



**METHODOLOGICAL GUIDE FOR ASSESSING VULNERABILITY TO
CLIMATE CHANGE IN PILOT SITES IN ALGERIA, LEBANON,
MOROCCO, TUNISIA AND TURKEY
FFEM PROJECT
«MAXIMIZE THE PRODUCTION OF GOODS AND
SERVICES OF MEDITERRANEAN FOREST ECOSYSTEMS IN THE
CONTEXT OF GLOBAL CHANGES»**



1. Context

The project aims at encouraging stakeholders to manage/restore Mediterranean woodlands to ensure a sustainable provision of goods and services by these ecosystems.

To achieve the main aim of the project, several specific targets have been identified:

- Integrate climate change impacts in forest policies by providing information and tools related to forests vulnerability and adaptation capacities;
- Assess the economic and social values of goods and services rendered by Mediterranean wooded ecosystems, to support decision-making processes and promote the integration among sectoral policies;
- Improve governance of woodlands at territorial scale through participation of stakeholders in the conception and implementation of strategies aimed at reducing the pressures on ecosystems;
- Optimize and value the mitigation function of Mediterranean forests with methodological tools to value local efforts of ecosystems protection/restoration ;
- Strengthen coordination and exchanges of experiences among stakeholders in the region: coordination and communication through the Collaborative Partnership on Mediterranean Forests (CPMF);
- Promote the specificity of Mediterranean forests to the international community and particularly in the context of international negotiations on climate change.

The project is composed by five components that develop in four times (from the pilot site to the regional exchange and then to the international scene):

- A focus on 5-10 pilot sites (4-6 per component, depending on the relevance of the sites and with a maximum of components declined on each site), which are proposed by the countries and selected by the Steering Committee;
- An effort of regional capitalization;
- An exchange between countries and sub-regional institutions and with other Mediterranean countries/institutions;
- The promotion of project results on the international scene.

2. Component 1

Activities scheduled for the Component 1 are focused on production of data and tools supporting decision making relating to the vulnerability of Mediterranean forest ecosystems to climate change impacts and their adapting capacities.

They include five main actions:

- Literature review and synthesis on the impacts of climate change on Mediterranean forest ecosystems and key genetic resources;

- Review and synthesis on activities implemented to adapt Mediterranean forests to climate change in the region;
- Analysis of vulnerability and adaptation capacities of Mediterranean forest ecosystems to climate change impacts in five pilot sites;
- Capitalization of outcomes and elaboration of tools to support decision making in terms of adaptation to climate change for forest managers and policy makers;
- Exchanges of experiences between countries, included countries involved in the project ForClimAdapt, through a regional workshop.

Component 1 is closely articulated with component 4, which focuses on the optimisation and enhancement of the role of mitigation Mediterranean forests (carbon sinks):

- The two components require common data, which are presented both in this methodological guide and in the methodological guide for the analysis of drivers and causes of deforestation of component 4. Common data will be collected coordinating the two components.
- The results of component 1 will contribute to project idea notes (PIN) on REDD+ to be carried out in the content of component 1, through:
 - Insofar as possible, taking into account the estimated direct impact of climate change on forest cover or indirectly on other causes of deforestation and degradation. This consideration could contribute to enhance the carbon potential of possible measures to reduce vulnerability to climate change (adaptive silvicultural practices, new management plans);
 - Integration of recommendations on adaptation to climate change in the proposed REDD+ activities.

3. Pilot sites selected for the implementation of component 1 and component 4

Country	Site	Component
Algeria	Sénilba	C1/C4
Lebanon	Jabal Moussa	C1
Morocco	Maamora forest	C1/C4
Tunisia	Siliana forest	C1/C4
	Barbara forest	C4
Turkey	Duzlercami	C1/C4

4. Assessing the current status of the five pilot sites selected for the implementation of component 1

For each data provided, thank you to specify the data source, the methodology that has generated the data and a simple qualitative assessment of its quality.

If possible, provide maps in digital form (vector)

Data to be collected:

- Site limit (common data C1/C4) in vector format, with the boundaries of administrative units (e.g. departments, cantons, etc.) and management methods (e.g. plots/forest management units, protected areas) (e.g. Figure 1).

The site can include:

- *e.g.* forest ecosystems where both vulnerability assessments to climate change in the context of component 1 and the analysis of the causes of deforestation and degradation under component 4 will be performed;
- *e.g.* other non-wooded lands (other uses) where forest users are present with farmlands or urban areas and where alternative activities to reduce pressure on forest ecosystems (*e.g.* improved agricultural or livestock practices) or to improve forest carbon stocks (*e.g.* plantations) could be proposed in the context of component 4 (Figure 2).

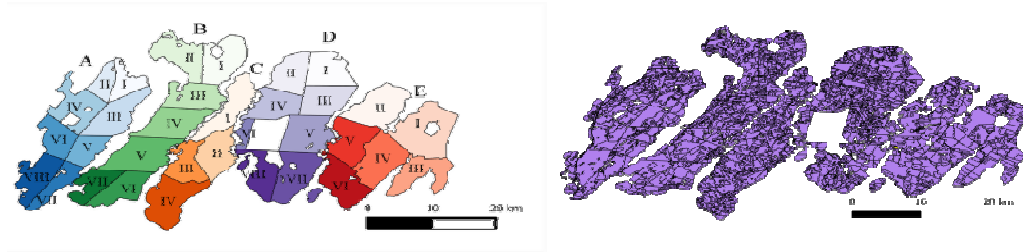


Figure 1. Administrative limits of Maarmora pilot site (Morocco) (cantons on the left and plots on the right). Source : VITO.

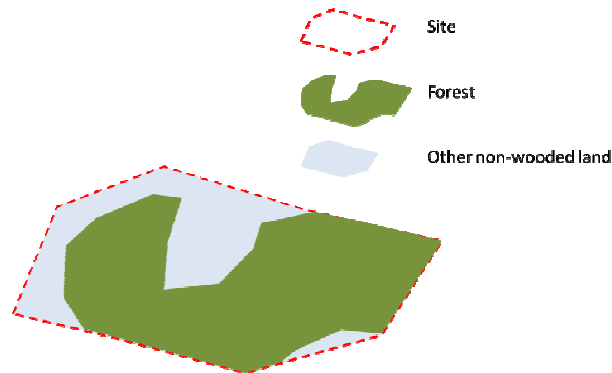


Figure 2. Identification of territories within a site.

- **Biophysical data**

Extract, from past studies and national databases, all relevant biophysical data to characterise the pilot site and its vulnerability to climate change.

Minimum common data C1/C4:

- ✓ Digital Elevation Model (DEM);
- ✓ slope (vector map);
- ✓ soil map (showing diversity of soil types) (vector map) ;
- ✓ hydrography (vector map).

Specific data for C1:

- ✓ aspect map (vector map) ;

- ✓ geological map (vector map) ;
- ✓ soil depth map (vector map).

- **Climatic data**

Extract climatic data from databases (e.g. JRC-MARS (<http://mars.jrc.ec.europa.eu/>) or recommended national meteorological stations in the pilot site, when available).

Minimum common data C1/C4:

- Evolution of **annual precipitation** and **minimum, maximum, average temperature** since 1975;
- Identification of extreme/exceptional climatic and biophysical events since 1975:
 - ✓ **extreme weather events** (drought, storms, etc.);
 - ✓ any observed phenomena of **erosion** and/or **flooding** in watersheds, if relevant for the pilot site;
 - ✓ episodes of decline of forest cover and causes (insect pests, diseases);
 - ✓ wildfires (specify burned area, causes, number of affected trees). If possible, describe the future evolution of fire regimes and prevention measures proposed to mitigate risks.

Try to identify in the scientific literature, databases (national databases or satellite images) or asking experts, the impact of these extreme events on forest cover (impact on affected surface and changes in structure).

Specific data for C1:

- Evolution of the **Emberger's pluviothermic quotient (Q)**, since 1975, to identify potential changes in the climatic type following the Mediterranean classification;
- Evolution of the **Agriculture Stress Index (ASI)** on each pilot site since 1981.

Emberger's pluviothermic quotient (Q)

This indicator defined par Quézel (1976) delimits for the Mediterranean region six climatic types:

- Inframediterranean, (type: Saharian, arid or semi-arid with ocean influence)
- Thermomediterranean ($m > 3^{\circ}\text{C}$),
- Eumediterranean ($0 < m < +3^{\circ}\text{C}$),
- Supramediterranean ($-3 < m < 0^{\circ}\text{C}$),
- Mountainous Mediterranean ($-5 < m < 3^{\circ}\text{C}$),
- Oromediterranean ($-7 < m < -5^{\circ}\text{C}$)

m = mean minimum temperature of the coldest month expressed in $^{\circ}\text{C}$.

The Emberger's pluviothermic quotient is calculated as follows:

$$Q = \frac{1000 * P}{0,5 * (M + m) * (M - m)} = \frac{2000 * P}{M^2 - m^2}$$

P = annual precipitation in mm,

M = mean maximum temperature of the hottest month expressed in $^{\circ}\text{K}$

m = mean minimum temperature of the coldest month expressed in $^{\circ}\text{K}$.

Agriculture Stress Index System (ASIS)

FAO Global Information and Early Warning System (GIEWS) and Natural Resources and Environment (NRC) Division developed a new global product to support crop and vegetation monitoring based on near real-time remote sensing data. The system will ensure autonomous, automated acquisition of METOP 1 km resolution NDVI imagery and perform a temporal and spatial integration of the raw data for agricultural areas.

The resulting index, represented visually on a map, will provide an at-a-glance view across the whole globe of where the agricultural areas are probably suffering from lack of moisture.

This visualization of the index will assist analysts in timely identification of areas where in-depth monitoring is required.

The ASIS is being implemented on behalf of FAO by the Flemish Institute for Technical Research NV (VITO) with technical support from JRC-MARS.

- **Land use changes**

In the methodological guide for component 4, it is also asked to make an inventory of existing land use maps and evolution of these uses. Please provide additional data to have comparable information in each pilot site and approach the level of requirements of REDD+ methodologies currently validated under the VCS (Verified Carbon Standard).

Minimum common data C1/C4:

- ✓ Land use maps (1990/2000/2005/2010/2013) (vector map);

- ✓ **Forest cover map and other non-wooded land map** (1990/2000/2005/2010/2013) (vector map) using the definition of forest adopted at national level and/or registered by national authorities under the United Nations Framework Convention on Climate Change (UNFCCC) ;
- ✓ **Species range maps** of the most characteristic species of the pilot site (1990/2000/2005/2010/2013) (Figure 3) (vector map). In addition, please provide the pilot site spatial location with respect to the overall distribution range of these main species (is it at the limit of the species distribution?)

If available, thank you to provide all the maps of years 1990/2000/2005/2010/2013 or at least of 2000 and one recent year (2010 to 2013).

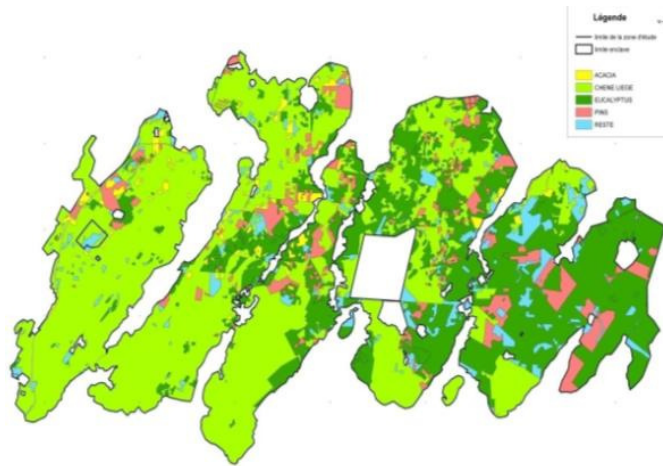


Figure 3. Distribution of the main species of Maamora site. Source : VITO.

- **Historical data on forest management**

Minimum common data C1/C4:

- ✓ Forest management plans applied during the past fifteen/twenty years;
- ✓ Describe briefly the main lines of past and current management plans and also give indications on the orientation of the next years if the management plan is currently being updated in the different forest management units of the pilot site;
- ✓ Describe the actions already taken to mitigate the impact of extreme climatic events and changes in temperature/precipitation.

- **Socio-economic data**

For socio-economic data, see the Methodological guide of component 4.

5. Modeling future impacts of climate change in the pilot sites

A projection to 2040 under two climate scenarios (Figure 4) has been chosen:

- The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic

development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines;

- The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

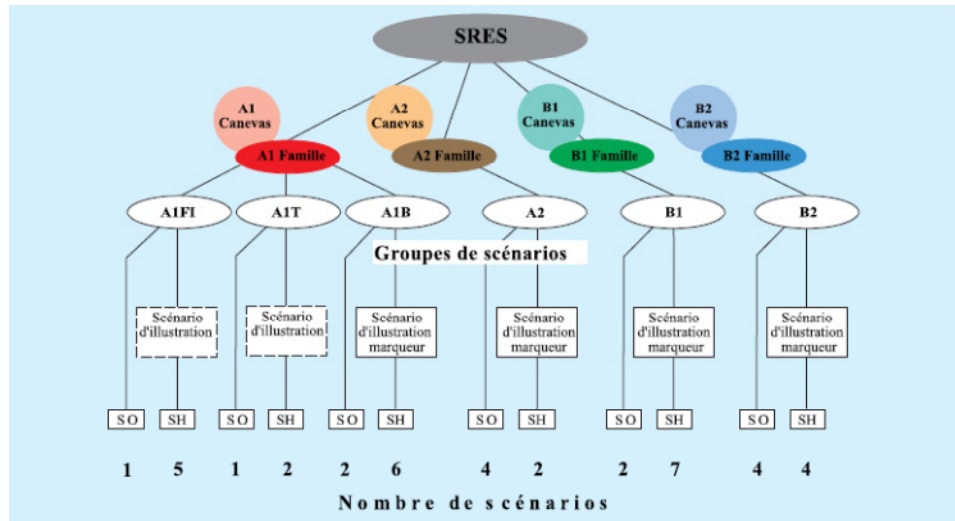


Figure 4. Schematic illustration of SRES (Special Report on Emissions Scenarios) scenarios. Four qualitative storylines yield four sets of scenarios called “families”: A1, A2, B1, and B2. Altogether 40 SRES scenarios have been developed by six modeling teams. All are equally valid with no assigned probabilities of occurrence. The set of scenarios consists of six scenario groups drawn from the four families: one group each in A2, B1, B2, and three groups within the A1 family, characterizing alternative developments of energy technologies: A1FI (fossil fuel intensive), A1B (balanced), and A1T (predominantly non-fossil fuel). Within each family and group of scenarios, some share “harmonized” assumptions on global population, gross world product, and final energy. These are marked as “HS” for harmonized scenarios. “OS” denotes scenarios that explore uncertainties in driving forces beyond those of the harmonized scenarios. The number of scenarios developed within each category is shown. For each of the six scenario groups an illustrative scenario (which is always harmonized) is provided. Four illustrative marker scenarios, one for each scenario family, were used in draft form in the 1998 SRES open process and are included in revised form in this Report. Two additional illustrative scenarios for the groups A1FI and A1T are also provided and complete a set of six that illustrates all scenario groups. All are equally sound. Source: IPCC, 2000¹.

The method to be used for modeling future impacts of climate change in the pilot sites is the **Multifactorial Spatial Analysis (MSA)** (Figures 5 and 6).

It is composed by 5 major steps:

1. Selection of factors that explain the vulnerability of a natural ecosystem;

¹ Intergovernmental panel on climate change, 2000. Special report. Emissions scenarios. Summary for Policymakers. ISBN: 92-9169-113-5.

2. Grouping variables by thematic;
3. Data analysis (level 1) by: thresholding, weighting, integration to assess the vulnerability of each factor;
4. Data analysis (level 2) by: thresholding, weighting, and integration to assess the global vulnerability;
5. Application of the projected data (2040) according to the selected scenarios (A2-B2).

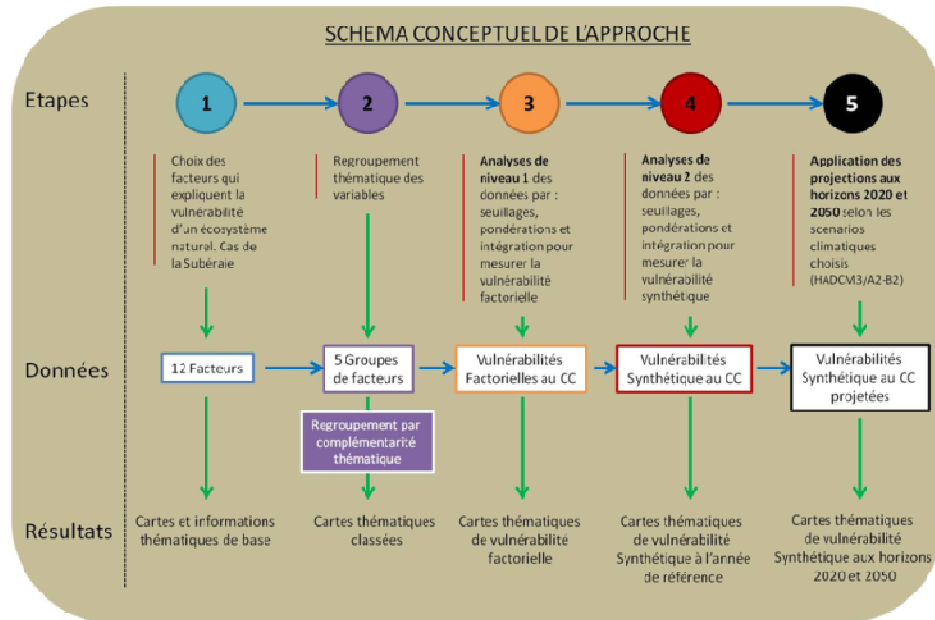


Figure 5. Conceptual diagram of the Multifactorial Spatial Analysis (MSA). Source : GIZ Tunisie, 2013².

² GIZ Tunisie, 2013. Guide méthodologique de l'approche spatiale multifactorielle d'analyse de vulnérabilité des écosystèmes face au changement climatique,

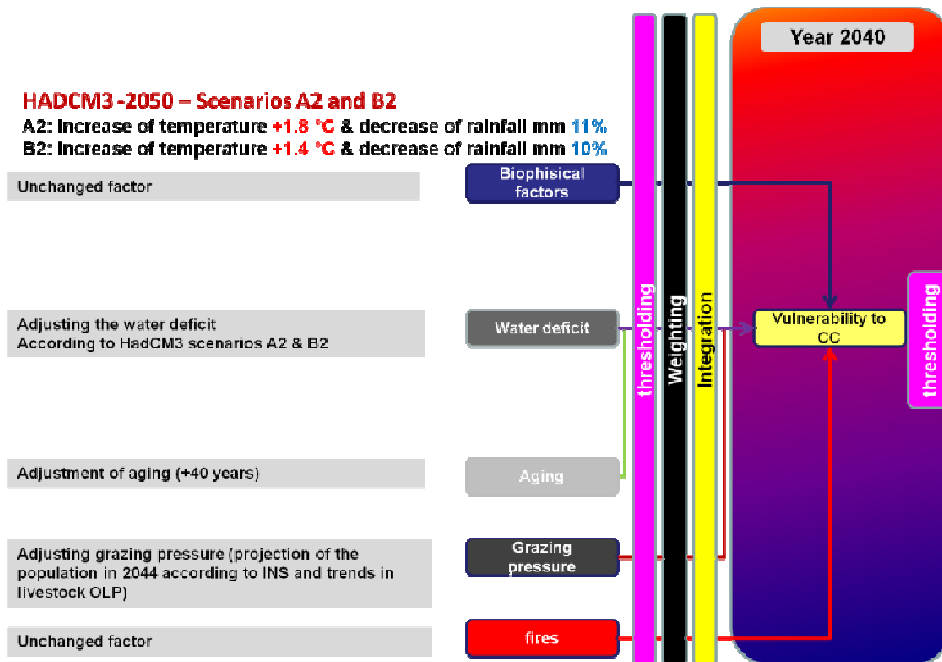


Figure 6. Methodological framework of the Multifactor Spatial Analysis. Source: GIZ Tunisie, 2013 (see Annex 1).

More details about the proposed method are mentioned in the «**Guide méthodologique de l’approche spatiale multifactorielle d’analyse de vulnérabilité des écosystèmes face au changement climatique**» prepared by GIZ Tunisia (see Annex 1) (Figure 7).

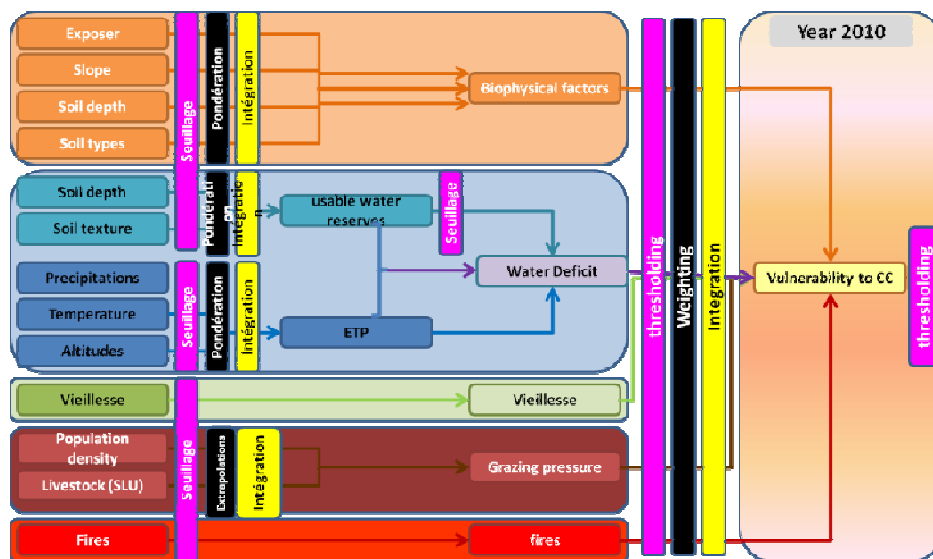


Figure 7. Simplified scheme of the Multifactorial Spatial Analysis (MSA) of the vulnerability of the Tunisian cork oak ecosystem used. Source: GIZ Tunisie, 2013 (see Annex 1).

The **ecological niche approach** (Figure 8) will also be available through an inventory of forest genetic resources to be compiled by *Institut national de la recherche agronomique* (INRA) de Avignon.

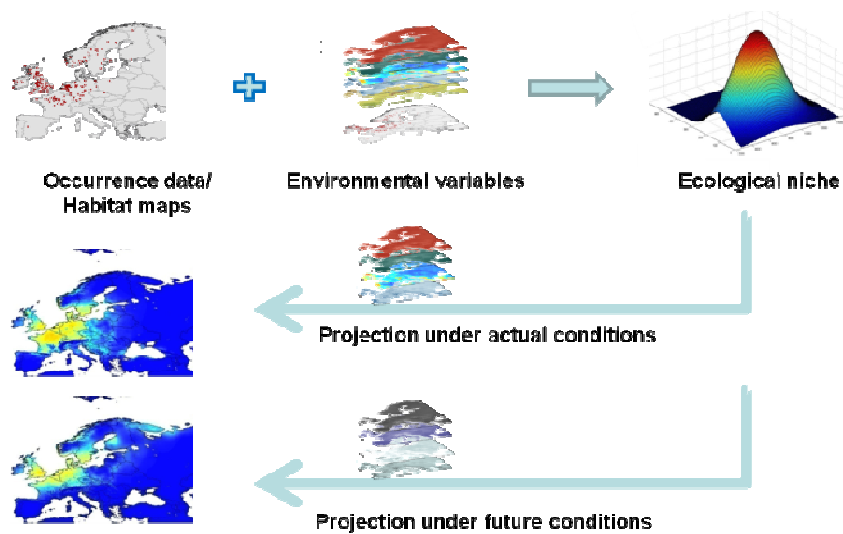


Figure 8. Methodological framework of the ecological niche approach. Source GIZ Tunisie, 2013 (see Annex 1).

This report compiled by *Institut national de la recherche agronomique* (INRA) de Avignon will include:

- Regional mapping of current main forest species ranges in pilot sites;
- Information, provided for each pilot site, on the **status of each tree forest species** related to:
 - ✓ its marginality respect to the overall species distribution;
 - ✓ climate change risks.
- The modeling of **future distribution ranges** for the most important tree species present in the pilot sites.