

# LIFE Nadapta: A regional-scale strategy using soil condition assessment for evaluating climate change vulnerability and adaptation of agriculture in Navarre, Spain

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## 1. INTRODUCTION and GOALS



The Life Nadapta project (<https://lifenadapta.navarra.es/en/inicio>) aims to develop a **regional-scale integrated strategy for climate change adaptation in the region of Navarre (Spain)**.

This strategy encompasses the most affected economic sectors, including **agriculture**.

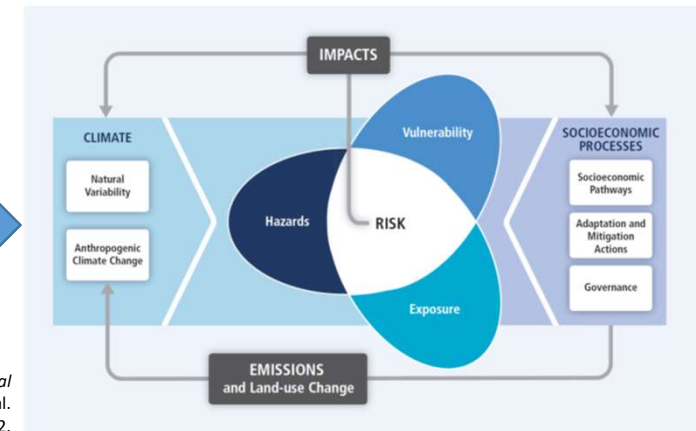
**Agriculture** is highly dependent on climatic conditions, and therefore especially **vulnerable to changes in climate**.

This vulnerability is dependent, among other factors, on **soil characteristics and condition**.

The interaction of this vulnerability with the exposure of agrosystems to climate change impacts (*drivers of change*) can explain the expected **risks associated to these impacts**.



Understanding the **resilience and possibilities of adaptation** of agrosystems requires **assessing how they can modulate their vulnerability and/or reduce their exposure**.



Source: IPCC, 2014: Summary for policymakers. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B et al. Eds] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.



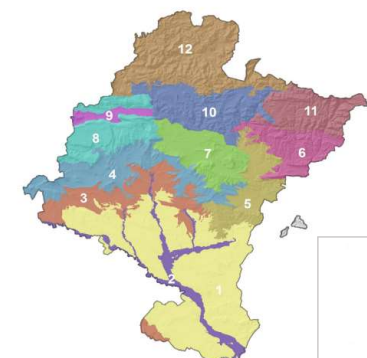
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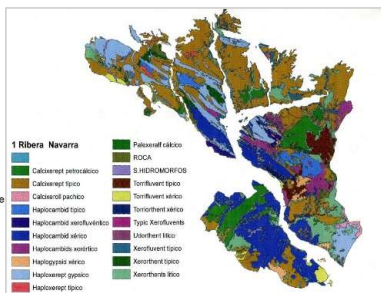
**2. A THREE-STEP APPROACH to assess VULNERABILITY & ADAPTABILITY**

**2.1. Zoning for soil vulnerability assessment**

A preliminary diagnosis of soils vulnerability in the territory was conducted, including a division in 12 homogeneous areas and the particular assessment of soil characteristic in each of them.



**Example Zone 1**



- ZONIFICACIÓN**
- 1 Ribera Navarra
  - 2 Fluviales de la Ribera
  - 3 Zona Media Sur
  - 4 Zona Media Norte
  - 5 Zona Media Oriental
  - 6 Prepirenaico Oriental
  - 7 Cuenca de Pamplona
  - 8 Urbasa-Andia -aralar
  - 9 Corredor del Arakil
  - 10 Valles al Norte de la cuenca de
  - 11 Pirenaico Oriental
  - 12 zona Noroccidental

- 1 Ribera Navarra
- Calcareo setoso
- Calcareo paco
- Haplocambis seco
- Haplocambis húmedo
- Haplocambis xerico
- Haplocambis xerico
- Haplogypsis húmedo
- Haplostepano húmedo
- Haplostepano
- Palustral cálcico
- ROCA
- S.HIEROMORFOS
- Sortiuvent tipico
- Sortiuvent húmedo
- Sortiuvent húmedo
- Typic Xerofluvisol
- Ustiovent húmedo
- Xerofluvent tipico
- Xerofluvent tipico
- Xerofluvisol húmedo

**Soil vulnerability (intrinsic soil properties) and Soil indicators for resilience**

Climate Drivers	Impacts		Vulnerability diagnosis	Indicators for evaluation
	Intermediate	Direct (on soils)		
Temperature increase Change in rainfall distribution in space and time Heat waves	Thermal stress Increased evapotranspiration Water deficit / Drought	Soil organic matter loss	Associated especially with the superficial horizon and very dependent on management, which requires a local evaluation.	<b>Organic C storage in the tilled layer</b> (0-30 cm)
		Salinization	From existing cartographic information on soil salinity	<b>Electrical conductivity</b> (surface horizon) <b>Structural stability</b>
		Productivity loss	Associated with both intrinsic properties (texture, stoniness, soil depth, etc.) and dynamic ones (structure, water retention, etc.)	<b>Plant available water retention ability</b> in the tilled layer. <b>Bulk density</b>
Extreme rainfall events	Erosion		Associated with the morphology of the terrain, the management, the intrinsic properties of the soil and the dynamic properties of the surface horizon.	<b>Structural stability</b>



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## 2. A THREE-STEP APPROACH to assess VULNERABILITY & ADAPTABILITY

### 2.2. CC adaptation strategies and network of plots for soil indicators assessment

Three major strategies of agricultural management aiming to improve the adaptability of agrosystems (namely crop rotations, organic fertilization and conservation agriculture) are assessed by selecting representative agricultural plots under contrasted management in each of the areas.



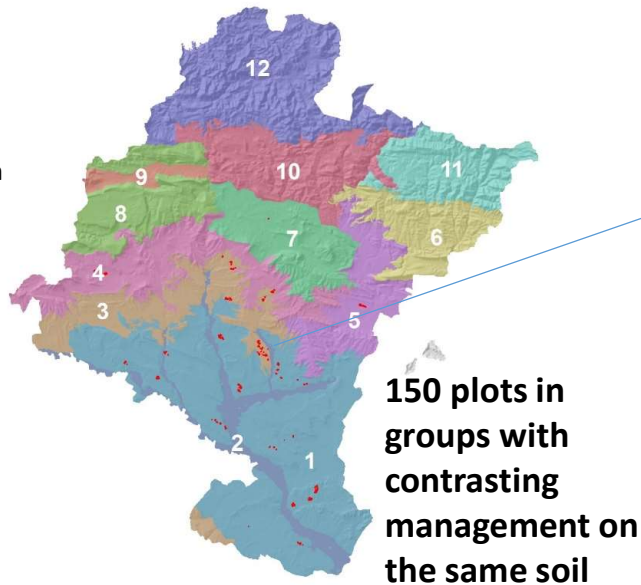
Organic fertilization



Conservation Ag.



Crop rotations



**3. Representative sampling area per plot (Stolbovoy et al., 2007)**



**4. Sampling and analysis**



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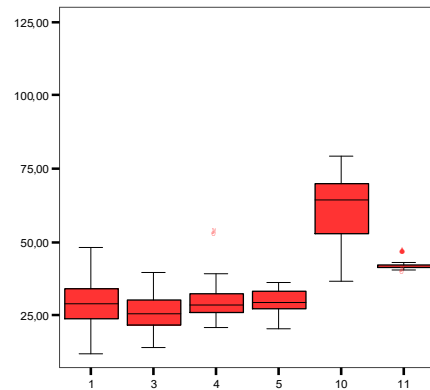


## 2. A THREE-STEP APPROACH to assess VULNERABILITY & ADAPTABILITY

### 2.3. Assessment of soil resilience indicators per strategy and area

Different responses of SOC and other soil indicators to the strategies tested, depending on the natural characteristics of the soils and the historical land-use in the territory (preliminary results).

#### Differences in soil organic C storage among zones (0-30 cm)



Organic C storage (Mg C/ha, 0-30 cm) by zones  
(Reference situation: conventional farming)

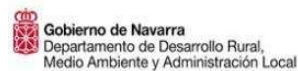
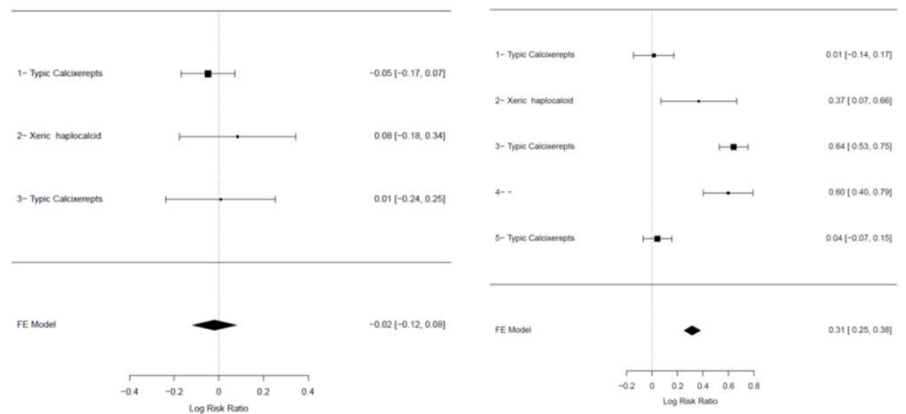
#### Uneven effects of adaptive management on organic C storage (0-30 cm)



Crop rotations  
Zone 1



Conservation Agriculture  
Zone 1



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**MORE INFORMATION AT...**

<https://lifenadapta.navarra.es/en/inicio>

