +1°C to +3°C (depending on the region) during the period 1998-2007 compared to 1971-1980.

Figure 1. Precipitation and temperature anomalies between 1971-1980 and 1998-2007 in Morocco

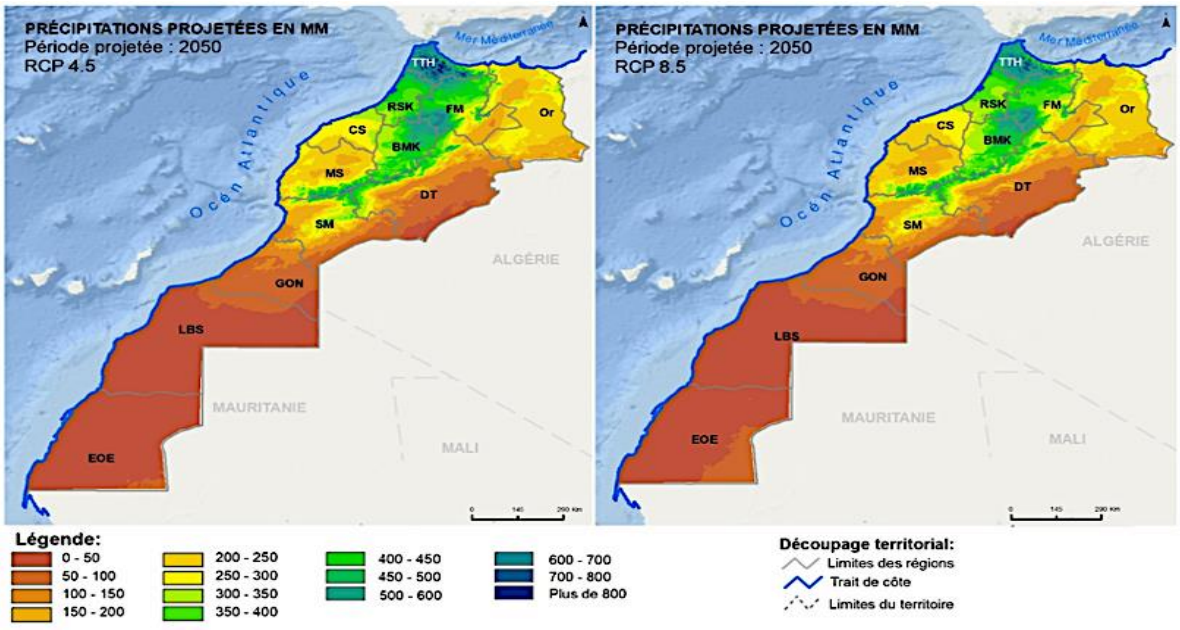


Source: Ait Brahim et al., 2011

2. Climate projections

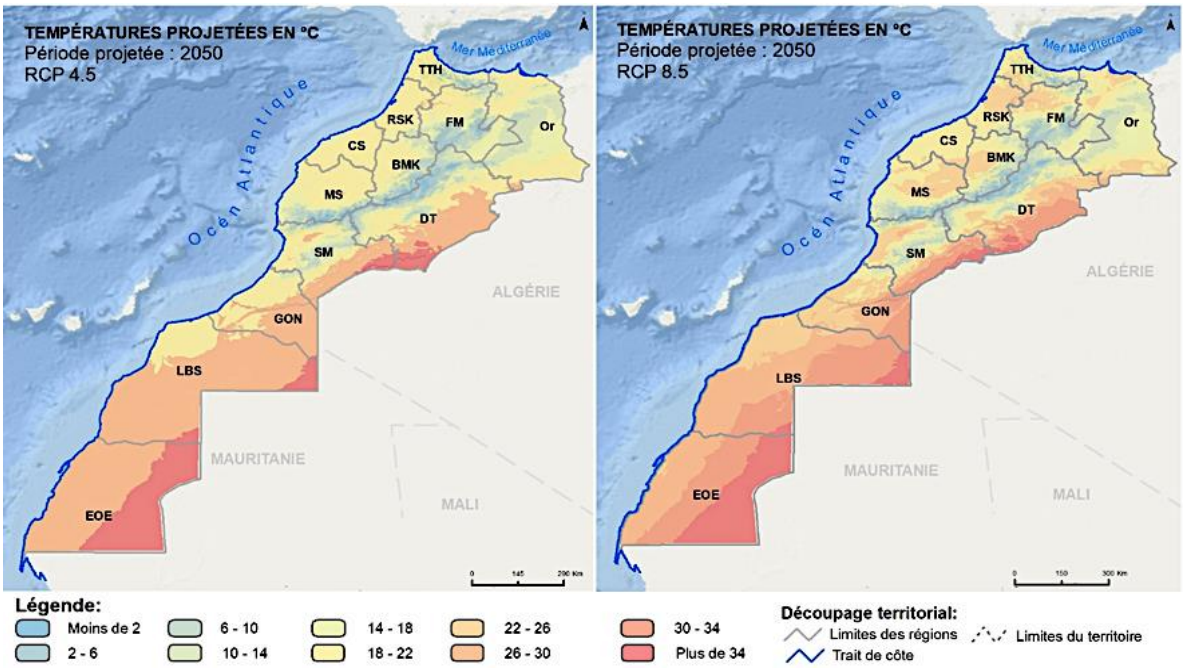
Climate projections established by the National Meteorological Directorate forecast an increase in average summer temperatures of around 2°C-6°C. In terms of precipitation, for all time horizons set by the IPCC in its 5th report, there is a downward trend in annual rainfall totals which varies between 10-20%, reaching 30% in the Saharan provinces by 2100.

Figure 2. Geographical distribution of projected precipitation by 2050 according to the RCP 4.5 and 8.5 scenarios



For average annual temperatures, an upward trend of 0.5°C-1°C is projected by 2020, and 1°C-1.5°C by 2050 and 2080 for the whole country (Figure 3).

Figure 3. Geographical distribution of average annual temperatures projected by 2050, according to the RCP 4.5 and 8.5 scenarios

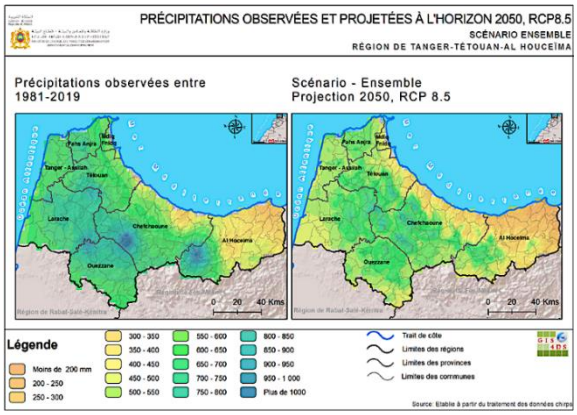


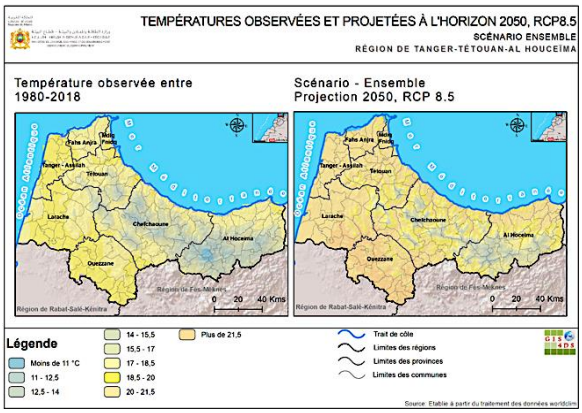
Data source: WorldClim, 2018; data processing by GIS4DS

B. CLIMATE EVOLUTION OBSERVED DURING THE LAST DECADES AND PROJECTIONS IN THE TTA REGION

For the RCP 8.5 scenario, climate projections in the TTA region reflect the national trends, *i.e.,* an increase in average temperatures in almost all provinces, except some mountainous municipalities, and a downward trend of precipitation by 2050, especially in the coastal municipalities (Figure 4).

Figure 4. Observed and projected precipitations and temperatures by 2050 for the TTA region





III. Gender: general considerations

The detrimental effects of climate change, in general and for Morocco as well, can be felt in the short-term through natural hazards, such as landslides, floods and hurricanes; and in the long-term, through more gradual environmental degradation. The adverse effects of these events are already felt in many areas, including in relation to agriculture and food security; biodiversity and ecosystems; water resources; human health; human settlements and migration patterns; and energy, transport and industry. In many of these contexts, women are more vulnerable to the effects of climate change than men, primarily since they constitute the majority of the world's poor, and are more dependent for their livelihoods on natural resources that are threatened by climate change. Furthermore, they face social, economic and political barriers that limit their coping capacity. Yet, it is also acknowledged that women and men bring different skills, experiences and knowledge in environmental sustainability efforts, and can become agents of change pioneering solutions for adapting to climate change.

Women and men in rural areas in developing countries are especially vulnerable when they are highly dependent on local natural resources for their livelihoods. Those responsible for securing water, food and fuel for cooking and heating face the greatest challenges. When coupled with unequal access to resources and participation in decision-making processes as well as limited mobility, women in rural areas are disproportionately affected by climate change. Morocco's High Commission for Planning (HCP) has reported that 8 out of 10 women in the country remain outside the labour market, with 73.7% of them working as housewives. The low rate of women participation and productivity burdens the country's economic growth and sustainable development. Women are responsible for 84% of the creation of domestic activities added value, mainly meal preparation and home maintenance services. Indeed, women spend an average of 5 hours a day on housework, almost 7 times more time than that spent by men. It is thus important to identify gender-sensitive strategies to respond to the environmental, social and humanitarian crises caused by climate change.To this end, this study seeks to integrate gender as a key prism of analysis in evaluating climate risks in TTA. The degree to which people are affected by climate change impacts is defined by their social and economic status, age and gender. It is widely acknowledged that women in general are disproportionately affected by climate change impacts due to persistent gender inequalities. Women have lower capacity compared to men to build resilience and adapt to climate change's impacts as a result of:

- limited access to and control over resources;
- limited access to finance and markets;
- limited access to and use of technology;
- limited access to information and social capital;
- reduced mobility.

Moving beyond a vulnerability approach, women are effective actors and agents of change when it comes to climate mitigation and adaptation. Women often have a strong body of knowledge and expertise that can be used in climate change mitigation, disaster reduction and adaptation strategies. Furthermore, women's responsibilities in households and communities and as stewards of the land as well as natural and household resources, place them in a crucial position to develop livelihood strategies that are adapted to changing environmental realities.

Limiting factors

A number of factors account for the discrepancy between women's and men's differentiated exposure and vulnerability to climate change risks (UNDP, 2013):

1. Gender discrimination in legislation still prevents women from acquiring assets and, consequently, using them as collateral to access finance and build their resilience to climate change. According to the World Bank, ownership of assets seems to be a challenge for women in Morocco. For example, sons and daughters do not have equal rights to inherit assets from their parents, while female and male surviving spouses do not have equal rights to inherit assets. Moreover, the law does not provide for the valuation of non-monetary contributions, therefore dismissing women's time spent on household tasks.
2. Gender-based differences in time use, access to assets and credit and treatment by markets and formal institutions (including the legal and regulatory framework) constrain women's opportunities. As a result, there is a global gender gap in earnings and productivity. Women make between 30-80% percent of what men earn annually. Overall, women make up half of the agricultural labour force in the least developed countries, while in developing countries (where data is available), they own between 10-20% of the land. The cumulative effects of poverty and socioeconomic and political barriers mean that women will often be disadvantaged in coping with adverse climate impacts (UNISDR, UNDP and IUCN, 2009).
3. Compared to men, women face significant challenges in accessing all levels of policy and decision-making processes. This hinders their ability to influence policies, programmes and decisions that ultimately impact their lives. Women have great potential to contribute to the country's economic growth, since 57% of students enrolled in higher education institutes are females, while women run 13% of organised businesses and 19% of NGOs in the country. They also hold 40% of management positions in the country.
4. Socio-cultural norms can limit women from acquiring the information and skills necessary to escape or avoid hazards (e.g., swimming and climbing trees to escape rising water levels). Women's over-representation in unpaid care work is one of their main obstacles to accessing economic opportunities and building resilience to climate change. Likewise, dress codes imposed on women often restrict their mobility in times of disaster, as well as their responsibility for small children who cannot swim or run. Such social influences render women disproportionately vulnerable to disasters and the related negative effects of climate change.
5. Lack of sex-disaggregated data in all sectors (e.g., livelihoods, disasters' preparedness, protection of environment, health and well-being) does not allow proper identification of needs and design of appropriate actions to build women's resilience to climate impacts.

A. METHODOLOGICAL CONSIDERATIONS

This methodology proposes to introduce a gender-sensitive lens in the interpretation of climate risk impact and management and adaptive resilience to disruptive events generated on a local territorial scale by climate change. To this end, social indicators were selected, relating to distinct key thematic areas:

- **Education;**
- **Labour market;**
- **Health status;**
- **Socioeconomic vulnerability.**

These indicators were chosen because of their usefulness in accounting for the way in which the inequalities between men and women are differently distributed within TTA, and therefore present a greater or lesser intensity than the average gender gap, depending on the province of reference. However, the final selection was strongly conditioned by one factor: the availability of sex-disaggregated data between males and females on a provincial scale, instead of aggregated data at regional or even national level. This element should be underlined as a relevant outcome of our research.

The relevance of a gender-sensitive approach in the study of social phenomena has been established by a growing number of research and international cooperation programs, and has now entered the mainstream of scientific literature and best practices handbooks. In Morocco, there is now a rich documentary production that focuses on the gender dimension of socioeconomical, political and cultural mechanisms.

The impacts of climate change on people's quality of life are not in fact symmetrical, but rather tend to manifest more or less intensively according to their gender, in close connection with the distribution of wealth, power, opportunities and ability to access and control the material and intangible resources present in every territory, as well as the possibility of

escaping and coping with the adverse effects of ecological upheavals. Although this theoretical and political awareness is now significantly widespread, we should not ignore a certain analytical myopia among research and planning programs on these issues. Indeed, the lack or of reliable data disaggregated by sex in every area (health, education, quality of life, access to medical care, lifestyles, distribution between labour sectors, etc.) continues to lead to an underestimation of women's vulnerability to the effects of climate change, and therefore also to huge delays in addressing the issue.

More specifically, the gender-sensitive approach has so far tended to be deployed either at a macro-analytical level, through the countless gender gap rankings produced periodically worldwide, or at a micro-analytical level, through extremely interesting case studies, best practices and individual, often inspiring, stories. The latter are excellent examples of social innovation, but are certainly not representative beyond the circumscribed territory in which they are carried out. They often remain “first woman ever", and are difficult to replicate in the daily routines of normality.

The entire intermediate area of gender-sensitive studies therefore remains uncovered, specifically in terms of studies that have at least provincial and sometimes even regional territorial borders as their setting, for which sex-disaggregated data is unfortunately still rare. Instead, it is precisely at this local level that the relevance of a gendered approach should emerge more clearly, because it is one of the main explanatory mechanisms for understanding territorial polarisations and the heterogeneity in the development of an area as multifaceted as TTA. National averages are, by definition, abstract methodological constructions that can be useful to draw international or national comparisons, but less so for supporting the observation and harmonisation of the environmental, socioeconomic, cultural, and political at hand within specific local territories.

B. GENDER-BASED DIFFERENTIATION IN DISASTERS AND VULNERABILITY

Women and men experience, perceive and identify risks differently. Everyone can be equally exposed to a hazard, but women and men have different levels of vulnerability and access to resources - they have also, therefore, developed different coping skills (UNISDR, UNDP and IUCN, 2009).

Analysing damage experienced during disasters constitutes a major source of information for vulnerability and capacity identification. A historical analysis of disaster data provides the information to deduce levels of risk based on past experiences. In this respect, a study of 141 countries found that more women than men die from natural hazards, and that this disparity is linked most strongly to women’s unequal socioeconomic status. Where the socioeconomic status of women is high, men and women will die in roughly equal numbers during and after natural hazards, whereas more women than men die (or die at a younger age) where the socioeconomic status of women is low (Neumayer and Plümper, 2007). Table 2 illustrates specific implications of the gendered nature of risk and vulnerability for women.

Table 2. Gender-based differentiation in disasters and vulnerability: implications for women[1]

Condition/situation	Specific implications for women	Examples
Direct impacts of sudden onset hazards (floods, cyclones, tsunamis, mud slides etc.).	● Women are at greater risk of injury and death due to societal restrictions and gender roles. ● Swimming is not a skill that girls and women are encouraged to learn in some cultures. ● In some regions, women’s clothing limits their mobility. ● In some societies and cultures, women cannot respond to warnings or leave the house without a male companion. ● Loss of crops and livestock managed by women (directly detrimental to family food security).	More women die from disasters than men. Statistics from past disasters including the Indian Ocean Tsunami and the 1991 Bangladesh Cyclone have shown that women are overrepresented in mortality rates. Due to recent floods in Nepal caused by the Saptakoshi River, women report that they cannot feed their children because the river swept away their cows.

[1] Based on (Aguilar, 2004; Basnet, 2008; Boender & Thaxton, 2004; Cabrera et al., 2001; Daniell, 2007; Dankelman et al., 2008; Davis et al., 2005; FAO, n.a.; Nanzala, 2008; Neumayer & Plümper, 2007; Oglethorpe & Gelman, 2004; Sillitioe, 2003; Thomalla, Cannon, Huq, Klein, & Schaerer, 2005; Thomas et al., 2004).

Condition/situation	Specific implications for women	Examples
Impacts of slow onset hazards (drought, desertification, deforestation, land degradation etc.)	● Increased workload to collect, store, protect, and distribute water for the household – often a responsibility that falls entirely on women. ● Increased domestic workload to secure food. ● Increased numbers of women-headed households due to men's migration. ● Women's access to collect food, fodder, wood, crops, seeds and medicinal plants diminishes.	In East Africa, women are known to walk for over 10 km in search of water, and when droughts worsen some even return home empty-handed. In Senegal, as in so many other areas around the world, most of the arable land is lost due to erosion. As a result, most of the young people and males migrate to the cities to find jobs leaving women in charge of the households. More women than men rely on forest-based products to sustain households. Up to 80% of the population of some developing countries rely on traditional medicine as their primary source of health care. Women often have a more specialized knowledge of native seeds and wild plants used for medicine than men.
Lesser access to early warnings and lower ability to respond	● In many cases, warnings do not reach women. They may have less access to means of communication than their male counterparts in households. ● Women lack adequate awareness of how to act in case of warnings. ● Women lack life-saving skills such as swimming and climbing. ● Women tend to take the responsibility of carrying children and elderly to safety.	During the 2006 tsunami in Southeast Asia, more women died than men – for example in Indonesia and Sri Lanka, male survivors outnumbered female survivors by 3 or 4 to 1.
Lower land and other asset ownership	● Less control over production and markets. ● Loss of income. ● Less ability to adapt to environmental impacts on crops, resulting in crop failure.	Fewer than 10% of women farmers in India, Nepal and Thailand own land. In Malawi, the value of assets owned by male-headed households is more than double that of female-headed households. Male-headed households are more likely to own agricultural assets.
Lower income	Greater vulnerability in the face of shocks such as food shortages, crop failure, extreme weather events and disasters.	Women earn only 70-80% of the earnings of men in both developed and developing countries. Women have less access to secure and better paid jobs in the formal sector. They are mostly occupied in the informal sector, making less money, with less employment security.
Lower levels of education	Hampers women's access to information and limits their ability to prepare and respond to disasters.	876 million people in the world are illiterate, of which two-thirds are women.
Lower levels of participation in decision-making bodies	Women's capacities are not applied, their needs and concerns are not voiced, and they are overlooked in policies and programmes.	Women are poorly represented in decision-making bodies. Sociocultural norms and attitudes prevent women's participation in decision-making.
Poor access to resources	Women suffer inequitable access to markets, credit, information and relief services resulting in less ability to recover from disaster losses.	Analysis of credit schemes in 5 African countries found that women received less than 10% of the credit given to men. Women face more difficulties in accessing credit, as they do not possess assets for collateral.

Source: UNISDR, UNDP and IUCN (2009), Making Disaster Risk Reduction Gender-Sensitive-Policy and Practical Guidelines

As described in Table 2**, women face different levels of risk and have different vulnerabilities and coping capacities resulting from gender-based political, cultural and socioeconomic differences and inequalities. Indeed, gender relations shape the four factors of vulnerability: economic, social, physical, and environmental.** Women are on average more vulnerable to disasters due to their increased vulnerability across all of these aspects. The intersection of these factors with economic, racial,

and other inequalities, create hazardous social conditions that place different groups of women at risk differently when disastrous events unfold (Enarson, 1998):

Physical aspects: Assessing physical vulnerability mainly focuses on how site specificity, location and the built environment can worsen the impacts of a disaster. Poor women are usually in the wrong place at the wrong time because they cannot improve the quality of their houses, choose a good location to live, or store food adequately, due to a lack of resources (Cannon, 2002). While poor men are also physically vulnerable to natural hazards, poor women tend to be more vulnerable due to gender-based inequalities, such as fewer opportunities, less access to resources, and more limited mobility than men in the same social class.

Indeed, the Mediterranean region has been identified as "highly vulnerable to climate change" by the IPCC AR5, leading to multiple stresses and systematic failures. One of the primary impacts will be on water resources availability: Morocco is classified as a water-scarce country, confronted with dwindling groundwater reserves and a strong dependence on rain-fed agriculture. Domestic water provision is traditionally allocated to women within the household, and FAO's global water information system (AQUASTAT) calculates that "up to four hours" per day are lost by Moroccan women and girls in undertaking this activity. Thus, climate risks could both maintain and worsen this status quoi in terms of water access, while further worsening water insecurity. Vulnerable women and girls in Morocco may be faced with climate-related "time poverty", defined as a situation where a certain person's time is inflexible, consumed by non-remunerative and non-productive tasks, perpetuating their absence from decision-making and raising the opportunity costs for other profitable pursuits.

Social and cultural aspects: Assessing social vulnerability looks at the wellbeing of individuals, communities, and society. It includes access to basic human rights, education and literacy levels, good governance, organisational systems, values, customs and ideological beliefs. Gender inequalities in these areas make many women more vulnerable to disasters compared with men:

- ***Women have different social roles:***
  - Differences in socially assigned roles of men and women result in different skills, which can increase women's disaster vulnerability (Neumayr and Plumper, 2007).
  - In many countries, women's traditional role is to look after and protect children and the elderly as well as their family's domestic property. During seasonal disasters, women's intensive domestic roles mean they usually possess excellent risk management and coping skills. However, limits on women's social roles can also mean that they often lack the skills needed to survive major catastrophes, such as understanding and responding to warning signals, or participating in disaster prevention. (Castro García and Reyes Zúñiga, 2006; Neumayr and Plumper, 2007).
- ***Women have less education***
  - In many parts of the world, women and girls face obstacles to their education, lessening their ability to receive information and to understand early warning messages. Disaster impacts can also be an obstacle to gaining more education.
  - Of the 876 million people in the world who are illiterate, two thirds are women.
  - Three-fifths of the 115 million children that do not go to school are girls (Lara, 2004).
  - After a disaster or other stressful impacts, many girls are forced to drop out of school to help with chores in the house, or to save money (Davis et al., 2005).
- ***Women are less well-targeted by public information***
  - In many cases, women do not receive hazard warnings because their behaviour patterns or information preferences are not taken into account. It is assumed that they will simply absorb information from men in the community.
  - In the case of the 1991 Bangladesh Cyclone, warning information was transmitted by men to men in public spaces, meaning women did not receive information directly (WECF, 2004).
  - In Peru, early warning messages about the arrival of El Niño were only transmitted to the fishermen, who were warned that fish availability was going to be severely affected, with potentially serious economic implications. Women were not alerted since they were not directly involved in fishing. But in fact, they managed the household budgets. Had women known about the onset of El Niño, they would have saved more household funds and budgeted differently to prepare for the event, reducing the eventual economic impacts of the disaster (Anderson, 2002).
- ***Women have poorer health***

- Disasters tend to exacerbate existing gender inequalities in health. For example, women already have poorer nutrition, which increases the burden on women coping with hazards that affect food production, such as drought (Cannon, 2002). Women are more prone to nutritional deficiencies because they have unique nutritional needs (especially when they are pregnant or breastfeeding), and in some cultures are lower on the household food hierarchy. In some regions, women's nutrition is particularly precarious. In South and Southeast Asia, 45-60% of women of reproductive age are underweight and 80% of pregnant women present iron deficiencies (FAO, 2000). There are also more female than male famine victims due to bias against female babies and children (Neumayer and Plümper, 2007).
- Women are also more predisposed to infections and are more exposed to communicable diseases. For example, in the Lushoto region of Tanzania, plague affects women more than men because men sleep in beds and women and children sleep on the ground, where there is a greater risk of coming into contact with rodents carrying plague-bearing fleas (Boender and Thaxton, 2004). Also, women in many countries are in charge of cooking, which exposes them to indoor pollution - the cause of a total of 1.2 million deaths a year (World Health Organization, 2007). This increases women's vulnerability to diseases that spread in the aftermath of disasters that have damaged health and sanitation services.
- Studies have reported worse reproductive health for women after disasters. For example, in Israel, an increase in delivery rates was reported during the 48 hours following an earthquake, with a particular increase in premature delivery. Also, social taboos about menstruation and norms about appropriate behaviour have contributed to health problems for young women in disaster situations. A study reported that during the 1998 flood in Bangladesh, there was an increase in perineal rashes and urinary tract infections in adolescent girls because they were not able to properly wash and dry their menstrual rags (World Health Organization, 2005).

Economic aspects. Women's access to assets (physical, financial, human, social and natural capital), largely determines how they will respond to a given hazard. The more assets people have, the less vulnerable they are - the greater the erosion of people's assets, the greater their insecurity.

- **Environmental aspects.** Women and men use and understand natural resources differently. This results in gender-differentiated impacts when the abundance, accessibility or state of natural resources change. In many places, women are traditional gatherers of water and of natural resources from the wild. These changes might limit women's access and control over natural resources (i.e., land, water, cattle, trees for fruit and fibre, seeds and medicinal plants…) and reduce their abilities to provide for their families. Women are also particularly affected by drought and desertification:
- The loss of harvest and livestock due to drought and desertification disproportionately impacts on women in regions where they are the primary agricultural producers. Rural women produce half of the world's food. In developing countries, they are responsible for 60-80% of food production. As an order of magnitude: Southeast Asia, women provide up to 90% of labour for rice cultivation, while in Egypt, women represent 53% of all agricultural labour. In sub-Saharan Africa, women produce up to 80% of basic foodstuffs both for household consumption and for sale (FAO, 1995).

C. SOCIOECONOMIC AND GENDER BASELINE IN MOROCCO

Morocco faces different developmental challenges and socioeconomic disparities. With composite national-level statistics, these can be somewhat empirically quantified.

Table 3. Composite statistical indices

Index	Rank	Relevance
Human Development Index (HDI) - UNDP, 2018 *This index measures the three basic dimensions of human development (long and healthy life, knowledge and decent standard of living) and provides an overall socioeconomic landscape of a country.*	123rd out of 188 countries	In Morocco, with 'medium human development', adaptation measures may not be socioeconomically equitable.
Gender Inequality Index (GII) - UNDP, 2018 *This index, showing inequality in achievement among men and women in three aspects (reproductive health, empowerment and labour market) provides a useful gender baseline in terms of health equity,*	119th out of 159 countries	Morocco's rank among the bottom 40 countries is disconcerting: political, social and economic capital are not equitably distributed among Moroccan men and women. Without access to these vital resources, climate risks will

Index	Rank	Relevance
economic capital and financial access, and the differentiated opportunities offered to men and women.		disproportionately burden those at the lower echelons of society.
Gender Development Index (GDI) *The GDI shows the ratio of female to male HDI values. This further reiterates the results of the HDI and GII, and shows the real gender gap in human development achievements* (1= high equality; 5= low equality between males and female on the HDI)	Group 5	The gender gap in Morocco is quite pronounced, putting the country in league with global conflict zones such as Yemen.

Exploring different poverty indices (Table 4) also shows how different demographics are strewn across the country, and what capacities they possess to build climate resilience.

Table 4. Poverty indices

Index	Rank	Relevance
Lower-Middle-Income-Country Poverty Line *Consumption below the standardised poverty line of $3.10/day.*	15.5%	In Morocco, there has been a steady decline in poverty, though the underlying factors may be remittances, deceleration of population growth and macroeconomic stability. Inequalities between rich and poor are still abounding, and poverty essentially has a rural face in the country. The Multidimensional Poverty Index[2] also reveals that an additional 12.6% of Moroccans are dangerously 'near' poverty. Among the 15.5% poor, 5% are in 'severe' multidimensional poverty.
Rural-urban divide *Climate risks take different forms in rural and urban areas, but the lack of rural development often impedes the adaptive capacities of vulnerable demographics, who often derive their livelihoods from managed and natural resources.*	3 million out of the country's 4 million poor live in rural areas	The subjective poverty rate has increased by 15% from 2004 figures in rural Morocco. Meanwhile, the urban poverty rate is half the national average in 2001, and in 2014, stands at one-third.[3]

Labour and employment indicators (Table 5) also reveal that the dependence on the informal economy, the gender gap in labour force participation and coherent macroeconomic policies impede social development.

Table 5. Labour statistics

Index	Rank	Relevance
Labour force participation (% of active working age population)[4] *The existing gap in labour force participation indicates that women*	25% female 74.1% male	Female labour force participation is very low in Morocco, and the gender difference in the labour force participation of the MENA region is the widest in the world. Women face the highest proportion of legal restrictions (*de jure* discrimination) in the MENA region, as well as sociocultural norms (*de facto*

[2] Calculated by the Oxford Poverty and Human Development Institute (OPHI), and UNDP, the global Multidimensional Poverty Index (MPI), measures acute poverty in countries. It complements traditional income-based poverty measures by capturing the severe deprivations with regard to different indicators: education, health, and living standards. The index not only identifies those living in multidimensional poverty, but the extent (or intensity) of their poverty. The MPI can help the effective allocation of resources by making possible the targeting of those with the greatest intensity of poverty; it can help address some SDGs strategically and monitor impacts of policy intervention. See UNDP's Technical Notes (2016) for more.

[3] World Bank. (2018). https://www.worldbank.org/en/country/morocco/publication/poverty-in-morocco-challenges-and-opportunities

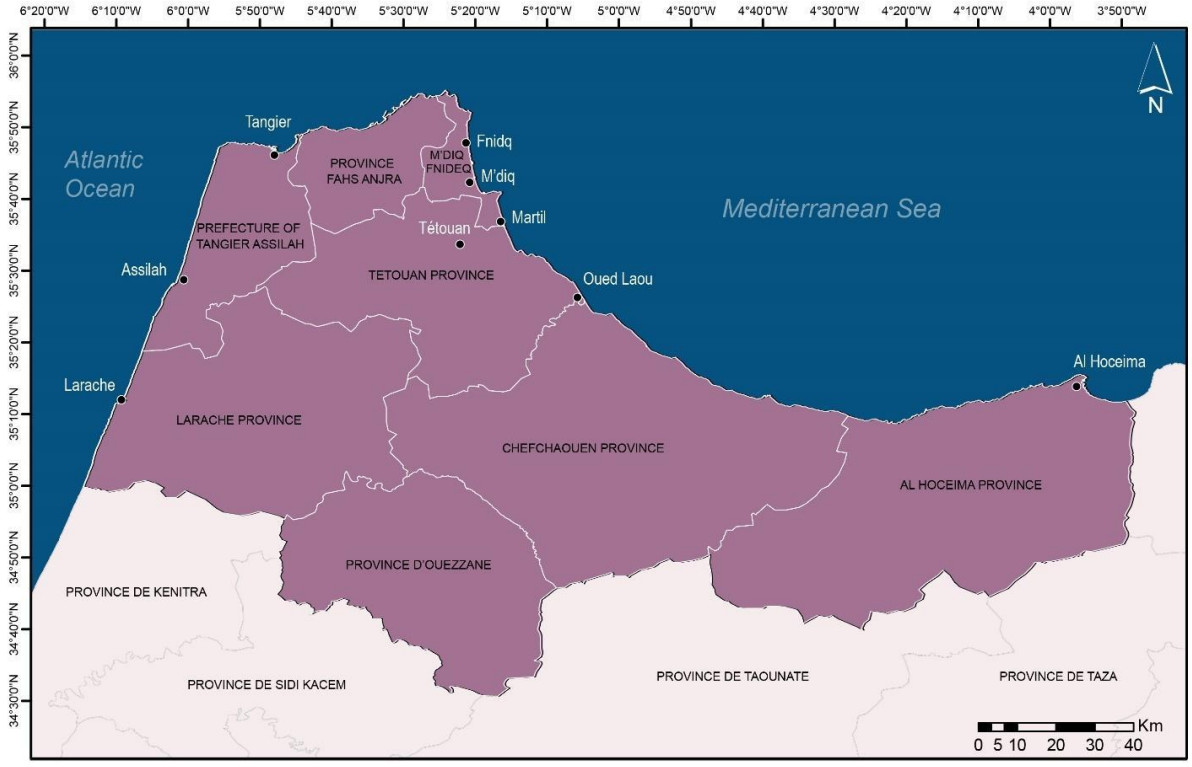
[4] World Employment and Social Outlook: Trends for Women. (2017). https://www.ilo.org/infostories/en-GB/Stories/Employment/barriers-women#intro/labour-force

Index	Rank	Relevance
possess less economic capital and are limited to gendered (mostly "invisible", unpaid care work) roles. This directly correlates to less adaptive capacity against climate risks.		discrimination) that stipulate limits to women's entry in the public and working sphere. Young females are particularly discouraged from seeking employment (Morikawa, 2015).

IV. TTA: an overview

TTA covers an area of 17,262 km^2 and counts 3.5 million inhabitants (GoM, 2014), with a density of 206 inhabitants per km^2 and an area representing 2.43% of the national territory. Located in the extreme north-west of Morocco, it is limited to the north by the Strait of Gibraltar and the Mediterranean, to the west by the Atlantic Ocean, to the south-west by the Rabat-Salé-Kénitra region, to the south-east by the Fez-Meknes region and to the east by the Oriental region. The region counts two prefectures, Tangier-Assilah and M'Diq-Fnideq, and six provinces: Al Hoceima, Chefchaouen, Fahs-Anjra, Larache, Ouezzane and Tétouan. The capital of the region is the prefecture of Tangier-Assilah (Figure 5).

Figure 5. Provinces and Prefectures of TTA



A. GEOGRAPHY AND GEOMORPHOLOGY

Located at the junction of two seas, TTA is positioned on two maritime facades and is characterised by the presence of reliefs of large sizes and average altitudes. This biogeographical context is the reason for TTA's significant microclimates. Indeed, this variant of the Mediterranean climate presents a great heterogeneity, and is the result of three elements: altitude, latitude and the ocean. Altitudes influence the distribution of precipitation. Placed under the domination of the disturbances of the Azores anticyclone, the slopes exposed to the West or South-West winds, as well as the high peaks are well watered, while those oriented towards the East or South-East form semi-arid areas (400 mm/year). The entire coastline is classified as a humid or sub-humid zone. In the sub-humid region, areas located at an altitude of less than 500 m experience an accentuated meso-Mediterranean climate, with less than five dry months and more than 700 mm of rain.

Apart from the coastal plains, areas with steep or strongly undulating geomorphology cover more than 80% of the regional territory. The climate is of the Mediterranean type along the Mediterranean coast, under the effect of the continental influence:

- To the west, low coastal plains heavy and fertile alluvial soils are threatened by flooding and by the salinity of terraces (around Assilah, and between Ksar El Kébir and Larache) and rounded hills of low altitude (less than 200 m);
- To the north and east, there are higher hills with pronounced relief whose altitudes are 200 m-500 m;

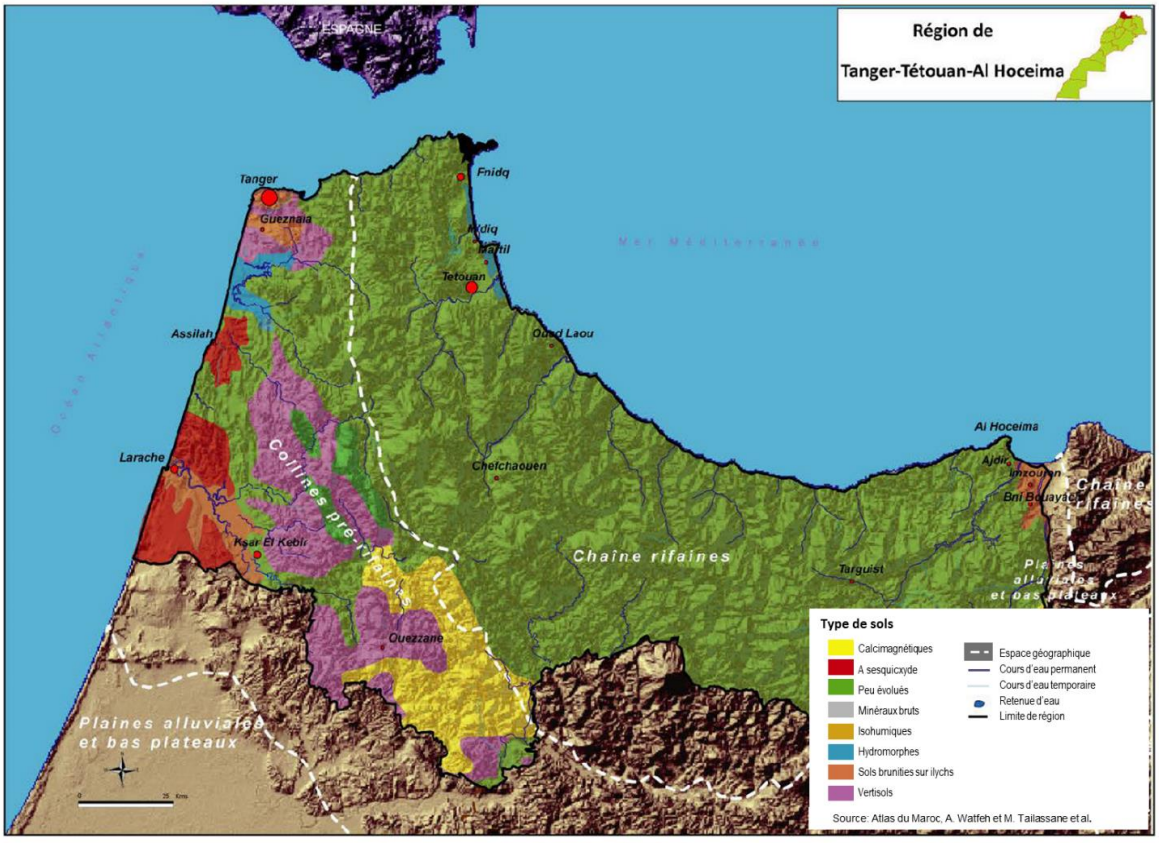
- There are many beaches on the Atlantic coast, covering almost 152 km;
- The coastline of the strait is rugged, dotted with rocks and beaches at the mouth of the wadis.

We then distinguish at the level of this region, four main homogeneous zones:

- The Tangérois, located in the Strait of Gibraltar between the Mediterranean and the Atlantic Ocean, approximately coincides with the Mharhar wadi basin and presents an alternation of valleys, covered mainly with quaternary alluvium, and marl-sandstone hills;
- The coast and the Mediterranean basins constitute the axial zone of the Rif chain, and largely cover the provinces of Tétouan and Chefchaouen;
- The Jbala, corresponding to the mountainous sub-zones and the interior valleys of the Rif zone. The relief conditions and the configuration of the hydrographic network, reduce the space in very pronounced slopes in the interior valleys, thus transforming them into authentic enclaves;
- The Bas Loukkos basin is the most developed natural space in the region, thanks to the quality of its soils and an abundance of water. It covers the clayey alluvial plains and the sandy plateau of Larache.

The types of soils are diversified, and are composed of limestone, marly or flysches formations, showing a complex of poorly evolved soils, resulting from raw mineral soils, brown soils and, on forest land, soils with iron oxides and manganese.

Figure 6. Soil types in TTA

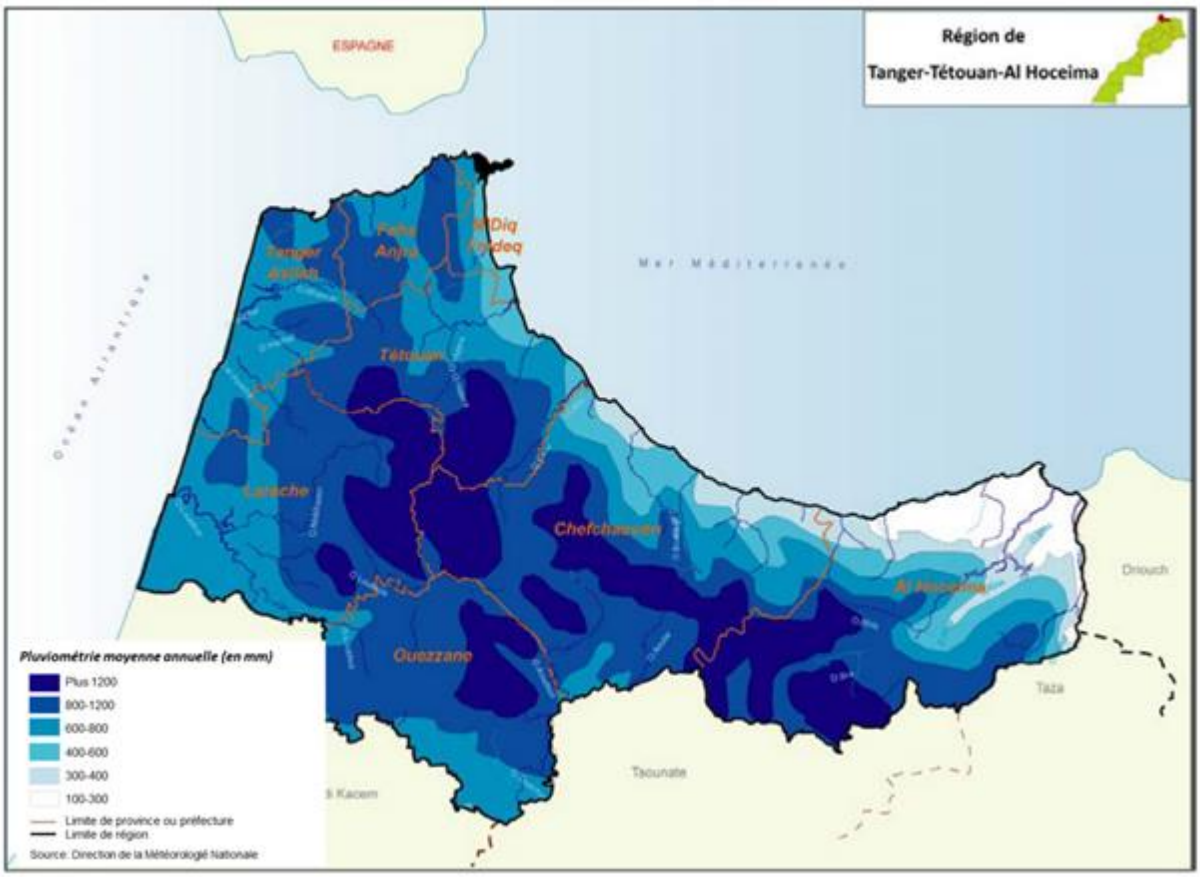


B. CLIMATE AND PRECIPITATION

Due to their location and the variability resulting from the numerous mountainous massifs of the Rif chain and the coastal plains, the basins of Loukkos, Tangier and the Mediterranean coast are subject to various weather conditions. Thus, the oceanic influence which characterises the basins of Loukkos and Tangier is gradually attenuated in the coastal basins of the North with an increasingly pronounced aridity from West to East.

The whole part of the western coast between Larache and Martil belongs to the humid or sub-humid zone with rainfall that can exceed 700 mm/year. The eastern part of the region (particularly for the lower basins located between Jebha and Al Hoceima) receives barely 400 mm/year. At the level of the high reliefs, the average rainfall varies between 1800 mm on the western part of the Rif (mountainous massifs of Haouz and the limestone ridge) and 600 mm on the high basins of the Rif east of Oued Ouringa. Temperatures generally remain mild in winter, mild in summer, both on the coasts and at altitude.

Figure 7. Average annual rainfall



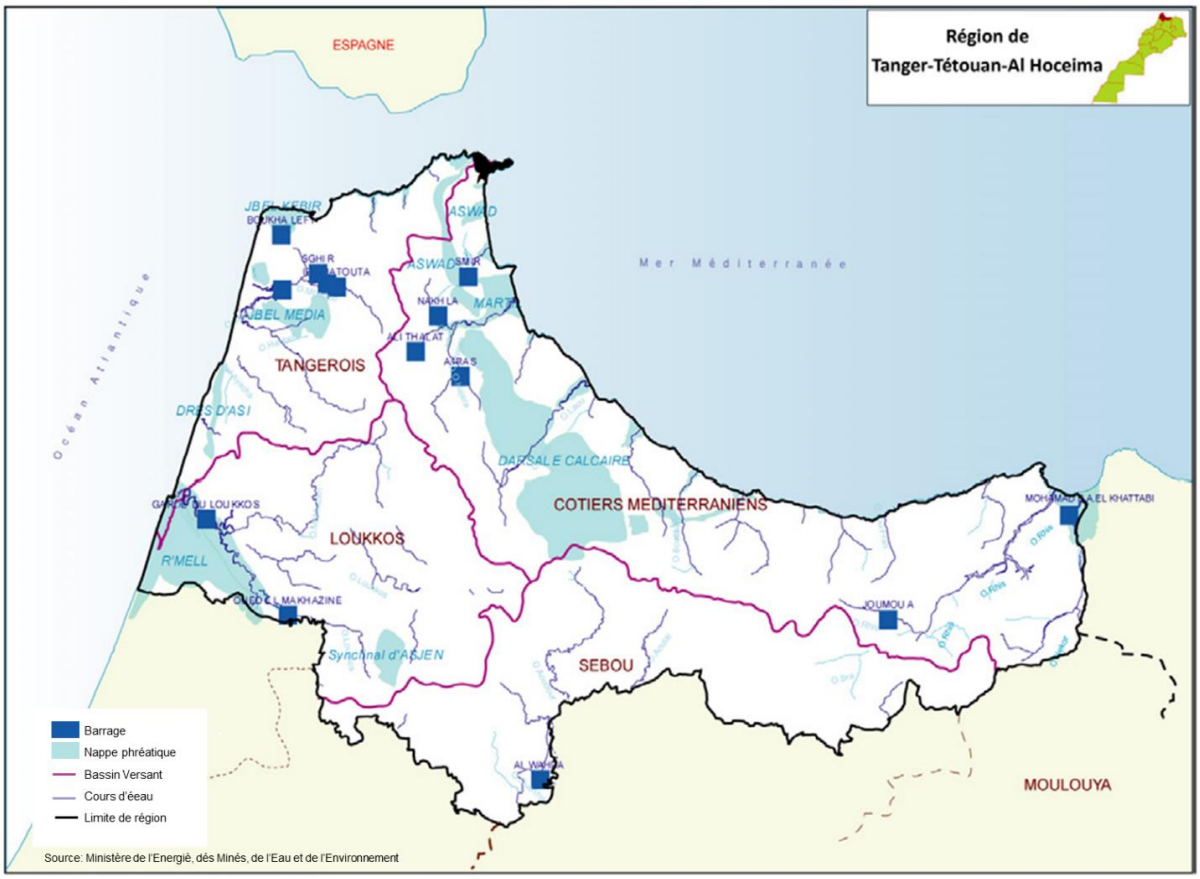
C. HYDROGRAPHIC RESOURCES

The hydrographic network of the region is composed of important rivers and contains several dams which play a major role in meeting drinking, industrial and agricultural water needs. TTA is spread over two hydrological domains:

1. the Sebou basin, which partly touches the provinces of Chefchaouen, Ouezzane, Al Hoceima;
2. the Loukkos basin that covers the rest of the territory of the region.

The region is mainly made up of the basins of three wadis: M'harhar, El Hachef wadi, Ayacha, Ouergha, Innaouen, Ghiss and Nekkor with average inflows of 640,106 m^3/year, draining surface water over an area of about 2,800 km^2. However, the M'harhar wadi remains the most important river in the Tangier basin: on its own, it presents an average annual contribution of around 450,106 m^3/year. For this area, the main dams are those of Ibn Batouta with a capacity of 35,106 m^3, and 9 Avril with a capacity of 300,106 m^3.

Figure 8. Regional water resources



The fundamental groundwater table is that of Charf El Akab which, with a total reserve estimated at 25,106 m^3, constitutes an authentic natural reservoir. Most of these hydraulic resources are used to supply water to the urban population. Indeed, only 1% of the resources available in the Tangier area are intended for irrigation.

The Nekkor and Ghiss watersheds of the Mediterranean border are considered to belong to the Loukkos watershed domain, and extend over areas of 70 km^2 and 82 km^2 respectively. These two basins are distinguished by a hydrological regime of a pluvial nature, where the floods are brutal because of the steep slopes and the annual rainfall regime varying from 300 to 400 mm/year on average.

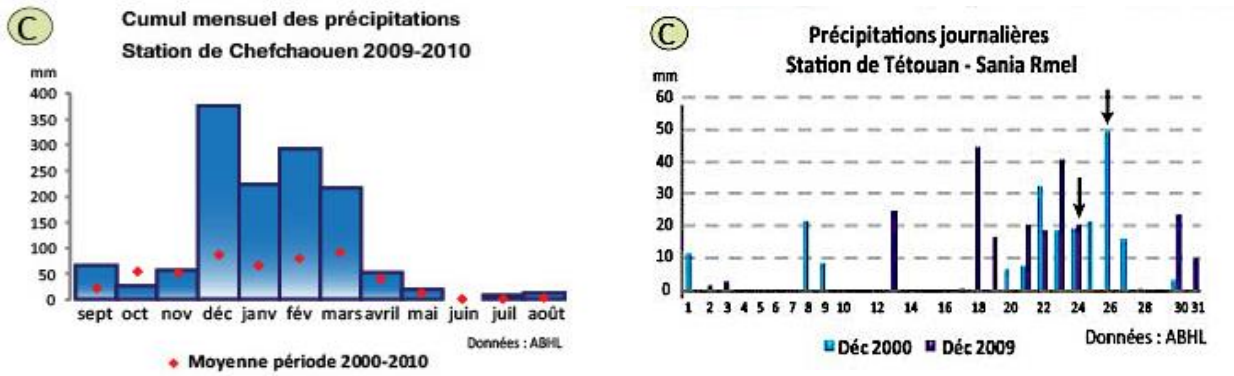
The Mediterranean coastal basins mainly include the Smir, Martil, Amsa and Laou wadis which extend over an area of 2,914 km^2, and provide average inflows of 1,245,106 m^3/year. In addition, some 38,106m^3/year mobilised from underground aquifers which, with the exception of limestone aquifers, are closely linked to the watercourses that cross them, as is the case of the Smir, Laou and Martil wadis. The main dams in the area are that of Smir, with a capacity of 43,106 m^3, that of Nakhla with a current capacity of 5.7,106 m^3 and the small Ajras dam, with a capacity of 3,106 m^3, exclusively intended for irrigation. Finally, the Raouz dam is currently under construction. While in the province of Tétouan the water supply is mainly obtained from surface water, in the province of Chefchaouen, the main source is groundwater that originates in the limestone ridge.

Concerning the Loukkos basin, wadi El Makhazine is the most important river of the region which presents a pluvial hydraulic regime of a strong interannual irregularity. The region also has underground water resources at different depths which allow its irrigation needs, and which potentially constitute an important asset for its socio-economic development. This watercourse is regulated through the El Makhazine dam with a capacity of 773,106 m^3, which offers the possibility of irrigating nearly 85,000 ha. Further downstream on the Loukkos wadi, a guard dam, with a capacity of 4,106 m^3, was installed there in order to protect its lower valley against rising sea water level, and also guarantee a sufficient source of

water for irrigation. The main aquifers in this basin are the R'mel aquifer (9,106 m^3/year) south of Larache, and the Ouled Ogbane aquifer (1.4,106 m^3/year), located upstream of the town of Ksar El Kebir.

The abundance of precipitation, the mountainous character of the region as well as the impermeability (natural and anthropogenic) of most of this land means that surface runoff is high in the Riffian watersheds. Indeed, during major storms, rivers experience sudden and violent floods, causing heavy material damage and even loss of life, especially in highly urbanised areas. The city of Tétouan, for example, has experienced catastrophic flooding over the past 15 years.

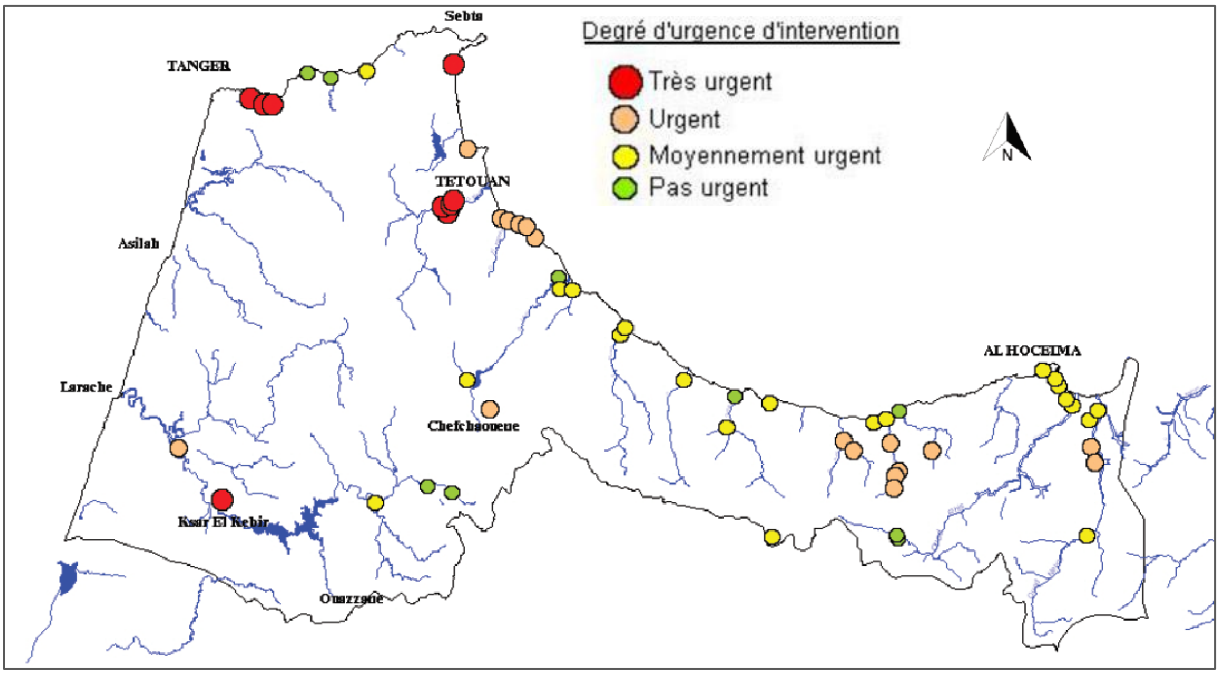
Figure 9. Cumulative monthly rainfall in Chefchaouen (2009-2010) and cumulative daily rainfall in Tétouan



Source: Pateau, 2014, data from ABHL

Figure 10 shows the degree of urgency of interventions in TTA where, several sites require urgent action to avoid flood disasters.

Figure 10. Flood sites in TTA.



Source : Agence du Bassin Hydraulique du Loukkos (2017)

Figure 11. Landslide density in TTA

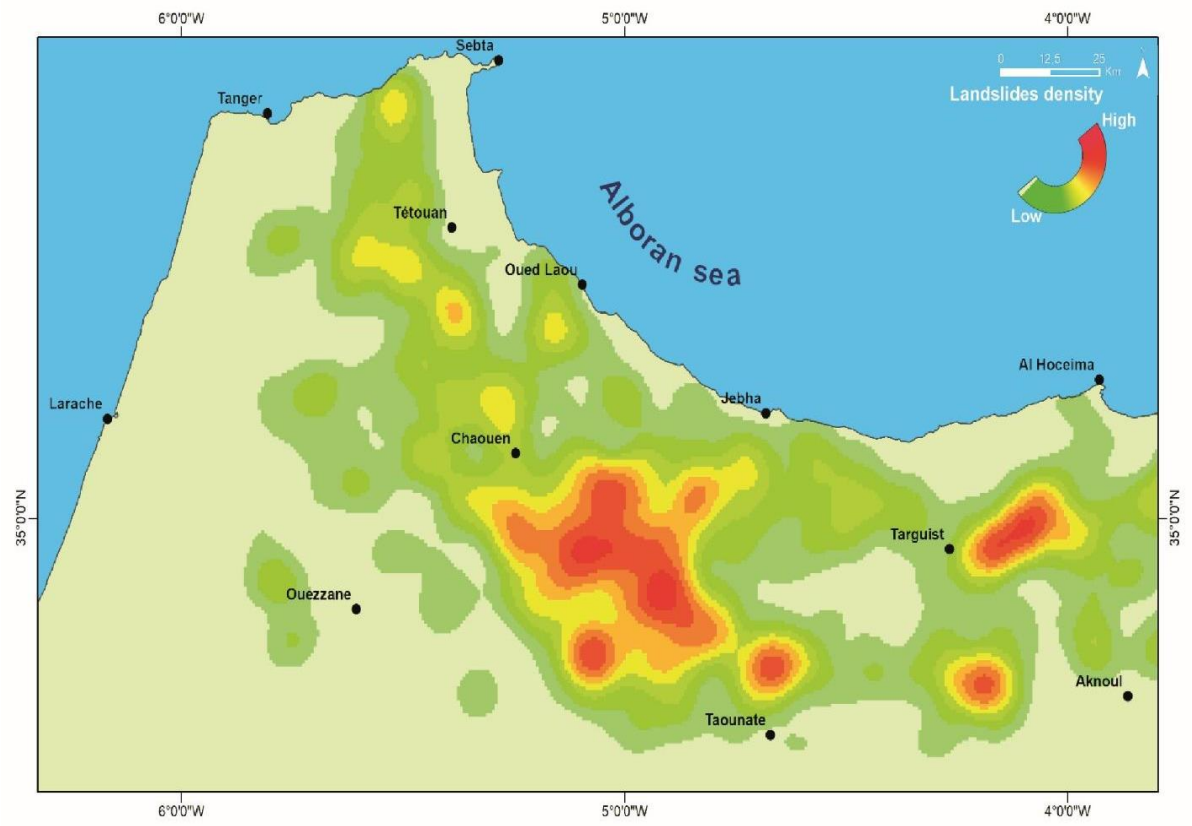


Figure 11 depicts the landslide hazard in the Rif: the slopes corresponding to the triangle Chefchaouen-Jebha-Taounate are the most exposed.

To meet the growing drinking water needs of the population in TTA, efforts have been made to treat both surface and groundwater. Although the urban environment is served almost entirely, shortages in supply are most felt in the rural environment, despite the efforts made by the State (e.g., the PAGER and Fight against Drought programmes), which aim to generalise access to drinking water. Indeed, in rural communes, small urban centres are generally supplied by a network, while many *douars*[5] and isolated areas are still supplied by groundwater wells.

D. FOREST COVERAGE

In 2011, the forests of TTA covered an area of 487,300 ha, which is equivalent to 28.3% of the total regional area, of which nearly 50% were natural hardwood forests, 36% scrubland and 11% natural resinous essences. The main forest species listed in the region are cork oak, holm oak, zen and tauzin oak, maritime pine, pine, cedar, and fir.

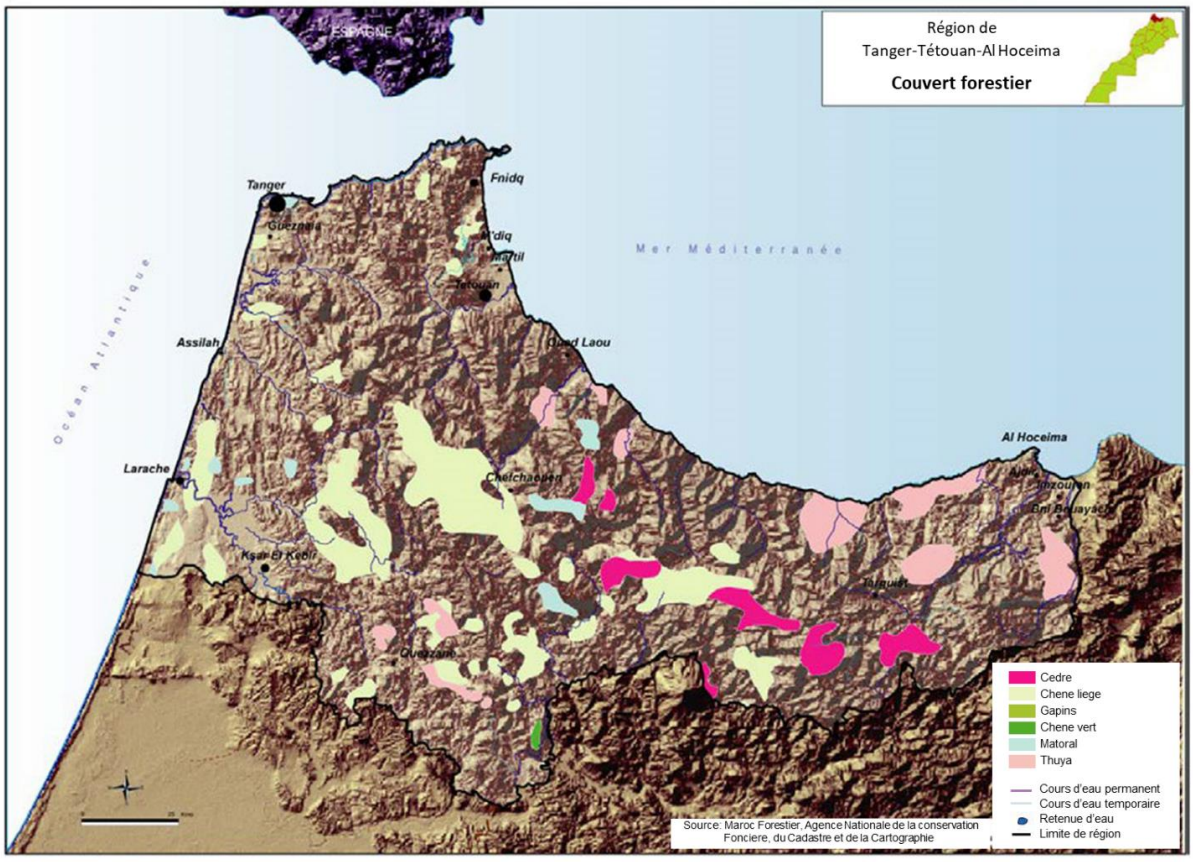
The province of Chefchaouen represents just over 43% of the entire forest of the region, followed by the provinces of Al Hoceima (22%), Tétouan (18%), Larache (14%), and the prefecture of Tangier-Assilah (5%). Reforestation efforts have certainly led to an increase of the area of vegetation cover by providing the region with a total of 100,507 ha of reforested forest. The main beneficiary is the province of Al Hoceima with its 27,953 hectares (28% of the total reforested forest), followed by the provinces of Chefchaouen (17%) and Tangier-Assilah (16%). However, the natural forest regrowth and reforestation rates are insignificant in the region. The proportion reforested in 2011 remains relatively modest, i.e., 14% of the total reforested area of reforestation, of which nearly a third only concerns the territory of Al Hoceima.

[5] A *douar* is a camp or village of tents.

The socio-economic and environmental advantages offered by this natural heritage are constantly threatened by:

- Forest fires that are quite frequent in the North;
- Intensive demand for arable land in favour of cereals;
- The urban growth of small, medium and large towns;
- Heavy infrastructure tourism projects distort the landscape.

Figure 12. Forest cover of the region



E. INFRASTRUCTURE

In terms of infrastructure, the region has a very satisfactory road network compared to the rest of the national territory, including motorways and railways, urban roads as well as agricultural and unclassified tracks, which form approximately 6.8% of the entire national network. The length of paved provincial roads is greater than that of regional and national roads (51%). TTA is connected to the national and international network by three airports: Ibn Battouta Airport in Tangier, Tétouan-Sania R'mel airport and Al Charif Al Idrissi Airport in Al Hoceima.

TTA benefits from a double maritime façade on the Mediterranean and the Atlantic Ocean, with a length of 447 km. In terms of maritime interfaces, it counts eleven ports (Tangier Mediterranean, Tangier city, Port of Al Hoceima Marina Smir, Larache, M'diq, Port of Assilah, Kabila, Ksar Sghir, Jebha Cala Iris), of which are three used for the transport of goods and passengers (two in Tangier and one in Al Hoceima) and other ports intended for maritime fishing activities and yachting. The main ports in the region are:

- The Tangier-Mediterranean port, the new strategic Mediterranean hub: the region is currently experiencing an economic boom with major structural projects, such as the Tangier-Mediterranean project, one of the largest in the Mediterranean.
- The Port of Tangier city is located at the entrance of the Strait of Gibraltar, on the western edge of the harbour of Tangier, facing north-west. Located in the city of Tangier, Morocco's main maritime gateway to the Mediterranean,

the port of Tangier is located at the crossroads of the Atlantic Ocean and the Mediterranean Sea, in a bay between Cape Spartel and Cape Malabata. This exceptional and strategic position allowed the port of Tangier to be the first Moroccan port for passenger traffic and international road transport.

- The port of Al Hoceima is located on the Mediterranean coast, about 150 km west of Nador. It is located at the western end of Al Hoceima Bay and is the only opening to the Mediterranean in the Center North region. It is located in a landlocked region behind the Rifmountain range, the reliefs of which are highly rugged. Before 2003, the main activities were fishing and boating. With the commissioning of the ferry terminal in July 2003, passenger traffic has become the main lever for the development of commercial traffic.
- The fishing port of Larache is located on the northern Atlantic coast of Morocco, 90 km south of Tangier. It is situated on the left bank of the Oued Loukkos, about 750 m from its mouth and leads directly to the road network that connects Rabat to Tangier. With 45 ha of land, 20 ha of basin and a length of 1138 quays, it is the second fishing port in the region.
- The fishing and leisure port of Assilah was built in 1992, as part of the development policy for the North of the Kingdom. It is located in the centre of the city, on the Atlantic coast, 40 km south of Tangier and 30 km north of Larache, in the province of Tangier-Assilah. It allows the protection of the old Medina, which is threatened by coastal erosion.
- The port of Cala Iris is located 57 km west of the city of Al Hoceima and 3 km west of Torres d'Al Kalaa. Cala Iris is situated on the border of the Western Rif and the Eastern Rif, wedged between the hills and cliffs covered with dense forests of cedars. It also borders the western limit of Al Hoceima National Park, the dominant features of which are a little-exploited rocky coast with the presence of protected coves as well as cliffs, generally inhabited by fishermen.

TTA counts three hydroelectric plants, two thermal power plants and four wind farms. Electricity production in the region represents approximately 12% of that produced by ONEE (*Office national de l'électricité et de l'eau potable*) throughout the national territory. In addition, the energy sector is being reinforced, with the construction of a combined cycle thermal power plant in Tahadart.

F. ECONOMIC ACTIVITIES

TTA has experienced significant growth in various productive sectors and a growing demand for investment projects for several years, particularly in the fields of industry, tourism and real estate. The city of Tangier and its outskirts concentrate most of these projects, followed by the prefecture of M'Diq-Fnideq and the province of Al Hoceima. This craze for investments in Tangier and its outskirts is due to the city's ideal geographical position. The other provinces of the region are also benefiting from this situation, as evidenced by various investment projects.

Each locality in this region is characterised by a distinct economic profile. Indeed, the Prefecture of Tangier-Assilah is distinguished by its rather industrial and touristic character, while the Province of Larache is at the regional vanguard in terms of agriculture and fishing. Tétouan, taking advantage of nearby Sebta, has always enjoyed strong commercial and tourist activity. As for Chefchaouen, it is characterised by the presence of artisanal activities while in Al Hoceima, fishing has always played an important role and harbours significant investment opportunities in the fields of aquaculture and the processing industry.

1. Agriculture

The agricultural sector is the main driver of the national economy and of TTA's. Indeed, this region is characterised by a geomorphological and climatic diversity which has enabled it to develop a strong agricultural potential, particularly in the Loukkos plain. This sector is currently experiencing continuous development, generating 14% of TTA's GDP in 2013. TTA comprises 9% of Morocco's useful agricultural area, placing it in third position at the national level. Through the various sectors of plant and animal production, agriculture represents a significant contribution to TTA's economy, by generating an average production value of approximately 5.8 billion Dirhams and a total number of working days approaching 23.65 million Dirhams per year. The region is characterised by a diversified production dominated by cereals, fruit trees and legumes, which respectively occupy 48.9%, 24.3% and 11% of TTA's total Utilised Agricultural Area. The province of Larache comes first, with a production of 30%, while Al Hoceima stands at 19%. Together, Chefchaouen and Ouezzane contribute 31% of regional production.

2. Livestock breeding

TTA is a livestock breeding region. In its irrigated areas, the sector has experienced considerable growth thanks to significant fodder and stubble production, as well as the importation of pure breeds for dairy and the improvement by hybridisation

of local breeds. The total number of livestock in 2012, all species combined, is 2,223,000 heads and represents 8% of the total number at the national level. It is distributed as follows: 888 thousand head of sheep, 481.2 thousand head of cattle and 854.2 thousand head of goats. Livestock dynamics in the region are affected by the vagaries of the weather, which periodically reduce their numbers during dry years and increase in good rainy years. Beekeeping is one of the oldest agricultural practices in the Western Rif. Traditional beekeeping in mountains and forests typically involves depositing beehives made of cork oak bark. In the Loukkos perimeter area, the modern beekeeping sector has evolved considerably in terms of production, productivity, packaging, marketing and the professional organisation of the sector.

3. Fishing sector

The seafront of the region is about 447 km and gives it a favourable geographical location for the expansion of the maritime fishing sector. This sector represents a non-negligible supplementary activity (i.e., 2% of GDP), in particular thanks to its contribution to the mobilisation of a large workforce, mainly at the level of rural coastal municipalities where agriculture is not a flourishing sector. The fishing sector employs around 16,100 people in TTA, most of whom are active in the ports of Tangier, M'diq and Larache. However, this sector remains artisanal and under-equipped, and represents only 4% in quantity and 7% in value of national production. The port of Larache comes first with a production of 18,507 tons, generating a value of 161 billion Moroccan dirhams per year.

4. Extractive industries

Mining resources are an asset for TTA, given the significant and diversified wealth contained in its subsoil, located in different metalliferous layers. The development of mining activities is favoured by this varied geological structure, renowned for its concentration of minerals. The region is rich in quarries, with a clear predominance of the province of Al Hoceima, is home to 29% of TTA's quarries. While quarrying plays an important economic and social role by generating jobs and tax revenues, it has numerous negative impacts on the environment. Existing data clearly reveals non-compliance with the measures and provisions mentioned in the legal specifications regarding this activity.

5. Industry

The industrial sector plays a very important role in the economic and social development of TTA. It occupies the second position in the economy of the region, generating 31% of GDP in 2013. It essentially concerns the processing industries, in particular the agro-food, chemical and para-chemical industries. Tangier carries the most weight in TTA, with nearly 25% of investments and 20% of regional jobs, thanks to the restructuring of its industry and an increase in productivity, which led to a jump in production and exports. Thanks to its transport infrastructure and as Morocco's main wind energy production hub, TTA is Morocco's second industrial hub with the establishment of the first and largest automobile assembly site (Renault Tanger Med), the development of Free Zones (industrial and logistics) and the development of heavy industries, with two cement plants in its territory.

With 1730 units, representing 11% of the total number of industrial establishments, TTA contributes 7% of industrial exports, 11% of the total workforce, 7% of industrial production and 25% investments of Morocco, placing it second in the country. However, the distribution of activity at the level of the regional territory reflects a stark imbalance. Indeed, the Tangier-Assilah prefecture takes the lion's share. It concentrates 80% of industrial establishments, 81% of permanent jobs and generates 80% of the region's turnover. In terms of activity, the Textile and Leather Industry occupies a little more than half of the regional workforce, followed by the Electrical and Electronic Industry. The Agro-Food Industry comes in third position with 13% of the regional workforce, followed by the chemical and para-chemical branch (10%) and the Metal and Mechanical Industry (4%).

6. Tertiary sector activities

TTA's tertiary sector comprises trade and services (administrations, businesses, crafts, transport and communication activities) and employs a large number of workers.

Artisanal activities

The crafts sector plays a key role in TTA, both socially and economically. This sector is closely linked to the tourism sector and is a vital activity for the regional economy. It counts numerous craftsmen (23,035 craftsmen in 2013) who excel in

crafts including leather, textiles, ironwork and artisanal carpentry. Indeed, craftsmanship is an income-generating sector. Its importance is revealed in particular by:

- An important source of foreign currency thanks to exports of various handicrafts;
- Revenue generation and wealth creation through the development of small and medium enterprises;
- The encouragement and development of investments through the exploitation of local raw materials;
- The participation of crafts in the growth of other sectors, especially tourism and foreign trade.

However, the sector suffers from the predominance of the informal sector, the lack of training and qualification of craftsmen and strong competition from low-cost Asian products.

Commercial activities

Trade is one of the main economic activities of the region. Indeed, it presents a significant source of income for TTA's population. While modern commerce (such as malls or shopping centres) has established itself in the large urban centres, in particular in Tangier and Tétouan, commercial activity in the region has, however, retained its traditional character and remains concentrated in urban and rural souks. Some of these souks, such as Tangier's, are permanent, while most of them are organised weekly on a specific day of the week. In addition, smuggling activities, particularly in the cities of Tétouan and M'Diq-Fnideq given their proximity to the free zone of Sebta, have led to the creation of intense parallel commercial activities. The influx of merchants attracted by this situation means that commerce is difficult to define with precision.

Touristic activities

In terms of tourism demand, TTA represents the fourth major destination in Morocco. It is one of TTA's key sectors, due to the region's privileged geographical location, its natural and landscape assets and its proximity to Europe:

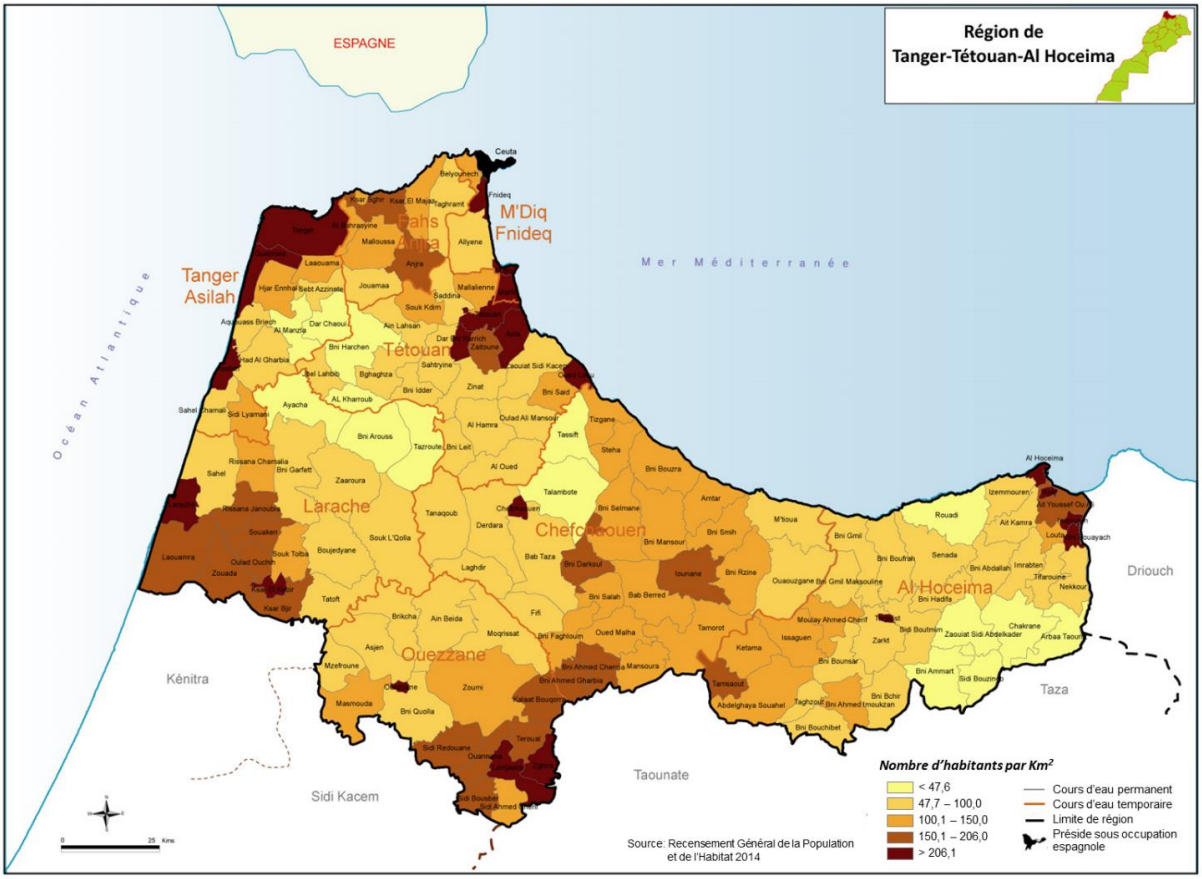
- A coastline that allows for the development of seaside tourism over 447 km between two coasts;
- A rich and diversified ecosystem that harbours immense opportunities (natural parks; Rif Mountains, etc.) for the development of ecotourism;
- Important historical and cultural sites that allow for the development of cultural tourism;
- A mountain and a coastline bordered by the flanks of the Rif range and punctuated by beaches and coves make the region a first-rate touristic destination situation.

G. POPULATION AND DEMOGRAPHY

According to the 2014 population census, TTA is ranked fifth in terms of population with 3,556,729 inhabitants, representing 10.51% of Morocco's total population:

- The Prefecture of Tangier-Assilah houses 30% of the population, followed by the Province of Tétouan (15%);
- The Prefectures of M'Diq-Fnideq and Tangier-Assilah recorded the highest growth rates: 8.11% and 3.13% respectively, distantly followed by the Provinces of Chefchaouen (0.79%), Tétouan (0.62%), Larache (0.50%) and Al Hoceima (0.10%).
- The Provinces of Fahs-Anjra and Ouezzane recorded the lowest negative rates in the region (-0.04% and -0.13% respectively).
- TTA is the third most densely populated region in the country, after the Casablanca-Settat and Rabat-Salé-Kenitra regions. At the municipal level, population density varies from 28 inhabitants/km² (21 municipalities have a density below 50 inhabitants/km²) and 18,000 thousand inhabitants/km² in M'diq and Tangier (14 municipalities have a density above 500 inhabitants/km²).

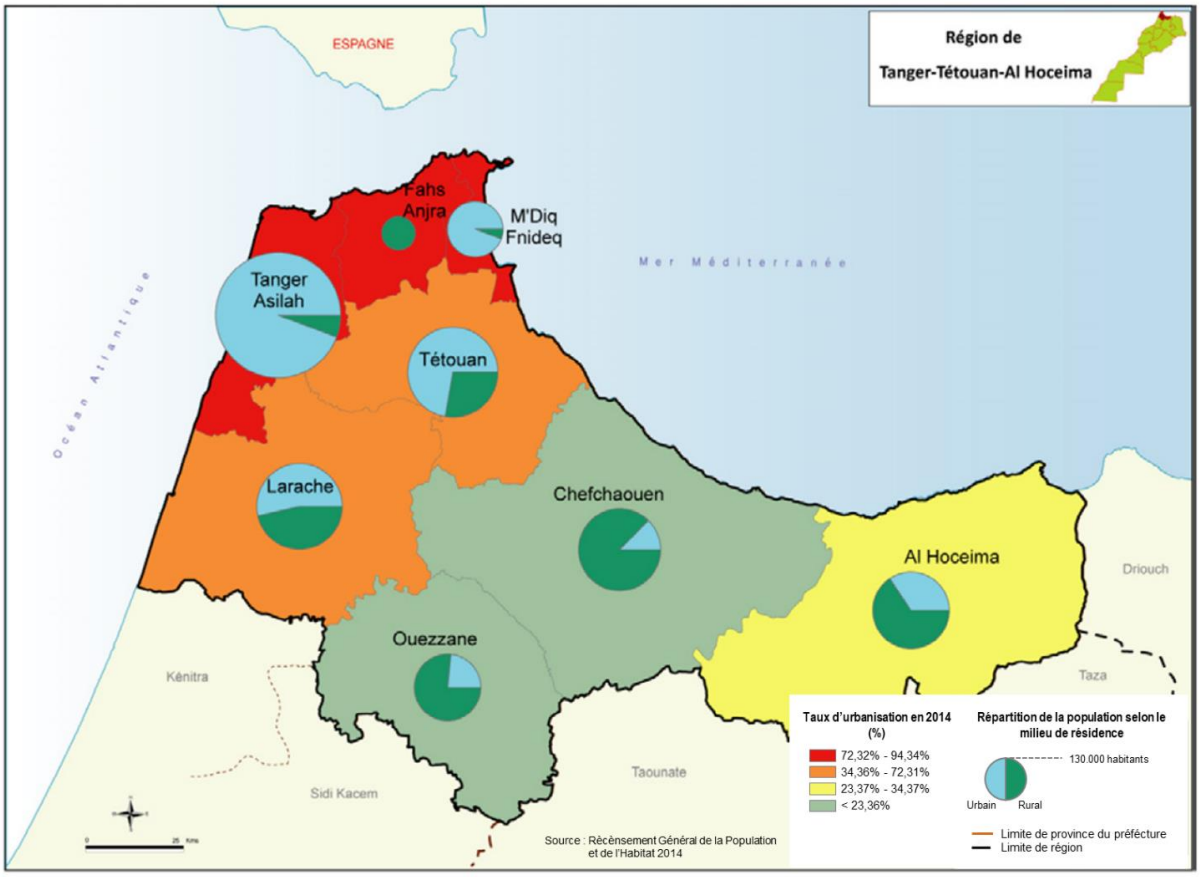
Figure 13. Municipal population density in 2014



TTA's active population is predominantly rural: the highest rate is in the Province of Al Hoceima: 52.4% followed by the Province of Chefchaouen with 51.9%. On the other hand, unemployment is higher in the Province of Tétouan and the Prefecture of Tangier-Assilah, which respectively record unemployment rates of 17.6% and 11.4%.

According to the General Population and Housing Census of 2014, the distribution of the population according to place of residence highlights the urban character of the region. In fact, 59.93% of the population live in urban areas, against 26.39% in rural areas. This urban population represents 25% of the Moroccan urban population. The Prefecture of Tangier-Assilah alone is home to almost half of the region's urban population (47%) while the Province of Tétouan is home to 19% and that of Larache 12%.

Figure 14. Urbanisation rate in 2014



This distribution of the population is largely due to:

- The emergence of several small urban or rural centres along the coastal strip;
- The development of touristic complexes leading to a gradual "hardening" of the coastline through the construction of hotel complexes or rows of second homes: 50% of touristic reception capacity is built there;
- The concentration of industrial activities: 80% of the permanent industrial workforce and 92% of foreign trade is located in the major cities of the region on the coastal axis.

A disconnect between the economy and demography, increased by significant migratory flows, is already appearing in TTA's urban spaces. According to the study "*Les relations entre la croissance démographique et le développement économique au Maroc*" elaborated by the Haut-Commissariat au Plan du Royaume du Maroc, the majority of development theorists are unanimous in recognizing that rapid and accelerating population growth rates poses serious problems, especially since the country's economic evolution cannot keep up with this rate. Indeed, this rapid population growth causes a decrease in available resources that are likely to improve the population's living conditions. A country with a high birth rate and a low mortality rate must necessarily devote significant resources to the construction of schools, hospitals, housing and other services needed by the population, knowing full well that the funds invested in these operations are socially indispensable, but not immediately productive.

It turns out that these resources are difficult to accumulate. The capital necessary for development, if it does not result from savings on income, must come from a loan. However, the daily needs of a large family leave little room for savings, whether for a household or for the whole nation. This is one of the reasons why one is obliged to turn to foreign investors or to contract international foreign loans which become a burden for future generations. Thus, this strong growth hinders economic development in two ways: first, a disproportionate share of available capital is used for social rather than economic purposes; second, the formation of capital itself is hindered, because the increase in production must be used to

support the excess population resulting from demographic growth, improve the living conditions of the existing population and generate a surplus to be reinvested into economic performance.

In the case of Morocco, its natural potentialities are capable of supporting this possible increase in population while improving the living conditions of the existing population, provided that its available resources are better used and distributed. The problem is not one of subsistence production, nor of the improvement of social organisation: the population limit is not fixed by means of subsistence or income, but by the equitable distribution of growth. Therefore, Morocco's position vis-à-vis birth prevention must differ significantly from other developing countries, since it should be considered as a means of combating underdevelopment. Indeed, any birth prevention policy presupposes an improvement in the social, cultural and economic levels of the population. Indeed, it is possible to determine the optimum number of people that lead to maximum wellbeing in a given community (optimum population). Despite the remarkable improvement in the social situation of TTA, the gaps are flagrant between its territories:

- The Provinces of Chefchaouen, Fahs-Anjra and Al Hoceima record very low Human Development Indexes compared to those of Tangier-Assilah and M'diq-Fnideq;
- This improvement does not concern the women of TTA, who still remain excluded from these improvements in the region's socio-economic dynamics;
- Disparities between urban and rural areas and between the sexes in terms of children's schooling, illiteracy, access to drinking water and sanitation network, access to employment, access to service public health, are still significant;
- Rural territories, particularly landlocked and under-equipped mountain areas, are hotspots of poverty and impoverishment, and are often the cause of rural exodus, depopulation of the countryside and mountains and "coastalisation", which contribute to accentuate territorial disparities;
- Unemployment in the region remains a mainly urban phenomenon: it reaches 11.5% in urban areas against 3.9% in rural areas. Unemployment also affects women more than men, since the female unemployment rate almost doubles compared to that of men, with 13.3% and 7.0% respectively. Unemployment affects women more in urban areas where they are the most affected with a rate of 22.3%. On the other hand, they constitute the category least affected by unemployment in rural areas, because of unpaid employment (family helpers) which remains widespread there. Finally, unemployment particularly affects young people: it is highest among workers aged under 25 with a rate of 22%.

Table 6 presents the distribution of some socio-economic indicators according to gender. The activity and employment rates are those which show the largest differences to the disadvantage of women.

Table 6. Selected socio-economic indicators according to gender in TTA

		Men	Women
Population- 2020 [6]		1,93 million	1,88 million
Breakdown of household heads by gender - 2014		85%	15%
Illiteracy rate -2014 [7]	Urban	13,5%	30,9%
	Rural	31,1%	58,8%
	Total	20,5%	41,8%
Activity rate – 2018 [8]	Urban	69,9%	15,6%
	Rural	77,9%	22,7%
	Total	72,9%	18,1%
Employment rate – 2018	Urban	63,8	12,4
	Rural	75,1	21,9
	Total	68,3	15,8
Unemployment rate – 2018	Urban	8,4%	20,5%
	Rural	3,6%	3,6%
	Total	6,3%	13,0%

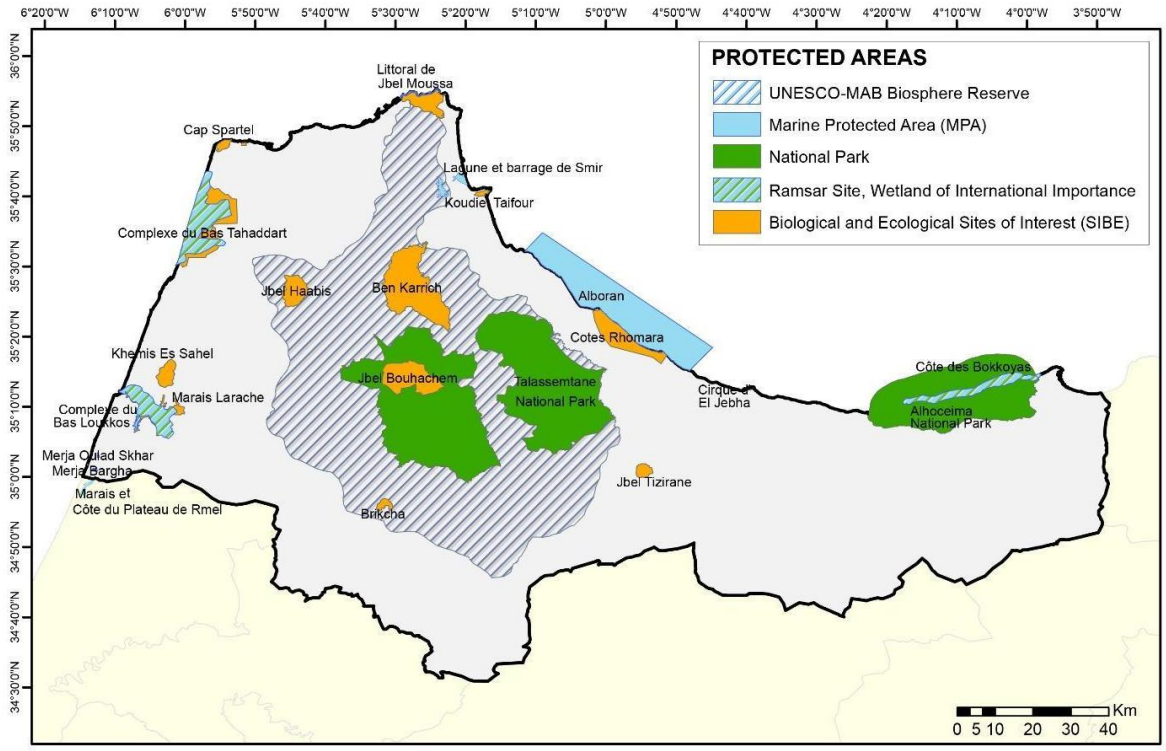
[6] GoM, Haut-Commissariat au Plan (2018), Projections de la population des provinces et préfectures de la région TTA
[7] GoM, Haut-Commissariat au Plan (2014), Recensement général de la population et de l'habitat
[8] GoM, Haut-Commissariat au Plan, Enquête Nationale sur l'Emploi

H. NATURAL RESOURCES AND ENVIRONMENTAL CHALLENGES

TTA comprises the Intercontinental Biosphere Reserve of the Mediterranean (RBIM) which extends over nearly one million hectares between Spain and Morocco. It is considered an important area of communication between Africa and Europe and counts a remarkable natural and cultural heritage as well as numerous touristic attractions. TTA also comprises:

- 22 Sites of Biological and Ecological Interest (SIBE), spread over the entire territory of the region and integrating maritime, coastal, continental and wetlands;
- 3 natural parks (out of 10 in Morocco): Bouhacheme Natural Park Project, Talasmtane Park and Al Hoceima Park;
- Ramsar sites: Complexe du Bas Tahaddart, Complexe du Bas Loukkos, Littoral de Jbel Moussa, Côte des Bokkoyas, Lagune et barrage de Smir and part of the Marais et Côte du Plateau de Rmel ;
- One Marine Protected Area: the Alboran MPA.

Figure 15. Protected areas of TTA



The main threats to the region's ecosystems and biodiversity are both anthropogenic and natural:

Natural threats mainly result from climate variability and change, leading to drying out, desertification, silting, loss of agricultural land, etc. For example, fires are increasingly threatening forests in TTA. The Rif is the region most affected by fires on a national scale: it loses approximately 1,185 ha/year, or 43% of the overall area burned at the national level.

Anthropogenic threats are related to urbanisation and coastal development, which consume more and more space and resources. These activities generate domestic and industrial pollution, which in turn induce health problems, the disappearance of ecological habitats and spaces vital to species. Growing food security needs also impact biodiversity through deforestation and overgrazing, compounded by the overuse of water resources for irrigation purposes. Furthermore, the overexploitation of fisheries due to the proliferation of fishing activities and certain fishing practices (particularly trawling) in TTA place additional pressure on marine ecosystems, and can lead to gradual resource depletion, as is the case with overfishing of certain species (tuna, sardines, swordfish, cephalopods, hake, crustaceans, coral...).

TTA mainly suffers from problems related to the **degradation of the environment**, **natural resources and the living environment**. These problems are diverse: land degradation, pollution of ecosystems and groundwater, deforestation of natural environments, etc. In recent decades, urban growth in the region, combined with population growth, contribute to the imbalance between housing supply and demand, the development of precarious and anarchic housing and the

proliferation of unsanitary and unregulated neighbourhoods. Rapid population growth has also affected the ability of municipalities and communes to monitor water quality and other environmental components, to provide drinking water and adequate sanitation services in emerging centres and rural communities, and to preserve the environment.

Concerning **soil resources,** agricultural and natural areas are under pressure. This is further exacerbated by urban expansion, damage caused by abandoned quarries without rehabilitation and the illegal exploitation of coastal dunes. The latter activity modifies the profile of the coastline and is probably one of the causes of coastal erosion, in addition to unbridled seaside urbanisation. The main causes of soil degradation in this region are highly eroding rains, a rugged topography, a shift towards intensive agriculture, overgrazing, increased urbanisation, quarrying, wind erosion and salinization.

I. WOMEN IN MOROCCAN SOCIETY

1. Employment and Economic Activities

Female labour force participation rate in Morocco, ranks in the bottom 20% of countries and that very little progress has taken place in the last 20 years (Islamic Development Bank, 2019). All in all, women earn 30-50% less than men depending on the sector. Morocco ranks 137th out of 149 countries on the World Economic Forum's Global Gender Gap Report's economic participation and opportunity indicator in 2018. This is unsurprising, given that women's labour force participation rate in Morocco has been on the decline since 1990. This rate declined from 30% to 26% between 1990-2010, and it currently stands at 24.9%. While the informal sector is not included in the data in Table 7, it has been observed that it employs many women who work as unskilled and non-unionized employees with no social security contributions and labour entitlements.

However, Morocco's manufacturing sector employs 191,000 women, approximately 31% of the workforce in the sector, of which 83% were skilled labourers. Almost half of the female employees were in the textile and leather industries, with the chemical and para-chemical sub-sector the least feminised at 12%, compared with 33% in the electrical and electronic industries and 27% in the agri-food industry.

Table 7 reveals that women are disadvantaged in all the working categories. There are more women in the unemployed, contributing family workers, or unpaid workers categories, -the non-paying classification. Furthermore, there are fewer women in the high skilled and own account workers categories, that are high paying. Finally, women earned almost four times less than men in 2017.

Table 7. Employment and Economic Activities

Categories	Female (%)	Male (%)
Unemployed	10.3	9.5
Estimated Earned Income (PPP)	3.445	13.075
High Skilled workers	2.8	5.5
Contributing family workers	47.3	12.5
Own account workers	16.5	33.6
Labor force participation rate	24.9	72.6

2. Agriculture

Women are the main stakeholders in the agriculture sector, and account for almost 50% of the rural population for whom agriculture is the main economic activity. Besides, they are 90% of the agriculture workforce and dominant across all the subsectors - grain and legume, industrial crop, strawberry, and stock breeding. Despite their dominance in the sector, women's work is either unpaid or underpaid, and they lack access to land, finance, and technical advice. Moreover, 73% of female labour is unpaid, and they earn 50% less than men, the largest gender wage gap for the same job and qualification of any sector in Morocco. However, women's land ownership is not commensurate with their participation rate in the sector as they owned only 7% and 1% of land in the urban and rural areas, respectively.

Most of these women are unskilled workers, with only 20.5% being owners. Their agricultural activities include planting, clearing, cutting, uprooting, milking, feeding, watering, among others, and are also involved in the processing of agricultural products. Even though new agricultural programs have been launched in recent years, the outreach to female workers is limited because there are few women agriculture extension workers. At the Ministry of Agriculture, women make up 27% but the number might increase soon as they now account for 50% of recent agriculture graduates in the country.

The Department of Agriculture's signature program, the *Plan Maroc Vert* (Green Morocco Scheme) was launched in 2010 but did not specifically include women in either of its two Pillars. Pillar One, aimed at maximizing production from modern large-scale farms through the promotion of agribusiness and investment and Pillar Two, on reducing poverty and hunger through the support of small-scale farmers in marginal areas. However, between 2011-2015, 7806 or 47% females engaged in the scheme's target projects and 1,779 women's cooperatives with 32,126 members benefited from the programs initiated under Pillar Two of the Scheme.

3. Education

Equity in primary school enrolment was almost at par between boys and girls in 2016. However, the differences between the sexes started manifesting towards the end of their primary education. For example, there are more female repeaters and fewer female students who finished the last grade of primary school and transitioned to secondary school. The difference between the sexes in the out-of-school children category is minimal, but is glaring among adolescents. Girls in rural areas are more likely to drop out after primary school. Tt is not surprising that the net enrolment in lower secondary school in 2014 was 33.7%, against 83.2% in urban areas. While lack of adequate sanitation and transportation facilities, poor transportation and sociocultural barriers impede girls' education in the rural areas, the most significant hurdle to girls pursuing their education is the distance to secondary schools.

Even though girls had lower enrolment rates at the secondary school level, they excelled in their graduation exams. They accounted for 49.4% of those passing the general examination, 58.4% of those graduating with a technical and commercial specialisation and 29.5% of those with a technical industrial specialisation. Furthermore, apart from Arabic and Islamic law, girls enjoyed better success in examinations. The literacy rate between the sexes is glaring. The technical, vocational and education training is limited to traditionally female courses such as embroidery, sewing, cooking, baking, and hairdressing. Moroccan female university graduates in 2017 were concentrated in the arts and humanities, business and law, health and welfare and the social sciences. In contrast, male tertiary institution graduates over the same period predominated in agriculture, engineering, information technologies, and services.

4. Entrepreneurship

In general, Morocco's entrepreneurship sector is characterised by an unfavourable business climate, characterised by a lack of finance and growth in both domestic and export markets as well as bureaucratic and legalistic obstacles. For women, it also includes socio-cultural discriminatory practices, lack of access to information, networks, market and inputs, and support programs, as well as mentors to guide them in developing their ideas. Female-owned enterprises are mainly small and medium-sized enterprises in services (37%), trade (31%) and manufacturing (21%). The number of women entrepreneurs declined from 12.5% in 1999 to 10.5% in 2014, more than 65% of these enterprises are managed by their owners and are more likely to export their products and access foreign investments than male-owned enterprises. Furthermore, only 40% of women have access to finance compared to 92.5% of men because they lack immovable collateral to guarantee their loans. Only 5% of female account holders use their account for business purposes compared to 23% of men.

In acknowledging the lack of credit for women and their low participation rate in entrepreneurship, the GoM notes that the development of women's entrepreneurship is the pathway to integrating them into economic and social development. To this end, the GoM, in partnership with various development partners, has put in place women-specific programs to promote female entrepreneurship. Among these are the "*Ilayi*", "*Infitah min Ajiliha*", "*Wad' Yati*", and auto-entrepreneurs. The Security Fund, "*Ilayji*" ("For You") was launched in March 2013 to encourage banks to provide loans to female entrepreneurs. Since the launch of the program to September 2015, the Fund provided a total of 81.5 million Dirhams in loans to 236 enterprises and created jobs for 762 persons. Although there are no gender quotas in the gender-neutral programs, women's participation rate ranges from 10%-50%. The Association of Women Enterprises in Morocco (AFEM) was launched in 2006 to provide technical, mentorship, and capacity building to assist future female entrepreneurs. The Ministry of Handicraft and Social and Solidarity Economy strengthened vocational and continuing education by building

new institutions and upgrading old ones. Young people were encouraged to take up handicraft professions (53% females) and training in accounting and management (28% female).

5. Water Supply and Sanitation

Morocco is a highly-stressed water country: its renewable water resources amount to less than 600 m^3 per person/year. While drinking water production increased fivefold over the past three decades, the storage capacity of the 145 dams lies below annual water consumption. The provision of social amenities such as water, sanitation, all-weather roads and energy services will reduce women and girls' time poverty by lessening the time used in performing burdensome tasks such as fetching water, collecting firewood and searching for a safe place to defecate. For instance, the provision of water in schools and homes (or close to homes) has reduced school dropout rates, increased attendance and completion rates, thereby paving the way for their employability later in life. In the case of women, the provision of water in the homes or nearby has given them the opportunity to engage in income-earning activities, leading to economic empowerment as a result of the time saved from fetching water. The draft Water Law provides for a gender quota of at least one-quarter of women in regional water committees, basin councils and the Supreme Council. Furthermore, the proposed law calls for the institutionalisation of gender mainstreaming in the development and management of water resources. Hopefully, the implementation of the gender provisions in the law will increase women's participation in the Agriculture Water Users' Association.

6. Energy

Even though Morocco is an energy insecure country, its electrification rate increased from 18% in 1996 to 99% in urban areas, and 97% in rural areas in 2015. Morocco imports more than 94% of its energy needs. Coal and oil are imported from global markets, supplemented by gas and electricity from Algeria. Despite Morocco's preference for fossil fuels for its energy needs, the country has wind, solar and hydropower capacity. This would increase its share of sustainable energy to 42% by 2020 (it stood at 34% in 2015). The Tarfaya wind farm, the continent's biggest wind power was inaugurated in 2014, and the Noor Ouarzazate Solar Complex, one of the largest concentrating solar power facilities in the world switched on in 2016, are leading the way towards Morocco achieving its goal of achieving energy self-sufficiency. In 2016, King Mohammed VI announced the possibility of increasing Morocco's share of renewable energy to 52% by 2030 with appropriate financing. Noor Ouarzazate adopted gender equality and social responsibility compensation to ensure that every group reaps benefits from its presence, thus establishing a community-based instead of individual compensation scheme. For example, instead of paying out cash for appropriated land, which would have benefited only male landowners, they invested in basic amenities and social services such as drainage and irrigation channels, drinking water facilities, and mobile health caravans. Other projects such as the construction of a dormitory for female students, sport, and camp programs benefited only women.

Due to their inadequate qualifications, women's participation in the workforce is low at only 4%. Their work encompasses traditional sectors such as cleaning, catering, and administration, and in technical areas, they are found in quality control and the health and safety units, and in highly skilled positions they work as topographer and welder. The GoM's gender-specific energy provision under the Morocco Global Electrification program aims to achieve 99.7% rural electrification through solar power between 2006-2016 across 2,970 villages. The beneficiaries will be women and children in homes, schools, health centres, agriculture, among others. The wood energy program will provide improved cookstoves to rural women of 5 kg of wood instead of the 20 kg wood required by the older, more inefficient models. Regrettably, both initiatives to promote gender equality in the renewable energy sub-sector do not include programs to support female entrepreneurship or women's ability to participate in decision-making in the energy sector.

7. Rural Development

Morocco's rural program provides an integrated development package to increase access to necessary social infrastructure and services (roads, electricity, schools with separate toilets for girls, boys, and teachers, hospitals, water and sanitation), and boosting rural incomes. There has been noteworthy progress in the provision of social amenities in rural areas. The new road network covers about 3 million inhabitants. Primary school enrolment in rural areas has also increased substantially, with girls' enrolment rising by 7.4%. Through the program, an increase in the number of visits to health facilities took place, complemented by a substantial reduction of tedious chores such as firewood collection. Butane gas for cooking is now delivered to their homes, with beneficial effects on indoor air quality as well.

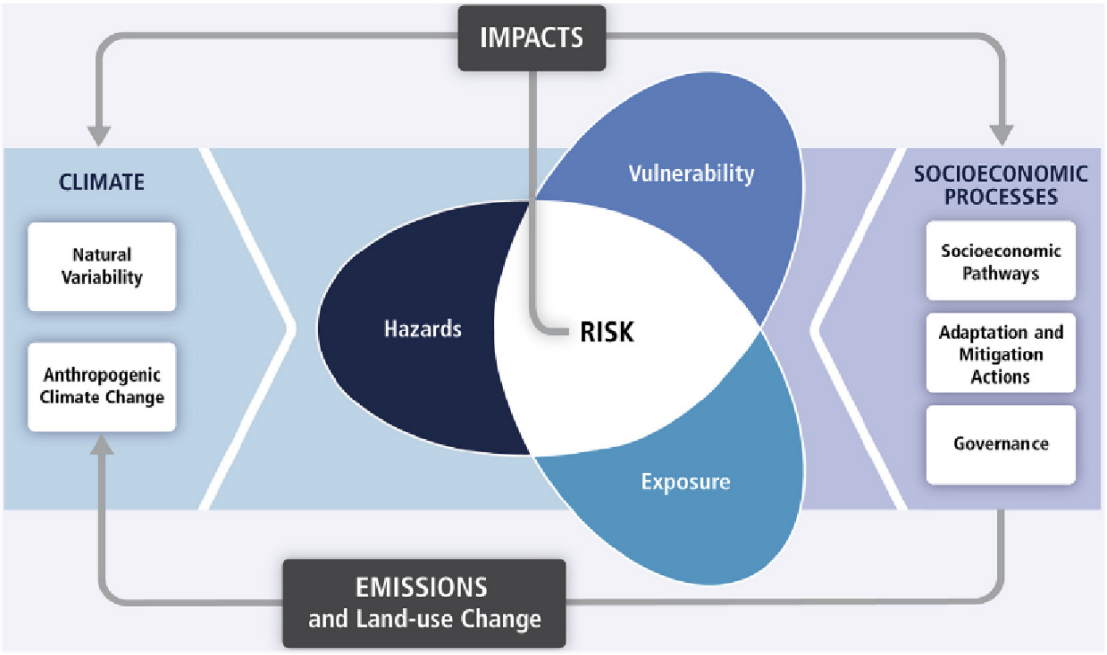
V. Application of the Multi-Scale Coastal Risk Index at the Local Scale (CRI-LS) in TTA

A. CRI-LS: CONCEPTS AND STEPS

The conceptual framework for risk and vulnerability refers to the concept of risk defined in the last reports of the IPCC (AR 4 to AR6). In particular, according to the Sixth Assessment Report (AR6), **risk is defined as the potential for adverse consequences for human or ecological systems, recognizing the diversity of values and objectives associated with such systems**. In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system. In the context of climate change responses, risks result from the potential for such responses not to achieve the intended objective(s) or from potential trade-offs or negative side-effects. **Risk management is thus defined as plans, actions, strategies or policies to reduce the likelihood and/or magnitude of adverse potential consequences, based on assessed or perceived risks.**

Figure 16 shows Risk as a product of an interaction between hazards associated with climate change and variability on one side, and the vulnerability and its exposure to hazards on the other side (IPCC, 2014b). Climate and non-climate forcing acting on coastal hazards, namely erosion and flooding, generate risk. **In the MS-CRI index, forcing and hazard are incorporated in one factor called hazards (H), which interacts with the vulnerability (V) and exposure (E) factors.** The definition of spatial attributes and the selection of variables is carried out on the basis of the relationships among these three factors.

Figure 16. The interaction among the physical climate system, exposure, and vulnerability producing risk



Source: IPCC, 2014b

According to Figure 16 (IPCC, 2014b), vulnerability and exposure are influenced by development (socio-economic pathways, adaptation and mitigation actions and governance). Climate and development changes represent the key drivers of the different core components (vulnerability, exposure, and hazards) that contribute to risk (IPCC, 2014b). In sum, Risk can be considered as a function of three factors:

Risk = f (hazards, vulnerability, exposure)

As proposed by other indices in the scientific literature (Davidson and Lambert, 2001; Peduzzi et al., 2009), Risk (R) follows a multiplicative formula, based on the standard formulation of risk "as the product (or more correctly, convolution) of hazards, exposure, and vulnerability" (Davidson and Lambert, 2001) as described in the simplified equation:

R = H * V * E

The **Multi-scale coastal risk index (MS-CRI) (**Satta et al., 2015) was implemented and tested within the framework of the ClimVar Project. The Multi Scale Coastal Risk (MS-CRI) consists of an index-based approach dealing with qualitative and quantitative spatial attributes, representing physical, environmental and socio-economic variables of the coastal system. The MS-CRI provides a simple numerical basis for ranking sections of coastline in terms of their potential for change. This can be used by managers to identify regions where risks may be relatively high, and the results can be displayed on maps. Thus, the MS-CRI:

- is a multi-scale risk assessment approach;
- integrates the theoretical framework of AR5 (IPCC, 2014a);
- integrates a large set of socio-economic variables;
- risk assessment targets are represented by variables that are separated into three sub-indices;
- takes the interaction among different subsystems into account and presents an easy calculation process to analyse the different vulnerability factors;
- outcomes consist of vulnerability and risk maps.

The MS-CRI can thus be expressed as the product of three factors: Coastal Hazards (CH), Coastal Vulnerability (CV) and Coastal Exposure (CE). The MS-CRI equation can be expressed as follows:

MS-CRI = CH * CV * CE

The MS-CRI combines multiple variable layers, representing different aspects of risk, in sub-indexes (hazard, vulnerability and exposure) layers, in such a way that risk 'hotspots', as well as areas of relatively lower risk, emerge from the integration of the layers.

The application of the MS-CRI at the local scale (CRI-LS) aims to support policy makers and coastal managers to evaluate how climate and non-climate forcing interact with existing hazards to impact the coastal zones. The CRI-LS methodology aims to integrate the provisions of the Article 8 of the ICZM Protocol that requests Mediterranean countries to define a coastal hazard zone. As a direct policy implication, the CRI-LS provides a definition of the coastal hazard zone and a set of risk maps that can assist policy makers in prioritising coastal management efforts that need to be undertaken to minimise risks or mitigate the consequences of climate and non-climate related hazards**. This tool can easily be integrated into overall coastal management and adaptation strategies to support the implementation of the ICZM Protocol, with particular reference to the ongoing elaboration of a Coastal Plan for TTA, the *Schéma régional du littoral*, led by PAP/RAC in the context of MChild Project 2.1 of the GEF MedProgramme, and informed by Plan Bleu/RAC's participatory foresight methodology, Climagine.** Indeed, a test of Multi-Scale Coastal Risk Index application at the Local Scale (CRI-LS) has been already performed on the coastal zone of Tétouan (Satta, 2016). The same method was used for this study concerning TTA.

The distinguishing feature of the application of the MS-CRI at the local scale (CRI-LS) lies in the definition of a methodology to define the limits of the coastal hazard zone and the setback line. The coastal hazard zone, considered as a coastal area where the risk occurs, represents the spatial field of application of the method (Satta, 2014). The CRI-LS methodology is articulated around five main steps:

1. Definition of the coastal hazard zone;
2. Variables choice and ranking;
3. Assignation of weights to risk variables;
4. Aggregation of variables, sub-indices and final index calculation;
5. Construction of the risk maps.

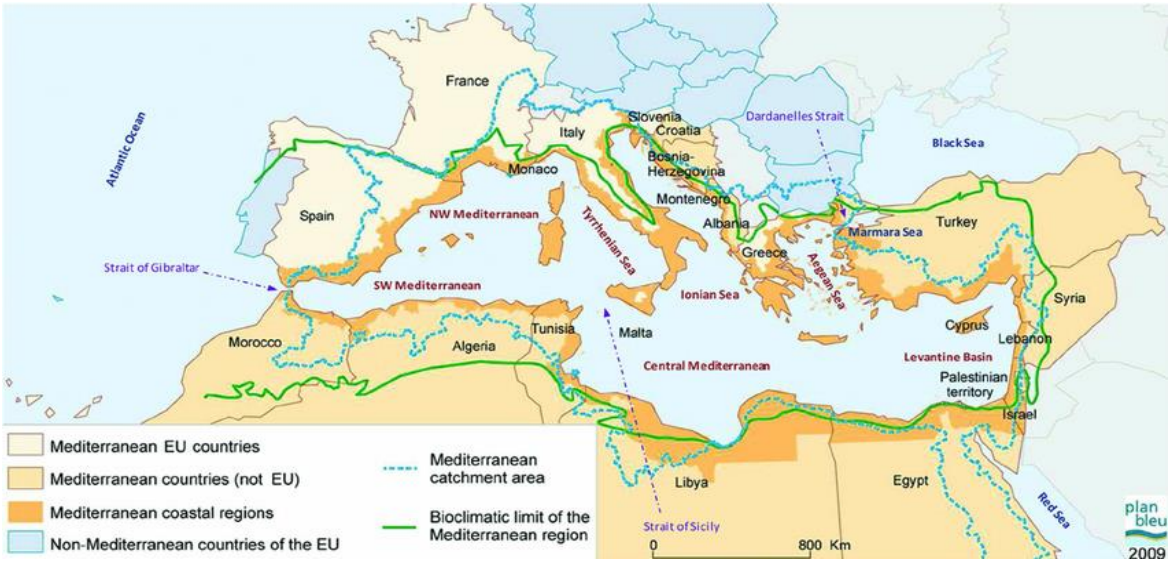
A description of the main steps is described below.

1. Step 1: Definition of the coastal hazard zone

The coastal hazard zone is defined as *"the coastal zone affected by the occurrence of the hazard effect, which has the potential to cause damage to, or loss of, natural ecosystems, buildings, and infrastructure"* (Satta, 2014). In other words, the coastal hazard zone is the landward limit of the buffer zone situated behind the coastline, in which an acceptable level of risk produced by coastal forcing is observed (Satta, 2014).

There is no specific definition in the scientific literature in terms of the best scientific methods to identify the coastal hazard zone (Satta, 2014). Nevertheless, there are some operational definitions developed in the technical literature, and related to the needs of coastal planning. For this study, and in order to have enough information to analyse the links between climate impacts and gender gaps, the methodology has been applied to Morocco's Mediterranean coastal region.

Figure 17. A multi-dimensional Mediterranean region



Source: Plan Bleu, 2009

2. Step 2: Variable selection and ranking

For the calculation of the CRI-LS, three sub-indexes are required: coastal hazard, coastal vulnerability and coastal exposure. The choice of variables to be applied for the TTA study starts from the classes proposed by Satta (2014) and adjustments applied for the study of risks of climate-related hazards in coastal zones for the local context of Tétouan (Satta, 2016). The variables and related rankings used for the Tétouan case study are presented in Table 8.

Following Torresan et al. (2012), the allocation of scores assigned to variables was performed using a 1-5 scale. The 1-5 scale, used for every variable, standardises the scoring system and enables variables measured in different units to be combined mathematically (McLaughlin and Cooper, 2010). The maximum score 5 is assigned to the highest risk class of the variable in terms of its relative contribution to generate risk and in the same way, the minimum score 1 is assigned to the lowest risk class in the subset of classes defined for each variable (Torresan et al., 2012).

Table 8. Choice and ranking of the variables used for the CRI-LS index for the Tétouan case study (2016)

Variable	Description	Unit	Score 1	2	3	4	5
Coastal Hazard							
SLR (SLR)	Level of the sea increased in one year. Satellite altimetry data provides accurate measures for a limited time range.	mm/y	< 1	1 – 1,6	1,7 – 2,4	2,5 – 3,2	N > 3,2
Storms (SWH)	Average number of detected SWH above 95 percentile / year (SWHx95p), which represents the number of events exceeding the long term (e.g., return period Tr = 100 years) 95 percentile of daily SWH.	cm	< 50	50 – 150	151 – 250	251 – 350	> 350
Droughts (DRO)	Significantly driest winters experienced by the Mediterranean regions during 1971-2010, relative to the comparison period of 1902-2010. Low values indicate a scarce sediment supply to beaches, contributing to erosion.	mm	> 36	36 – 12	11 – (-12)	-13 – (-36)	< -36
Mean Annual Max Daily Precipitation (MDP)	Equal to the highest amount of precipitation received during the year, averaged over 30 years. Daily rainfall categories adapted from Alpert et al. (2002).	mm/d	< 16	16 – 32	33 – 64	65 – 128	> 128
Population growth (PGR)	Population growth (annual %) is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage.	%	< 0,1%	0,1% – 0,5%	0,51% – 1%	1,01% – 2%	> 2%
Tourism arrivals (TOUR)	International inbound tourists are the number of tourists who travel to a country other than that in which they have their usual residence.	%	> 0%	0% – 1%	1,01% – 5%	5,01% – 10%	> 10%
Coastal Vulnerability							
Landform (LF)	Expresses the erodibility of the coastal zone. Scores are ranked according to the relative resistance of a given landform to erosion.	Qualitative	Hard rock shores	Soft rock shores	River deltas, estuaries and cobble beaches	Sandy shores backed by bedrock or artificial frontage	Sandy shores and water plains
Coastal slope (SLO)	Related to the relative risk of the shoreline retreat. Low sloping coastal regions should retreat faster.	%	> 0,1	0,1 – 0,05	0,049 – 0,034	0,033 – 0,02	< 0,02

Variable	Description	Unit	Score 1	2	3	4	5
Land roughness (LR)	Represents the resistance to surface flow exerted by the land surface and is measured with Manning's coefficient.	Manning's coefficient	Urban areas	Forest and water bodies	Shrubland, grasslands, sparse vegetation	Agriculture	Bare areas
Historical Shoreline change (HSC)	Percentage of eroded coast / sediment budget.	%	> 30% in accretion	30% – 10% in accretion	9,9% – -9,9% stable	10% - 30% erosion	> 30% erosion
Elevation (ELE)	Represents the surface of selected coastal unit (pixel) within a specific class of elevation Xi (e.g., 0.15m_Xi _ 0.3 m).	m	8 – 5,26	5,25 – 3,6	3,59 – 2,76	2,75 – 1	< 1
Distance from the shoreline (D)	Related to progression of the risk according to the inland penetration of the flooding.	M	> 4.500	4.500 – 2.100	2.099 – 900	899 – 300	< 300
River flow regulation (RFR)	Represents the impact of any dam infrastructure on rivers in terms of flow regulation that is negative in terms of new sediment contribution (Oziurt, 2007).	m^3/s	No dams	/	Dams only in the minor tributaries	/	Dams in the largest tributary
Ecosystems health (EH)	Expresses the contribution of the ecosystem as a protection against storm surges, flooding and other coastal hazards. Ecosystems include coral reefs, seagrass beds, sand dunes, coastal wetlands and coastal forests.	Qualitative	No detectable change	Slight signs of disturbance	Moderate distortions with loss of 50% of species	Major distortions	Severe distortions with loss of all species
Education level (EDU)	Percentage of population whose level is equal at least to Level 3 of the international standard classification of education (ISCED).	%	> 60	60 – 44	43 – 28	27 – 10	< 10
Age of population (P65)	The oldest and the youngest are expected to be the least able to absorb and respond to changes.	%	< 3	3 – 8,5	8,6 – 15	16 – 20	> 20
Coastal protection structures (CPS)	Artificial protection structures to prevent coastal erosion.	%	> 50	50 – 31	30 – 21	20 – 5	< 5
Coastal Exposure							
Land Cover (LC)	Physical material on the surface of land in coastal zones.	Qualitative	Bare areas	Shrubland, grasslands, sparse vegetation	Forest and water bodies	Agriculture	Urban areas
Population density (PDE)	The population density is derived by dividing the population count grids by the land area grid. It represents population per km^2.	pop / km^2	< 25	26 – 50	51 – 100	101 – 250	> 250

Source: Satta, 2016

3. Step 3: Assignation of weights to risk variables

The integration of expert judgements is very important for the allocation of scores to physical, natural and ecological variables, while the role of policy makers is fundamental in evaluating socioeconomic parameters (Satta, 2014). With the aim to assign weights to each variable on a large and participatory basis, a panel of scientific experts and local policy makers was involved for the application of the CRI-LS to the coastal zone under analysis in 2022. They were selected from the inventory of stakeholders to engage in the participatory process of the TTA Coastal Plan, which was elaborated in the framework of the MedProgramme (cf. Annexes 1 and 2).

4. Step 4: Aggregation of variables, sub-indices, and final index calculation

The numerical values for the three sub-indices (coastal hazard, coastal vulnerability and coastal exposure) have to be weighted according to value judgements and multiplied through a GIS raster calculator function. The formulas for deriving the three sub-indexes are reported below:

Coastal Hazards (CH) sub-index	$\{[(W_{SLR} * S_{SLR} + W_{SWH} * S_{SWH} + W_{CI} * S_{CI} + W_{AI} * S_{AI} + W_{PGR} * S_{PGR} + W_{TOUR} * S_{TOUR}) - 1] / 4\}$
Coastal Vulnerability (CV) sub-index	$\{[(W_{SLO} * S_{SLO} + W_{ELE} * S_{ELE} + W_{D} * S_{D} + W_{LR} * S_{LR} + W_{EH} * S_{EH} + W_{ILR} * S_{ILR} + W_{LEB} * S_{LEB} + W_{ACTR} * S_{ACTR} + W_{EDU} * S_{EDU} + W_{PR} * S_{PR} + W_{PD} * S_{PD} + W_{PM} * S_{PM}) - 1] / 4\}$
Coastal Exposure (CE) sub-index	$\{(W_{LC} * S_{LC} + W_{PDE} * S_{PDE}) / 4\}$

S and W indicate respectively the score and the weight of the variables of each sub-index. The formulas allow us to calculate an index included from 0 to 1.

The final CRI-LS index is computed by multiplying the three sub-index values, as shown in the formula below:

CRI-LS = CH sub-index * CV sub-index * CE sub-index

5. Step 5: Elaboration of the risk maps

The risk maps represent the main outcome of the CRI-LS methodology. In order to build them, it is necessary to define the minimum size of the pixel according to the resolution of the different variable layers. Smaller pixel dimension corresponds to a higher resolution and better results. Each pixel score is calculated using a GIS raster calculator function, which allows performing calculations based on existing pixel values and obtaining the results written into a new raster layer. The results must then be categorised by creating classes as a percentage of the maximum and minimum possible scores.

B. GENDER-SENSITIVE CRI-LS: VARIABLES CONSIDERATIONS

As mentioned above, the TTA gender-sensitive Climate Risk Assessment was developed using the same Multi-Scale Coastal Risk Index application at the Local Scale (CRI-LS) as for the Tétouan case study. This also allowed for a thorough review of the variables used in this case study in 2016 in order to:

- Concretely represent the main coastal hazards, vulnerability and exposure of the overall TTA;
- Focus on gender-sensitive analysis.

During the study, a comprehensive review of available studies and data for the development of the TTA gender-sensitive Climate Risk Assessment was conducted through consultations with relevant stakeholders and reviews of related databases and studies, in order to:

1. Assess the availability of existing climate risk assessments for TTA and collect data required for the replication of the CRI-LS methods already applied to Tétouan Satta, 2016) to the entire TTA area;
2. Understand how to integrate gender aspects into the CRI-LS.

The main consulted stakeholders and resources were:

- Direction Régionale de TTA - TTA's Regional Environmental Directorate
- Système d'Information Régional de l'Environnement et du Développement Durable (SIREDD) de la région de Tangier Tétouan Al Hoceima (Ministère de la transition énergétique et du développement durable - Département du développement durable)
- Ministère de l'Equipement, du Transport, de la Logistique et de l'Eau
- Haut Commissariat au Plan [9]
- Agence du Bassin Hydraulique du Loukkos : Projet du plan directeur intégré des ressources en eau des bassins du Loukkos, du Tangérois et côtiers méditerranéens
- Ministère de l'économie, des finances et de la réforme de l'administration: Profils régionaux and Coûts économiques des inégalités de genre dans le marché du travail au Maroc (2021)
- Ministère de la santé : Enquête Nationale sur La Population et la Santé Familiale (ENPSF -2018)

1. Climate-related variables

Starting with an overall characterization of TTA, and relying on the methodology to be applied, the assessment of existing data and information mainly focused on:

a. Verifying the validity of climate change and environmental variables of the CRI-LS method already applied for Tétouan (Table 8). The validity may depend on the main characteristics of the region and/or availability of the same type of data for the overall region.
b. Selecting alternative variables compared to those used for the CRI-LS method already applied for Tétouan (Table 8). Depending on data available for the whole of TTA, different variables may be selected by taking the main characteristics of the region into account.). The validity may depend on the main characteristics of the region and/or availability of the same type of data for the overall region.

It must be highlighted that as the TTA is a new administrative unit (created in 2015), no climate risk assessment studies covering the whole area are available yet, and there are no climate change data available at the regional level yet either.

As briefly described in Chapter 2, TTA borders both the Mediterranean Sea and the Atlantic Sea, the meteorological-climatic characteristics of which are different. What is more, both interfaces are characterised by a great variability in terms of geomorphology, climate, biodiversity, as well as socio-economic characteristics (e.g., different main economic sectors in the 6 provinces). Available data and information therefore differ in terms of data sources, methodology used and frequently in terms of distribution and resolution.

Many studies have been carried out for the province of Tétouan, which was identified as a hotspot for climate change at the Mediterranean level, but the same results cannot be extended to the other provinces. As regards to socio-economic data, specifically, some data are available at the local level (e.g., municipal level), others at the provincial level, and others only at the national level. Moreover, at the local and province levels, data are not always homogeneously distributed and available (i.e., lack of some municipalities or provinces).

According to these main findings, a thorough analysis of the variables to be used for the application of the CRI-LS for TTA was conducted, with specific focus on the maintenance or replacement of those variables whose required data are available

[9] With specific reference to:
- Annuaire statistique de la Région Tangier-Tétouan- Al Hoceima (2019)
- Atlas sociodémographique de la Région Tangier-Tétouan- Al Hoceima (2016)
- La Femme marocaine en Chiffres - 20 ans de progrès, 2021
- La Femme marocaine en chiffres - tendances d'évolution des caractéristiques démographiques et socioprofessionnelles, 2008
- La femme marocaine en chiffres - Évolution des caractéristiques démographiques et socioprofessionnelles, 2020
- La femme marocaine en chiffres - Évolution des caractéristiques démographiques et socioprofessionnelles, 2020 (Excel Format)
- Monographie de la Région Tanger-Tétouan- Al Hoceima, 2018
- Monographie provinciale d'Al Hoceima, 2017
- Monographie provinciale de Chefchaouen, 2019
- Monographie provinciale de Larache, 2019
- Monographie de la Préfecture de M'diq Fnideq, 2018
- Monographie préfectorale de Tangier, 2017
- Monographie provinciale de Tétouan, 2019
- Cartographie de la pauvreté régionale, 2004-2014_rtta (Excel File)

(or can be easily made available) for the entire study area. **MEDSEA's selection of variables was therefore based on the availability of data, while bearing the replication potential of the same methodology to other case studies in mind**. Table 9 summarises the considerations on required variables to be used for TTA studies and related data concerns, i.e., availability, data sources, compared to the original methodology already applied for the Tétouan case study (Satta 2016).

Table 9. Consideration on variables to be used for the CRI-LS index for TTA and first data analysis

Variable used for the Tétouan study	Description	Unit	Data sources for Tétouan study	Data search - main findings for TTA	Variable considerations/changes
Coastal Hazard					
SLR (SLR)	Level of the sea increased in one year. Satellite altimetry data provides accurate measures for a limited time range.	mm/y	AVISO database https://www.aviso.altimetry.fr/en/data.html Georeferenced image at Medit. Sea level (25km px resolution)	AVISO database https://www.aviso.altimetry.fr/?id=1599 Geo-tiff image (25 km pixel resolution)	**This variable is confirmed.**
Storms (SWH)	Average number of detected SWH above 95 percentile / year (SWHx95p), which represents the number of events exceeding the long term (e.g., return period Tr = 100 years) 95 percentile of daily SWH.	cm	El Mrini (2011) & Niazi (2007) Tables - According to the iso-values of the SWH trends map (within 500m offshore from the shoreline). The studies cover only the Tétouan area.	Copernicus Climate Change Service Dataset title: Ocean surface wave indicators for the European coast from 1977 to 2100 derived from climate projection. Periods: 2041-2070, 2071-2100 https://cds.climate.copernicus.eu/cdsapp#!/dataset/sis-ocean-wave-indicators?tab=overview accessed: 6/01/2022 Resolution: Coastal grid point of 30km	**This variable is confirmed.** The Horizontal coverage of the Copernicus data is the European coastline along the 20 m bathymetric contour, and also includes Morocco's coastline. The wave model is built considering the climate scenario of RCP4.5 and a return period of 100 years.
Mean Annual Max Daily Precipitation (MDP)	Equal to the highest amount of precipitation received during the year, averaged over 30 years. Daily rainfall categories adapted from Alpert et al. (2002).	mm/d	http://www.water.gov.ma/ Statistical data	Several sources of information are available on Annual average precipitation. Daily precipitations may be available for monitoring stations, but considering the great variability of elevation and climatic conditions, a simple interpolation of recorded data may yield results that are not relevant for the study. Long term forecasts are not available. Some studies refer to the Daily precipitation concentration index (CI) that is used as a concentration measure. A high precipitation CI value indicates that precipitation is more concentrated within a few rainy days during the year and vice versa. Studies shows that CI is an estimator of erosivity and aggressivity of rainfall, but it should be considered that this study may not be available, nor easily replicated.	The variable shall be substituted by the **Daily precipitation concentration index (CI).**
Droughts (DRO)	Significantly driest winters experienced by the Mediterranean regions during 1971-2010 relative to the comparison period of 1902-2010. Low values	mm	NOAA website Medit. Countries - image (.jpg)	Drought maps covering the whole area do not seem to be available. Available Maps can refer to the Desertification and Aridity indexes. Notes: Drought is the deficit of rainfall over a long period, such as a season, a year or several years, related to the statistical average of a region. Desertification is "the degradation of dry, semi-arid and sub-humid lands resulting	The variable shall be substituted by the **Aridity Index.**

Variable used for the Tétouan study	Description	Unit	Data sources for Tétouan study	Data search - main findings for TTA	Variable considerations/changes
	indicate a scarce sediment supply to beaches, contributing to erosion.			from various factors, such as climatic variations and human activities", as defined by the United Nations Convention to Combat Desertification (UNCCD). Among these factors, the most devastating is deforestation. Aridity is a measure of 'dryness' of the climate expressed as the ratio of precipitation to evapotranspiration; the lower the ratio the drier the climate.	
Population growth (PGR)	Population growth (annual %) is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage.	%	https://www.hcp.ma/	Data on total Population growth is available, but women population growth is not available. Women growth could be estimated, as women represent almost 50% of the total population.	**The variable is confirmed.** It represents a forcing on the territory as a total population growth.
Tourism arrivals (TOUR)	International inbound tourists are the number of tourists who travel to a country other than that in which they have their usual residence.	%	https://mtataes.gov.ma/fr/tourisme/	International tourists by province available.	**This variable is confirmed.** Tourism is an important economic activity for the region. However, it is not the only one: agricultural activity in TTA seems most important. However, tourism is more important for coastal provinces and this variable may be maintained as an expression of socio-economic exposure for the coastal provinces.
Coastal Vulnerability					
Landform (LF)	Expresses the erodibility of the coastal zone. Scores are ranked according to the relative resistance of a given landform to erosion.	Qualitative	Niazi, 2007 The map covers the entire Moroccan Mediterranean border.	The map used for Tétouan study belongs to the CRI-MED application and covers the entire Moroccan Mediterranean border. New data sources to be found for the Atlantic coastal side. Unfortunately, required data are not available.	**This variable is removed.**
Coastal slope (SLO)	Related to the relative risk of the shoreline retreat. Low sloping coastal regions should retreat faster.	%	Niazi, 2007	Coastal slope can be derived from Elevation (ELE) by means of GIS tools.	**The variable is confirmed.**
Land roughness (LR)	Represents the resistance to surface flow exerted by the land surface and is measured	Manning's coefficient	Chow, 2009	The variable "land roughness" varies according to the land cover. Data can be obtained from LC maps.	**The variable is confirmed.**

Variable used for the Tétouan study	Description	Unit	Data sources for Tétouan study	Data search - main findings for TTA	Variable considerations/changes
	with Manning's coefficient.				
Historical Shoreline change (HSC)	Percentage of eroded coast / Sediment budget.	%	El Mrini (2011) & Niazi (2007)	The map used for Tétouan study belongs to the CRI-MED application and covers the entire Moroccan Mediterranean border. New data sources to be found for the Atlantic coastal side. Unfortunately, the required data are not available.	**The variable is removed.**
Elevation (ELE)	Represents the surface of selected coastal unit (pixel) within a specific class of elevation Xi (e.g., 0.15m_Xi _ 0.3 m).	m	GIS DEM Image resolution 90m	European Space Agency, Sinergise (2021). Copernicus Global Digital Surface Model (DSM). Distributed by OpenTopography. https://doi.org/10.5069/G9028PQB. Accessed: 26/01/2022 DEM at 100m resolution may be available.	**The variable is confirmed.**
Distance from the shoreline (D)	Related to progression of the risk according to the inland penetration of flooding.	m	GIS	Distance from the shoreline can be derived by GIS tools.	**The variable is confirmed.**
River flow regulation (RFR)	Represents the impact of any dam infrastructure on rivers in terms of flow regulation that is negative in terms of new sediment contribution (Oziurt, 2007).	m^3/S	www.water.gov.ma	Information on rivers and dams have been found in the *Monographie Générale* of TTA	**The variable is removed.** Consideration: considering the scale of the study, this variable may lose relevance.
Ecosystems health (EH)	Expresses the contribution of the ecosystem as a protection against storm surges, flooding and other coastal hazards. Ecosystems include coral reefs, seagrass beds, sand dunes, coastal wetlands and coastal forests.	Qualitative	Bibliography & expert judgement	The source of the Protected areas of Morocco is the World Database on Protected Areas (WDPA), UNEP and IUCN: www.protectedplanet.net	**This variable is retained but in terms of the presence/absence of protected areas.** The presence of a protected area (that imposes a certain level of management) is an important variable in terms of natural mitigation of coastal hazards.
Education level (EDU)	Percentage of population whose level is equal at least to Level 3 of the international standard classification of education (ISCED).	%	www.hcp.ma	Some data related to education are available at the province level, and for some of them, also by gender, such as: – School enrolment rate (in %) of children aged 7-12 by gender and province/prefecture, 2014 (Source: HCP) – Secondary level by sex, and province, 2018-2019 (Source: *Académie Régionale de l'Education et de Formation*) – Education level (Coastal provinces) (College level), by gender (Source: HCP).	**The variable is substituted by other gender variables**.

Variable used for the Tétouan study	Description	Unit	Data sources for Tétouan study	Data search - main findings for TTA	Variable considerations/changes
				Other information is available at the national level.	
Age of population (P65)	The oldest are expected to be the least able to absorb and respond to changes.	%	www.hcp.ma	Data available at the province level.	**The variable is substituted by other gender variables**.
Coastal protection structures (CPS)	Artificial protection structures to limit coastal erosion.	%	Expert evaluation	New data shall be collected or reconstructed by means of digitalization into GIS of a dedicated layer. For the Mediterranean Coast, the following data could be used, from IMAP/Indicator 16 - *Couche SIG: «Coastline_AN»: Ligne de côte artificielle/naturelle avec table attributaire*, shared by PAP/RAC.	**The variable is removed.** Consideration: considering the scale of the study, this variable may lose relevance.
Coastal Exposure					
Land Cover (LC)	Physical material on the surface of land, in coastal zones.	Qualitative	European Space Agency map - the LC map from 2010 is a global land cover map at 300m spatial resolution.	Copernicus, Geo-tiff 100m pixel resolution: https://land.copernicus.eu/global/products/lc, accessed 24 Jan 2022	**The variable is confirmed.**
Population density (PDE)	The population density is derived by dividing the population count grids by the land area grid. It represents population per km^2.	pop / Km^2	http://www.hcp.ma/	Columbia University, Geo-tiff 100m pixel resolution Disaggregated data do not exist for women, but we can estimate it indirectly from the % of women and the density at the provincial level.	**The variable is confirmed.**

2. Gender-related variables

In order **to consider the links between climate and gender, and in particular the need to understand the differentiated impact of hazards, two main analytical and methodological steps are required**:

1. To **identify natural hazards** (hydro-meteorological and geophysical) as a result of diverse climate-related stimuli, for example change in annual mean SLR, or the relative change in annual mean precipitation;
2. To explain, using causal mechanisms, **why these natural hazards could amplify existing gender inequalities at the national scale of Morocco and in TTA**, and potentially increase the multifaceted socio-economic vulnerability gaps between women and men, based on an intersectional perspective that goes beyond gender to take at least two other elements into account: age and socio-economic status.

In order to account for this differential risk, and after having explained the potential causal mechanism in a clear and reasonable way based on the most recent literature, the inequalities and socio-economic gaps mentioned above (for Morocco as a whole, and downscaled to TTA) were quantified and measured to the extent possible. The gender component of the TTA Climate Risk Assessment will be explored as follows:

a. **The potential risk suffered by women and men**, and by women compared to men, on the basis of the likely **amplification of pre-existing gender inequalities** that natural hazards, exacerbated by climate forcing, could generate;
b. **The resilience that could be potentially expressed** – again in gender terms, by women and men and by women compared to men - **in case of the actual occurrence of natural hazards**, through the use of specific adaptation measures and skills.

A list of possible indicators focused on pre-existing gender inequalities at risk of amplification is reported in Table 10. The main key areas in which a "gendered" differential hazard could be potentially highlighted can be essentially linked to:

a. Health status (e.g., mortality, and for several types of causal determinants);
b. Participation in the labour market;
c. Participation in the educational and training system;
d. Family dynamics, in terms, for example, of marriage and reproductive behaviours;
e. Territorial placement of resident population between city and countryside, internal and coastal areas, areas at risk and areas perceived as safer, etc.

Regarding the potential "resilience indicators" (Table 11), an inspiring example is suggested by Swarna Bintay Kadir (Kadir, 2021). Although it refers to Bangladesh, it presents an adaptable scheme to assess the capacity to prepare, to recover and to adapt to climate and environmental disasters by women compared to men, provided that this kind of information is available. In particular, the key areas considered for the definition of this type of resilience indicators are:

a. Education and knowledge;
b. Information access;
c. Intra-household relations;
d. Community engagement behaviour;
e. Socio-economic status.

Table 10. Amplification of pre-existing gender inequalities

Key areas of gender gaps	Specific mechanism	Morocco / TTA
HEALTH STATUS (in addition to the absolute number of victims directly recorded as connected to any selected specific catastrophic event or processual phenomenon, disaggregated by gender and age)	Gap in early childhood survival between boys and girls	Mortality rate at birth by gender
		Infant mortality rate (under one year of age) by gender
		Child mortality (under 5 years of age) by gender
		Child mortality (between 5-14 years of age) by gender
	Gap in life quality experienced on average by women and men	Teen mortality rate (between 10-19 years of age) by gender
		Young adult mortality rate (between 15-24 years of age) by gender
		Elderly mortality rate (65 years and older) by gender
		General mortality rate by gender
		Average life expectancy at birth by gender
		Maternal mortality ratio (number of deaths per 100.000 live births) by age

	Gender gap in the incidence of different deprivation and disease factors	Death rate for malnutrition by gender and age
		Epidemic/viral infection(s) fatality rate by gender and age
		Mortality rate for respiratory disease by gender and age
		Proportion of people with disability by gender and age
LABOUR MARKET	Gender gap in the possibility of participating in the labour market in conditions of security and stability, and of thus being able to acquire an individual economic autonomy in terms of income earned and spending capacity, not necessarily dependent on the household to which one belongs.	Activity rate by gender and age
		Employment rate by gender and age
		Unemployment rate by gender and age
		Youth unemployment rate (15-24) by gender
		Gender pay/wage gap (average difference between the remuneration for men and women who are working)
		Proportion of employed females in the primary sector (e.g., agriculture, fishing, etc.) to total employment in this sector
		Proportion of employed females in primary sector (e.g., agriculture, fishing, etc.) to total female employment
		Proportion of employed females in secondary sector (e.g., manufacturing) to total employment in this sector
		Proportion of employed females in secondary sector (e.g., manufacturing) to total female employment
		Proportion of employed females in tertiary sector (e.g., services, commerce, etc) to total employment in this sector
		Proportion of employed females in tertiary sector (e.g., services, commerce, etc) to total female employment
		Proportion of female entrepreneurs to total entrepreneurial population
		Average proportion of retired people by gender and type of retirement scheme (e.g., minimum social welfare benefit or contributory pension)
EDUCATION	Gender Gap in the possibility of attending the educational system, from primary school to university, to invest in one's individual human capital, ranging from the learning of basic literacy and mathematics skills - essential for the exercise of active citizenship - up to the acquisition of a primary, secondary or higher qualification/degree that can be used on the job market.	Literacy rate by gender and age
		Youth female literacy rate (15-24 years)
		Net attendance rate of primary school by gender
		Share of population with primary education as highest education level by gender
		Out-of-school population among lower secondary education by gender
		Net enrolment rate in secondary school by gender
		Share of population with secondary education as highest education level by gender
		Gender ratio among people enrolled in higher/academic education
		Share of population with tertiary education by gender (bachelor's degree, master's degree, Ph.D.)
FAMILY DYNAMICS	Gender asymmetries in the choices and decisions relating to one's family life, with specific reference to marriage and reproductive behaviours, and in the socially expected division of tasks related to childcare and care for disabled members.	Total fertility rate per woman
		Mean age of women at birth of first child
		Total marriage (and civil union) rate by age of spouses
		Mean age of women at birth of first child
		Separation and divorce rate by gender
		Widowhood rate by gender and age
		Single-parent families' proportion by householder's gender
		Proportion of neolocal households (located apart from the families of both spouses) out of the total number of households
		Share of family households with children under age of 15
		Share of family households with one or more members with a disability
TERRITORIAL PLACEMENT	Territorial distribution of the resident population by gender and age, (individually and as members of a family unit, in case of available data)	Population size and density by gender and age
		Average age of the resident population by gender
		Population growth rate by gender
		Population size and density between urban and rural areas (disaggregated by gender and age)
		Population size and density between coastal and inner areas (disaggregated by gender and age)
		Population size and density between areas potentially "at risk" and areas perceived as potentially safer (disaggregated by gender and age)

Table 11. Potential gendered coping skills

Key areas of potential resilience	Specific mechanism	Morocco / TTA
EDUCATION AND KNOWLEDGE	Gap in learning and possessing physical skills and know-how aimed at countering, resisting or not succumbing to the risks associated with climate change and environmental disasters (by gender and age)	Indigenous knowledge about hazardous environmental and climatic phenomena by gender and age
		Involvement in emergency training by gender and age
		Water quality awareness by gender and age
		Sanitation hygiene awareness by gender and age
		Proportion of people that can swim by gender and age
		Proportion of people with driving license by gender and age
		Sports participation and attendance by gender and age
INFORMATION ACCESS	Gap in the possibility of accessing the main information channels (old and new media) and technological devices, by gender and age	Technology gap by gender and age (incidence of people with access to a personal computer and with technological skills necessary to use it)
		Digital divide by gender and age (incidence of people with access to internet and skills necessary to use it)
		Incidence of people that can access and use at least a social network by gender and age
		Incidence of possess and use of mobile phone by gender and age
		Incidence of people that watch television (e.g., on a daily basis) by gender and age
		Incidence of people that read newspapers (e.g., on a weekly basis) by gender and age
INTRA-HOUSEHOLD RELATIONS	Gender and generational division in the assignment of decision-making and managing roles within the household frame	Incidence of dual earner families with and without children
		Incidence of single-income households with and without children by gender of householder
		Role of women in making household decision (through qualitative sample surveys if available, like the Eurostat model)
		Role of women in managing family living expenses and savings (through qualitative sample surveys if available, like the Eurostat model)
COMMUNITY ENGAGEMENT BEHAVIOUR	Availability and access to a wider community network to give and receive support	Participation in community meetings by gender and age
		Capability to activate bridging links with relatives and/or neighbours by gender and age (e.g., to obtain or make a loan with or without interest)
		Participation in volunteer associations by gender and age
		Capability to activate links with GOs and NGOs by gender and age
SOCIO-ECONOMIC STATUS	Availability and access to financial, economic and material resources to be able to resist crisis events	Poverty rate by gender and age (and for type of family if possible)
		Household relative poverty incidence by household typology and gender of reference person
		Household relative poverty incidence by gender of reference person and number of minor children
		Access and use of health services by gender and age
		Average monthly income by gender
		Asset (house, land, vehicle) ownership by gender
		Savings by gender

As described previously, and as expressed by the two lists of potential indicators above, several factors account for the discrepancy between women's and men's differentiated exposure and vulnerability to climate change risks as well as for potential resilience. **Even though the application of the CRI-LS does not limit the number of variables, the use of several variables presents some limits in terms of the applicability and replicability of the method, since more variables mean that more data needs to be collected, and this data is not always available)**. On the other hand, the use of complex indexes (integrating several variables) is limited by the fact that existing complex indexes require large amounts of data, and that the creation of a new and unrecognised index may lead to a weak consistency of results.

A selection of the main key areas for gender gaps and potential resilience indicators was therefore conducted, taking into consideration the key variables recognized at the scientific level. The final selection of gender variables relies on data availability (even of spatial data) in order to highlight the spatial distribution of gender-sensitive risk values to the

fullest extent possible. In this sense, for example, data at the municipality or province level (or prefecture level) yield more precise information than national data.

Within the broad spectrum of ways in which the same type of climatic or environmental phenomenon can translate into an unequal risk for exposed men and women, thereby potentially consolidating or even the gender inequalities identified in the key areas mentioned above, only a few mechanisms have been selected, because they are essential to this type of analysis. In fact, the indicators that we have chosen (cf. Table 12) are an expression of the most rooted and powerful gaps that are structurally linked to the asymmetrical distribution of the resources necessary to satisfy the basic needs of existence between men and women:

- Individual health care from earliest childhood;
- Direct access to work, and therefore to a source of income that attributes a non-mediated basis of independence and spending capacity that is not completely subordinate to the main and default figure that is active on the labour market (usually the male breadwinner);
- The ability to become informed, to acquire first-hand knowledge of the social trends taking place in the reference context, to access studies that can support one's independence on the labour market, offering different and better options than the rigid confinement of the female gender at home, within the family care space;
- Unpaid labour that is not recognized as a real job, despite having an economic value that can also be theoretically accounted for;
- A differential positioning in space, where the most vulnerable individuals, with fewer cultural and economic resources necessary to move in search of better fortune, are more often represented by women of all ages, immobilised for example in rural and/or economically disadvantaged areas;
- The unequal level of poverty, below the subsistence line, which even within the same families often leads to an unequal distribution of primary resources (starting with food, or the unequal habit of accessing quality health services by gender, especially in case of extreme severe conditions).

Work, education and health are the essential pillars around which the sociological and economic scientific literature has analysed socio-economic stratification experienced by different groups within the same society. These pillars are also helpful in observing and understanding the "sliding" from gender differences to gender inequalities (among the various possible factors of asymmetry) and are fully part of this analytical model.

Based on the first selection of variables to be primarily used for the gender-sensitive coastal risk assessment of TTA, an in-depth data analysis was carried out in order to assess the potential use of running the CRI-LS method. Table 12 presents the selected indicators, the data assessment and availability results. **Current available data are not fully satisfactory to highlight TTA's regional context, but more for Morocco as a whole. This is because most gender-related data are only available at the national scale.**

A thorough check for further available data was conducted, and the selection of the final gender-related variables to be retained for the study was made, mainly by considering the following:

- To select at least 1 gender variable per key area;
- To select variables with sex-disaggregated data by province

It is important to underline that some variables were not selected for this study not because they are less significant, but because no sex-disaggregated data (even for the entire TTA) are available at the moment. This element constitutes one of the analytical results of the research, but does not invalidate the proposed methodology, as we argue at the end of this report.

Table 12. Gender variables: considerations and final selection

Key areas	Specific Mechanism	Morocco / TTA	First data analysis and considerations	Final considerations and selection
GENDER GAPS				
HEALTH STATUS	Gap in early childhood survival between boys and girls	Child mortality (under 5 years of age) by gender	**Data available at the national level. No data for TTA.** Data refer to the mortality probabilities of children under 5 for the 2011-2018 period, according to different socio-economic variables (gender, background, woman's age at birth, birth order, well-being quintile, highest certificate obtained, subdivided by age [neonatal, post-neonatal, infantile (1 years), juvenile (4 years), infanto-juvenile (5 years)]). Source: Ministry of Health, ENPSF, 2018	**The variable cannot be selected due to lack of data for TTA.**
	Gap in life quality experienced on average by women and men	General mortality rate by gender	**Data available at the national level. No data for TTA.** They refer to the mortality rate in ‰, by gender and for 2 different years (1987 and 2010).	**The variable cannot be selected due to lack of data for TTA.**
		Average life expectancy at birth by gender	**At the national level**, available data refers to 2 different years (2004 and 2010), also disaggregated for urban and rural areas. Data on women available. **At TTA level**, data are available by gender, and disaggregated by urban and rural areas. Source: HCP.	**The variable is selected.** The availability of the data at a disaggregated level by territory (therefore for TTA, as a general data for comparison), and its distinction by gender at this scale allows the calculation of the gap between females and males, although at the TTA level only (and not disaggregated by province). This variable must be included in the analysis since it is a good summary proxy of the "Health Status" area regarding asymmetries in life quality experienced on average by women and men.
LABOUR MARKET	Gender gap in the possibility of participating in the labour market in conditions of security and stability and of being able to acquire in this way an individual economic autonomy in terms of income earned and spending capacity, not necessarily dependent on the household to which one belongs.	Activity rate by gender and age	**Data available at the national level (years 2009 and 2019) and TTA level (not disaggregated by provinces for 2018).** They refer to the structure (in %) of the population aged 15 and over, for the years 2009 and 2019, disaggregated by type [employed, unemployed, inactive] and by gender. Source: National Employment Survey, HCP. **At TTA level,** the activity rate is also subdivided by gender and by rural and urban areas.	**The variable is selected.** The availability of the data at a disaggregated level by territory (therefore for TTA, as a general data for comparison), and its distinction by gender at this scale allows the calculation of the gap between females and males, if at the TTA level only (and not disaggregated by province). This variable must be included in the analysis, in the absence of a data relating to the gender distribution by sectors at this scale. Indeed, the distinction between urban and rural areas is a further added value regarding our understanding of the economic activities that are probably prevalent in these areas, in which we can

				consider the representativeness of the female population compared to the male one.
		Gender pay/wage gap (average difference between the remuneration for men and women who are working	**Data available at the national level. No data for TTA.** They refer to: - evolution of the male/female wage ratio for years 1991, 1999, 2007 and subdivided by rural and urban areas. Source: M. Douidich, Economia. - Inequality between men and women aged 15 and over in terms of workload (in %), disaggregated by gender and type of work (professional and domestic). Source: National Time Use Survey 2012, HCP.	**The variable cannot be selected because of a lack of data for TTA.**
		Proportion of employed females in primary sector (e.g., agriculture, fishing, etc.) to total employment in this sector	**At the national level**, data refer to the breakdown (in %) of the employed adult population by sector of economic activity, gender and place of residence (urban or rural). Economic activities refer to: agriculture, forest and fishing; industry and artisanal activities; construction and public works; services; other activities. **At the TTA level, data are available but not disaggregated by gender.**	**Not selected. But the variable can be useful for qualitative considerations.** The unavailability of this data by gender, although disaggregated at the regional level, does not allow us to make detailed considerations on the focus we are interested in (unfortunately, because the gender difference documented by economic sectors would be very important). However, we should keep the general data (not disaggregated by gender) relating to the distribution of the active population by sectors in this region, because it gives us a measure of the relative weight of the different production areas in TTA, which may perhaps allow analytical inferences with respect to the previous data (e.g. the relevance of female labour participation in rural areas can be considered the more significant the more agriculture is generally an important sector compared to the others in the region).
EDUCATION	Gender gap in the possibility of attending the educational system, from primary school to university, to invest in one's individual human capital ranging from the learning of basic literacy and mathematics skills - essential for the exercise of active citizenship - up to acquisition of a primary, secondary or higher education degree that can be used on the job market	Illiteracy rate by gender	At the **national level,** data refer to the ratio of the population aged 10 and over unable to read and write to the total population of the same age. **Source:** Ministère de l'Education nationale, de la formation professionnelle de l'enseignement supérieure et de la recherche scientifique At the **TTA level**, data available for 2014 are disaggregated by gender and by urban and rural area. **Source:** RGPH 2014	**The variable is selected.**
		School enrolment rate of children aged 7 to 12	At the **national level,** data refer to school education rate (in %) of children aged 7 to 12 by gender and province.	**The variable is selected.** The availability of this data disaggregated even by province, as well as by gender, makes it useful to keep the variable, even if with two constraints that we will have to argue: the most recent data recorded dates back to 8

			Source: Ministère de l'Education Nationale, de la Formation Professionnelle de l'enseignement supérieure et de la recherche scientifique. At **TTA level**, data available for 2014 are disaggregated by gender and province and by urban and rural area, **Source:** RGPH 2014	years ago (2014) and refers only to the infantile cohorts that cover primary and lower secondary school (between 7 and 12 years). Despite these limitations, it remains an essential data, because it allows us to analyse the relevance of the investment in basic human capital made by families of origin on their children also on the basis of whether they are male or female, taking the current legislation on compulsory education into account.
		Share of population with tertiary education by gender (bachelor's degree, master's degree, Ph.D)	At the **national level,** data refer to the rate of women (in %) enrolled in the different cycles of education for the periods 2008/2009 and 2018/2019. Source: HCP. **At TTA level**, concerning the tertiary education level, the only available data refer to the period 2018-2019 and to the number of students and graduated from *Grandes Ecoles* and universities, disaggregated by gender. Available as well data related to the secondary level' education, for the period 2018-2019, disaggregated by gender and province. Source: Regional Academy of Education and Training.	**The variable is selected.** The availability of this data disaggregated even by province, as well as by gender, makes it crucial to maintain this variable, which allows us to consider two different phases of investment in human capital through education, corresponding to different age cohorts and different qualifications, then expendable on the labour market: the secondary level (e.g., diploma/graduation) and the tertiary level (e.g., master's degree or postgraduate qualifications). The data is also quite updated (2018-2019). In the case of the tertiary qualification, it would also be useful to distinguish by disciplinary area with respect to gender (e.g., how many women in STEM disciplines, usually related to a higher employment rate and pay, as well as to a better social status, including in terms of emancipation and personal economic autonomy).
TERRITORIAL PLACEMENT	Territorial distribution of the resident population by gender and age, (individually and as members of a family unit, in case of available data)	Population growth rate by gender	**Data available at TTA level is not disaggregated by gender.** They refer to the Average Annual Growth Rate (%) by province. No data disaggregated by gender are available.	**Not selected. But the variable can be useful for qualitative considerations.** The unavailability of this data disaggregated by gender makes it impossible to calculate the gap between female and male prevalence, on which our analysis should be focused, but let's keep it in the background as an overall figure that could be useful to understand the level of population density of the region and of the specific provinces, because it could allow us to think about more detailed analytical considerations (e.g. the greater presence of the population in general should correspond to a greater presence of households, where the gender complementarity in the distribution of production and reproduction roles is obviously represented).
		Population size and density between urban and rural areas	**Data available at the TTA level.** Data refer to 2014 and to population by place of residence (urban/rural). Source: Statistical Yearbook, 2019, HCP.	**Not selected. But the variable can be useful for qualitative considerations.** This is useful data, for which this variable must be kept, despite its constraints, which are: the fact that the data is not very up-to-date (it dates back to 8 years ago, 2014, and we must assume that in the meantime, events of an environmental nature or specific climatic disasters have not had an impact in the redefinition of the distribution of

				the population in the region); the fact that it is articulated only on urban and rural areas and not on single provinces. Despite these critical elements, the data must certainly be held as a proxy for territorial placement.
POTENTIAL RESILIENCE				
SOCIO-ECONOMIC STATUS	Availability and access to financial, economic and material resources to be able to resist crisis events	Poverty rate by gender and age (and for type of family if possible)	**Data available at the TTA level** refer to: a) Overall poverty rate (in %) by place of residence and province and prefecture, 2014. b) Rate (in %) of monetary poverty according to place of residence and provinces and prefectures, 2014. c) Multidimensional poverty rate (in %) by place of residence and province, 2014. d) Distribution (in %) of forms of poverty according to place of residence and province and prefecture, 2014. e) Breakdown of multidimensional poverty (in %) by source of deprivation and by province and prefecture, 2014.	**3 variables out of 5 are selected.** **a) Selected.** **b) Selected.** **c) Selected.** **d) Not Selected.** **e) Not Selected.** The selected variables can be considered distinctively. They give a good image of the specific causes of the state of poverty and of its multidimensional nature, and allows one to measure territorial imbalances, by positioning it in the place of residence. However, the lack of disaggregation by gender doesn't allow to measure this specific gap between women and men, even at the regional level. The absence of a gender dimension is regrettable, because these are crucial variables, but even in this case they must be kept, because a large part of the literature highlights how the poverty of women and children - as in general subjects on average less autonomous and more vulnerable from a socio-economic point of view - is strictly dependent on and correlated to the poverty of the family unit to which they belong. Therefore, these data must be kept in any case.

3. Final variable selection and ranking

In this section, the final list of variables selected for the application of the gender-sensitive CRI-LS for TTA is reported. Following Torresan et al. (2012), the allocation of scores assigned to variables was performed using a 1-5 scale. The 1-5 scale, used for every variable, standardises the scoring system, and enables to mathematically combine variables measured in different units (McLaughlin and Cooper, 2010). The maximum score 5 is assigned to the highest risk class of the variable in terms of its relative contribution to generate risk and in the same way the minimum score 1 is assigned to the lowest risk class in the subset of classes defined for each variable (Torresan et al., 2012). The assignment of the different scores of the climate and environmental variables was based on a literature review and expert judgement. Most of the scores correspond to the classes used in previous application of the CRI-LS at Mediterranean scale.

Regarding gender-related variables, by specifying that the variables allow to express the gap between the value assigned to women compared to the value related to men (and not absolute values), the classes (and related ranks) have been defined by comparing the gender gaps observed for each province to the average gender gap observed at the regional TTA level, trying to highlight (as much as possible) the difference between different provinces (where data are available).

For instance, in the case of the Illiteracy rate variable, the Provincial Gender Gaps have been compared to the TTA regional gender gap. A negative difference indicates that the situation of women in the considered province is better compared to the average situation at the regional level. A positive value means a worse situation, or a larger gap. When necessary, and to maintain the same classes and related values, the comparison with TTA's regional value has been calculated as ‰ instead of % for gender-related variables.

Table 13. Illiteracy Rate (2014)

Province	GAP F-M (no.)	% (vs TTAH)	Classes				
			1	2	3	4	5
			< -20	-20 to -5	-5 to 5	5 to 20	>20
Larache	20	-6,0%					
Tanger-Assilah	16,5	-23,0%					
Fahs-Anjra	23,5	10%					
Mdiq-Fnidq	17,8	-16,0%					
Tetouan	18,7	-12,0%					
Chefchaouen	28,6	34%					
Al Hoceima	26,9	26%					
Region TTAH	21,3						

Table 14. Final list of variable and related ranking value to be used for the gender sensitive CRI-LS for TTA

Variable	Description	Unit	1	2	3	4	5
Coastal Forcing							
SLR (SLR)	Level of the sea increased in one year. Satellite altimetry data provides accurate measures for a limited time range.	mm/y	< 1	1 – 1,6	1,7 - 2,4	2,5 - 3,2	> 3,2
Significant Waves Height (SWH)	This parameter represents the average height of the highest third of surface ocean/sea waves generated by wind and swell with a return period Tr =100 yrs. Waves are computed using the ECMWF's Wave Model considering the emission scenario (RCP4.5) and a temporal coverage from 2014 to 2100.	m	< 4,7	4,71 – 6,65	6,66-8,13	8,13 – 9,57	> 9,57
Aridity Index (AI)	Aridity is a measure of 'dryness' of the climate expressed as the ratio of precipitation to evapotranspiration. The lower the ratio, the drier the climate. An area with an Aridity Index less than 0.65 is classified as a Dryland.	Qualitative	Non dryland				Dryland
Daily precipitation concentration index (CI)	Daily precipitation concentration index (CI) that is used as a concentration measure. High precipitation CI value indicates that precipitation is more concentrated within a few rainy days during the year and vice versa. Studies show that CI is an estimator of the erosivity and aggressivity of rainfall.	N.	< 0,64	0,64 - 0,66	0,661 - 0,68	0,681 - 0,70	>0,70
Population growth (PGR)	Population growth (annual %) is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage.	%	≤ 0,1%	0,1% - 0,5%	0,51% - 1%	1,1% - 2%	>2%
Tourism arrivals (TOUR)	International inbound tourists are the number of tourists who travel to a country other than that in which they have their usual residence.	%	≤ 0 %	0,1% - 1%	1,01 - 5%	5,01% - 10%	> 10%
Coastal Vulnerability							
Elevation (ELE)	Represents the surface of a selected coastal unit (pixel) within a specific class of elevation Xi (e.g., 0.15m_Xi _ 0.3 m).	m	< 8	6-8	4-6	2-4	2
Coastal slope (SLO)	Slope is a measure of change in elevation. Percent slope describes the surface's normal ratio of change in height to change in horizontal distance.	%	>12	12-8	8-4	4 -2	<2
Land roughness (LR)	Represents the resistance to surface flow exerted by the land surface and is measured with Manning's coefficient.	Manning's coefficient	> 0,06	0,06 - 0,04	0,041 - 0,03	0,031 -0,02	< 0,02
Distance from the shoreline (D)	Related to progression of the risk according to the inland penetration of flooding.	m	d > 1200	800-1200	800- 400	400 < d < 200	d < 200
Ecosystems health (EH)	Expresses the contribution of the ecosystem as a protection against storm surges, flooding and other coastal hazards. Ecosystems include coral reefs, seagrass beds, sand dunes, coastal wetlands, and coastal forests.	Qualitative (presence/absence)			Presence of protected areas		Absence of protected areas
Illiteracy rate (ILR) (education)	Illiteracy rate by gender. The variable measures the lack of investment in basic human capital on the basis of gender and refers to the ratio of the population aged 10 and over unable to read and write to the total population of the same age.	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%

Variable	Description	Unit					
			1	2	3	4	5
Average life expectancy at birth by gender (LEB)	Gap in life quality experienced on average by women and men. The variable expresses a good summary proxy of the "Health status" key area, regarding asymmetries in life quality experienced on average by women and men. In this sense, it offers a good perspective view of the overall biographies of the population based on gender.	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%
Activity rate by gender and age (ACTR)	Gender gap in the possibility of participating in the labour market in conditions of security and stability and of being able to acquire in this way an individual economic autonomy in terms of income earned and spending capacity, not necessarily dependent on the household to which one belongs.	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%
Tertiary Education (EDU)	Share of population with tertiary education by gender (bachelor's degree, master's degree, Ph.D.). The variable is an expression of two separate phases of investment in human capital through education, corresponding to different age cohorts and different qualifications, then expendable on the labour market: the secondary level (e.g., diploma/graduation) and the tertiary level (e.g., master's degree or post-graduate qualifications).	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%
Overall poverty rate (PR)	Overall poverty rate by area of residence, province, and prefecture.	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%
Poverty distribution (PD) or monetary poverty	Rate (in %) of monetary poverty according to place of residence and provinces and prefecture.	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%
Multi-dimensional poverty (PM)	Multidimensional poverty rate (in %) by place of residence and province and prefecture. The literature highlights that the poverty of women and children is strictly dependent on and correlated to the poverty of the family unit to which they belong.	%	< -20%	-20% - (-5%)	(-5%) - 5%	5% - 20%	>20%
Coastal Exposure							
Land Cover (LC)	Physical material on the surface of land, in coastal zones.	Qualitative	Bare areas	Shrubland, grasslands, sparse vegetation	Forest and water bodies	Agriculture	Urban areas
Population density (PDE)	Population size and density between urban and rural areas (disaggregated by gender and age).	Pop/km2	< 25	26 - 50	51- 100	101 - 250	> 250

C. ASSIGNATION OF WEIGHTS TO RISK VARIABLES

In summary, we obtain:

- 6 variables for Coastal Hazard (4 related to climate impacts and 2 to social status);
- 2 variables for Coastal Vulnerability (5 related to the environmental conditions and 7 to the gender gap);
- 2 variables for Coastal Exposure.

The final Coastal Risk Index results from the aggregation of selected variables to generate each risk factor (forcing, vulnerability and exposure). The variables can be expressed in qualitative or quantitative form and can be available at different scales and expressed in different units of measurement (McLaughlin & Cooper, 2010). Variables are not all equally important and weight should be assigned to each one of them to reflect its importance in terms of contribution to the estimated overall risk. The methodological choice made for the definition of the variables' weights is based on a panel of scientific experts and local policy makers. That filled out an online questionnaire available in English and French (cf. Annex 2). The final weights are reported in the following Table 15:

Table 15. Final weights to be used for the gender-sensitive CRI-LS for TTA

Variable	Unit	Weights
Coastal Hazard		
SLR (SLR)	mm/y	17%
Significant Waves Height (SWH)	m	18%
Aridity Index (AI)	qualitative	17%
Daily precipitation concentration index (CI)	N.	18%
Population growth (PGR)	%	16%
Tourism arrivals (TOUR)	%	14%
Coastal Vulnerability		
Elevation (ELE)	m	8%
Coastal slope (SLO)	%	8%
Land roughness (LR)	Number	9%
Distance from the shoreline (D)	m	8%
Ecosystems health (EH)	Qualitative	9%
Illiteracy rate (ILR) - (Education)	%	9%
Average Life Expectancy at birth by gender (LEB) - (Health status variables)	%	7%
Activity Rate by Gender and Age (ACTR) - (Labour market)	%	8%
Tertiary Education (EDU) - (Education)	%	8%
Overall poverty rate (PR) - (socio-economic status)	%	9%
Poverty distribution (PD) or monetary poverty - (socio-economic status)	%	9%
Multidimensional poverty (PM) - (socio-economic status)	%	9%
Coastal Exposure		
Land Cover (LC)	qualitative	52
Population density (PDE)	Pop/km^2	48

D. CONSTRUCTION OF THE RISK MAP

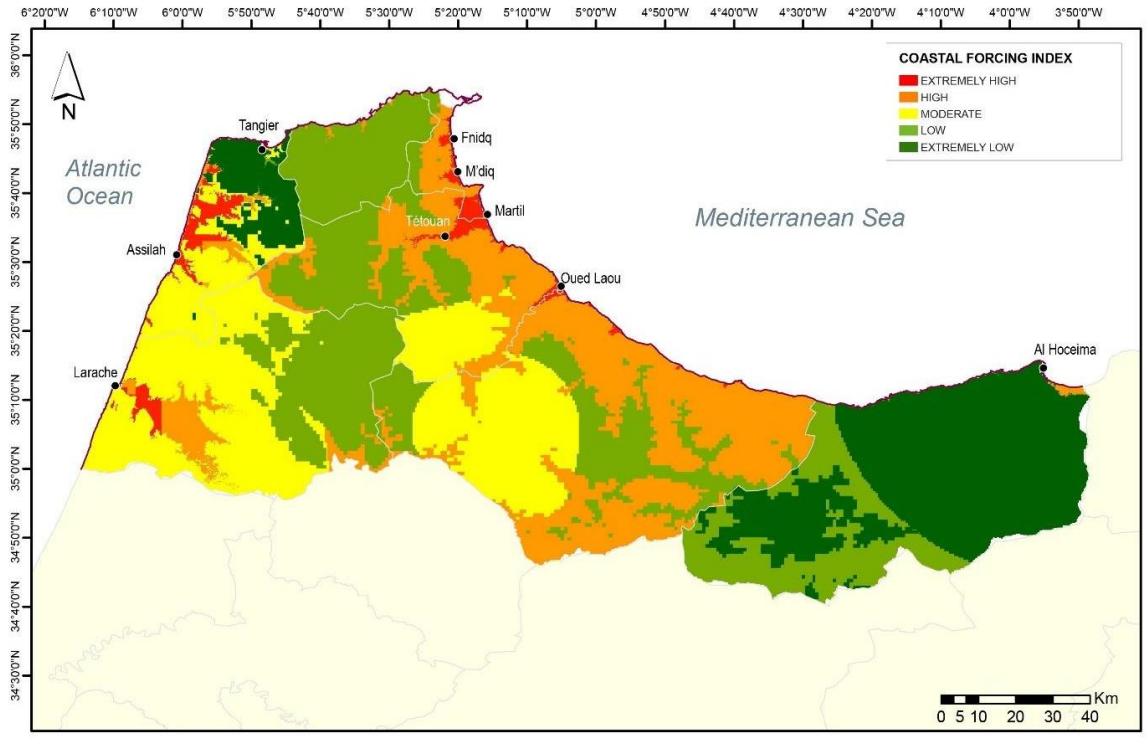
As described in part V. A-CRI-LS: concepts and steps, the Coastal Risk Index is a function of the Coastal Forcing Index, the Coastal Vulnerability Index and the Coastal Exposure Index.

All variables of the 3 sub-indexes were georeferenced using different procedures depending on the type of data formats. In particular, all climate and environmental variables were available as shapefile or geo-tiff, with spatial coverage and coordinate system already defined, while the data of the gender variables were available only in a numeric format with no geographical references. Once collected, the gender data were georeferenced, by MEDSEA experts through GIS tools, associating the correspondent province boundary to each value. Then, in order to have a unique format and to be able to operate between variables, each one of them has been converted to a raster image with Geographic Coordinate System WGS 1984 and a pixel unit of approximately 30 x 30 m.

1. Coastal Forcing Index map

The Coastal Forcing Index Map (Figure 18) shows the coastal areas that are facing significant pressures from multiple forces driven by climate change, such as rising sea levels and increasing impacts of waves and storms coming from the sea, as well as extreme precipitation and desertification that are affecting both coastal areas and the inland. Population growth and tourists' presence represent an added pressure to coastal and inland areas. Extreme values of forcing appear along the coast and more to the inland in flat areas.

Figure 18. Map of the Coastal Forcing Index



a) Forcing-related variables

To better understand the results shown in the Figure 19, the following paragraphs provide a description of the pressure's factors of Climate Forcing and their geographical distribution:

- Sea Level Rise
- Significant wave height
- Soil Aridity
- Extreme precipitations
- Population Growth
- Tourism trend

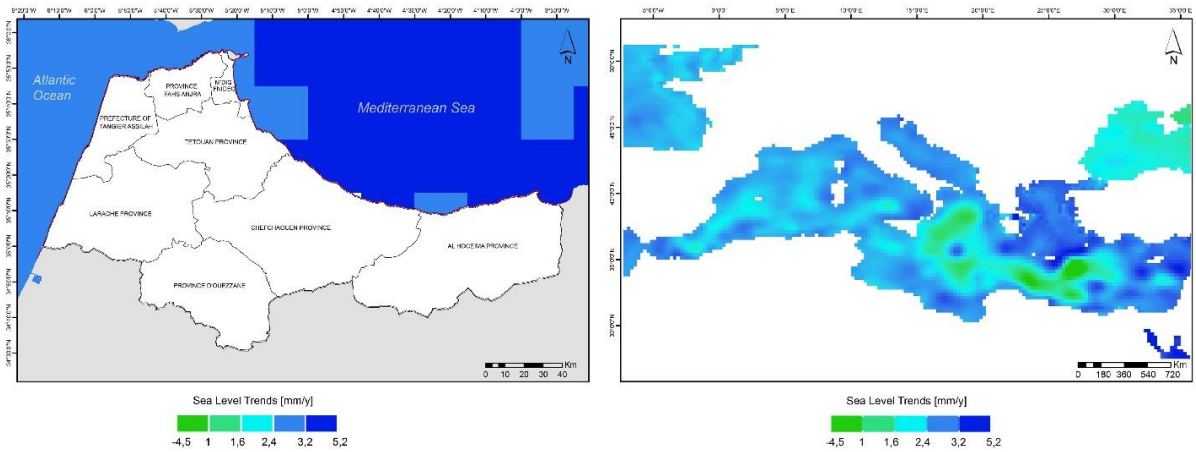
Sea Level Rise (SLR)

Coastal risks will increase by at least one order of magnitude over the 21st century due to SLR impacting ecosystems, livelihoods, infrastructure, food security and cultural and natural heritage. Concentrated in cities and settlements by the sea, these risks are already being faced and will accelerate beyond 2050, continuing to escalate beyond 2100, even if warming stops. Historically rare extreme sea level events will occur annually by 2100, compounding these risks. Continued and accelerating SLR involves flood risks, combined with other secondary risks such as coastal erosion, salt intrusion, the loss or alteration of important low-lying coastal ecosystems such as wetlands, and the loss of marine and coastal biodiversity. All of these impacts will also have important consequences on settlements, infrastructure, and productive activities in coastal areas. If urbanisation trends in exposed areas continue, this will exacerbate the impacts,

with more challenges where energy, water and other services are constrained. The number of people at risk from climate change and associated loss of biodiversity will progressively increase (IPCC, 2022).

As shown in the following images, TTA recorded SLR values between 2.4 and 5.2 mm per year, which are among the highest values recorded along the entire Mediterranean coast. In particular, the coast of TTA on the Mediterranean side, between January 1993 and October 2019, recorded a higher growth trend than the Atlantic side.

Figure 19. Multi-mission Sea Level Trends (Zooms on TTA and the Mediterranean basin). Period: January 1993-October 2019.



Source: AVISO

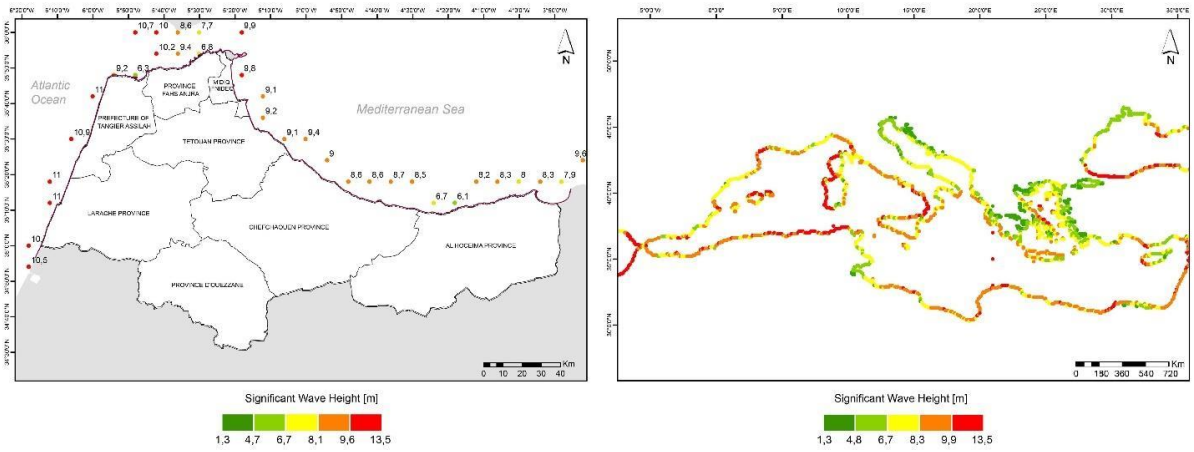
Significant wave height

It is well known that storm surges associated with violent winds, strong waves, intense currents and flash floods triggered by heavy rains are able to damage marine and coastal ecosystems. The scientific community believes that, in all likelihood, current coastal protection structures will not be sufficient to contain the increase in the frequency and intensity of major marine floods, leaving most of the Mediterranean coastal areas exposed to flooding.

In order to analyse the impacts of Extreme Waves, the maximum wave height has been extrapolated from the "Ocean surface wave indicators for the European coast from 1977 to 2100 derived from climate projection" Copernicus dataset computed using the Wave Model (WAM, ECMWF) for coastal points with spacing of 10km, in order to have a good coverage along the coast and with reference to the IPCC's climate projections: RCP 4.5 (for period 2070-2100). This scenario, with a moderate increase in emissions, is the more relevant scenario to assess on the long term (period 2071-2100), assuming that the extreme scenarios may still be avoided. In fact, even if the CRI focuses on extreme events and conditions, it is reasonable to think that after 2050, due to strong flood events in the near future, society will choose to adapt carbon emission scenarios in order to make the far future scenario less extreme.

According to this scenario, TTA's values range from 6.1-11 m. The coasts of the Prefecture of Tangier and Assilah and the Province of Larache, facing the Atlantic Ocean, record the highest values ranging from 10-11 metres. Comparing these values with the rest of the Mediterranean coast (Figure 20), TTA appears to be exposed to extreme waves such as the eastern coasts of Sardinia and Corsica, the eastern coasts of the Balearics, the coasts of Algeria and the north of the Tunisian coast up to Tunis.

Figure 20. Significant wave height (SWH) (zooms on TTA and the Mediterranean basin) - 100-year return period. Experiment: RCP4.5, Period: 2071-2100



Source: Copernicus

Soil Aridity

One of the major consequences of a warming climate is the potential for increased global aridity. Aridity is a climate phenomenon characterised by a shortage of water and is a commonly used index to measure changes in aridity. The Aridity Index (AI) is a simple but convenient numerical indicator based on long-term climatic water deficits and is widely used to measure the dryness of the climate at a given location. The six subtypes of arid lands or drylands derived from the AI are listed below.

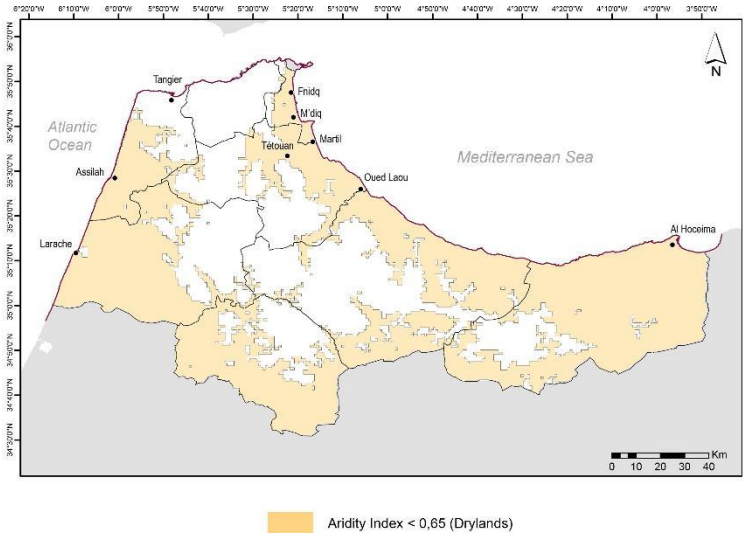
Table 16. Climate classification and dryland subtypes based on the Aridity Index

Climate Type	Aridity Index
Dryland Subtypes	
Hyper-arid	AI < 0.05
Arid	0.05 ≤ AI < 0.2
Semi-arid	0.2 ≤ AI < 0.5
Dry Subhumid	0.5 ≤ AI < 0.65
Non-Drylands	
Humid	AI ≥ 0.65
Cold	PET < 400 mm

Source: Middleton and Thomas, WAD2, 1997

Decreases in AI mean that conditions are becoming drier, while increases in AI mean conditions are getting wetter. Hence, as air temperature systematically increases globally – accompanied by shifts in other key variables, including precipitation, relative humidity, solar radiation, and wind speed – a long-term shift to increased aridity is anticipated. Indeed, recent observational studies have shown that the average AI is decreasing (a drying effect) as the globe warms. Figure 21 shows that more than 60% of TTA, or more than 9,760 km^2, is classified as dryland, in particular, all the coastal areas beside the northern area of the Prefecture of Tangier-Assilah, the whole Province of Fahs Anjra and the internal areas.

Figure 21. Aridity Index (AI)



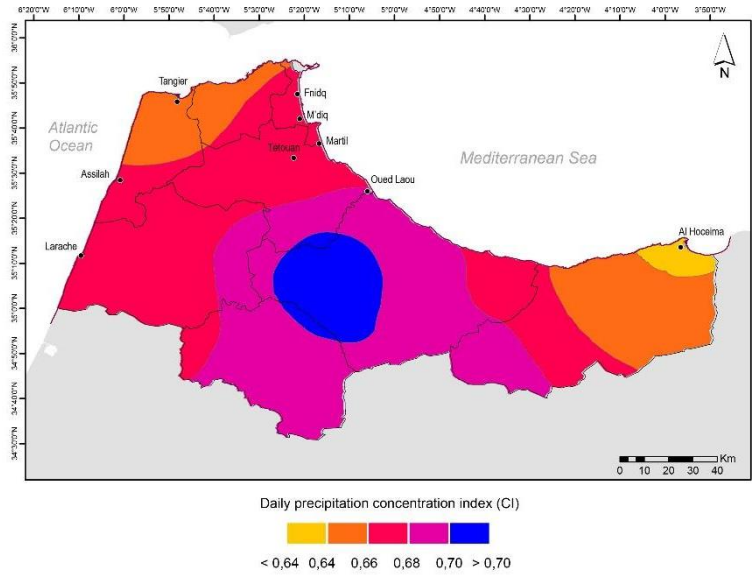
Source: World Atlas of Desertification (2019).

Extreme precipitations

Heavy rains represent a natural hazard causing huge human and economic damages in the Mediterranean countries. Climatic scenarios indicate a significant temperature rise associated with an annual rainfall decrease and a multiplication of extreme rainfall events in many parts of the Mediterranean basin (Kyselý et al., 2012). The quick flood generation potential is important throughout the Mediterranean basin due to its steep topography, small-sized basins, and scarce vegetation cover (Salhi et al.,2019).

Northern Morocco is particularly sensitive to extreme hydroclimatic events, especially floods (related to intense rainfall events) and droughts (related to the high interannual variability of rainfall). For example, the cities of Tétouan, Tangier and Al Hoceima are located downstream of their respective watersheds exposed to serious damage during repetitive violent floods (Schilling et al.,2012). Figure 22 shows the 5 classes spatial distribution of rainfall and the increase of the Daily precipitation concentration index (CI) from the eastern to western area of TTA and from the coastal plains to the high mountains (Salhi et al., 2019).

Figure 22. Daily precipitation concentration index (CI)



Source: MEDSEA elaboration based on Salhi et al.,2019

Population growth and tourism trends

Human-induced forcing for the coastal zones can be divided into two separate variables: urban development and tourism trend. The first is shown by the average population growth and the second by tourism arrivals in the coastal provinces. Increase of tourism arrivals have a huge impact, putting local infrastructure, habitats and resources under enormous pressure. Tourism overdevelopment has the same problems as other coastal developments, but often has a greater impact as the tourist developments are located at or near fragile coastal and marine ecosystems.

Figure 23. Population growth

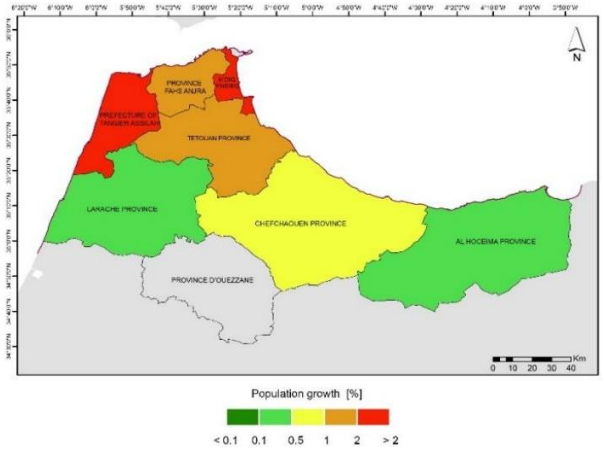
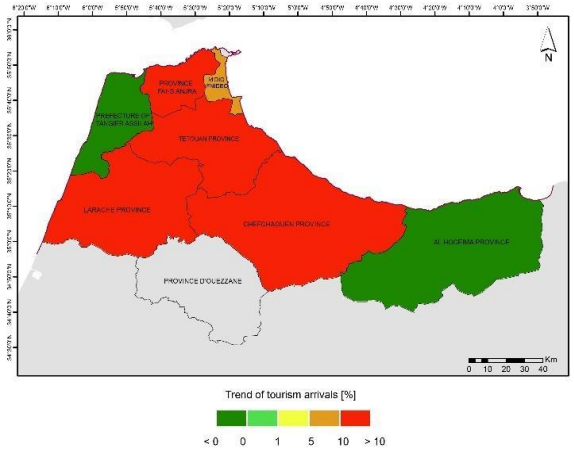


Figure 24. Trend of tourism arrivals



2. Coastal Vulnerability Index map

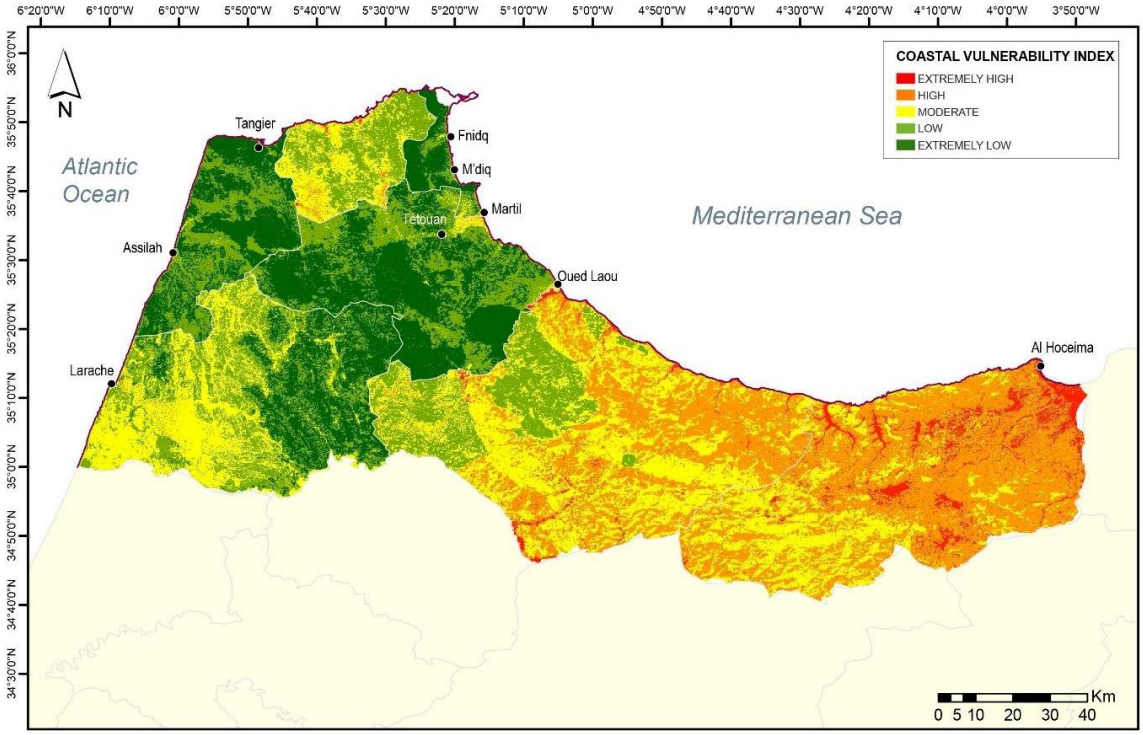
According to the IPCC definition (AR6, 2022), vulnerability is the propensity or predisposition to be adversely affected and encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. Vulnerability is now widely understood to differ within communities and across societies, also changing through time.

The Coastal Vulnerability Index Map (cf. Figure 25) shows the susceptibility of coastal areas to extreme climate impacts and their capacity to recover, survive, and adapt depending on their geo-morphological, ecological, and socioeconomic characteristics. At the same time, it highlights the areas where communities are more vulnerable because gender gaps are higher than others.

As described in the previous paragraphs, many more variables were adopted to calculate the coastal vulnerability index compared to the previous application of the CRI-LS index for the Tétouan case study (Satta, 2016). In fact, the methodological choice of including more gender variables than environmental ones for the calculation of this Index was made to reinforce the focus on gender in TTA.

For this reason, the entire 2 Provinces of Al Hoceima and Chefchaouen appear in the map as the most vulnerable areas instead of the coastal zones. By analysing the two groups of variables separately, it is possible to see how the vulnerable areas according only to environmental parameters are located more along the coast (Figure 26), while taking only gender gap parameters into account, (Figure 27), the most vulnerable areas correspond to the eastern province of TTA.

Figure 25. Map of the Coastal Vulnerability Index



a) Climate related variables

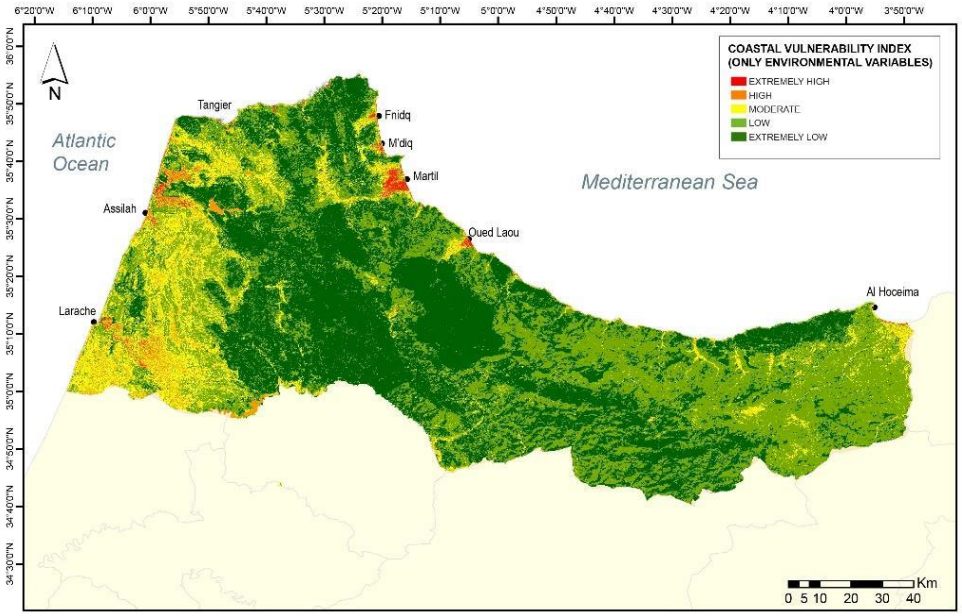
As anticipated in the previous paragraph, by considering the coastal vulnerability index as an exclusive function of the 5 following climate related / environmental variables:

- Elevation;
- Coastal slope;
- Land roughness;
- Distance from the shoreline;
- Ecosystem health.

...and distributing 100% of the weights among them[10], the map of TTA would have shown the extremely high and highly vulnerable areas mainly located in the low-lying coastal areas. This result is driven by the fact that three variables out of five describe the susceptibility of the territory to hazards such as coastal inundation and coastal erosion.

[10] Elevation (weight 22%), Coastal slope (weight 19%), Land roughness (weight 18%), Distance from the shoreline (weight 20%), Ecosystem health (weight 21%).

Figure 26. Map of the Coastal Vulnerability index considering only environmental variables

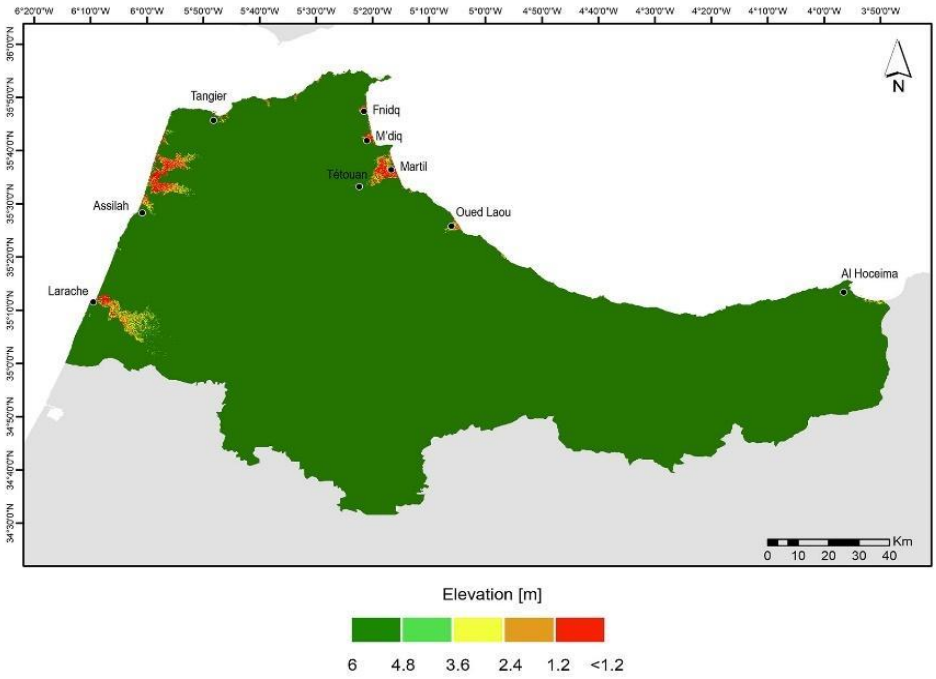


Elevation

The geographical characteristics of a coastal region are one of the main aspects that influence its vulnerability to coastal climate hazards such as erosion and flooding. The areas located under 1,5 m, the worst SLR scenario defined for this research, will be submerged, and even an exceptionally low flooding event will strongly impact these areas.

The TTA elevation map was built from DEM (30 m) downloaded from the United States Geological Survey (USGS). Based on Table 16, the elevation class is divided into five classes. The lowest score was assigned to the areas with the highest altitude and vice versa.

Figure 27. Map of the Elevation of TTA

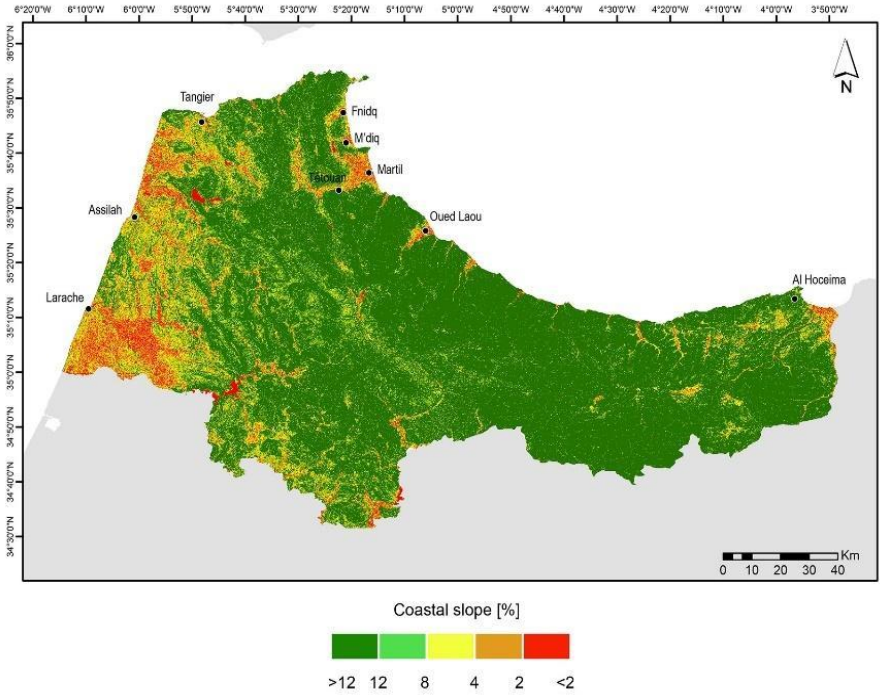


Coastal slope

This variable is used to determine the relative risk of the shoreline retreat. Low sloping coastal regions should retreat faster. The steepness or flatness of the coastal region is linked to the susceptibility of a coast to inundation by flooding.

The slope computation is derived from the Digital Elevation Map using the Slope tool of ArcGIS with a planar computation method. For the planar method, the slope is measured as the maximum rate of change in value from a cell to its immediate neighbours.

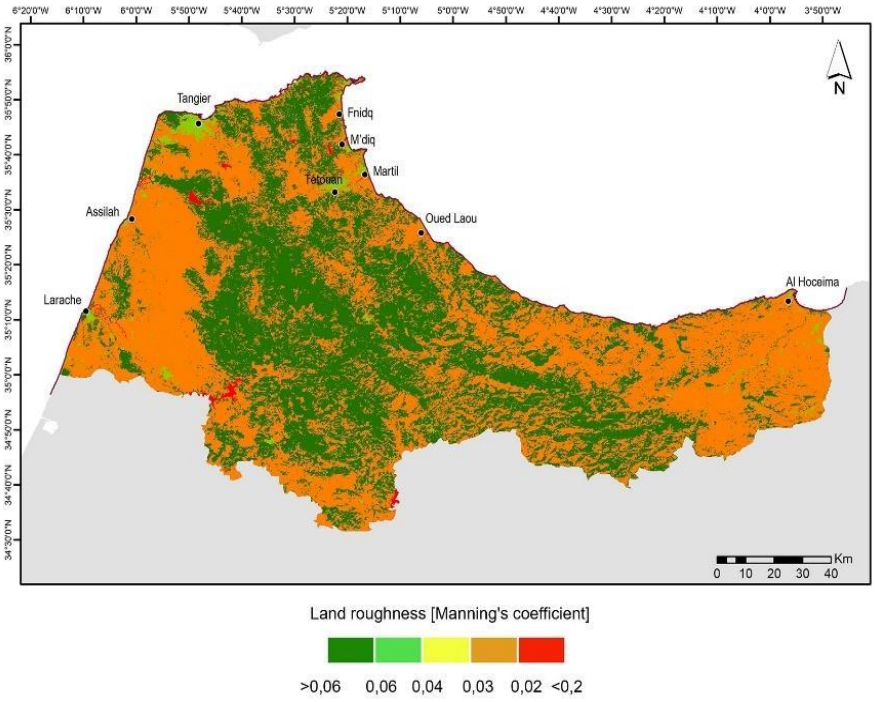
Figure 28. Map of the Coastal slope



Land roughness

Roughness represents the resistance to flow of a surface. The Land roughness map was built based on the Copernicus Land Cover map, assigning roughness coefficients to the different classes of land use according to the literature (Manual of Coastal Engineering, 1976). The lowest value of Manning's roughness, corresponding to low resistance to surface flows coefficient, was assigned to water surfaces (0.0125) and asphalt roads (0.025). The highest roughness value, corresponding to high surface resistance, was assigned to forests (0.075) and followed by landscape and vegetated areas (0.062). As shown in Table 16, the higher scores were assigned to the pixels with the lower Manning coefficients and vice versa.

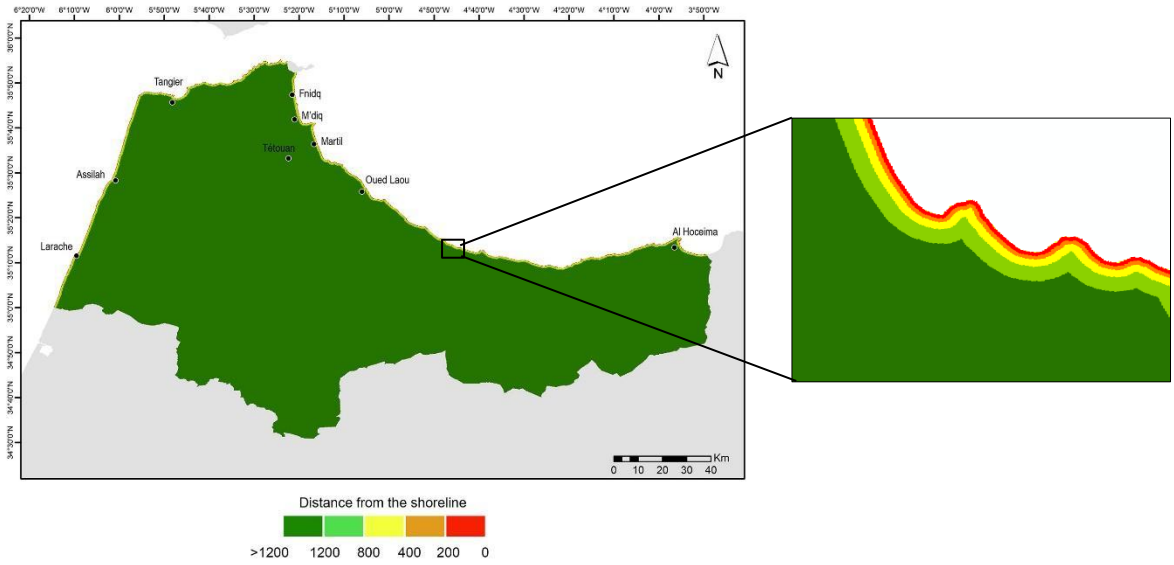
Figure 29. Map of land roughness



Distance from the shoreline

This represents the distance of each point of the region from the shoreline, taken perpendicularly to the same shoreline Coastal flooding concerns only the areas near the coast. Coastal flooding risk increases the closer a point is to the coastline, and vice versa, especially for low-altitude areas such as plains and coastal wetlands. The distance map Figure 30) was built using multiple buffer tools in a GIS environment. The 5 scores reported in Table 16 are inspired by a study on risk mapping of coastal flooding areas (Taher et al, 2022) conducted in Nekor Bay, Morocco. The highest score was assigned to the class with the shortest distance from coastline and vice versa.

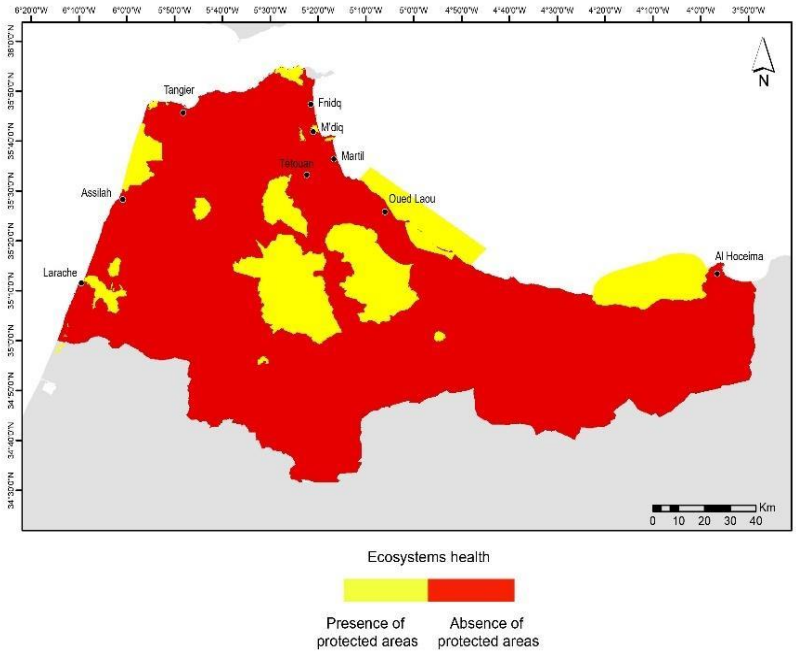
Figure 30. Map of the Distance from the shoreline.



Land roughness

The map was created based on the info already reported in the paragraph IV.H of this report (Figure 15) assigning a score equal to 3 to the terrestrial areas with the presence of protected areas, considering that the protection measures in place contributes to make the territory more resilient compared to the areas without any environmental protection measures.

Figure 31. Map of the Ecosystem health



b) Gender-related variables

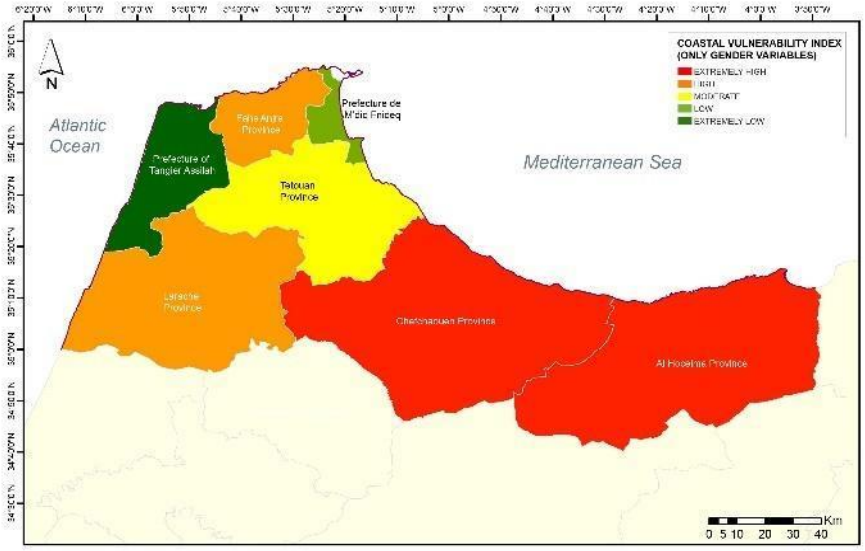
This analysis has introduced the gender aspect by declining it into four main key areas, through the choice of one or more variables per key area:

1. **Education**: this is the most debated in international policy proposals to combat gender inequalities and measures capable of making the most of investment in human capital, especially in developing national contexts. This key area counts three distinct variables: the illiteracy rate, the primary school enrolment rate, and the share of the population with tertiary education;
2. **Labour market:** covered by the activity rate indicator;
3. **Health status and quality of life:** traced back to the indicator of average life expectancy at birth;
4. **Socio-economic status:** three distinct indicators for measuring poverty.

Proceeding analytically, for each of these areas the data collected provided a relevant descriptive picture of the complexity of the territory examined and its internal divisions. It notably shows how, in the presence of quite marked gender asymmetries on each front in the national average, their incidence is much deeper and presumably more difficult to overcome and counteract in the medium term in some contexts than in others. This is especially true considering the mechanisms of impact, adaptation, and resilience to climate change with regards to women, who are usually more vulnerable than men under the same residential conditions.

On the methodological front, the gender gap detected for each indicator on a provincial scale has been compared with the average gender gap detected on a regional scale. This highlights how gender asymmetries emerge with a different intensity and clarity both within TTA's different administrative districts, and in relation to the rural or urban contexts in which they are located. Only in the case of poverty indicators did the absence of sex-disaggregated data available at the provincial level lead to a comparison of the overall local values with the regional average value. In this case, the different incidence of the socio-economic weaknesses between urban and rural areas was also taken into account.

Figure 32. Map of the Coastal Vulnerability index considering only gender variables



Education

Education is fundamental for defining the extent of investment in human capital and for promoting the learning of skills and capabilities deemed useful for achieving an autonomous, independent, and adequately remunerated position in the labour market. It is also crucial to the acquisition of the necessary tools to consciously participate in social and cultural activities, to access and interpret information, and to access political representation and decision-making roles in the medium term.

This key area has been investigated taking into consideration three variables. All found strong asymmetries in the opportunities assured to the male and female populations, taking into account a framework of foundational inequalities that continue to mark individual biographical paths based on gender. This is true of Morocco as a whole and, with greater or lower intensity, of specific areas of TTA.

The first indicator is the **illiteracy rate** - the ratio of the population aged 10 and over unable to read and write to the total population of the same age). At the level of the entire region, it presents an extremely high overall value, although slightly lower than the national average: it is equal to 31% of the population compared to the average figure of 32.2% in the entire Moroccan population). The analysis shows quite different values in the seven provinces considered, ranging from the highest value recorded in the province of Chefchaouen (equal to 40.2%) to the lowest recorded in the province of Tangier-Assilah (equal to 21.8%).

Of even greater interest for the objectives of this report, however, is the disaggregation of this overall figure on the basis of gender, which shows - for the year 2014, the most recent data available at this territorial scale - a situation that is much more critical for the female population: 42.1% of Moroccan women were in a state of total illiteracy at this date, and TTA was certainly no exception, with a figure just below the national average, equal to 41.8%. The figures are much lower amongst the male population (respectively 22.2% and 20.5%). This means that the gap between men and women with respect to basic training and educational opportunities, consisting in the minimum ability to be able to read and write, is equal to over 20 percentage points (21.3) at the regional level. Thus, women of this territory are in a condition of total illiteracy in more than double the cases compared to their male counterparts. The intensity of this gap is consistent and appears particularly intense in the Provinces of Chefchaouen and Al Hoceima, in which it exceeds the gap found at the regional level by 34% and 26%, while it seems to tend to decrease in the regions of Tangier-Assilah, M'diq-Fnideq and Tétouan (where the gender gap appears smaller than the regional one by 23%, 16% and 12%, respectively).

Finally, data closer to the regional average are recorded in the Province of Larache, with a gap of just 6% (but starting from values higher than the average both for women, with 46.6%, and for men, with 26.6%) and in the Province of Fahs-Anjra, classified as totally rural, where the value instead exceeds the regional gap by 10% (also in this case starting from higher data for both women, with a rate of 51.4%, equal to more than one in two women in conditions of total

illiteracy, compared to men, where the same condition affects almost 28% of the total and therefore more than one in four men).

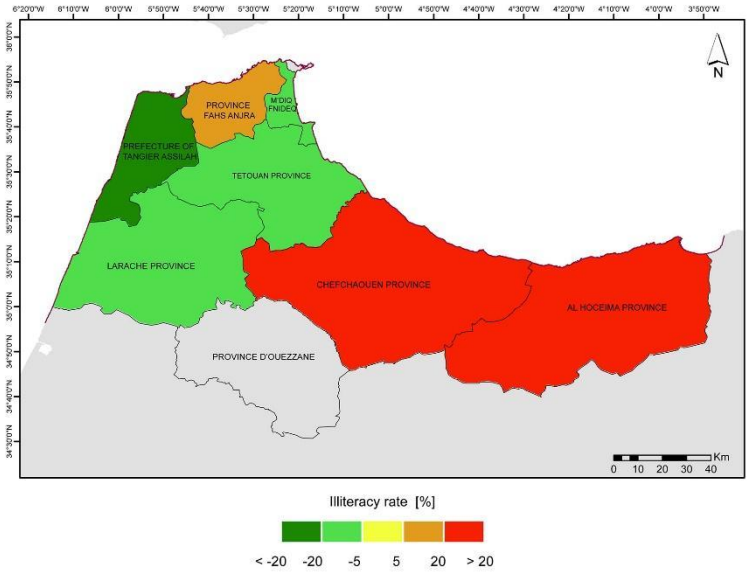
Distinguishing between urban and rural territories highlights how illiteracy rates are much lower in the former case than in the latter. Although the total value oscillates between 20.6% in the Province of Tangier-Assilah and 27.3% in the Province of Chefchaouen, the picture in rural areas is much more severe: the illiteracy rate ranges from 50.4% in the Province of Larache (with peaks of 62.1% for women) to 35.1% in the Province of M'diq-Fnideq, where the figure for women remains very high, at 48.2%, compared to 22.5% for men.

At the level of the entire TTA, the contrast between rural and urban areas deriving from the sum of very heterogeneous local contexts is on the whole equally clear: compared to the illiteracy rate of 44.7% of the population residing in rural areas (with a value of 58.8% for women compared to 31.1% for men) there is a rate of "just" 22.1% in urbanised areas (which also maintains a gap of 17.4% between the value of 30.9% of women and that of 13.5% of men).

Table 17. Illiteracy rate: gender data for TTA, by Province and by Rural and Urban area

Province	Illiteracy rate											
	Total				% (vs TTA)	Rural				Urban			
	Overall %	F %	M %	Gap F-M	Gap F-M	Overall %	F %	M %	Gap F-M	Overall %	F %	M %	Gap F-M
	2014					2014				2014			
Larache	36,5	46,6	26,6	20,0	-6%	50,4	62,1	39,4	22,7	24,9	34,2	15,4	18,8
Tangier-Assilah	21,8	30,2	13,7	16,5	-23%	42,1	53,0	32,1	20,9	20,6	28,9	12,6	16,3
Fahs-Anjra	39,3	51,4	27,9	23,5	10%	39,3	51,4	51,4	23,5	-	-	-	-
M'diq-Fnideq	24,2	33,3	15,5	17,8	-16%	35,1	48,2	48,2	25,7	23,5	32,4	15,1	17,3
Tétouan	27,5	36,9	18,2	18,7	-12%	45,2	58,0	33,0	25,0	21,1	29,5	12,6	16,9
Chefchaouen	40,2	55	26,4	28,6	34%	42,8	58,4	28,3	30,1	22,4	32,3	12,9	19,4
Al Hoceima	39,3	52,7	25,8	26,9	26%	45,7	60,5	30,8	29,7	27,3	38,1	16,5	21,6
Region TTA	31	42	20,5	21,3	-	44,7	58,8	31,1	27,7	22,1	30,9	13,5	17,4

Figure 33. Illiteracy rate: gender gap map for TTA, by Province



The second indicator selected (**Share of population with tertiary education**) refers to the last stage of the school cycle. This is the share of the population with tertiary education distinguished by gender and disaggregated on a provincial scale based on the latest survey available at this territorial level (2014).

In this case, the overall performance of TTA is lower than the national average, with a value equal to 5% compared to 6.1% for Morocco as a whole. The gender gap is quite small, equal to 1 percentage point in favour of men. Given these generally rather low rates, it is still significant. However, this is a slightly smaller gap than the national one, which is equal to 1.4 percentage points (between the figure of 6.8% for men and 5.4% for women). Observing the declination of this variable in the various provinces of the region, the best data concerns the Province of Tangier-Assilah, with 7.2% of the population with a tertiary education qualification, and a gender gap of 1.1 percentage points against women compared to men (6.6% and 7.7% respectively).

The worst figure concerns the rural Province of Fahs-Anjra, with an average value of just 0.9% (0.7% for women and 1.1% for men) Between these two extremes, the situation appears extremely varied, both in terms of overall percentage values and gender gaps. In addition to Tangier-Assilah, the Provinces of Tétouan and M'diq-Fnideq are driving the regional average, with percentages of 6.9% and 5.1% respectively, and extremely small gender gaps (0.2 and 0.5 percentage points in both cases). On the other hand, the most critical situations in addition to Fahs-Anjra are the Provinces of Chefchaouen and Al Hoceima, with rates of 1.9% and 3.8% marked by gender gaps that are not negligible: 1 and 2.2 percentage points respectively, where women with university degrees represent just 2.7% of the female population.

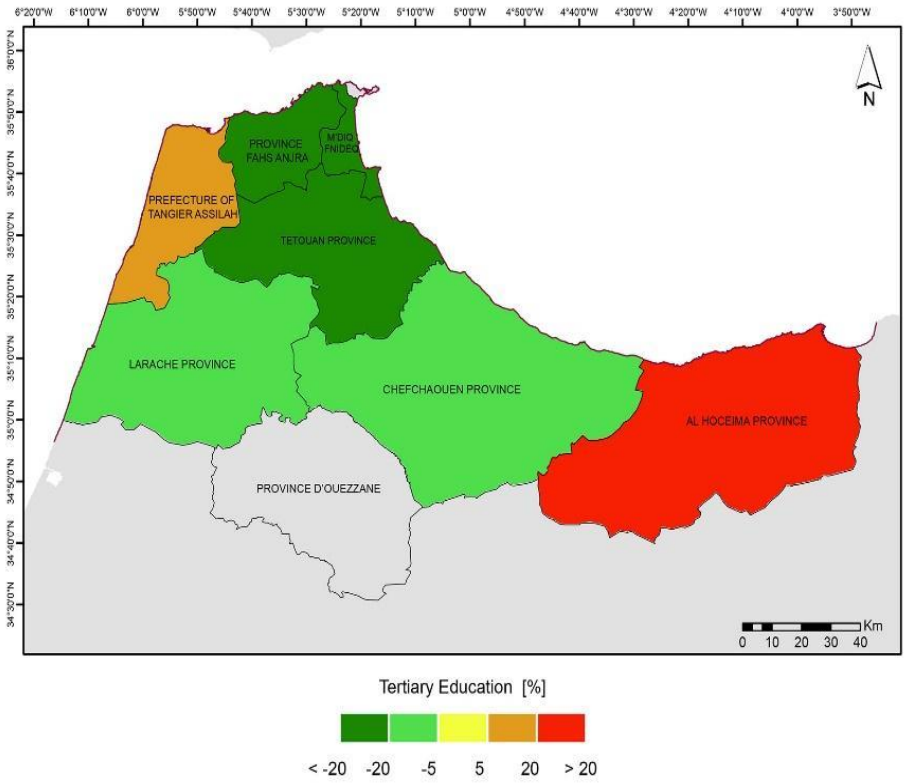
Compared to the other variables selected for education, the difference between urban and rural areas appears even more marked. It denotes two truly distant socio-cultural worlds marked by the urbanisation of the younger and more educated cohorts of the last decades, further accentuating the erosion of the human capital left in rural areas. Just 1.1% of the population residing in rural areas holds a tertiary qualification at the TTA scale (0.7% for females and 1.5% for males). This value increases to 7.7% for the urban population (7.0% for women and 8.3% for men). In rural areas, the worst situation can be found in the Province of Larache (with an overall figure of 0.6%, which drops to 0.4% for women), while the best situation concerns the Province of Al Hoceima (with a value of 1.5%). A similar performance is found in the rural areas of the province of Tangier-Assilah (with a rate of 1.2%), but between these two provinces the gender gap varies significantly: it is very limited in the second case (just 0.4% to the detriment of women) and rather significant in the former (as much as 1.4 percentage points of difference).

In urban areas, the best scenario is found in the Province of Tétouan (with an overall rate of 9.3% and a gap reduced to just 0.3 percentage points for women) to the Province of M'diq-Fnideq (with an overall value of 5.3%, and a 0.6 percentage point gender gap). The most marked gender gap is evident in the urban areas of the Province of Al Hoceima, where, with an overall figure that is higher than the regional average (equal to 8.3%), 4 percentage points separate women (6.3 %) from men (10.3%).

Table 18. Share of population with tertiary education gender data for TTA, by Province and rural and urban area

Province	Share of population with tertiary education												
	Total				% (vs TTA)	Rural				Urban			
	Overall %	F %	M %	Gap F-M	Gap F-M	Overall %	F %	M %	Gap F-M	Overall %	F %	M %	Gap F-M
	2014					2014				2014			
Larache	4	3,5	4,4	-0,9	-10%	0,6	0,4	0,8	-0,4	6,9	6,1	7,7	-1,6
Tangier-Assilah	7,2	6,6	7,7	-1,1	10%	1,2	1,0	1,4	-0,4	7,5	6,9	8,1	-1,2
Fahs-Anjra	0,9	0,7	1,1	-0,4	-60%	0,9	0,7	1,1	-0,4	-	-	-	-
M'diq-Fnideq	5,1	4,8	5,3	-0,5	-50%	0,7	0,7	0,6	0,1	5,3	5,0	5,6	-0,6
Tétouan	6,9	6,8	7	-0,2	-80%	0,7	0,7	0,8	-0,1	9,3	9,1	9,4	-0,3
Chefchaouen	1,9	1,4	2,3	-0,9	-10%	0,9	0,5	1,2	-0,7	8,7	7,7	9,5	-1,8
Al Hoceima	3,8	2,7	4,9	-2,2	120%	1,5	0,8	2,2	-1,4	8,3	6,3	10,3	-4,0
Region TTA	5	4,5	5,5	-1,00	-	1,1	0,7	1,5	-0,8	7,7	7,0	8,3	-1,3

Figure 34. Map of the tertiary education gender gap related for TTA, by Province



Labour Market

In close connection with Education, the second key area taken into consideration in our analysis relates to labour market participation, in an attempt to highlight unequal access between women and men in economic competition and opportunities to achieve economic and personal autonomy. The indicator selected is the activity rate, i.e., the ratio between the number of active persons (occupied labour force and the unemployed) and the corresponding total population. In this case, 2014 corresponds to the most recent availability of disaggregated data, both by gender and at the provincial scale.

At the TTA level, the overall **activity rate** reaches a value of 51.55%, higher than the national average (47.6%), with an enormous difference of 53.5 percentage points between females (24%) and males (77.5%). The heterogeneity of the territory at the provincial level is expressed by a variation of this rate from the maximum of 55.2% recorded in the Province of Tangier-Assilah to the minimum of 47.6% recorded in the Province of Al Hoceima. The gender gap also shows considerable variability, peaking at 63.5 percentage points in the rural Province of Fahs-Anjra, where the value recorded for women is just 15% compared to 78.5% for men. This is also due to the prevalent female presence in unpaid domestic and care work, and the lack of formal regularisation of their contribution in the different phases of the production chain of the agricultural and agro-food sectors, especially in the context of small family-run businesses.

The smallest gap (equal to 47.9 percentage points) is in the Province of Tangier-Assilah, which is the most affluent in terms of job opportunities in all economic sectors and therefore also more open to female recruitment and access to the labour market, especially in the tertiary sector and in tourism. In this Province, the female activity rate is above the regional average (around 30.8%), compared to a male figure that is also higher, but not as markedly, compared to the regional figure (78.7%). Conversely, the Provinces of Chefchaouen, Larache and M'diq-Fnideq are under average (with values of 21.1%, 21.9% and 22% respectively), with significant differences compared to the male resident population, but never higher than 7% compared to the regional gap, and therefore in line with the average context.

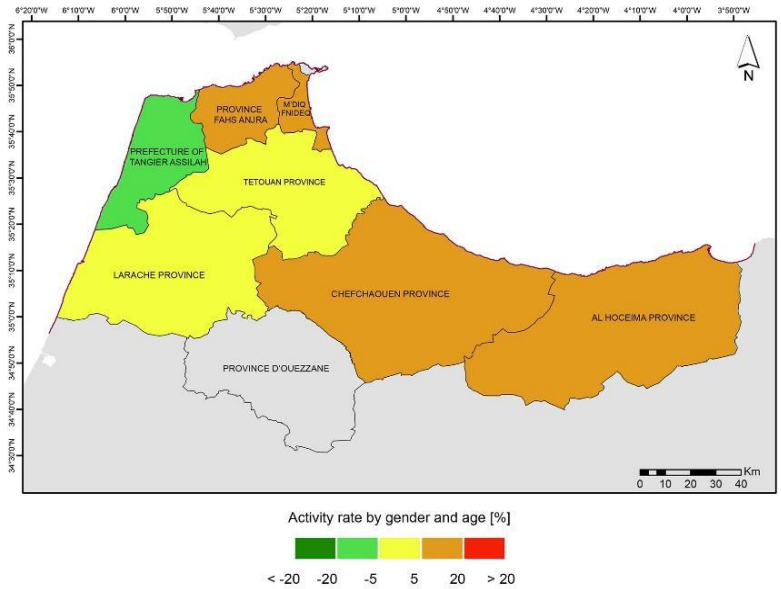
Table 19. Activity rate gender data for TTA, by Province and Rural and Urban area

Province	Activity rate												
	Total				% (vs TTA)	Rural				Urban			
	Overall %	F %	M %	Gap F-M	Gap F-M	Overall %	F %	M %	Gap F-M	Overall %	F %	M %	Gap F-M
	2014					2014				2014			
Larache	49,5	21,9	76,8	-54,9	3%	50,8	18,1	81,5	-63,4	48,4	24,9	72,8	-47,9
Tangier-Assilah	55,2	30,8	78,7	-47,9	-10%	52,2	20,1	81,4	-61,3	55,3	31,4	78,5	-47,1
Fahs-Anjra	47,9	15	78,5	-63,5	19%	47,9	15,0	78,5	-63,5	-	-	-	NA
M'diq-Fnideq	51,4	22	79	-57	7%	46,7	13,3	78,8	-65,5	51,7	22,5	79,0	-56,5
Tétouan	50,1	23,1	77,1	-54	1%	50,6	16,7	82,5	-65,8	49,9	25,3	75,2	-49,9
Chefchaouen	51	21,1	78,6	-57,5	7%	51,1	20,9	79,1	-58,2	49,8	22,9	75,5	-52,6
Al Hoceima	47,6	18,2	77,5	-59,3	11%	48,5	18,6	78,9	-60,3	45,9	17,4	74,9	-57,5
Region TTA	51,1	24	77,5	-53,5	-	1,1	0,7	1,5	-60,2	7,7	7,0	8,3	-49,5

As usual, a difference emerges between rural and urban areas, with a much more pronounced gender gap in the former case than in the latter. At the regional scale, the activity rate of the population residing in rural areas is 49.6% (79% for men and 18.8% for women, with a gap of 60.2 percentage points to the disadvantage of women), while the indicator reaches a total value of 52% in urban areas, with a gap of "only" 49.5 percentage points between men (76.6%) and women (27.1%).

Downscaling to the provincial level, in rural areas the best performance is in the Province of Tangier-Assilah, with a rate of 52.2% (and a gap of 61.3 percentage points between 81.5% for men and 18.1% for women), while the lowest figure is found in the Province of M'diq-Fnideq (46.7%) with a substantial gap of 65.5 percentage points between the male (78.8%) and female data (13.3%, the lowest in the region). A gender gap that is lower than the regional one is found in the Province of Chefchaouen, where it reaches 58.2 percentage points (between 79.1% for men and 20.9% for women, with an overall figure of 51.1%). In urban areas, the most positive picture is in the Province of Tangier-Assilah, with a value of 55.3% (78.5% for men and 31.4% for women, with a gap of 47.1 percentage points), while the starkest contract compared to the regional average is in the Province of Al Hoceima (45.9%, between 74.9% for men and 17.4% for women, with a difference of 57.5 percentage points).

Figure 35. Map of the activity rate gender gap for TTA, by Province



Health Status

Health status, in connection with the average quality of life, has been intercepted through a very meaningful variable in socio-demographic studies: **average life expectancy at birth**, expressed in years, and higher everywhere for women than for men. Given the lack of availability of disaggregated data at the provincial level, regional data was used in this case, comparing the value detected for the TTA with those found at the national level and in other regions of the country, and then attributing the same TTA value to all its provinces, except one.

In fact, the Al Hoceima Province was included in the statistics provided for 2019 by the "*Les indicateurs sociaux du Maroc*"[11] report in the Taza-Al Hoceima-Taour region, while the other provinces fall within the Tangier-Tétouan region. This distinction is necessary to highlight the difference in the data collected for the two partitions of TTA. In general, the average life expectancy at birth is 73.7 years for the Tangier-Tétouan sub-region, with a value of 75.27 years for women and 71.96 years for men, and a difference of 3.31 years for the benefit of women. This is lower than the national average, equal to 76.4 years overall, with a similar gap (3.4 years) between the 78.2 years attributed to the female population and the 74.8 associated with the male population. In the case of the Province of Al Hoceima, assuming the data referring to the composite partition with Taza-Taour, there is an interesting peculiarity, because the value of the average life expectancy at birth drops to 69.4 years overall, with a value of 71.95 years for women and only 66.6 years for men, also revealing a more consistent gender gap than the national average, equal to 5.35 years, and signalling a less favourable welfare profile than the rest of the region. This certainly needs to be taken into consideration in the analysis of potential vulnerability differentials within TTA, including from a gender perspective.

Table 20. Average Life Expectancy at birth gender data in TTA, by Province

Average Life Expectancy at birth (2019)		
Province	**GAP F-M (years)**	**% (vs National Average)**
Larache	**3,31**	**-3,0%**
Tangier-Assilah	**3,31**	**-3,0%**
Fahs-Anjra	**3,31**	**-3,0%**
M'diq-Fnideq	**3,31**	**-3,0%**
Tétouan	**3,31**	**-3,0%**
Chefchaouen	**3,31**	**-3,0%**
Al Hoceima	**5,35**	**57%**

[11] GoM, Haut-Commissariat au Plan (2020) Les indicateurs sociaux du Maroc

Figure 36. Average Life Expectancy at birth gender map in TTA, by Province

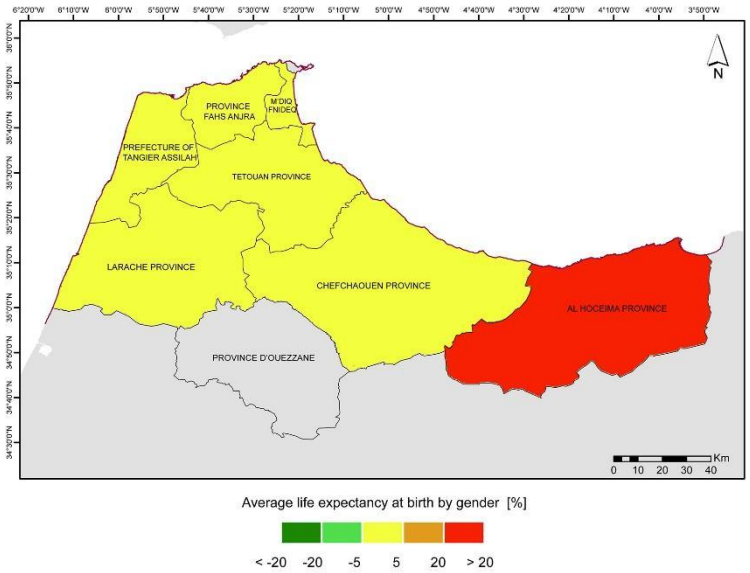


Table 21. Average Life Expectancy at birth gender data for Morocco's Regions

REGIONS	Years				% (vs National)
	F	M	Total	GAP F-M (Years)	
Régions du Sud	78,07	74,79	76,5	3,28	-4,0%
Souss-Massa-Drâa	78,73	75,2	77	3,53	4,00%
Gharb-Chrarda-Beni Hssen	76,58	73,92	75,3	2,66	-22,00%
Chaouia-Ouardigha	74,96	71,6	73,3	3,36	-1,0%
Marrakech-Tensift Al Haouz	75,11	72,05	73,6	3,06	-10,0%
Oriental	77,44	74,54	76	2,9	-15,0%
Grand Casablanca	80,61	77,95	79,3	2,66	-22,0%
Rabat-Salé-Zemmour-Zaër	78,11	75,11	76,6	3	-12,0%
Doukkala-Abda	72,35	69,47	70,9	2,88	-15,0%
Tadla-Azilal	72,91	69,52	71,3	3,39	0,00%
Meknès-Tafilalet	72,88	69,34	71,2	3,54	4,00%
Fès-Boulemane	74,52	71,88	73,2	2,64	-22,0%
Taza-Al Hoceima-Taounate	71,95	66,6	69,4	5,35	57,00%
Tangier-Tétouan	75,27	71,96	73,7	3,31	-3,0%
National	78,2	74,8	76,4	3,4	

Socio-economic status

Finally, the key area of socio-economic status was investigated by referring to three distinct indicators for poverty. However, they do not present data disaggregated by gender, not even on a regional scale but on a national one, and even in this case only for the monetary poverty indicator. Given their importance in accounting for socio-economic fragility within the provincial partitions in the heterogeneous territory of TTA, we felt that it was appropriate to report the mapping of these value differentials with respect to the regional average. It is hoped that soon, a distinction by gender at the local level will be available (especially concerning the different relative vulnerability of families with male or female heads of household), also in light of the fact that the data collected requires an update beyond 2014.

The first indicator selected is the most classic and used in the literature on socio-economic inequalities, i.e., the **overall poverty rate**, which consists of the ratio of the number of people whose income falls below the poverty line, taken as half the median household income of the total population.

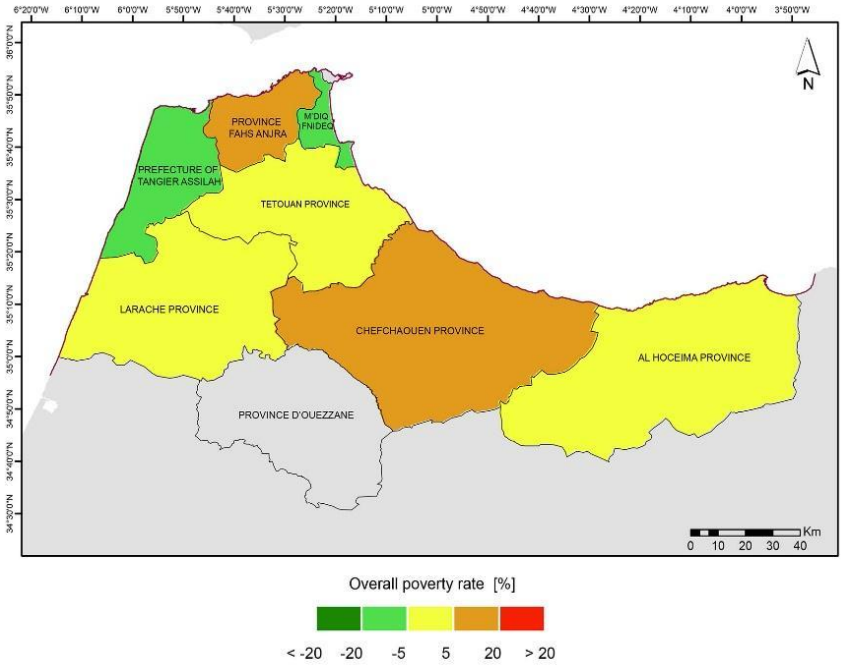
Compared to the national average figure of 11.7% and above all the regional TTA figure of 11.1% of the population burdened by this condition of overall poverty, the worst situation is found in the Province of Chefchaouen, with an almost double rate, equal to 21.2%. The scenario also presents quite marked criticalities in the rural Province of Fahs-Anjra and in those of Larache and Al Hoceima, with rates of 17.15%, 15.96% and 13.9% respectively. A condition that almost coincides with the regional data is that of the Province of Tétouan (10.67%), while the general socio-economic status reported in the Provinces of M'diq-Fnideq and Tangier-Assilah is significantly better, with rates of just 3.69% and 3%. Relevant in this case, even more markedly than the other indicators chosen, is the discrepancy between rural and urban areas,

If at the national level the overall poverty rate records values of 23.7% in rural areas and 3.95% in urban areas, a similar gap is replicated in TTA, with values of 22.9% and 3.3% respectively. Entering the framework of the provincial subdivision, the main difference emerges between the rural and urban areas of Tétouan, with a gap of 27.52 percentage points between the former (30.53%) and the latter (3.01%). The smallest gap is instead found between the rural and urban areas of the Province of M'diq-Fnideq, with 10.64 percentage points of difference between the rate, respectively, of 13.75% and 3.11%. The best data is recorded in the urban areas of the more developed region of Tangier-Assilah, where only 2.8% of the resident population is in this situation of socio-economic degradation.

Table 22. Overall poverty rate gender data in TTA, by Province and rural and urban area

Province	Overall Poverty Rate (2014)			
	Total %	Rural %	Urban %	‰ (vs TTA)
Larache	15,96	27,59	5,84	4,40‰
Tangier-Assilah	3,6	17,02	2,8	-6,80‰
Fahs-Anjra	17,15	17,15	-	5,50‰
M'diq-Fnideq	3,69	13,75	3,11	-6,70‰
Tétouan	10,67	30,53	3,01	-0,40‰
Chefchaouen	21,2	23,83	2,85	9,10‰
Al Hoceima	13,9	19,44	3,24	2,50‰
Region TTA	11,1	22,9	3,3	-

Figure 37. Overall poverty rate gender map in TTA, by Province



The second indicator selected for this key area is **poverty distribution or monetary poverty**. In this case, nationally disaggregated data is available, including with regards to the gender of the household head, both for the general reference year of this report (2014) and for the most recent year of 2019.

In 2014, the Moroccan rate was 4.8%, between 3.9% of female-run households and 4.9% of male-run households. A significant difference for this indicator was evident between the data recorded in rural areas (equal to 9.5%, with a difference of just 0.1 percentage points between the female and male values) and that found in urban areas (equal to 1.6%, with a 0.3 percentage point gap between the female and male component).

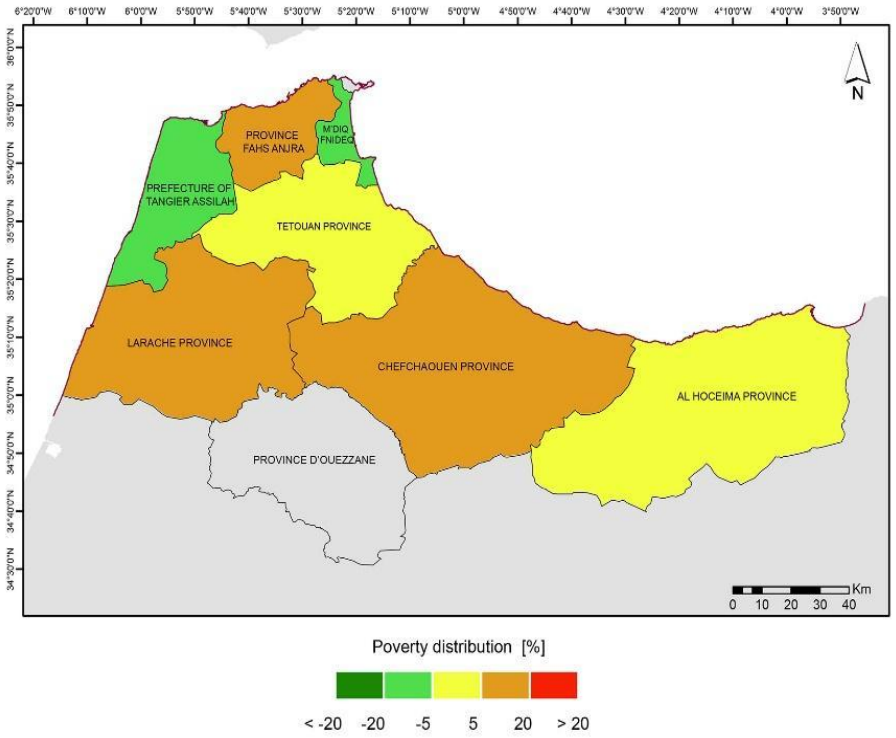
In 2019, the situation presents a quite different general picture. This is why it would be useful to also have these data at other territorial scales - to highlight the distribution of this overall improvement in the socio-economic situation of the country. First, the general rate drops to 1.7%, with female and male values equal to 1% and 1.9%, respectively. Furthermore, the gaps between rural and urban areas also decreased, with respective values of 3.9% (3.2% for women and 4% for men) and just 0.48% (with female and male rates of 0.26% and 0.54%).

Coming back to 2014, from the regional level downwards the disaggregation by gender disappears, but the scenarios still appear interesting to describe. The overall figure for TTA is lower than the national average for the same period, at 2.6%, although with a notable distinction between rural (5.02%) and urban (0.97%) areas. The situation remains heterogeneous on a provincial scale, with the worst performance recorded in the Provinces of Fahs-Anjra and Larache (respectively, 5.47% and 5.33%) and the best performance in the Provinces of M'diq-Fnideq and Tangier-Assilah (with values of 0.65% and 0.93%). The worst data is found in the rural areas of the Province of Larache (7.89%), while the best one concerns the urban areas of the Province of M'diq-Fnideq (0.46%).

Table 23. Poverty distribution or monetary poverty gender data in TTA, by Province and rural and urban area

Province	Poverty Distribution or Monetary Poverty (2014)			
	Total %	Rural %	Urban %	‰ (vs TTA)
Larache	5,33	7,89	3,1	10,50%
Tangier-Assilah	0,93	5,25	0,67	-6,40%
Fahs-Anjra	5,47	5,47	...	11%
M'diq-Fnideq	0,65	3,86	0,46	-7,50%
Tétouan	2,01	5,45	0,69	-2,30%
Chefchaouen	4,66	5,23	0,7	7,90%
Al Hoceima	2,23	3,06	0,65	-1,40%
Region TTA	2,6	5,02	0,97	-

Figure 38. Poverty distribution gender map in TTA, by Province

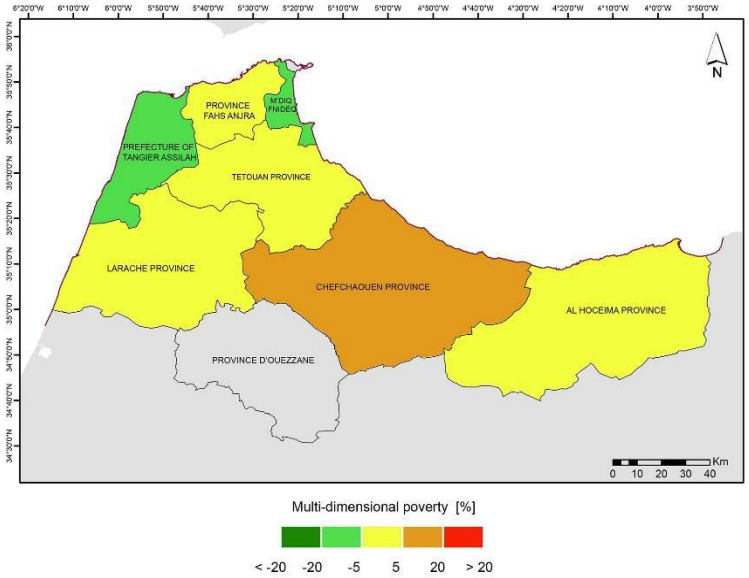


The last selected indicator, defined as **multidimensional poverty**, presents a value of 9.5% at the TTA scale, distinguished between the large gap of 20.1% in rural areas and 2.5% in urban areas. These data are higher than the national average for the same period, equal to 8.2%, between 17.7% of rural areas and 2% of urban areas. On a provincial scale, the highest values regard the Provinces of Chefchaouen, Fahs-Anjra and Al Hoceima (respectively, 18.8%, 13.8% and 12.7%), while the more contained ones, again, refer to the Provinces of M'diq-Fnideq and Tangier-Assilah, with values of 3.2% and 2.9%. The worst performance, from this point of view, is found in the rural areas of the Province of Tétouan (with an extremely high value, equal to 28.5%) but also with the highest difference - compared to any other province - in comparison with its urban areas (with a value of just 2.4%, that is lower than the regional average, and a gap of 26.1 percentage points).

Table 24. Multidimensional poverty gender data for TTA, by Province and rural and urban area

Province	Multidimensional Poverty (2014)			
	Total %	Rural %	Urban %	‰ (vs TTA)
Larache	12,2	22,7	3,1	2,80%
Tangier-Assilah	2,9	13,4	2,2	-6,90%
Fahs-Anjra	13,8	13,8	..	4,5%
M'diq-Fnideq	3,2	11,1	2,7	-6,60%
Tétouan	9,7	28,5	2,4	-0,20%
Chefchaouen	18,8	21,2	2,3	9,80%
Al Hoceima	12,7	18	2,6	3,40%
Region TTA	9,5	20,1	2,5	-

Figure 39. Multidimensional poverty gender map in TTA, by Province

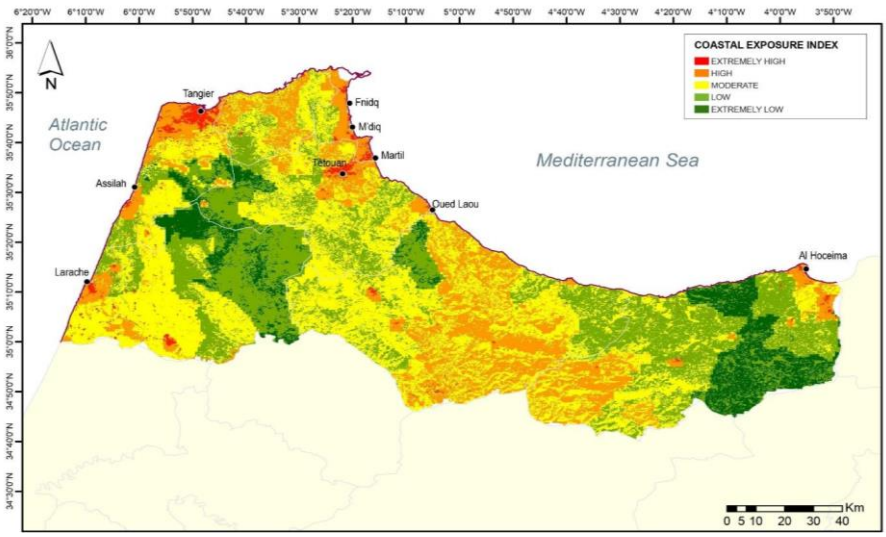


3. Coastal Exposure Index map

Exposure is defined as the presence of people, livelihoods, species or ecosystems, environmental functions, services and resources, infrastructure or economic, social, or cultural assets in places and settings that could be adversely affected. Current unsustainable development patterns are increasing the exposure of ecosystems and people to climate hazards. According to the IPCC (AR6, 2022), the exposure of many coastal populations and associated SLR is high, increasing risks, and is concentrated in and around coastal cities and settlements. High population growth and urbanisation in low-lying coastal zones will be the major driver of increasing exposure to SLR in the coming decades. By 2030, 108– 116 million people will be exposed to SLR in Africa (compared to 54 million in 2000), probably increasing to 190–245 million by 2060.

The Exposure Map shows the coastal elements at risk and includes all components within a particular coastal area that may be adversely affected by a hazard, directly or indirectly (Lummen & Yamada, 2014). **Analysing the TTA map, it appears that "Extremely high" and "High" exposed assets are located along the coast, where the most important urban areas of TTA with high population density and a concentration of economic activities appear**.

Figure 40. Map of the Coastal Exposure index

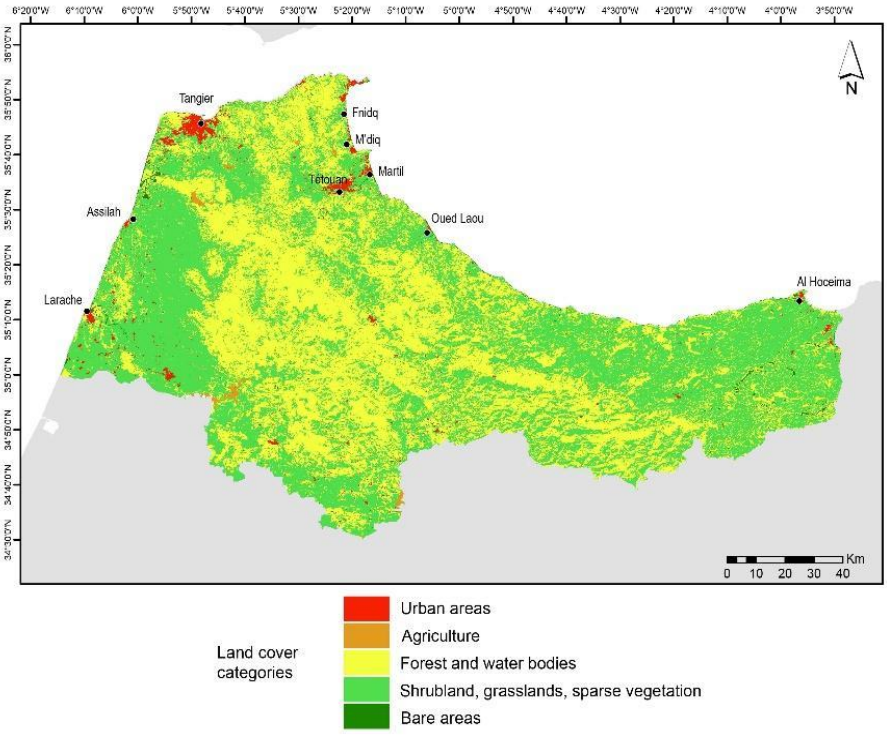


a) Exposure-related variables

Land Cover

The Land cover variable helps to identify the different physical, socio-economic, cultural and environmental assets that could be adversely affected by climate impacts. Land cover and land uses maps represent spatial information on different types (classes) of physical coverage of the Earth's surface, such as forests, grasslands, croplands, lakes, wetlands[12]. Merging these land cover categories in the 5 groups defined in the Table 16, the study area is covered mainly by "Shrubland, grasslands, sparse vegetation" and "Forest and water bodies", with nearly 50% for each category, while less than 3% is covered by the remaining 3 groups. Urban areas represent 1,5% of the whole region and are mainly located in the coastal areas.

Figure 41. Land cover map



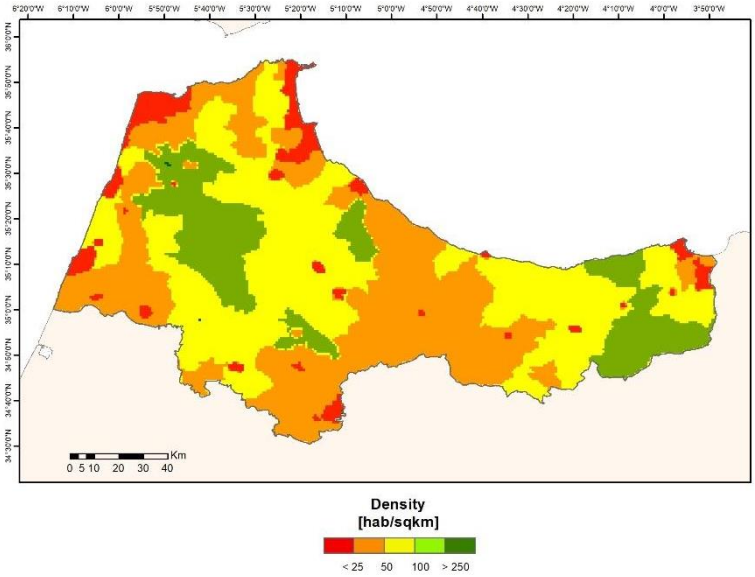
Source: MEDSEA, based on Copernicus Land Service data

[12] The dataset chosen for the analysis is produced by the global component of the Copernicus Land Service, derived from PROBA-V satellite observations and ancillary datasets. It is a high resolution map, GeoTIFF format with 100m pixel, referred to the year 2019 with 23 land cover classes defined using the Land Cover Classification System (LCCS) developed by the United Nations (UN) Food and Agriculture Organization (FAO): six types closed forest, six types open forest, Shrub, Herbaceous vegetation, Herbaceous wetland, Moss and lichen, Bare / sparse vegetation, Cultivated and managed vegetation (cropland), Urban / Built-up, Snow and Ice, Permanent inland water bodies, Missing data, Open sea.

Population density

The population density map identifies the dense population clusters generally coinciding with city, or urban or metropolitan areas, while low density values usually coincide with rural areas or sparsely populated areas.

Figure 42. Population density map (MEDSEA, based on Columbia University data)

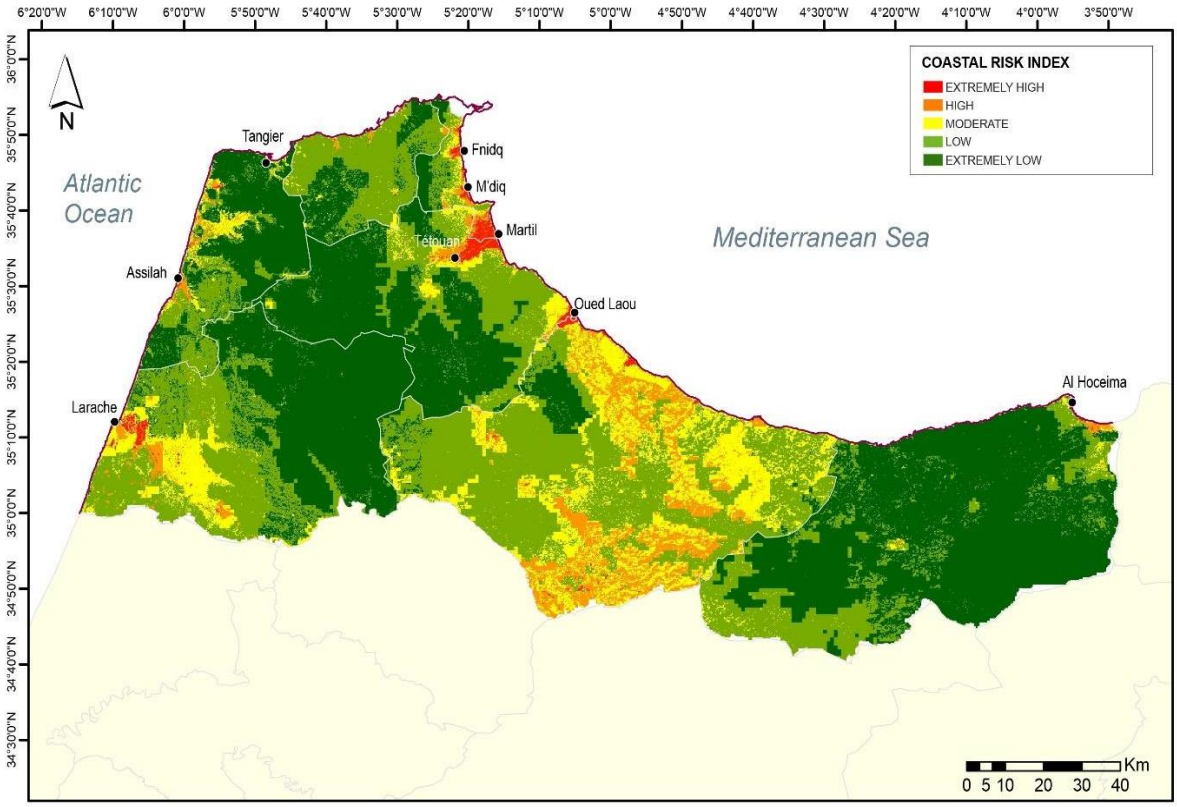


4. Coastal Risk Index map

By multiplying the values of the 3 sub-indexes, the Coastal Risk Index is obtained. The Risk Map shows the relative risk of the coastal region in relation to potential coastal hazards generated and/or exacerbated by climate forcing. It refers to the cumulative risk on the coastal area that can increase existing gender gaps. The methodological choice of enlarging the Hazard zone from the coastal zone to the coastal provinces of TTA has resulted in a map that identifies the level of risk not only for the coast but also for inland areas.

As a result of the interaction between climate change impacts and existing gender gaps between women and man, the “Extremely high-risk” areas are mainly located to the Mediterranean side, corresponding to the plain areas of Fnideq and M'diq, the Martil-Alila plain and going south of the Oued Laou area. On the Atlantic side, the area most at risk is the city of Larache and the Loukkos river basin. A concentration of “high-risk” areas appears in the Province of Chefchaouen and around the urban zones of Tétouan, Al Hoceima and Assilah.

Figure 43. Map of the Coastal Risk index



Final considerations

TTA is a new administrative unit created in 2015. There are no available climate risk assessments covering the whole area yet, nor are there data available on climate change at the regional level. The development of this gender-sensitive climate risk assessment through the application of the Multi-Scale Coastal Risk Index at the Local Scale (CRI-LS), as already performed for the coastal zone of Tétouan (Satta, 2016) required a review of variables to be used. Regarding climate change and environmental variables, the present report focused on the selection of the climate risk assessment method and on the representativity of the same variables for TTA.

Despite some difficulties in finding homogeneous data, climate change and environmental variables can be retained. Only some of them, specifically related to the susceptibility and resilience of the coastline to the erosion hazard [Landform (LF), Coastal protection structures (CPS), Historical shoreline changes (HSC) and River flow regulation (RFR)] were considered less relevant, considering the large extension of the study area and compared to the vulnerability gender variables, and were thus removed.

As for the climate change aspects we can summarise the results of the assessment around 3 considerations:

- **Climate risk is increasing fast**

Data and recent studies demonstrate how climate change impacts and risks are becoming increasingly complex and more difficult to manage. Biodiversity and ecosystem services have limited capacity to adapt to increasing global warming levels, which will make climate resilient development progressively harder to achieve beyond 1.5°C warming (IPCC, 2022). This means that the level of risk and the development of a climate resilience will depend on concurrent near-term trends in vulnerability, exposure, level of socioeconomic development and adaptation.

Multiple climate hazards occurring at the same time or within the same space are no longer a “worst case scenario” for research, but they have been observed in many inhabited regions, with many regions experiencing unprecedented consequences. In the last decade, the impacts of droughts, precipitation, storms and SLR have intensified causing coastal and internal inundation, soil erosion and highlighted societal vulnerabilities. Evidence of observed impacts, projected risks, levels and trends in vulnerability, and adaptation limits, demonstrate that worldwide climate resilient development action is more urgent than previously assessed so far.

Considering the peculiarity of TTA, the trends of the main ongoing climate pressures, the vulnerability of the local society and communities that have been analysed within this report, it is possible to consider that TTA is a climate hotspot in the Mediterranean context. In the coastal cities and settlements of the region, risks to people and infrastructure will get progressively worse in a changing climate, with increasing SLR and storm events, both in terms of frequency and intensity, and with ongoing coastal development.

- **What kind of measures should be implemented?**

It is fundamental to work on measures that reduce vulnerability and increase resilience. Adaptation plays a key role in reducing exposure and vulnerability to climate change. The ability of societies and ecosystems to adapt to current coastal impacts depends on immediate and effective mitigation and adaptation actions. Safeguarding biodiversity and ecosystems is fundamental to climate resilient development, considering the threats that climate change poses to them and their roles in adaptation and mitigation.

Building the resilience of biodiversity and supporting ecosystem integrity can maintain benefits for people, including livelihoods, human health and well-being and the provision of food and water, as well as contributing to disaster risk reduction and climate change adaptation and mitigation. At the same time, a focus on climate risk alone does not enable effective climate resilience. Integrated, inclusive planning and investment in everyday decision-making about urban infrastructure, including social, ecological, and grey/physical infrastructure, can significantly increase the adaptive capacity of urban and rural settlements.

- **Why do we need more knowledge about climate risk and social vulnerability?**

This Gender-Sensitive Climate Risk Assessment and the risk map, including all the sub-indexes and related maps), based on measures and processes analysis, can enable, accelerate and sustain adaptation implementation by highlighting ongoing climate change impacts, and how these climate change impacts are being experienced by societies. It is

demonstrated that societies with high levels of inequity are less resilient to climate change. This study focused on assessing climate risks by modelling past, present and future climate change impacts with climate projections and observations, together with social and cultural understandings.

Given the relative ease of use and readability of the resulting maps, the proposed coastal risk index method has great potential to be used by stakeholders and decision-makers as a support tool when considering and integrating climate change and gender related issues into their planning for sustainable development and adaptation and ICZM strategies.

Local knowledge is crucial to build a social-ecological system resilience, to help local communities to accept and implement adaptation measures, support decision makers to implement mitigation measures and support adaptation finance. Breaking adaptation down into manageable steps over time can increase the prospect that effective adaptation plans will be actioned in timely and effective ways by stakeholders, sectors and institutions. The actions and decisions taken today determine future impacts and play a critical role in expanding the solution space for future adaptation.

As for the gender-sensitive aspect of this climate risk assessment, the study considers that gender is linked to the potential risk suffered by women and men, and by women compared to men, on the basis of the probable amplification of pre-existing gender inequalities that natural hazards generated by climate forcing could activate. It also considers the resilience that could be potentially expressed - again in gender terms, by women and men and by women compared to men - in case of the actual occurrence of natural hazards, through the use of specific coping skills.

For the reasons described above, only a small part of the wide range of social indicators proposed in the phase of preliminary identification of the variables was selected for this study, it should be reiterated that the validity of this rich, variegated, and overabundant proposal should be preserved. In fact, the proposed model retains its replicability in contexts where all these data are already available and sex-disaggregated at the smallest local territorial scale. It is worth bearing in mind that the last census dates from 2014, and should be updated soon. This would allow for a better degree of territorial and gender unbundling. In fact, the lens of gender asymmetries offers a richer and more reliable picture of the socio-economic mechanisms operating in such a composite and heterogeneous territory. Not taking them into account, due to the absence of analytical depth, certainly means missing the aim of a locally founded and rooted development, whose amplifications manifest in the entire national growth performance. The gender perspective is not, in fact, "only" analytically correct and methodologically necessary, but is indispensable in terms of the effectiveness of any political measure to promote sustainable, inclusive and lasting development.

Concerning the temporal factor, a study such as this one highlights the need to access updated data, disaggregated more frequently by gender and by local scale. It is insufficient to rely only on census surveys and their ten-year hiatus, in such a period of accelerated and turbulent change and transformation. Some very recent publications of the Haut Commissariat au Plan of Morocco, during the last weeks, announced at the end of May 2022 and gradually released until the end of July 2022, constitute a precious source of information for the advancement of this research in the near future, but their limited reference to the national level and, at best, to the regional level - in many cases also from a gender perspective - continues to make it difficult to refer to more precise breakdowns, on a local scale, which should instead be increasingly desirable.

Finally, in such a disarming and urgent situation as the one imposed by climate change, it would be absurd to continue to ignore the role of women as mere portions of the population that are more exposed to all sorts of risks and vulnerabilities. Women are effective agents of change in the processes of adaptation and elaboration of ecological metamorphosis, beginning with management strategies in family and community organisation. This forms a basis from which to trace plausible and sustainable paths and processes of investment in human, social, economic, financial, and political capital, through gender-sensitive and non-gender-neutral actions, which are much more than a powerful cosmetic coverage of the recurrence of gender gaps in every area.

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Annexes

ANNEX 1: INVENTORY OF STAKEHOLDERS TO ENGAGE IN THE PARTICIPATORY PROCESS OF THE REGIONAL COASTAL SCHEME (SRL) OF THE TANGIER-TÉTOUAN-AL HOCEIMA REGION

	Composition de la Commission Régionale de Gestion Intégrée du Littoral Région Tangier-Tétouan-Al Hoceima
1.	Conseil de la Région Tangier-Tétouan-Al Hoceima
2.	Conseil Provincial de Tangier-Assilah
3.	Conseil Provincial de Fahs-Anjra
4.	Conseil Provincial de Chefchaouen
5.	Conseil Provincial de Tétouan
6.	Conseil Provincial de Al Hoceima
7.	Conseil Provincial de Larache
8.	Conseil Provincial de M'diq-Fnideq
9.	Communes ayant une façade maritime
10.	Préfecture de Tangier-Assilah
11.	Province de Fahs Anjra
12.	Province de Chefchaouen
13.	Province de Tétouan
14.	Province d'Al Hoceima
15.	Province de Larache
16.	Préfecture M'diq Fnideq
17.	Direction Régionale de l'Équipement, du Transport, de la Logistique et de l'Eau
18.	Tribunaux de première instance concernés dans la Région
19.	Cour d'appel de Tangier
20.	Cour d'appel de Tétouan
21.	Tribunal de commerce de Tangier
22.	Commandement Régional de la Gendarmerie Royale
23.	Commandement Régional des Forces Auxiliaires
24.	Commandement Régional de la Protection Civile
25.	Direction Régionale de l'Habitat et de la Politique de la ville
26.	Inspection Régionale de l'Urbanisme et de l'aménagement du territoire national
27.	Délégation Provinciale du Tourisme à Tangier
28.	Délégation Provinciale du Tourisme à Tétouan
29.	Délégation Provinciale du Tourisme à Al Hoceima
30.	Direction Régionale de l'Énergie et des Mines à Tangier
31.	Direction Régionale de l'Environnement
32.	Direction Régionale de la Santé
33.	Direction Régionale de l'Agriculture
34.	Délégation Provinciale de la Pêche Maritime de Tangier
35.	Délégation Provinciale de la Pêche Maritime de Jebha
36.	Délégation Provinciale de la Pêche Maritime de M'diq
37.	Délégation Provinciale de la Pêche Maritime de Al Hoceima
38.	Délégation Provinciale de la Pêche Maritime de Larache
39.	Direction de l'Agence Nationale pour le Développement de l'Aquaculture
40.	Direction Régionale de l'Industrie, du Commerce, de l'Économie verte et numérique
41.	Direction Régionale de la Culture
42.	Direction Régionale de l'Artisanat
43.	Direction Régionale des Eaux et Forêts et de la Lutte Contre la Désertification du Rif

44.	Centre Régional de la Direction générale de la météorologie du Nord-Ouest
45.	Centre Régional de l'Institut National de la Recherche Halieutique de Tangier
46.	Centre de l'Institut National de la Recherche Halieutique de M'diq
47.	Délégation Régionale de l'Office National des Pêches Maritimes
48.	Direction Régionale de l'Agence Nationale des Ports
49.	Agence du Bassin Hydraulique du Loukkos
50.	Amendis Tangier
51.	Amendis Tétouan
52.	Office National de l'Eau et de l'Électricité à Tangier
53.	Office National de l'Eau et de l'Électricité à Al Hoceima
54.	Régie Autonome de Distribution d'Eau et d'Electricité de Larache (RADEEL)
55.	Chambre des Pêches Maritimes de la Méditerranée à Tangier
56.	Agence Urbaine Tangier
57.	Agence Urbaine Tétouan
58.	Agence Urbaine Larache-Ouezzane
59.	Agence Urbaine Al Hoceima
60.	Agence pour la Promotion et le Développement des provinces du Nord (APDN)
61.	Centre Régional d'Investissement (CRI)
62.	Agence Régionale d'Exécution des Projets- (AREP TTA)
63.	Agence Spéciale Tangier Med (TMSA)
64.	Société d'Aménagement pour la Reconversion de la Zone Portuaire de Tangier
65.	Société d'Aménagement de la Vallée de l'Oued Martil (STAVOM)
66.	Université Abdelmalek Essaadi (3 représentants des instituts et centres de recherches dans le domaine du littoral de la Région proposés par la présidence de l'université et nommés par le Wali de la Région
67.	Confédération Générale des Entreprises du Maroc (CGEM)-Région Nord
68.	Cinq représentants d'ONGs actives dans le domaine de l'environnement dans la Région Tangier-Tétouan-Al Hoceima

ANNEX 2: ONLINE QUESTIONNAIRE: EXPERT'S ASSIGNATION OF WEIGHTS TO RISK VARIABLES

Expert's assignation of weights to risk variables

Plan Bleu's activities under SCCF Output 1.1. include the production of a "gender- sensitive climate risk assessment (coastal hotspots areas and based on a stakeholder- led process), which provides a platform for building coastal resilience to climate change in a sustainable and inclusive manner" in the Tangier-Tétouan-Al Hoceima region (TTAH), Morocco. The MEDSEA Foundation is developing the study by applying the Multi-Scale Coastal Risk Index application at the Local Scale (CRI-LS), already applied for the coastal zone of Tétouan (Satta, 2016), adapted in order to integrate gender variables.

The CRI-LS methodology is articulated in five main steps:

1. Definition of the coastal hazard zone;
2. Variables choice and ranking;
3. Assignation of weights to risk variables;
4. Aggregation of variables, sub-indices and final index calculation;
5. Construction of the risk maps.

As part of the third step, the integration of expert judgement is very important for the allocation of scores to physical, natural and ecological variables and the role of policy makers is fundamental in the evaluation of social and economic parameters (Satta, 2014). With the aim to assign weights to each variable you have been selected as a scientific expert and local policy makers for the application of the Multi-Scale Coastal Risk Index application at the Local Scale (CRI-LS) in relation to the development of a Draft Coastal Plan for the Tangier-Tétouan-Al Hoceima region (TTAH) region led by PAP/RAC, CP 2.1 of the MedProgramme.

PLEASE FILL IN THE FORM by assigning your weight to each variable.
*Required

1. Email *

_____

2. Name and Surname *

_____

3. Institution *

_____

4. Expertise *

_____

Before Starting

The conceptual framework for risk and vulnerability makes reference to the recently published WGII AR5 (IPCC, 2014a, 2014b), which mainly focuses on risk. The AR5 SPM (IPCC, 2014a) defines risk to climate-related impacts as the result of the interaction of hazards with vulnerability and exposure of human and natural systems (IPCC, 2014a). In the same report, IPCC introduces the role of non-climate drivers (anthropogenic climate change).

According to IPCC (2014b) risk can be defined as "The potential for consequences where something of human value (including humans themselves) is at stake and where the outcome is uncertain. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the consequences if these events occur". Figure 7 shows Risk as a product of an interaction between hazards associated with climate change and variability on one side, and the vulnerability and its exposure to hazards on the other side (IPCC, 2014b). Climate and non-climate forcing acting on coastal hazards, namely erosion and flooding, generate risk.

Vulnerability and exposure are influenced by development (socio- economic pathways, adaptation and mitigation actions and governance). Climate and Development changes represent the key drivers of the different core components (vulnerability, exposure, and hazards) that contribute to risk (IPCC, 2014b).

In the CRI-LS index forcing and hazard are incorporated in one factor called hazards (H), which interacts with the vulnerability (V) and exposure (E) factors. Definition of spatial attributes and selection of variables is carried out on the basis of the relationships among these three factors.

YOU ARE REQUESTED TO DEFINE THE IMPORTANCE OF EACH VARIABLE CONTRIBUTING TO COASTAL RISK according to your expertise and experience.

Weight scale and linguistic evaluation

Linguistic evaluation	Weight
Most important variable	5
Weakly less important variable	4
Strong less important variable	3
Demonstratively less important variable	2
Not important variable	1

COASTAL HAZARD

Coastal hazards are factors that expose a coastal area to risk of property damage, loss of life and environmental degradation.

1. SLR (SLR) *

Level of the sea increased in one year. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

2. Storms (SWH) *

Average number of detected SWH above 95 percentile / year (SWHx95p), which represents the number of events exceeding the long term (e.g., return period Tr = 100 years) 95 percentile of daily SWH. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

3. Daily precipitation concentration index (CI) *

Daily precipitation concentration index (CI) is used as a concentration measure. High precipitation CI value indicates that precipitation is more concentrated within a few rainy days during the year and vice versa. Studies shows that CI is an estimator of erosivity and aggressivity of rainfall. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

4. Aridity Index *

Desertification is "the degradation of dry, semi-arid and sub-humid lands resulting from various factors, such as climatic variations and human activities", as defined by the United Nations Convention to Combat Desertification (UNCCD). Among these factors the most devastating is deforestation. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

5. Population growth (PGR) *

Population growth (annual %) is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

6. Tourism arrivals (TOUR) *

International inbound tourists are the number of tourists who travel to a country other than that in which they have their usual residence. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

COASTAL VULNERABILITY

Coastal vulnerability is a spatial concept that identifies people and places that are susceptible to disturbances resulting from coastal hazards. Hazards in the coastal environment, such as coastal storms and erosion, pose significant threats to coastal physical, economic, and social systems.

7. Coastal slope (SLO) *

Related to the relative risk of the shoreline retreat. Low sloping coastal regions should retreat faster. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

8. Land roughness (LR) *

Represents the resistance to surface flow exerted by the land surface. *Mark only one oval.*

	1	2	3	4	5

Non-important variable						Most important variable

9. Elevation (ELE) *

Represents the surface of the selected coastal unit. Low coasts are more subject to sea hazards. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable						Most important variable

10. Distance from the shoreline (D) *

Related to progression of the risk according to the inland penetration of the flooding. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable						Most important variable

11. Ecosystems health (EH) *

Expresses the contribution of the ecosystem as a protection against storm surges, flooding and other coastal hazards. Ecosystems include coral reefs, seagrass beds, sand dunes, coastal wetlands and coastal forests. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable						Most important variable

12. Illiteracy rate (education) *

Illiteracy rate by gender and age. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable						Most important variable

13. Average Life Expectancy at birth by gender (Health Status variables) *

Gap in life quality experienced on average by women and men. The variable expresses a good summary proxy of the "Health status" key-area, regarding asymmetries in life quality experienced on average by women and men. In this sense, it offers a good perspective view of the overall biographies of the population based on gender. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable						Most important variable

14. Activity Rate by Gender and Age (Labour market) *

Gender Gap in the possibility of participating in the labour market in conditions of security and stability and of being able to acquire in this way an individual economic autonomy in terms of income earned and spending capacity, not necessarily dependent on the household to which one belongs. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable	◯	◯	◯	◯	◯	Most important variable

15. Tertiary Education (Education) *

Share of population with tertiary education by gender (bachelor's degree, master's degree, Ph.D). The variable is an expression of two different phases of investment in human capital through education, corresponding to different age cohorts and different qualifications, then expendable on the labour market: the secondary level (e.g. diploma/graduation) and the tertiary level (e.g. master's degree or postgraduate qualifications). *Mark only one oval.*

	1	2	3	4	5	
Non-important variable	◯	◯	◯	◯	◯	Most important variable

16. Overall poverty rate (socio-economic Status) *

Overall poverty rate by area of residence and province and prefecture. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable	◯	◯	◯	◯	◯	Most important variable

17. Poverty distribution (socio-economic Status) *

Distribution of forms of poverty according to place of residence and province and prefecture. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable	◯	◯	◯	◯	◯	Most important variable

18. Multidimensional poverty (socio-economic Status) *

Breakdown of multidimensional poverty by source of deprivation and by province and prefecture. Large part of the literature highlights the poverty of women and children - as in general subjects on average less autonomous and more vulnerable from a socio- economic point of view - is strictly dependent on and correlated to the poverty of the family unit to which they belong. *Mark only one oval.*

	1	2	3	4	5	
Non-important variable	◯	◯	◯	◯	◯	Most important variable

COASTAL EXPOSURE

The degree to which a coast is exposed to factors.

19. Land Cover *

Physical material on the surface of land, in coastal zones. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

20. Population density (Territorial Placement) *

Population density between urban and rural areas (disaggregated by gender and age). It represents a proxy for territorial placement by gender. *Mark only one oval.*

	1	2	3	4	5	
Non important variable	◯	◯	◯	◯	◯	Most important variable

Table 25. Moroccan stakeholders who participated in the online questionnaire

Name	Institution	Specialisation / Competence
Maria Snoussi	Freelance consultant	ICZM
Hajar Haybout	Ministry of Energy Transition and Sustainable Development	Biodiversity and Climate Change
Mohammed Malouli Idrissi	National Halieutic Research Institute/Tangier Regional Center for the Mediterranean	Fisheries and Marine Environment
Yahyaoui Abdelmajid	M'diq Fnideq Prefecture	Natural Risk Management and Environment
[Omitted]	Regional Environmental Directorate, Tangier Tétouan Al Hoceima Region	Environment, Head of Division
Abdessamad Ghacha	ONEE, Water Division	Water
Hicham Bouziane	Tangier Tétouan Al Hoceima Regional Council	Regional Development Director