RESCUE ME

RESILIENT CULTURAL LANDSCAPES

D1.1 ACTIONABLE RESILIENT HISTORIC LANDSCAPE FRAMEWORK.

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

resilientculturallandscapes.eu

Deliverable No.	D1.1
Work Package	WP1
Dissemination Level	PU
Author(s)	Alessandra Gandini (TEC), Aitziber Egusquiza (TEC)
Co-author(s)	Mikel Zubiaga (TEC), Natasa Manojlovic (TUHH)
Contributor(s)	Valerie Wischott (FHG), Anna Klose (FHG), Angela Santangelo (UNIBO), Claudia De Luca (UNIBO), Simona Bravaglieri (UNIBO), Vanessa Assumma (UNIBO)
Due date	30/09/2023
Actual submission date	05/10/2023
Status	Submitted
Revision	Version 1.0
Reviewed by (if applicable)	Maria Luisa Quarta (SIST), Caterina Selva (UNIBO)

TABLE OF CONTENTS

Summary 5

1 Introduction 10

1.1 Relation with other project's activities 10

1.2 Document Structure 12

2 Conceptual framework: resilience thinking and landscape approach 13

2.1 Adaptation of the standard CWA 17727:2022 13

2.2 Development of a taxonomy 15

3 Heritage metrics and indicators for the characterization of cultural landscapes values and resilience 18

3.1 Objectives and dimensions of cultural landscapes resilience: a review 19

The importance of Cultural Landscapes 19

The attributes of Cultural Landscapes 22

Quantification of resilience in cultural landscapes 28

3.2 Objectives and dimensions of cultural landscapes resilience: the RescueME framework 34

Integration of frameworks and models 34

Resilience indicators framework 41

3.3 Cultural landscapes resilience indicators 43

Resilience indicators evaluation method and selection 44
R-Labscapes' perspective 46
Resilience indicators' selection 46
Indicators' database 52

4 Hazards and stressors characterization and climate scenarios 58
4.1 Hazard definition 58
4.2 Method 63
Hazards 63
Climate Change scenarios 68

5 Resilience assessment framework 72

6 Conclusions 77

7 References 79

Annex I: Proposed changes to Standard CWA 17727:2022 82

Annex II- Keywords extraction for RescueME taxonomy 84

Annex III – List of resilience indicators 93

Annex IV – List of Hazard indicators 121

Summary

This document serves as the initial blueprint for the RescueME project, introducing the Actionable Resilient Historic Landscape (RHL) Framework and a comprehensive database covering relevant indicators for European Coastal Heritage Landscapes characterisation, hazards and climate scenarios.

In order to create an Actionable Resilient Historic Landscape framework, RescueME reviewed and adapted the standard CWA 17727:2022, originally designed for historic areas within urban areas, to include the Cultural Landscapes perspective. During this initial project phase, a comprehensive list of modifications has been proposed, as an initial step toward a complete standardization process. As part of this framework, RescueME has initiated the development of a taxonomy, which will be further refined throughout the project. This taxonomy will play a crucial role in information extraction and retrieval, crowdsourcing, and sentiment analysis, all of which are integral components of WP3 - Data Management and Digital Solutions.

To establish heritage metrics and indicators for characterizing the values and resilience of cultural landscapes, an exhaustive review of the significance, definition, and description of attributes associated with Cultural Landscapes has been performed. RescueME is dedicated to implementing an operative Resilient Historical Landscape (RHL) approach. Therefore, the proposed metric system aligns with the concept of Cultural Ecosystem Services from the environmental field, offering a heritage-centric perspective that considers both natural and cultural heritage, tangible and intangible aspects, as sources of benefit and improved quality of life. This metric system integrates attributes of cultural landscapes advocated by key instruments and links them to various capitals, including natural, social, financial, human, and built, suggesting a set of key elements associated with these capitals to enhance resilience through coping, adaptative, and transformative capacities.

The RescueME indicators framework is designed to function as a metric system for measuring resilience across different Cultural Landscapes, following a GLOCAL strategy that combines global and local factors, as well as top-down and bottom-up approaches. This flexibility allows to lay the foundation for establishing European-scale typologies of Cultural Landscapes and to adapt to the specific characteristics of the R-Labscapes involved in the project. To meet these requirements, the RACER criteria for technical assessment to evaluate indicators based on their overall global importance was used. Additionally, evaluations from the R-Labscapes were

considered to assess the meaningfulness and feasibility of indicators in their unique locations, taking into account their landscape types and challenges.

Furthermore, the critical importance of characterizing hazards, stressors, and climate scenarios when addressing risk assessment is considered. Identifying potential hazard areas is an integral part of the risk assessment process, requiring data on the frequency, probability, intensity, and severity of hazards. Secondary hazards resulting from initial events, such as landslides following earthquakes or floods, must also be considered. Consequently, we have included a database of indicators as an essential component of risk assessment.

Given that indicators have been developed with both European and local levels in mind, the work presented in this document lays the foundation for creating the Atlas of European Coastal Heritage Landscapes typologies (Task 1.2) and conducting local resilience baseline assessments for each R-Landscapes (Task 4.2).

List of figures

Figure 1: Overall methodological proposal of RescueME 11
Figure 2: Steps describing the process for building the RescueME resilience indicators framework 18
Figure 3: Concepts of cultural sustainability. Source: (Osman, 2022) 30
Figure 4: A conceptual framework for Cultural Heritage Risk Index: the components of risk and their related indicators. Source: (Ravankhah et al., 2021) 31
Figure 5: Structure of the indicator systems developed in this study. The numbers in brackets indicate the variables that make up each sub-index. Source: (Peña-Alonso et al., 2017) 32
Figure 6: Research approach for the assessment of cultural ecosystem services of rice landscapes based on the classification of the MA (2005). Source: (Tekken et al., 2017) 33
Figure 7: Landscape dynamics between overuse and abandonment. Source: (Lombardini and Scorza, 2016) 33
Figure 8: Elements of a Social-Ecological System. Source: (Milde et al., 2020) 36
Figure 9: RescueME key elements of CL resilience 39
Figure 10: RescueME indicators framework for CL values and resilience characterization 41
Figure 11: RescueME indicators framework and measuring objectives 42
Figure 12: Hazard classification as per IRDR, 2014 60
Figure 13 Classification and clustering of hazards in RescueME (Source: draft Fraunhofer Institute, unpublished (D1.2)) The colours of the boxes indicate the type of hazards considered; blue- flood related natural hazards; yellow- water scarcity related natural hazards; grey- geohazards; green- anthropogenic hazards; light brown- other hazards 64
Figure 14 Projected sea level rise (SLR) until 2300. The inset shows an assessment of the likely range of the projections for RCP2.6 and RCP8.5 up to 2100 (medium confidence). Projections for longer time scales are highly uncertain but a range is provided (4.2.3.6; low confidence). (IPCC 2023) 69
Figure 15 Mean Sea Level Rise till 2100 (IPCC, 2019/2023) 69

List of tables

Table 1: Summary of attributes provided by the different frameworks analysed 25
Table 2: References of papers analysed, scope of the study and relevance to RescueME 28
Table 3: SHELTER indicators framework. Source: Adapted from (Egusquiza et al., 2020) 35
Table 4: RURITAGE Approach to Community capitals (Based on (Flora, 2015)). Source: (Egusquiza et al., 2018) 37
Table 5: RescueME capitals' definitions 40

Table 6: RescueME objective's definitions based on (Deubelli and Mechler, 2021; IPCC, 2023a; Turchi et al., 2023) 42
Table 7: Parameters considered for the indicators' characterization 43
Table 8: RACER assessment: criteria and sub-criteria used 44
Table 9: RACER assessment, Labscape evaluation and selection of shortlisted indicators 47
Table 10: Final list of indicators, grouped by system, capital and key element and their measuring objective 53
Table 11: The main hazard groups, determinants and types as defined in SHELTER. Source: SHELTER project 61
Table 12 Type of hazard clusters addressed the RescueME R-Labscapes 65
Table 13 Initial list of indicators assessed as potentially relevant for the R-labscapes(floods) 66
Table 14 Initial list of indicators assessed as potentially relevant for the R-labscapes(droughts and wildfires) 67
Table 15: Data availability (EU or local level) for each indicator 73

List of acronyms

ACRONYM / ABBREVIATION	DESCRIPTION
ARCH	Advancing Resilience of Historic Areas against Climate-related and other Hazards. (H2020, GA N°820999).
CC	Climate Change
CEN	European Committee for Standardization
CEN/TC 465	Technical Committee 465 Sustainable Cities and Communities
CENELEC	European Electrotechnical Committee for Standardization
CES	Cultural Ecosystem Service
CH	Cultural Heritage
CHL	Coastal Heritage Landscapes
CIAM	Congres Internationaux d'Architecture Moderne
CL	Cultural Landscape
CWA	CWA
DEM	Digital Elevation Model
EU	European Union
GIAHS	Globally Important Agricultural Heritage Systems
GIS	Geographic Information System
GLOCAL	Both local and global.
HWL	Highest Water Level

ICOMOS	International Council on Monuments and Sites
IFLA	International Federation of Landscape Architects
IPCC	Intergovernmental Panel on Climate Change
ISCCL	International Scientific Committee on Cultural Landscapes
IUCN	International Union for Conservation of Nature
LCA	Landscape Character Assessment
LULC	Land use / Land cover
NGO	Non-Governmental Organization
NLP	Natural Language Processing
NPS	National Park Service
NWIP	New Work Item Proposal
PDO	Product with Designation of Origin
PGI	Product with Geographical Indications
RACER	Relevant, Accepted, Credible, Easy and Robust
RESIN	Climate Resilient Cities and Infrastructures (H2020, GA N°653522)
RHL	Resilient Historic Landscape
RS	Remote Sensing
RURITAGE	Rural regeneration through systemic heritage-led strategies (H2020, GA N°776465)
SES	Socio-Ecological Systems
SHELTER	Sustainable Historic Environments hoListic reconstruction through Technological Enhancement and community-based Resilience (H2020, GA N°821282)
TF-IDF	Term Frequency - Inverse Document Frequency
TSG	Traditional Specialties Guaranteed
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHCL	World Heritage Cultural Landscapes
WHS	World Heritage Site
WP	Work Package

1 Introduction

This document represents the basis of the project's foundational concept, introducing the Actionable Resilient Historic Landscape (RHL) Framework and the comprehensive database containing the indicators relevant to European Coastal Heritage Landscapes (CHL), hazards and climate scenarios characterisation, emphasising the importance of enhancing the resilience of Europe's cultural and natural heritage, and therefore ensuring that its legacy remains for future generations.

It sets the project's direction, ensuring the alignment with scientific objectives and addresses the multi-layered challenges of improving resilience in Cultural Landscapes (CLs). Within the scope of WP1 – Assessment and Monitoring of Heritage Values and Resilience, the project pursues a dual mission. Firstly, the development of the Actionable RHL Framework establishes a fundamental understanding of CHLs as complex socio-ecological systems (SES). This framework represents the essential components, dimensions and interconnections of Cultural Landscapes and their inherent resilience. Secondly, metrics and indicators aim to define the diversity of CLs, considering factors such as value, governance, built and natural environment, and socio-economic characteristics. These indicators play a pivotal role in quantifying ecosystem services and shaping strategies for resilience monitoring.

Furthermore, this report investigates the characterization of hazards and climate scenarios related to CLs, presenting a comprehensive database of indicators outlining their impacts and interconnected threats.

1.1 Relation with other project's activities

RescueME is structured in six Work Packages (WP) to ensure cross-fertilization among the different steps and partners and the achievement of the project objectives. The work described in this report is the first step of **WP1**, which has as one of the objectives to establish the conceptual and assessment framework that will be the basis to provide models, indicators, and quantification methods to assess the heritage values of our cultural landscapes. The assessment framework developed in this task will be further developed and implemented at the European level in the ATLAS of European coastal heritage landscape typologies and climate change impacts that will be developed by month 12 (Task 1.2). This top-down approach will be combined and completed with the bottom-up approach that will model the 5 R-labscapes as SES (socio-ecological systems) in Task 1.3.

The framework developed will be also an input for the other Work Packages and activities in the project:

- **WP2** will systematically gather, produce, and characterize the resilience measures and will make them available in a meta-repository of solutions (T2.1). The assessment framework will guide the structure of this meta repository in order to allow the evaluation of the impact of these measures in the resilience and will support the serious gaming approach for co-production of local resilience strategies (T2.4).
- **WP3**, identifies the data sources and develops the required geospatial intelligence will use the framework to produce the data-driven applications that will facilitate the decision-making, especially the Decision Support System (DSS-T3.4.1)
- **WP4**, encapsulates the co-creation and co-production activities, providing continuous inputs for local knowledge extraction, co-creation and final validation and replication of all the results. The assessment framework will directly facilitate the co-creation of the resilience baseline and impact chains in T4.2.

The figure below (Figure 1:) shows the role of this task in the overall methodological approach.

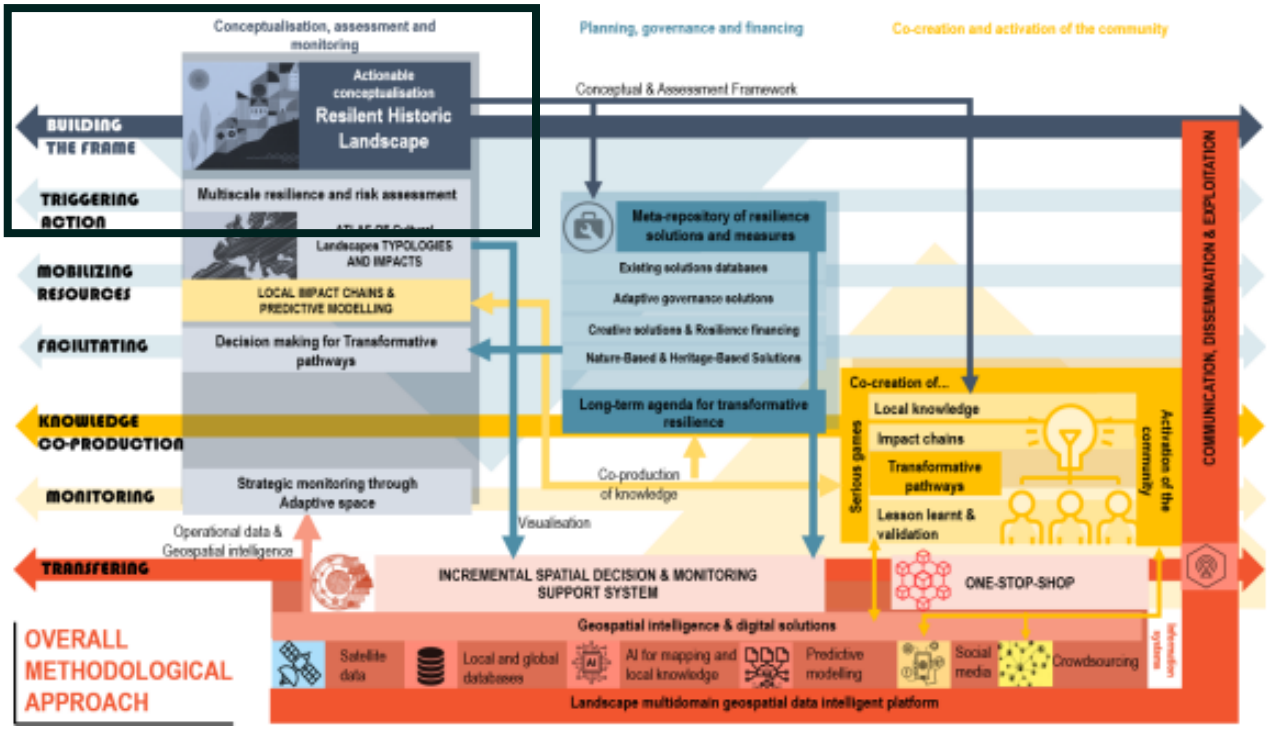

Figure 1: Overall methodological proposal of RescueME

1.2 Document Structure

Apart from this introductory section, the deliverable is structured in four main sections (as follows) and a conclusive chapter (Section 6) that summarizes the findings and leaves the floor for next scientific tasks of the project, especially WP1, WP2 and WP4.

Section 2. Conceptual Framework: resilience thinking and landscape approach

Based on a standard (CWA 17727:2022, "City Resilience Development — Guide to combine disaster risk management and climate change adaptation — Historic areas") and fed by previous H2020 projects (ARCH and SHELTER), it adapts the standard to a landscape approach and develops a first step for the RescueME taxonomy.

Section 3. Heritage metrics and indicators for the characterization of cultural landscapes values and resilience

It describes a theoretical review of the significance, definition and description of Cultural Landscapes identifying the attributes that represent and help characterise them. It structures a set of indicators aimed at measuring CLs values and resilience according to a conceptual framework based on capitals and vulnerability assessment.

Section 4. Hazards and stressors characterization and climate scenarios

It is based on existing literature to define a metric system (a set of indicators) that will enable measuring hazards and scenarios related to CL together with their combined threats.

Section 5. Resilience Assessment Framework

It deploys the assessment framework to be used in all project developments, and a basis for the characterization of resilience and solutions to be developed in WP2.

2 Conceptual framework: resilience thinking and landscape approach

This section describes some of the preliminary works done in the task in order to set the basis for further developments in the RescuME project:

- the work done to adapt the standard CWA 17727:2022 to a landscape approach
- the first steps to develop the RescueME taxonomy.

2.1 Adaptation of the standard CWA 17727:2022

The standard CWA 17727:2022, titled "City Resilience Development — Guide to combine disaster risk management and climate change adaptation — Historic areas," was created using the CEN Workshop Agreement (CWA) process, which follows CEN-CENELEC Guide 29 for rapid standards development and adheres to relevant CEN/CENELEC Internal Regulations – Part 2. This standard was approved on April 28, 2022, by a workshop involving representatives from various interested parties, facilitated by CEN through a public invitation for participation issued on April 22, 2021.

The process began in May 2021 with a CEN Workshop initiated, initially engaging 59 participants. Eventually, 42 members, including those from the ARCH project, SHELTER project, and diverse backgrounds like cities, ministries, research institutions, consultancies, standardization bodies, industries, and NGOs, approved the project plan, forming the "CEN Workshop ARCH." The entire development process can be found in (Lindner et al., 2021).

CWA 17727 was developed through online workshops and digital collaboration tools, managed by a core group consisting of five ARCH members and one SHELTER project representative. The resulting standard includes sections such as an introduction, scope, terms and definitions, a general description of historic areas, and 10 phases within the framework. It also features a European foreword listing contributors. Notably, the standard places greater emphasis on requirements, making compliance more obligatory than merely offering recommendations.

To further promote the standardization work that was being carried out in ARCH and the adoption of the CWA, ARCH established an official liaison between the project and CEN/TC 465 Sustainable Cities and Communities; the liaison person was Daniel Lückerath,

coordinator of ARCH. This opportunity was then used to develop a New Work Item Proposal (NWIP) for CEN/TC 465 to review all CWA of the City Resilience Development family (ARCH CWA 17727, and the three CWAs developed during the Smart Mature Resilience (SMR) project). NWIPs are the default process to initiate work on new documents within CEN bodies.

CEN/TC 465 did not adopt the NWIP but took this opportunity to establish a temporary working group to propose a larger concrete work plan on the topic of resilience. Fraunhofer (Daniel Lückerath) participated in this working group voluntarily. The result of this working group was an additional NWIP to establish a permanent working group within CEN/TC 465 and develop a Technical Report on Territorial Resilience, trying to harmonize definitions, approaches, and frameworks for resilience. The ARCH CWA and SMR CWAs will likely be included in this Technical Report and all further work of CEN/TC 465. With the conclusion of ARCH, the liaison ended.

From the outset, RescueME project was considered important to continue with this work as it was recognized that the standard resulting from the process held significant value for the objectives of the project. However, an adaptation process was deemed essential to make it applicable to cultural landscapes, given its initial urban-centric focus.

Accordingly, during the first stage of the project, the standard was reviewed, and the full list of proposed changes can be seen in Annex I. The proposed changes can be classified into the following categories:

Expand the scope:

- Expand the scale: an adaptation of CWA 17727 should expand the predominant focus on urban scale to urban and rural landscapes linking them with larger territories.
- Expand the considered hazards: it should include also anthropogenic stresses (e.g., unsustainable tourism and air pollution)
- Expand the goals: including Sustainable Development (not only Disaster Risk Management and Climate Change Adaptation)
- Expand the definition of resilience: including resilience as a short-term stable state vs. long-term transformative

Include/adapt new definitions such as:

- Cultural Landscapes
- intangible heritage
- heritage significance
- Ecosystem services
- resilience

- resilience strategy
- socioecological system
- Territory

Include new tools that support the implementation of the standard, such as:

- Adaption of the template of historic areas characterisation according to the results of this deliverable
- Include new indicators and metrics as results of this deliverable
- The tools developed in SHELTER and RescueME
- Include new standards for information models (e.g., CityGML)

To ensure the uplifting and transfer of the ARCH CWA (as well as the SMR CWAs), and a more immediate inclusion of related results into European standardization processes, a continued liaison is essential, as participation in meetings and the possibility to collaborate within working groups is the basis for result transfer. The timing of RescueME project (42 months) would allow the participation during a complete standardization process and funnel research results into standardization, following good examples like the H2020 RESIN project (where the IVAVIA method, developed by Fraunhofer was included in ISO 14092 due to continued involvement in ISO committee work). This would also give the opportunity to further develop the CWA in two directions:

- involve even more perspectives from experts across Europe, further detailing, e.g., issues of inclusion of traditional knowledge and social justice
- making the CWA more broadly applicable (e.g., connecting it to the resilience of contemporary urban and rural districts and issues of sustainable development).

2.2 Development of a taxonomy

To develop a first step for the RescueME taxonomy that will be further developed later in the project, a twofold method has been followed.

First, keyword extraction from relevant text has been used. Keyword extraction is a common task in natural language processing (NLP) that involves identifying and extracting important words or phrases from a text document. Keyword extraction is the task concerned with extracting keywords from a set of documents (corpora). In this context, keywords are a set of words (unlike a summary; generative) that ultimately capture the semantic essence of a document or corpora. From the statistical point of view, keywords can be found by maximizing a combined loss function based on the term frequency of a term in a document, and the inverse document frequency of a term in a set of documents (TF-IDF).

As the use of symbolic representations for natural language processing has declined over the years due to generalization issues, we leverage on distributional semantic-based models to intuitively perform the same retrieval. Word embeddings are extracted by a pretrained language model to give a semantic value to a whole document. Then, phrase/word embeddings are used to evaluate its similarity in a high dimensional space using a distance metric (e.g., cosine similarity). Words/n-grams (set of n contiguous words) can be identified as the words that best describe the entire document and worst relate to other documents.

Cultural and natural heritage preservation has several charters and international agreements that provide guidelines and principles for the conservation and protection of cultural heritage sites and artefacts. These charters help establish a common framework for preserving cultural and natural heritage worldwide. The selected texts for keyword extraction are some of the most significant and canonical texts related to cultural and natural heritage conservation, protection and valorisation trying to sample a wide range of different thematics and periods. The considered 31 texts are the following:

1. Recommendation On The Historic Urban Landscape (UNESCO, 2011)
2. Landscape Convention (Council of Europe, 2000)
3. Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO, 2003)
4. Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Committee, 2006)
5. Convention On The Protection Of The Underwater Cultural Heritage (UNESCO, 2001)
6. International Cultural Tourism Charter (ICOMOS, 1999)
7. Principles For The Preservation Of Historic Timber Structure (ICOMOS, 1999)
8. Charter On The Built Vernacular Heritage (ICOMOS, 1999)
9. The Burra Charter (ICOMOS 2013)
10. Measures To Promote The Integrated Conservation Of Historic Complexes Composed Of Immoveable And Moveable Property (Council of Europe, 1998)
11. NARA document on authenticity (ICOMOS, 1994)
12. Charter For The Protection And Management Of The Archaeological Heritage (ICOMOS, 1990)
13. Venice Charter (ICOMOS, 1964)
14. Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO, 1972)
15. Washington Charter- Charter For The Conservation Of Historic Towns And Urban Areas (ICOMOS, 1987)
16. Charter of Athens (CIAM, 1933)
17. Charter For The Interpretation And Presentation Of Cultural Heritage Sites (ICOMOS, 2008)
18. The Icomos Charter On Cultural Routes (ICOMOS, 2008)

19. International Charter for Cultural Heritage Tourism (ICOMOS, 2022)
20. ICOMOS Guidelines On Fortifications And Military Heritage (ICOMOS, 2021)
21. Principles For The Conservation Of Wooden Built Heritage (ICOMOS, 2017)
22. Salalah Guidelines For The Management Of Public Archaeological Sites (ICOMOS, 2017)
23. IFLA Document On Historic Urban Public Parks (ICOMOS, 2017)
24. IFLA Principles Concerning Rural Landscapes As Heritage (ICOMOS, 2017)
25. Valletta Principles (ICOMOS, 2011)
26. Dublin Principles (ICOMOS, 2011)
27. Historic Gardens (ICOMOS, 1982)
28. Charter On The Protection And Management Of Underwater Cultural Heritage (ICOMOS, 1996)
29. Principles For The Analysis, Conservation And Structural Restoration Of Architectural Heritage (ICOMOS, 2003)
30. Declaration of Amsterdam (Council of Europe, 1975)
31. Index Of Development Of A Multiscalar Framework For Heritage Sustainability (UNESCO, 2009)

The detailed results of this exercise can be seen in Annex II. The terms identified as more important regarding these texts will be reviewed, validated and completed with the R-Labscapes in order to identify a final set of terms that will be the base for crowdsourcing tools to be developed in WP3 (ST3.3.2)

3 Heritage metrics and indicators for the characterization of cultural landscapes values and resilience

This section describes a comprehensive review of the significance, definition and description of Cultural Landscapes and extracts, from existing literature, the attributes that represent them. The framework is structured towards the development of a metric system that will enable the characterization of Cultural Landscapes values and resilience capacity. The process that led to the final list of Cultural Landscapes resilience indicators is based on a scientific literature review and the analysis of past projects related to the thematic, together with a critical evaluation performed by technical partners and R-Labscapes, as represented in Figure 2:

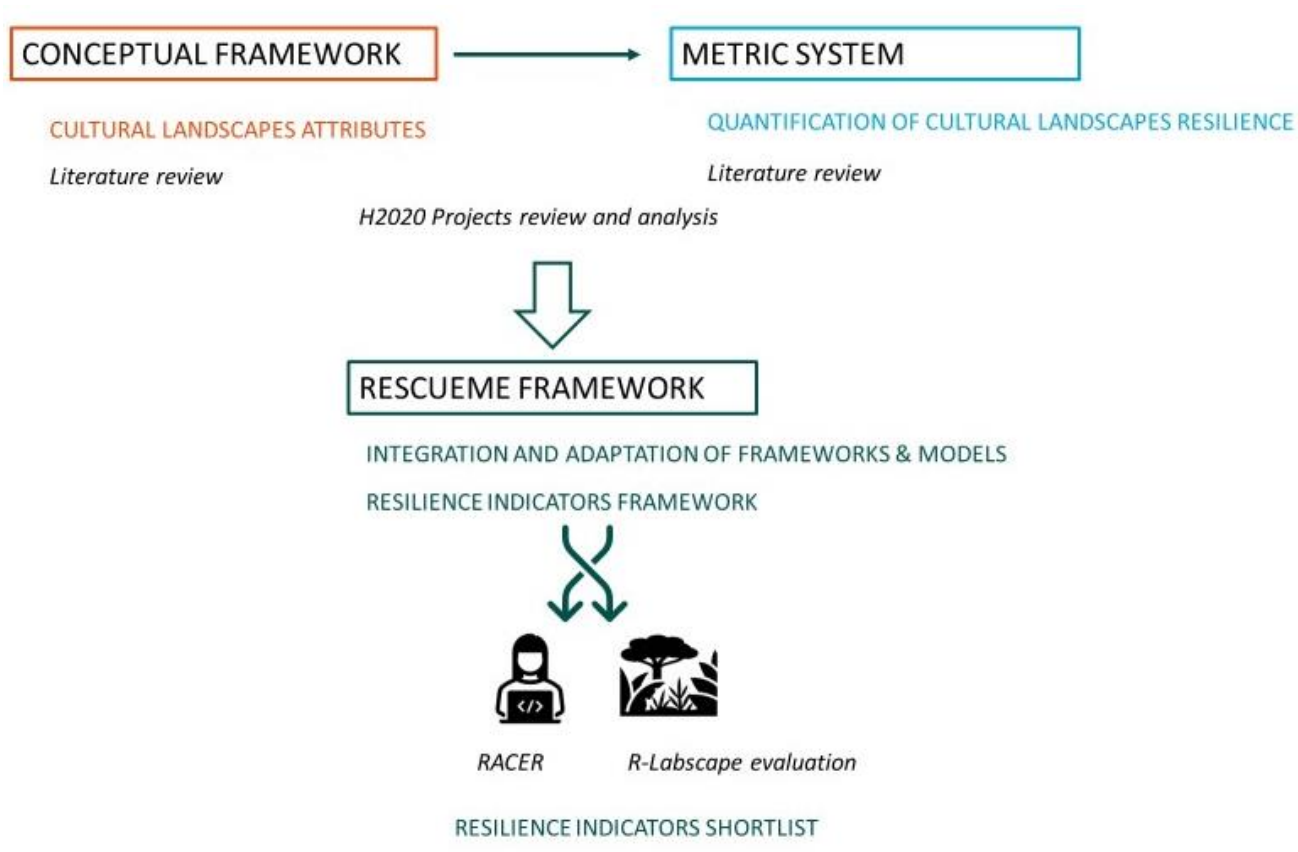

Figure 2: Steps describing the process for building the RescueME resilience indicators framework

3.1 Objectives and dimensions of cultural landscapes resilience: a review

The importance of Cultural Landscapes

Empowering communities and improving their quality of life is directly related to the survival and enhancement of their culture, built heritage and landscapes (Eppich, 2014). A landscape is a challenging to determine concept and, while it is always related to the natural values of a site, it is barely associated to the cultural and social activities often intrinsic to the existence and development of the landscape itself. Embracing a cultural landscape approach facilitates the integration of various typologies of heritage including historical structures, local material resources, and traditional construction methods, into a cohesive concept of identity and location (Moore and Whelan, 2016), which unifies tangible and intangible heritage as a vehicle that sustains people- centric approaches and local ownership.

Cultural Landscape is a term that has been frequently used among German geographers in the early 20th century, but started to gain relevance from the 1960s, as the term was adopted by different disciplines and professionals, including architects, historians, archaeologists, ethnologists, economists and environmental managers (Jones, 2003).

In 1992, the category of Cultural Landscape was adopted by UNESCO (UNESCO, 1992) defined as "*those sites where human interaction with natural systems has, over a long time, formed a distinctive landscape*". Later, the Operational Guidelines for the Implementation of the Convention classify cultural landscapes in three categories (UNESCO World Heritage Centre, 2008):

1. A landscape clearly **defined, designed and intentionally created by man**, such as gardens and parklands;
2. An **organically evolved landscape**, representing the process of evolution of their form and features. These can be divided into: i) relict or fossil landscapes, if its evolution ended at some point in the past, and ii) continuing landscape if it still maintains an active social role while still evolving;
3. An **associative cultural landscape**, whose characteristic are based on religious, artistic or cultural associations of the natural element rather than material cultural evidence.

There is a strong connection between World Heritage Cultural Landscapes and protected areas, which have been classified by the **International Union for Conservation of Nature** (IUCN). In this case, the definition of the category of protected area, which encompasses the

concept of cultural landscape, is stated as *"a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values."* It proposes six categories, were *protected landscape* is defined as *"an area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity"* (Dudley, 2008):

Therefore, when referring to the conservation of landscapes we need to deal both with cultural and environmental arguments. In this sense, Cultural Landscapes have led to global cooperation, paving the way for innovative projects with various United Nations (UN) agencies and cultural and natural values have been included in landscapes' policies and management procedures, as the Satoyama Initiative that evolved around the UN Convention on Biological Diversity, and the FAO initiative on Globally Important Agricultural Heritage Systems (GIAHS). GIAHS aims to "*identify, support and safeguard agricultural systems that sustain and conserve our biodiversity and genetic resources for food and agriculture, rural livelihoods, knowledge systems, cultures and remarkable landscapes*" and it characterizes the European agricultural heritage sites by the high value of their cultural landscapes' evolution, modelled by traditional and adaptive agriculture knowledge and practices (García *et al.*, 2020).

The World Heritage Cultural Landscapes - A handbook for conservation and management (WHCL handbook) (Mitchell *et al.*, 2009) seeks to protect the outstanding universal values of Cultural Landscapes and explore the connections between cultural and biological diversity. The International Scientific Committee on Cultural Landscapes (ISCCL), formed by the partnership of the International Council on Monuments and Sites (ICOMOS) and the International Federation of Landscape Architects (IFLA) has been created with the aim of producing cultural landscapes documentation, training and supporting UNESCO in the assessing and monitoring of World Heritage nominations.

In the U.S., the National Park Service (NPS) was created for historic preservation in the act of protecting and sustaining cultural and natural resources perpetuity; and has the role of researching cultural landscapes to define the values and associations that make them historically significant. Based on the NPS framework, the Urban Design Lab platform promotes critical thinking and constructive debate in relation to the architecture and landscape.

The Landscape Character Assessment (LCA), in the U.K., aims to identify the patterns and individual combinations of features – such as hedgerows, field shapes, woodland, land use,

patterns of settlements and dwellings – that make each type of landscape distinct and often special to those who live and work in it.

At the European level, in 2000 the Council of Europe adopted the European Landscape Convention, in which landscape is defined as "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*". It is the only international instrument entirely dedicated to the protection, management and planning of landscapes and which recognizes that landscape is an important feature of human surroundings, that it contributes to the formation of local cultures and that it is a basic component of the European natural and cultural heritage, contributing to human wellbeing and consolidation of the European identity.

It is recognised that Cultural Landscapes hold significant values for both individuals and the society as a whole and can be seen as repositories of collective memory (Mitchell *et al.*, 2009). These multifaced values encompass a wide range of social, environmental and cultural aspects, including:

Historical significance, as they are representative of human activities and cultural evolution of societies, offering insights into human-environment interactions and historical trends.

Cultural heritage, being vessels of architecture, art, traditions and practices, and providing knowledge transfer from one generation to another.

Ecological significance, as they may host unique ecosystems and biodiversity, where sustainable land management practices can contribute to conservation efforts.

Sustainable development, contributing to maintain sustainable land-use practices and supporting livelihoods and fostering local communities' management.

Aesthetic value, as some places are admired for their beauty and are source of inspiration for creativity

Sense of place and identity for local communities, as they help building emotional connections with inhabitants as well as serve as places of worship, pilgrimage, and reflection.

Social cohesion and cultural dialogue, as they provide spaces for celebrations and shared cultural experiences, promoting dialogues between different communities.

Educational value, as landscapes serve as educational resources, facilitating learning about history, culture and the environment, as well as being valuable for scientific research, including archaeology, anthropology, geography, and ecology.

Economic value, contributing to local communities' economic benefits, through tourism-related activities, agricultural activities and products, cultural and creative industries, branding and cultural events and festivals.

The attributes of Cultural Landscapes

Based on the outlined framework, RescueME aims to systematically break down and establish the specific attributes that both delineate and describe a Cultural Landscape. The metric system will be used to quantify the material and immaterial values associated with Cultural Landscapes and, thus, assessing their resilience capacity.

The National Park Service (NPS) ("NPS Cultural Landscapes 101", n.d.) has categorized Cultural Landscapes into four distinct types: Historic Designed, Historic Vernacular, Historic Agricultural, and Ethnographic. Within these broad categories, it has identified a total of thirteen unique landscape features that serve as crucial components for characterizing a Cultural Landscape. These features collectively contribute to a comprehensive understanding of the features, nature, and boundaries of these environments.

1. Natural systems and features: Processes and materials in nature influencing historical development or use.
2. Vegetation: Patterns of human-influenced plants, both native and introduced.
3. Spatial organization: Historical, three-dimensional arrangements of physical form.
4. Land use: Historical activities that influenced development or modification.
5. Cluster arrangement: Historical pattern of aggregation in forms.
6. Topography: Historical, human-created shape of the ground plane.
7. Views and vistas: Historical range of vision, both broad and discrete.
8. Buildings and structures: Historical constructed forms and edifices.
9. Archaeological sites: Historical or pre-contact ruins, traces, or deposited artifacts.
10. Small-scale features: Discrete, historical elements that provide detail and diversity.
11. Circulation: Historical systems for human movement.
12. Constructed water features: Historical constructed forms for water retention and conveyance.
13. Cultural traditions: Historical manifestation of collective cultural identity.

The Landscape Character Assessment (LCA) (Tudor, 2014) also considers the identification and description of features crucial for interpreting and comprehending the character of landscapes. This analytical process is instrumental in establishing a comprehensive understanding of the landscape context, which, in turn, aids in the definition and delimitation of the landscape itself. The LCA categorizes its analysis into four distinct domains: Natural, Cultural/Social, Cultural Associations, and Perceptual and Aesthetic Factors, each of which further defined into eighteen specific factors. Through the examination of these, the Landscape Character Assessment provides a comprehensive framework for not only understanding the intrinsic attributes of a landscape but also for appreciating the relation of natural and cultural elements that define their unique character and significance.

1. Geology
2. Landform
3. Hydrology
4. Air and climate
5. Soils
6. Land cover/flora and fauna
7. Land use (and management)
8. Settlement
9. Enclosure
10. Land ownership
11. Time depth (Archaeology and the historic dimension)
12. Art, literature, descriptive writings, music, myth/legend/folklore, people, events and associations
13. Memories
14. Associations
15. Perceptions
16. Touch/feel
17. Smells/ sounds
18. Sight

The ICOMOS-IFLA principles ("ICOMOS-IFLA Inventory form", n.d.) recognises rural landscapes as heritage and refer to the tangible and intangible heritage of rural areas, considering physical, cultural, and environmental attributes for its characterization. It also identifies associated cultural knowledge, social expressions and transformed tangible or intangible heritage as qualities of the Cultural Landscape. It classifies the Cultural Landscape attributes as follows:

1. Natural Systems
2. Vegetation
3. Spatial Organization
4. Land Uses, Patterns, Clusters
5. Topography, Surface Drainage
6. Visual Relationships
7. Spatial Character of Habitable Structures
8. Non-Habitable Landscape Structures and Buildings
9. Vocabulary of Site Furnishings and Objects
10. Circulation Systems
11. Water Features, Natural and Constructed
12. Location for festivals
13. Setting for traditional music, dance, performance
14. Route of pilgrimage

15. Setting for worship
16. Place of memory of past events
17. Place of traditional practices
18. Gathering place for native plants
19. Gathering place for craft materials
20. Traditional place for experience at a special time of year

The six European **Globally Important Agricultural Heritage Systems** (GIAHS) (García *et al.*, 2020) sites, representing a subset of the total 57 worldwide, stand out for their exceptional cultural landscape evolution. This evolution has been modelled and shaped by the enduring traditions and adaptive agricultural knowledge and practices that have been held in, by dedicated and organized communities. In the comparative analysis of these GIAHS sites, certain distinctive features (serving as sub-criteria for the comparative analysis), are considered to characterize them. These features are thoughtfully organized into five categories (Food and Livelihood security, Agro-biodiversity, Local and Traditional Knowledge Systems, Cultures, Value Systems and Social Organization, and Landscapes and Seascapes features), with a total of 22 attributes, each contributing to the understanding of insights and holistic perspective of the richness of the agricultural systems, as follows:

1. Socio-economic contribution of the system to the local community
2. Production
3. Evolution of the system
4. Tourism aspects
5. Biodiversity: Flora and fauna
6. Ecosystem function
7. Diversity on the main crop
8. General diversity of crops/livestock varieties.
9. Water and soil management
10. Agriculture and livestock techniques
11. Tools and infrastructures
12. Local organization within the system
13. Social organizations supporting the system
14. Festive events, rituals and beliefs
15. Traditional culinary culture
16. Traditional medicine
17. Promotion of the culture
18. Landscapes diversity
19. Evolution of the landscapes
20. Infrastructure and settlements
21. Analysis of the main planning and territorial protection tendencies
22. Resilience and sustainability

The following Table 1 summarize the main features and attributes of the frameworks described above.

Table 1: Summary of attributes provided by the different frameworks analysed

	NATIONAL PARK SERVICES (US)	ICOMOS-IFLA	URBAN DESIGN LAB	Landscape Character Assessment (UK)	FAO criteria for the assessment of potential GIAHS
NATURAL FEATURES & BIODIVERSITY	Natural systems and features Vegetation	Natural Systems Vegetation	Natural Systems and Features Vegetation	Geology Landform Hydrology Soils Air and climate Land cover/flora and fauna	Ecosystem function Landscapes diversity Biodiversity: Flora and fauna Resilience and sustainability
AGRICULTURE					Diversity on the main crop Production General diversity of crops/livestock varieties. Agriculture and livestock techniques Tools and infrastructures Resilience and sustainability
LAND MORPHOLOGY & TOPOGRAPHY	Spatial organization Land use	Spatial Organization Land Uses, Patterns, Clusters	Spatial organization Land use	Land use	Evolution of the landscapes

VIEWS	Cluster arrangement Topography	 Topography, Surface Drainage	Cluster arrangement	Enclosure	Evolution of the system
	Views and vistas	Visual Relationships	Views and vistas	Sight	
BUILT INFRASTRUCTURE AND HERITAGE	Buildings and structures Archaeological sites Small-scale features Circulation Constructed water features	Spatial Character of Habitable Structures Non-Habitable Landscape Structures and Buildings Vocabulary of Site Furnishings and Objects Circulation Systems Water Features, Natural and Constructed	Buildings and structures Archaeological sites Small-scale features Circulation Constructed water features	Settlement Time depht (Archaeology and the historic dimension)	Infrastructure and settlements Water and soil management
INTANGIBLE HERITAGE	Cultural traditions	Location for festivals Setting for traditional music, dance, performance Route of pilgrimage Setting for worship Place of memory of past events Place of traditional practices	Cultural traditions	Art, literature, music, myth, people, events Memories Associations Perceptions Smells/ sounds	Local organization within the system Social organizations supporting the system Festive events, rituals and beliefs Traditional culinary culture Traditional medicine Promotion of the culture

		Gathering place for native plants Gathering place for craft materials Traditional place for experience at a special time of year			
GOVERNANCE				Land ownership	Analysis of the main planning and territorial protection tendencies
ECONOMY & TOURISM					Tourism aspects Socio-economic contribution of the system to the local community

Despite of being complete in terms of biodiversity, natural features and morphological characteristics, the analysed frameworks defining the cultural landscape attributes seems to be more oriented to the preservation of the natural feature itself but lack of human and social aspects which help to maintain the landscape and its traditions alive through sustainable development. Only by addressing the challenges, transformative processes and evolutive characteristics of the cultural landscape as a whole, it is possible to propose resilience measures aimed at improving conservation and sustainable development of the areas.

Quantification of resilience in cultural landscapes

Further analysing relevant projects, a literature review was carried out, specifically addressing the measurable dimensions of resilience in cultural landscapes, with the objective of finding previously used indicators and their applicability both at European level as well as at local level.

Scopus database was searched with the following query (August 2023)

TITLE-ABS-KEY ("cultural landscapes" AND "resilience" AND "indicators")

giving a result of 14 papers (see Table 2), being 9 considered as relevant for the purpose of RescueME and described more in details below.

Table 2: References of papers analysed, scope of the study and relevance to RescueME

Reference	Scope	Relevancy
(Villodre *et al.*, 2023)	Discusses a decline of the resilience of protected rural landscapes, as a result of conservation efforts that prioritize natural environment over rural areas	Land use/ land cover and socio-economic variables
(Palazzo and Bardsley, 2022)	Analyse the adaptive capacity of an agricultural region in response to changing conditions as a means to address the future of cultural landscapes	Biocultural diversity
(Osman, 2022)	Highlights the vulnerability of cultural landscapes to external influences and change over time and the need to enhance resilience in the face of challenges such as acculturation and land cover change.	Cultural sustainability
(Yodsurang *et al.*, 2022)	It discusses how the construction of water-controlled structures and climate change have impacted the resilience of local communities in the floodplain of a site	Not relevant for RescueME as it focuses on specific infrastructure built in a case study
(Ravankhah *et al.*, 2021)	Integrated and systematic methodology of disaster risk assessment proposing a Cultural Heritage Risk Index that	Significance of cultural heritage

	considers hazard, exposure, and vulnerability components	
(Kaposi and Al-Shammari, 2021)	Examines how independent bookstores confront stereotypes about reading culture by creating urban spaces that cultivate readership, foster reader communities, and expand their influence through social media	Not relevant for RescueME, as is it specific for bookstores
(Henning *et al.*, 2021)	It addresses the importance of assessing the resilience of cultural landscapes, particularly in regions with rapidly changing conditions, and underlines the need for landscapes to adapt and maintain their essential qualities despite ongoing transformations.	Principles of redundant diversity, robust elasticity and decentralized concentration
(Tudorie *et al.*, 2020)	It discusses the increasing efforts by cities to enhance urban resilience and citizen well-being through urban greenery	Not relevant for RescueME purposes, as it focuses on urban greening
(Lee and Yan, 2019)	It highlights the potential for a landscape-centric, participatory approach to gain acceptance among rural communities in Taiwan	Adoption of Satoyama indicators for resilience in socio-ecological production landscapes and seascape
(Peña-Alonso *et al.*, 2017)	Investigates the relationships between geomorphological vulnerability, recreational quality, and heritage at beaches	Framework assessment
(Tekken *et al.*, 2017)	It describes how traditional rice production has created culturally significant landscapes but increasing development pressures and changes in small-scale production systems are affecting these landscapes' resilience.	Qualitative approach to ecosystem service assessments
(Leardini and Serventi, 2016)	It explores the current conditions and issues affecting a rural territory, emphasizing the importance of considering the entire territory, including	Not relevant for RescueME purposes, as it assesses the specific conditions of the site

	its agricultural plots and historical organization, in planning strategies	
(Lombardini and Scorza, 2016)	It analyses the concept of resilience in cultural landscapes, emphasizing its role in maintaining a system's internal structure while transitioning between equilibria.	Landscape related to production, generation of values and identity creation
(Cullen-Unsworth *et al.*, 2012)	It researches about the value of Indigenous ecological knowledge in preserving biodiversity and cultural landscapes	Not relevant for RescueME, as it is context specific

(Villodre *et al.*, 2023) discusses the decline associated with the abandonment and degradation of protected rural areas. The approach used in the study focuses on social-ecological factors to identify and analyse indicators of change within these landscapes, revealing a shift towards simplified land-use systems that rely less on traditional farming practices. It identifies 12 variables for Land use / Land cover (LULC) management and monitoring and 9 socio-economic variables, including farms, demographic and tourism related characteristics.

(Palazzo and Bardsley, 2022) use the concept of biocultural diversity to monitor adaptive mechanisms. The study looks at biological and cultural diversity patterns along "biocultural corridors" as indicators of both past and current adaptive capacity as a mean to measure trajectories of sustainable management in the landscape system.

(Osman, 2022) deploys a set of indicators to measure and assess the interaction between cultural sustainability and spatial factors like land cover change. The indicators proposed are considered essential for understanding how cultural landscapes adapt and respond to external pressures. It structures indicators in three domains: *Culture in*, including aspects related to economy, education, governance, social participation, gender equality, communication, heritage sustainability and intrinsic aspects;

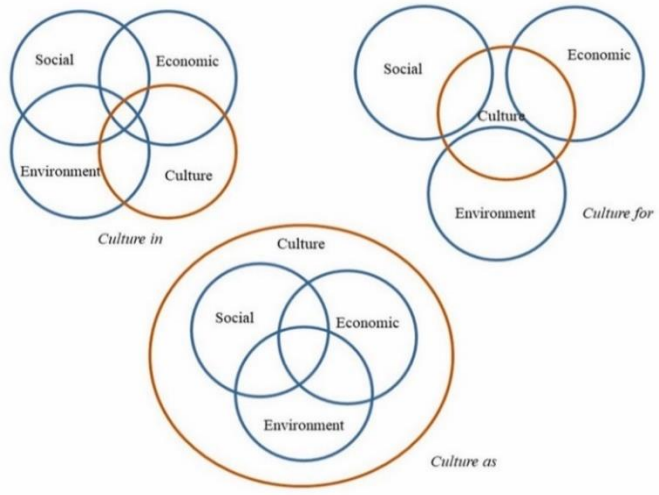

Figure 3: Concepts of cultural sustainability. Source: (Osman, 2022)

Culture for, including inter and intra-generational equity, diversity, precautionary principle and interconnectedness and *Culture as* including heritage, vitality, economic viability, diversity, locality and eco-cultural resilience and civilization.

To assess exposure, (Ravankhah *et al.*, 2021) define a significance assessment of heritage elements at risk, using architectural, historical, social, economic, and environmental indicators (Figure 4). Even if the study is specifically focused on earthquakes and sensitivity looks particularly at the fabric and structure, the proposed indicators help evaluate the importance of different assets within a cultural heritage site and highlights the need to consider tangible and intangible attributes of the site in the impact identification process, to better address risk management strategies.

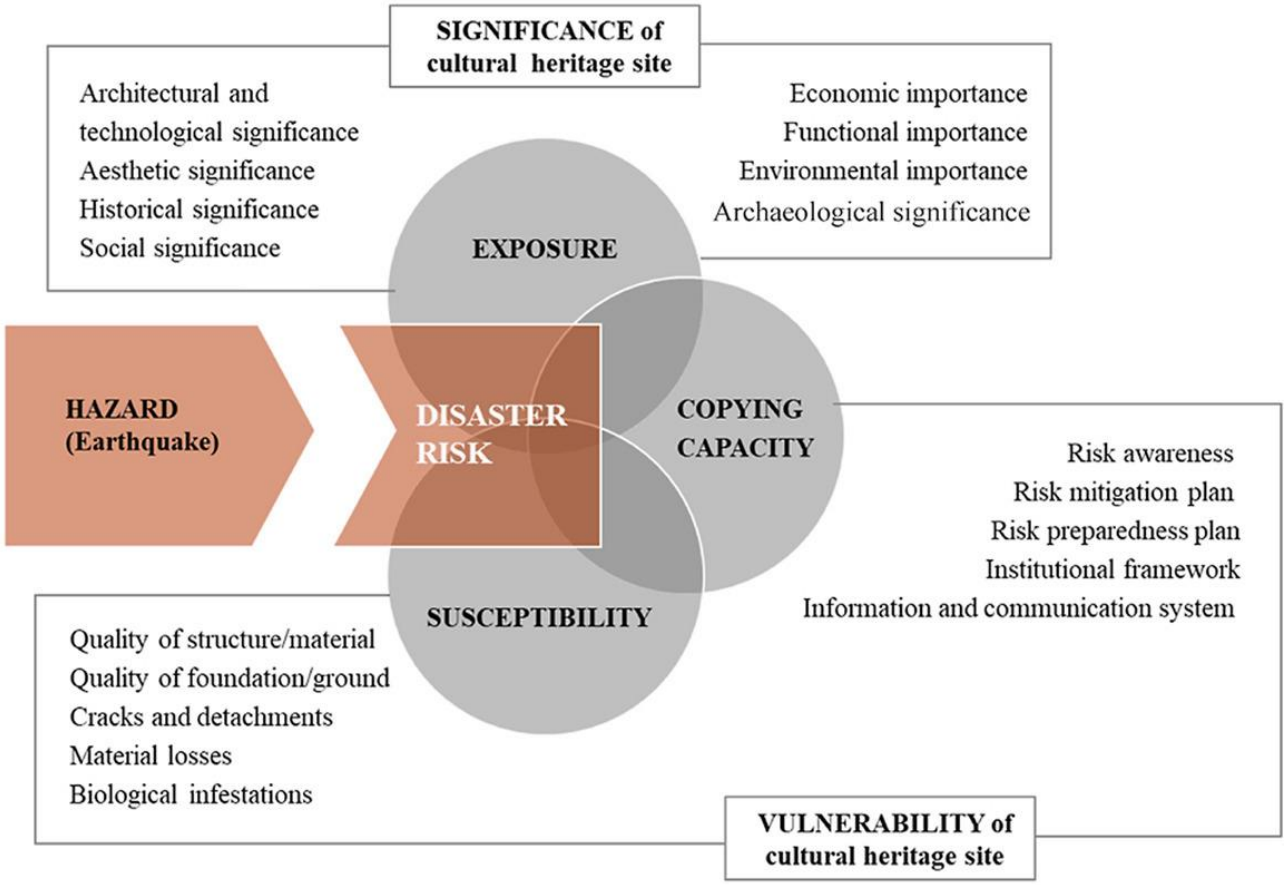

Figure 4: A conceptual framework for Cultural Heritage Risk Index: the components of risk and their related indicators. Source: (Ravankhah *et al.*, 2021)

The work presented by (Henning *et al.*, 2021) does not mention specific indicators, but it stresses the significance of evaluating factors such as diversity, robustness, and decentralization in assessing landscape resilience. These principles can potentially serve as indicators for monitoring the resilience of cultural landscapes.

(Lee and Yan, 2019) used local workshops to involve residents in the evaluation process of socio-ecological production of landscapes and seascapes, which provided effective empowerment of local communities, contributing to increase sustainability and well-being.

Even if the framework proposed by (Peña-Alonso *et al.*, 2017) is focused on beaches, which stand away from the RescueME approach, it addresses the challenge of overcrowding and increased human activity, a problem which is starting to become evident also in cultural landscapes and that will soon start to face. It utilizes a structured indicator system to analyse the relationships between geomorphological vulnerability, recreational quality, and heritage at different types of beaches and how overcrowding impacts on the conservation of natural and cultural heritage (Figure 5).

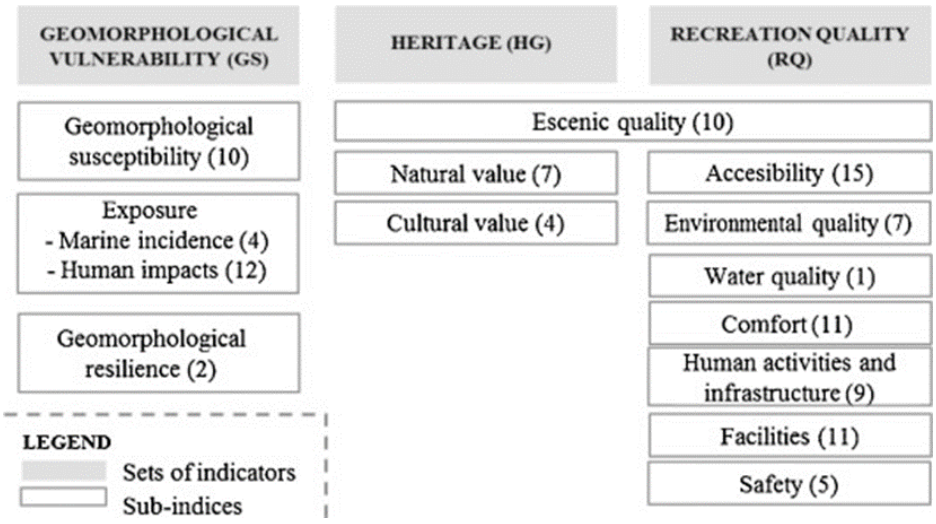

Figure 5: Structure of the indicator systems developed in this study. The numbers in brackets indicate the variables that make up each sub-index. Source: (Peña-Alonso *et al.*, 2017)

(Tekken *et al.*, 2017) defines a set of 73 indicators categorized into Cultural Identity, Landscape Aesthetics, and Knowledge Systems to assess the cultural values associated with rice landscapes (Figure 6). These indicators provide a framework for understanding the cultural significance of these landscapes and can inform conservation and management strategies.

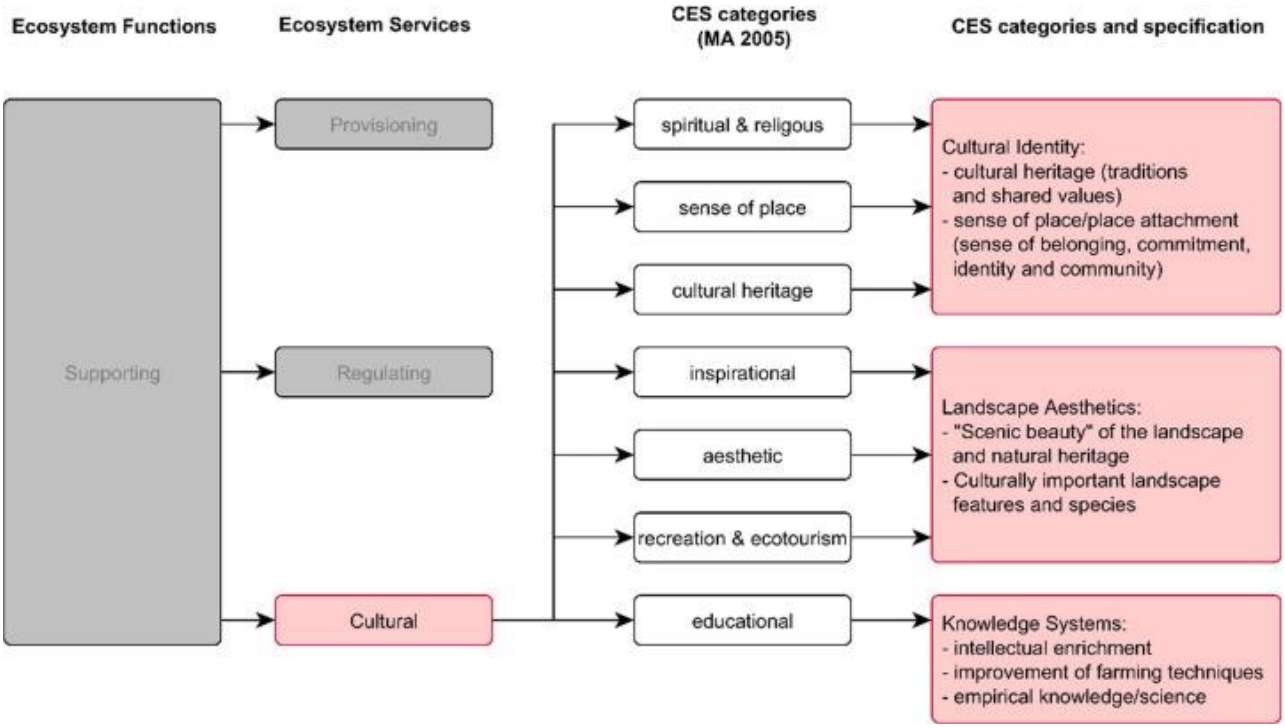

Figure 6: Research approach for the assessment of cultural ecosystem services of rice landscapes based on the classification of the MA (2005). Source: (Tekken *et al.*, 2017)

(Lombardini and Scorza, 2016) suggest that indicators for monitoring cultural landscape resilience should be constructed to interpret landscape changes, especially those related to soil quality, settlement morphology, road networks, and land cover, enabling an understanding of transitions and transformations in the landscape (Figure 7).

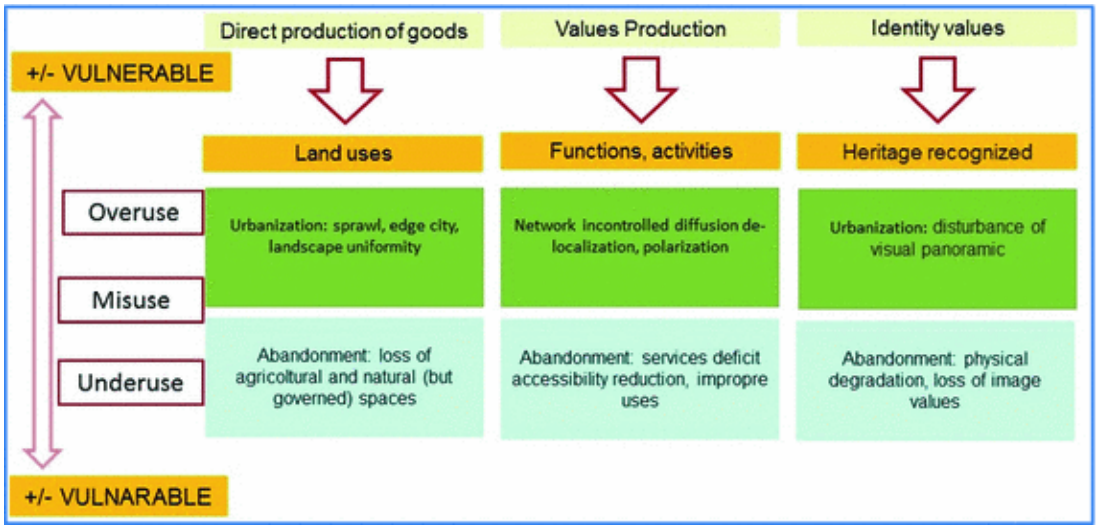

Figure 7: Landscape dynamics between overuse and abandonment. Source: (Lombardini and Scorza, 2016)

3.2 Objectives and dimensions of cultural landscapes resilience: the RescueME framework

Integration of frameworks and models

RescueME aims at implementing an operative Resilient Historical Landscape (RHL) approach by capitalizing on the results of previous research projects, bringing together their framework and proposing an assessment method that addresses resilience through an indicator-based approach in a GLOCAL strategy, where global and local factors are connected and top-down and bottom-up approaches are combined.

The SHELTER project - Sustainable Historic Environments hoListic reconstruction through Technological Enhancement & community-based Resilience - (H2020- GA No. 821282) established a conceptual framework and a set of indicators aiming at quantifying resilience in Historic Areas, which has been defined as "Resilience of Historic Areas refers to the ability of an historic urban or territorial system-and all its social, cultural, economic, environmental dimensions across temporal and spatial scales to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and use it for a systemic transformation to still retain essentially the same function, structure and feedbacks, and therefore identity, that is, the capacity to adapt in order to maintain the same identity" (Egusquiza *et al.*, 2019).

In this definition, resilience is understood as a dynamic concept that encompasses several key aspects, such as: i) multidimensionality, including cultural, environmental, economic, social, governance, and physical resilience; ii) complexity and adaptation, as heritage assets are viewed as complex and adaptive systems; iii) inherent resilience, including self-learning capacities, circular economy approaches, intrinsic sustainability, multi-stakeholder integration, redundancy, resourcefulness, and flexibility; iv) conservation friendly resilience, aimed at encountering a balance between preservation and adaptation; v) cross-scale resilience, considering both temporal and spatial scales; vi) heritage-centred vision that prioritizes cost-effectiveness in developing specific approaches only when the uniqueness of heritage assets necessitates it.

The SHELTER project performed an extensive literature review on the different dimensions of resilience addressed, namely historic building environment resilience, cultural resilience, social resilience, governance and institutional resilience, economic resilience and environmental resilience. Furthermore, a comparative analysis on different frameworks aimed at operationalising resilience was made to build an indicators framework able to cover all the dimensions of resilience, which is represented in the following Table 3:

Table 3: SHELTER indicators framework. Source: Adapted from (Egusquiza *et al.*, 2020)

<table>
<tr><th colspan="6">RISK</th></tr>
<tr><th rowspan="2">HAZARD/ SOURCE</th><th rowspan="2">EXPOSURE/ PATHAWAY</th><th colspan="4">VULNERABILITY</th></tr>
<tr><th>SENSITIVITY</th><th>COPING CAPACITY</th><th>ADAPTATIVE CAPACITY</th><th>TRANSFORMATIVE CAPACITY /INHERENT RESILIENCE</th></tr>
<tr><td>Frequency</td><td>Individuals</td><td>Social/ demography characteristics</td><td>Awareness/ information</td><td>Human capital/ education</td><td>Social memory/ Living with uncertainty</td></tr>
<tr><td>Magnitude</td><td>Community</td><td>Economic characteristics</td><td>Networks/ solidarity /Community preparedness</td><td>Social capital/ learning</td><td>Self-organisation, reflective and shared learning</td></tr>
<tr><td rowspan="4">Duration</td><td>Processes</td><td>Building/ infrastructure</td><td>Insurance/ Funds</td><td>Economic capital</td><td>Resourcefulness/ Efficiency</td></tr>
<tr><td>Activities</td><td rowspan="3">Environmental sensitivity</td><td>DRM</td><td>Institutional capital/ Governance</td><td>Collaboration/ inclusive/ diversity/ intersectoriality</td></tr>
<tr><td>Object/ Buildings/ infrastructure</td><td>Social memory</td><td>Cultural capital/ identity</td><td>Innovation</td></tr>
<tr><td rowspan="2">Ecosystems</td><td>Shelter capacity</td><td>Built capital/infrastructure</td><td>Robustness/ Strength/ appropriately connected</td></tr>
<tr><td></td><td>Protection of natural resources</td><td>Natural capital</td><td>Coupled with Local Natural Capital</td></tr>
<tr><th colspan="6">CONSEQUENCES</th></tr>
<tr><th colspan="2">CASUALTIES</th><th colspan="2">LOSS</th><th colspan="2">DAMAGES</th></tr>
</table>

Casualties	Indirect loss	Economic loss	Damages in buildings/ infrastructure/ objects	Damages in Ecosystems
RECOVERY				
Recovery rate		Reparability		

The ARCH project - Advancing Resilience of Historic Areas against Climate-related and other Hazards - (H2020, GA No. 820999) developed a tool – the ARCH Resilience Assessment Dashboard RAD – which enables stakeholders to evaluate the resilience level of their historic area through a questionnaire.

The project defined resilience of historic areas as: "The sustained ability of a historic area as a social-ecological system (including its social, cultural, political, economic, natural and environmental dimensions) to cope with hazardous events by responding and adapting in socially just ways that maintain the historic area's functions and heritage significance (including identity, integrity and, authenticity) (Milde *et al.*, 2020).

It therefore adopts the notion of Social-Ecological Systems (SES) when referring to historic areas, specifically as environments comprising of an ecological sub-system encompassing structural components, including the natural and built environment, and a social sub-system encompassing elements of society, culture, economics, and politics.

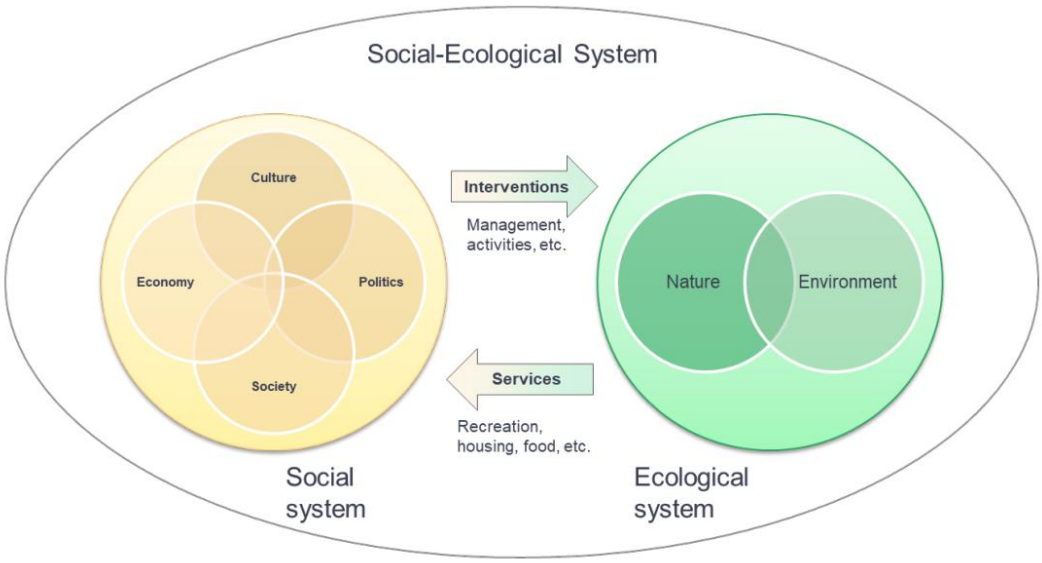

Figure 8: Elements of a Social-Ecological System. Source: (Milde *et al.*, 2020)

The RURITAGE project - Rural regeneration through systemic heritage-led strategies - (H2020, GA No. 776465) aimed at sustainably enhancing local heritage for regional and community development.
The project, following the Community Capitals Framework, considers six capitals, and their transformation over time, as mechanisms for measuring the effectiveness of strategic actions and interventions implemented (Emery and Flora, 2006). These are the following:

Table 4: RURITAGE Approach to Community capitals (Based on (Flora, 2015)). Source: (Egusquiza *et al.*, 2018)

CAPITALS	DESCRIPTIONS	RURITAGE APPROACH
CULTURAL CAPITAL	Cultural capital reflects the way people "know the world" and how they act within it, as well as their traditions and language. Cultural capital influences how creativity, innovation, and influence emerge and are nurtured.	In the RURITAGE context intangible heritage and rural traditions is one of the key assets including in this capital that the project aims to capitalise.
NATURAL CAPITAL	Natural capital refers to those assets that abide in a location, including weather, geographic isolation, natural resources, amenities, and natural beauty. Natural capital shapes the cultural capital connected to place	Natural Capital connected with biodiversity and landscape is one of the key assets that rural destinations are traditionally taking advantage of.
BUILT CAPITAL	Built capital refers to housing, transportation infrastructure, telecommunications infrastructure and hardware, utilities, heritage buildings and infrastructure.	Historic built heritage can play a key role in the heritage-led process if it is reused and maintained from a sustainability point of view.
SOCIAL CAPITAL	Social capital reflects the connections among people and organizations or the social "glue" to make things, positive or negative, happen. Bonding social capital refers to those close redundant ties that build community cohesion. Bridging social capital involves loose ties that bridge among organizations and communities. Political capital is included here reflects access to power, organizations, connection to resources and power brokers. Governance and political capital are included here as the ability of people to find their own voice and to engage in actions that contribute to the well-being and development of their community	In RURITAGE social capital is understand as the capacity of the community to build economic development networks, local mobilization of resources, and willingness to consider alternative ways of reaching goals.

HUMAN CAPITAL	Human capital is understood to include the skills and abilities of people to develop and enhance their resources and to access outside resources and bodies of knowledge to increase their understanding, identify promising practices, and to access data for community-building.	In RURITAGE, human capital is improved through practices that contribute to the health, training & education of the population.
FINANCIAL CAPITAL	Financial capital refers to the financial resources available to invest in community capacity-building, to underwrite the development of businesses, to support civic and social entrepreneurship, and to accumulate wealth for future community development	In RURITAGE the financial capital is understood as mean to achieve the growing of the other capitals.

On the one hand, being funded under the same topic, SHELTER and ARCH have joined efforts to build a compatible framework for resilience enhancement in Historic Areas, recognizing their complexity and interconnections by adopting the concept of socio-ecological system and resulting in the standard CWA 17727:2022 "City Resilience Development – Framework and guidance for implementation with a specific focus on historic areas". On the other hand, RURITAGE complements the previous results by bringing in the Community Capital Framework to strengthen the natural and cultural values of rural areas for sustainable development, especially addressing the role of intangible cultural heritage and the use of the tangible cultural heritage.

RescueME embraces the Cultural ecosystem service (CES) concept coming from the environmental field by proposing a heritage centric perspective, which considers natural and cultural heritage, tangible and intangible heritage as sources of benefit and life quality improvement, being cultural landscapes representative of the rich diversity of European heritage. It therefore integrates the cultural landscapes attributes proposed by main instruments available and associate them to the different capitals, namely natural, social, financial, human and built.

RescueME proposes a set of key elements which are linked to those capitals aimed at enabling resilience improvements, based on coping, adaptive and transformative capacities of cultural landscapes.

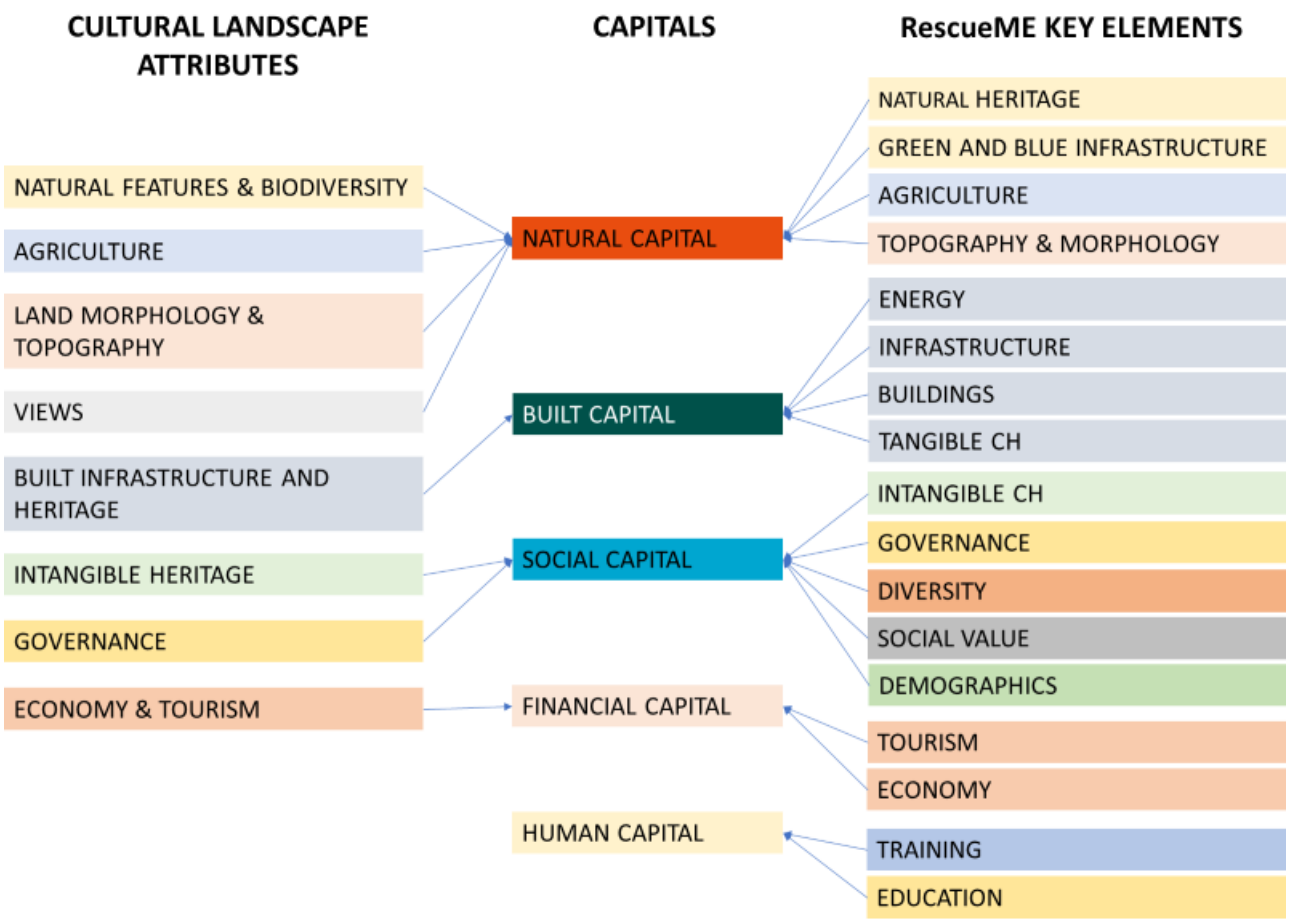

Figure 9: RescueME key elements of CL resilience

With respect to the capitals, RescueME is grounded on the RURITAGE project, but adopts a tailored definition for each of them. The main difference can be found in the cultural capital proposed by RURITAGE, which is not explicitly considered in RescueME, as it is assumed that cultural capital is embedded in all other capitals, especially when coming to the complex system of cultural landscapes, where human activities and local cultures have shaped, managed and valued the landscape.

The cultural capital can be therefore encountered in traditional practices, specially related to agriculture and intangible heritage, in the built capital, where traditional buildings and tangible heritage and connections are representative of local way of life, as well as on the governance mechanisms that rule landscape conservation and management and major economic activities. Creativity and innovation are therefore linked to the local background and the transformative opportunities offered by and to the local communities.

Table 5: RescueME capitals' definitions

CAPITALS	RESCUEME DEFINITION
NATURAL CAPITAL	Natural capital is related to natural resources and ecosystems providing benefits and services to local communities, including agricultural practices and biodiversity as well as recreational, and traditional practices.
BUILT CAPITAL	Built capital refers to human-made infrastructure, as a tangible representation of culture and history, and includes monuments, traditional buildings, industrial heritage, roads and connections as well as energy and water provision systems. Together with the natural capital, it contributes to shape the landscape unique character.
SOCIAL CAPITAL	Social capital is related to networks, relationships and trust that coexist in a community and influences how people contribute to the preservation and sustainable development of cultural landscapes. It includes community engagement practices, traditional knowledge sharing, advocacy and policy influence and governance mechanisms that include communities to mobilize support and influence decision-making.
HUMAN CAPITAL	Human capital is related to the skills and abilities of local communities and how these could be enhanced and fostered through continuous learning, education and training.
FINANCIAL CAPITAL	Financial capital refers to the economic contribution of cultural landscapes to local communities as well as the resources and funds available for their maintenance, management and improvement, including revenues from the touristic sector and cultural events.

Resilience indicators framework

The following graph shows the framework proposed by RescueME to structure the indicators aimed at characterizing the heritage diversity and resilience of Cultural Landscapes.

Figure 10: RescueME indicators framework for CL values and resilience characterization

The proposed indicators framework is therefore conceived to cover the three (3) systems and their associated capitals by measuring the dimensions proposed for each of them. Furthermore, capitals should be able to address all the vulnerability components of resilience (sensitivity, coping capacity, adaptative capacity and transformative capacity), as shown in Figure 11. This approach allows to better identify weakness and opportunities for strategies and solutions implementation.

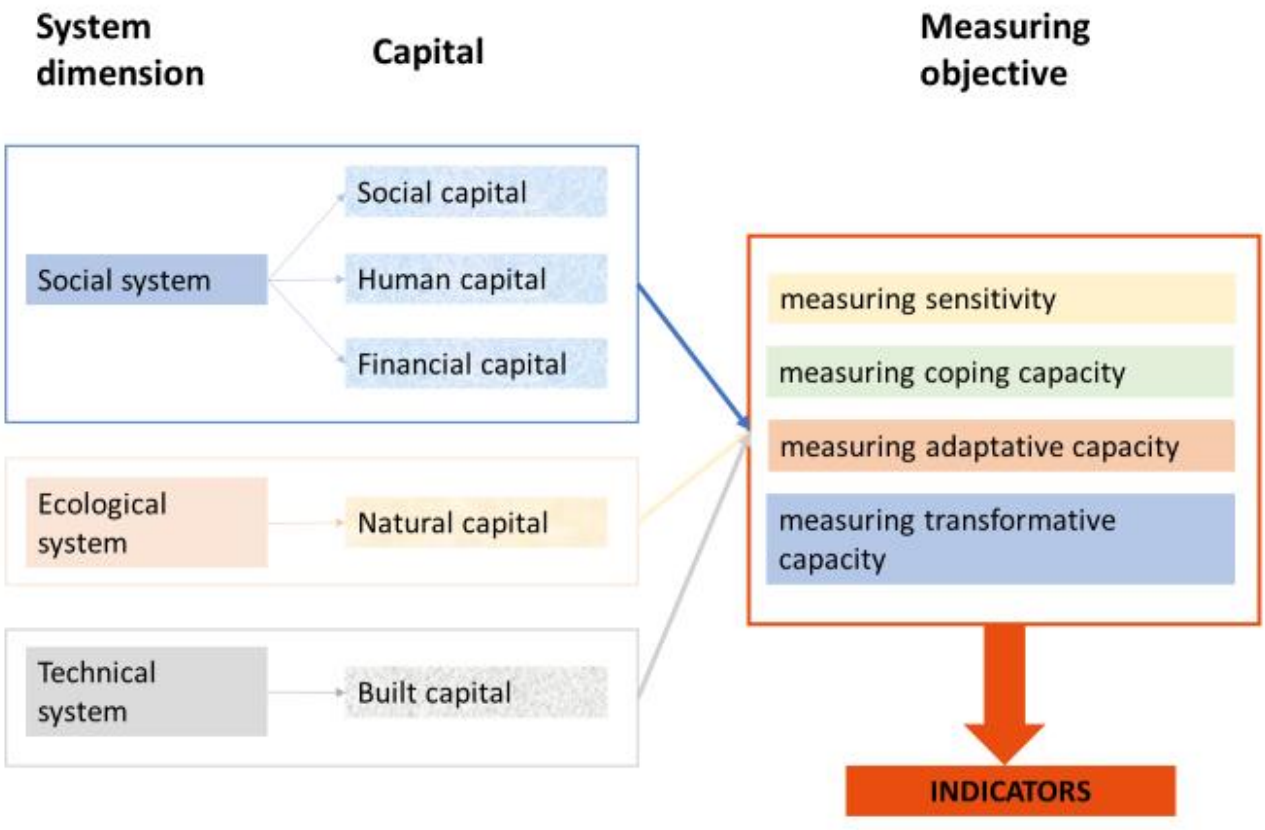

Figure 11: RescueME indicators framework and measuring objectives

The definitions adopted by the project to address the measuring objectives initially proposed by SHELTER, and based on the adaptation of (Deubelli and Mechler, 2021; IPCC, 2023a; Turchi *et al.*, 2023) are the following:

Table 6: RescueME objective's definitions based on (Deubelli and Mechler, 2021; IPCC, 2023a; Turchi *et al.*, 2023)

OBJECTIVES	RESCUEME DEFINITION
SENSITIVITY	The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change (IPCC, 2023a)
COPING CAPACITY	The ability of people, institutions, organisations and systems, using available skills, values, beliefs, resources and opportunities, to address, manage and overcome adverse conditions in the short to medium term, allowing them to absorb impacts and react ex-post (IPCC, 2023a; Turchi *et al.*, 2023)

ADAPTATIVE CAPACITY	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences in advance, learning from the past and preparing ex-ante (IPCC, 2023a; Turchi *et al.*, 2023)
TRANSFORMATIVE CAPACITY	The ability of people, institutions, humans and other organisms to prevent future adverse conditions and to radically transform the functioning of communities and systems, addressing deep-rooted changes (Deubelli and Mechler, 2021; Turchi *et al.*, 2023)

3.3 Cultural landscapes resilience indicators

Based on the literature review as well as on the experience of the R-Labscapes, an initial set of indicators to characterise the resilience of cultural landscapes was proposed. Each of them was characterized considering the methods and procedure for their calculation and data source availability, both at European and local level, according to the following parameters:

Table 7: Parameters considered for the indicators' characterization

ID	Unique number assigned to each indicator
SYSTEM DIMENSION	Social/ Ecological or Technical
CAPITAL	Natural/ Built / Human/ Financial or Social
KEY ELEMENT	Main key element addressed
OBJECTIVE	Sensitivity/ Coping capacity/ Adaptative capacity/ Transformative capacity
NAME	Denomination of the indicator
DESCRIPTION	Short description of the indicator
PARAMETER	Variable(s) used to calculate the indicator
CALCULATION METHOD	How variables are used for the calculation
UNIT	Unit of measure
UPDATE PERIODICITY	Frequency at which updates are recommended

EU LEVEL	Institution/ Organization providing the data at EU level. In case of indicators based on local data this column is filled with N/A
LINK TO SOURCE	Link to the indicator data source
TIME PERIOD AVAILABLE	Period covered by data
GEOGRAPHIC LEVEL	NUTS level or scale
GEOGRAPHICAL COVERAGE	Countries covered
UPDATE FREQUENCY	Frequency with which data are updated
LOCAL LEVEL	Institution/ Organization providing data at local level

Resilience indicators evaluation method and selection

The RACER criteria

In order to check and assess the appropriateness of resilience indicators, the RACER (relevant, accepted, credible, easy and robust) criteria was selected, as a framework used to assess the soundness of scientific tools for their use in policy making (Eisenmenger et al., 2016). The procedure of the assessment allows to evaluate each indicator against the different RACER criteria by using a simple numerical scale to define the degree in which it meets the requirement. As the assessment involves a certain degree of subjectivity, the evaluation was performed by two different technical partners.

The following
Table 8 shows the RACER criteria and sub-criteria that were used and adapted to RescueME purposes:

Table 8: RACER assessment: criteria and sub-criteria used

Criteria	Definition	Sub-criteria
Relevant	The indicator can be used to clearly assesses resilience of cultural landscapes	Is it MEANINGFUL?
		Is it COMPARABLE?
Accepted	The indicator is Approved and recommended by relevant stakeholders	Has it been PREVIOUSLY USED?

		Is it a STANDARD?
Credible	Method and data collection are clearly defined and traceable and results don't require extensive explanations	Is it UNANBIGOUS?
		Has it a CLEAR METHODOLOGY to be calculated?
Easy	Good quality data are directly accessible and don't need complicated processing	Are the data for calculating it AVALAIBLE?
		Is it EASY TO CALCULATE?
Robust	Results obtained can be compared and applied to other methos and are of good precision	Does the calculation use REAL DATA (not estimations)?
		Is it APPLICABLE TO SIMILAR CASES?
		Is it APPLICABLE IN ALL EUROPE?

The value scale used for the assessment of each indicator was the following

- 0= DOES NOT MEET THE CRITERIA AT ALL
- 1= PARTIALLY MEETS THE CRITERIA
- 2= FULLY MEETS THE CRITERIA

To derive the final score, the mean value of the sub-criteria was assigned to each criterion and then, the mean value of each criterion calculated. Values above 1,5 were considered as a positive result, while lowers as negative.

Besides the RACER criteria framework, two additional questions were included, one related to the impact that the indicator may have on the cultural landscape if measures or actions are implemented and the other related to the specific components of the landscape:

- Is the indicator especially relevant for measuring specific components/objectives of landscapes? This question is answered by a yes/no. If the RACER criteria had a negative result, the indicator is further discussed to evaluate if efforts are needed in its achievement.
- Impact of the indicator. This is assessed by a numerical scale being 1= impact on the indicators cannot be measured directly but it is related with resilience in general; 2= impact on the indicator can be expected by the implementation of long-term policies & strategies or actions not tested in RescueME; 3= impact on the indicator can be expected by the implementation of RecueMe actions. It has been introduced for those indicators that can help monitoring the impact of the project in the R-Labscapes. Again, if the RACER criterion was negative, it is further discussed to evaluate its inclusion in the data collection procedures of the Labscapes.

R-Labscapes' perspective

As the RescueME resilience indicators framework serves as a metric system for measuring resilience in different Cultural Landscape and pursue a GLOCAL strategy based on both global and local factors, as well as top-down and bottom-up approaches, it should be flexible enough to create the basis for establishing CL typologies at European scale and to adapt to the specificities and characteristics of the R-Labscapes involved in the project.

To meet these requirements, the RACER criteria was used, from a technical point of view, to assess indicators according to their overall and global importance, while the evaluation performed by the R-Labscapes was used to assess the meaningfulness and feasibility of the indicators in their specific locations, considering their type of landscapes and their challenges.

The R-Labscapes were asked to evaluate the indicators with a numerical scale (0-2), considering the following aspects:

- Meaningfulness: Do you consider the indicator is significant, and to what extent, to measure resilience in your labscape?
  - 0 Not significant
  - 1 Moderately significant
  - 2 Highly significant
- Feasible: Do you consider the indicator can be obtained or is it achievable?
  - 0 Not feasible
  - 1 Partially feasible
  - 2 Feasible

Indicators that are highly significant for at least one R-Labscape and feasible for at least one R-Labscape are considered to have a positive result.

Resilience indicators' selection

Both the RACER criteria framework and the R-Labscapes assessment were considered to select indicators, according to the following principles:

- If both RACER score was positive for both evaluators and R-Labscape assessment positive, the indicator has been selected
- If RACER score was positive for both evaluators, even if the R-Labscapes evaluation was negative, the indicator has been selected, as it may be relevant for EU level
- If at least one RACER score was positive and the R-Labscape evaluation was positive, the indicator has been selected

- If only one RACER was positive and the R-Labscape assessment negative, the indicator has been discarded
- If both the RACER score were negative for both evaluators and the Labscape assessment was negative, the indicator was discarded.

Table 9: RACER assessment, Labscape evaluation and selection of shortlisted indicators

INDICATORS DEFINITION		EVALUATOR 1	EVALUATOR 2	LABSCAPE EVALUATION	SHORTLIST
ID #	Indicator name	RACER score	RACER score	Meaningful & Feasible	
1	Population Density	1,9	1,9	YES	YES
2	Population change	1,9	1,7	YES	YES
3	Employment rate	2,0	1,9	YES	YES
4	Unemployment rate	2,0	1,3	YES	YES
5	Land cover change	1,9	1,4	YES	YES
6	Share of population aged 20 to 39 years (in %)	2,0	1,9	YES	YES
7	Share of population aged >65 years (in %)	2,0	2,0	YES	YES
8	Young-age dependency	2,0	2,0	NO	YES
9	Old dependency	2,0	1,4	NO	NO
10	Net migration rate (per 1000)	1,9	1,9	NO	YES
11	Tourism pressure (per 1000)	1,7	0,6	YES	YES
12	Tourist accomodation capacity	1,9	1,2	YES	YES
13	Highly educated working age persons	2,0	2,0	NO	YES
14	Quality of natural landscape based on Natura 2000 sites	2,0	1,9	YES	YES
15	Risk of Poverty and Social Exclusion	1,8	0,7	NO	NO
16	Early leavers from education and training	1,6	1,6	NO	YES
17	Available beds in hospitals	1,9	1,9	NO	YES
18	Quality of government index	1,4	1,4	NO	NO
19	Landslide susceptibility	1,6	1,7	YES	YES
20	Share of employment in ARTS, SPORTS AND RECREATION sector	1,8	1,3	NO	NO
21	Share of enterprises in ARTS, SPORTS AND RECREATION sector	2,0	1,3	NO	NO
22	Historical building stock	2,0	1,9	NO	YES
23	Land Uses, Patterns, Clusters	1,9	1,7	YES	YES
24	Imperviousness	2,0	1,9	YES	YES
25	Internet access	1,9	1,8	YES	YES

26	Classification as inner periphery	2,0	1,9	NO	YES
27	Environmental protection investments of total economy	1,8	2,0	YES	YES
28	Physicians or doctors	1,9	1,9	NO	YES
29	National adaptation strategies	1,5	1,5	YES	YES
30	Climate related economic loss	1,3	1,5	YES	YES
31	Suite of products (land use, population, street trees)	1,9	1,9	YES	YES
32	Lone-pensioner households	1,8	1,6	NO	YES
33	People born in another country	1,7	1,7	YES	YES
34	Affected areas due to an extreme event	1,5	2,0	YES	YES
35	Topography	1,8	1,6	YES	YES
36	Flood delineation	1,5	1,5	YES	YES
37	Reconstruction monitoring	1,4	1,4	NO	NO
38	Degree of urbanisation	1,9	1,8	YES	YES
39	Tourism Carrying Capacity	1,4	2,0	YES	YES
40	Settlements	1,9	1,9	NO	YES
41	% of rented houses	1,5	1,5	YES	YES
42	Surface cultivated with vineyards	1,1	1,0	YES	YES
43	Surface cultivated with olive trees	1,1	1,0	YES	YES
44	Total number of farm business	1,6	2,0	YES	YES
45	Crops surface	1,9	2,0	YES	YES
46	Farm business with owner/manager over 65 years old.	1,6	1,6	YES	YES
47	Farm business with owner/manager with full-time commitment/contract.	1,6	1,0	YES	YES
48	Average hidric resources for crops.	1,1	1,6	YES	YES
49	Agricultural unempoyment rate	1,6	0,9	YES	YES
50	Social Security affiliation in Agriculture	1,7	1,3	YES	YES
51	Land tenure system	1,1	2,0	YES	YES
52	Legal personality of the holder	1,3	1,1	NO	NO
53	Diversification of agricultural activities	2,0	2,0	YES	YES
54	Organic farming activities	2,0	2,0	YES	YES
55	Area with arable crops	2,0	2,0	NO	YES
56	Protected Areas Surface	1,7	1,5	YES	YES
57	Mayors Adapt membership	1,3	1,4	NO	NO
58	Parity in farm managers	1,5	1,8	YES	YES
59	Farm manager with agricultural studies	1,7	1,7	YES	YES
60	Agricultural studies	1,7	1,6	NO	NO (repeated)

61	Municipal budget	1,6	1,8	YES	YES
62	Heritage density: Number of designated or formally listed natural and cultural sites and intangible heritage per area	1,8	1,9	YES	YES
63	Existence of sites with recognised international designation (WHS, GIAHS, Capital of Culture, Cultural route)	1,8	1,7	YES	YES
64	Number of cultural facilities open to the public and aiming at promoting arts and culture per population	1,3	1,1	YES	YES
65	Availability of products with designation of origin or geographical indications (PDO, PGI), traditional specialties guaranteed (TSG)	1,6	2,0	YES	YES
66	Capacity building/ training activities/ mentoring opportunities promoted by institutions for improving cultural knowledge	1,0	1,1	YES	YES
67	Average of physical, mental and visual accessibility of cultural facilities and sites	1,1	1,2	NO	NO
68	Existence of adopted visitors' management plans that address seasonality of tourism and carrying capacity of properties	1,5	1,7	YES	YES
69	Resources allocated to landscape maintenance, improvement and accessibility, including installation of equipment for cultural use	1,2	1,5	YES	YES
70	Number of endangered cultural and natural heritage sites	1,3	1,7	YES	YES
71	Number of vacant and dilapidated tangible cultural heritage reused	1,1	1,1	NO	NO
72	Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage	1,5	1,1	YES	YES
73	Percentage of enterprises / establishments using a voluntary certification / labelling for environmental / quality / sustainability and/or Corporate Social Responsibility	1,1	1,0	YES	YES
74	Percentage of cultural facilities and sites accessible by public transport or other environmentally friendly transport or cycle tracks	1,5	1,4	YES	YES

75	Number of days in a year in which maximum tourism carrying capacity has been exceed	1,6	1,8	NO	YES
76	Net occupancy rate in accommodation per season (quarterly)	1,6	1,9	YES	YES
77	Employment rate in cultural sector	1,8	2,0	NO	YES
78	Percentage of Gross Domestic Product attributable to private and formal cultural production	1,5	1,9	NO	YES
79	Exports of PDO (Protected Denomination of Origin) or PGI (Protected Geographical Indication) as a percentage of all regional sale	1,5	1,9	NO	YES
80	Houses used for unofficial accommodation activities	1,1	1,1	NO	NO
81	Houses used for official accommodation activities	1,1	1,8	YES	YES
82	Owned houses with summer use only	1,1	1,6	YES	YES
83	Incentives for the maintenance of traditional agricultural activities	1,3	1,1	NO	NO
84	Funds spent in activities enhancing the terracing	1,1	1,5	NO	NO
85	Percentage of abandonment of terraces on the total terraced area	1,1	1,6	YES	YES
86	Areas affected by abandonment on the total of cultuvated areas	1,0	1,6	NO	NO
87	Percentage of terraced vineyards on the total land used for viticulture	1,1	1,3	YES	YES
88	Funds spent in initiatives aimed at raising awareness among tourists and the local population	1,1	1,1	YES	YES
89	Rates of housing category types of spaces (main resident, second home, or vacant)	1,1	1,5	NO	NO
90	Average housing prices	1,6	1,9	NO	YES
91	Annual income	1,7	1,9	NO	YES
92	Number of properties	1,0	1,6	YES	YES
93	Households with one or more retired persons as a percentage of total households	1,7	1,9	NO	YES
94	Gender employment gap	1,9	1,9	NO	YES
95	Number of strategic buildings	1,8	1,9	NO	YES
96	Number of emergency operators	1,6	1,9	YES	YES
97	Permanent cultivations surface	2,0	1,1	YES	YES
98	Precipitation variation	1,8	1,5	YES	YES
99	Number of PDO/PGI agriculture firms	1,6	1,7	YES	YES
100	Number of Bio agriculture firms	1,5	0,7	YES	YES

101	Number of young farmers	1,8	1,8	YES	YES
102	Participation of Municipalities in rural development projects	1,6	1,6	YES	YES
103	Number of bottom-up projects presented by citizens	1,3	1,2	YES	YES
104	Projects on landscape and CH included in the NEXT Generation EU	1,5	1,0	YES	YES
105	Municipal financing for Cultural Heritage	1,5	1,5	YES	YES
106	Production of biological energy	2,0	1,5	NO	YES
107	Green areas of high ecological quality	2,0	1,8	NO	YES
108	Dispersion of urban areas	1,9	1,7	NO	YES
109	Ecological diversity (Shannon-Evenness index)	1,9	1,7	YES	YES
110	Nature Based recreation potential	2,0	1,3	YES	YES
111	Habitat and species mantainance	2,0	1,5	NO	YES
112	Run-off retention/Flood control	2,0	1,7	NO	YES
113	Global climate regulation - Carbon sequestration	2,0	2,0	NO	YES
114	Local climate regulation - Cooling capacity	1,2	1,8	NO	NO
115	Number of forestry consortiums	1,9	1,7	NO	YES
116	Forestry viability / Firebreak roads	1,5	1,5	NO	YES
117	Mid real estate value of properties	1,4	1,7	NO	NO
118	Mid agriculture value	1,4	1,7	NO	NO
119	Number of fire events in a considered time period	1,7	0,2	YES	YES
120	Fire-ridden areas	1,7	0,2	YES	YES
121	Number of contaminated sites	1,5	1,4	NO	NO
122	Time distance from the main city	1,9	1,7	YES	YES
123	Conservation index of historical rural architectural heritage	1,1	1,3	YES	YES
124	Final energy consumption per capita in the agriculture sector	2,0	1,9	NO	YES
125	Final energy consumption per land area in the agriculture sector	2,0	1,9	NO	YES
126	Energy consumption from renewable carriers for space heating, hot water and cooling	2,0	1,9	YES	YES
127	Share of energy from renewable carriers for space heating, hot water and cooling	2,0	1,9	YES	YES
128	Participation rate in eduction & training	1,6	1,8	NO	YES
129	Farm manager with agricultural training	1,6	1,9	YES	YES

130	Nationally designated areas	2,0	2,0	YES	YES
131	Number of disadvantaged people engaged in community events (elderly, migrants, unemployed, etc.)	1,6	1,3	NO	NO
132	Number of sites accessible by people with disabilities	1,6	1,5	YES	YES
133	Annual number of festivals or cultural events connected to traditions/culinary practices/local products	1,4	1,5	YES	YES
134	Number of local associations connected to traditions/culinary practices/local products	1,4	1,5	YES	YES
135	Number of shops, restaurants and tourism facilities selling local products (0 Km)	1,4	1,5	YES	YES
136	Use of traditional or community knowledge of species occurrence, frequency and distribution	1,3	0,7	NO	NO
137	Attendance and participation in cultural activities and events	1,6	1,2	NO	NO
138	Number of people trained in traditional skills	1,5	1,2	NO	NO
139	Number of people from vulnerable groups involved in educational-training programs	1,6	1,3	NO	NO
140	Impairments through visual, acoustic or olfactory disturbances	1,0	1,1	NO	NO
141	Diversity of landscape (number of landscape typologies)	1,6	1,1	YES	YES

Indicators' database

Table 10 summarises the shortlisted indicators and the relation with the proposed framework. The complete list of indicators and their characterization can be found in Annex III.

Table 10: Final list of indicators, grouped by system, capital and key element and their measuring objective

System dimension	Capitals	Key elements	ID	Indicator name	Measuring objective
Social system	Social capital	Demographics	1	Population Density	measuring sensitivity
			2	Population change	measuring sensitivity
			6	Share of population aged 20 to 39 years (in %)	measuring sensitivity
			7	Share of population aged >65 years (in %)	measuring sensitivity
			8	Young-age dependency	measuring sensitivity
			10	Net migration rate (per 1000)	measuring sensitivity
			32	Lone-pensioner households	measuring sensitivity
			33	People born in another country	measuring sensitivity
			93	Households with one or more retired persons as a percentage of total households	measuring sensitivity
		Diversity	46	Farm business with owner/manager over 65 years old.	measuring sensitivity
			58	Parity in farm managers	measuring transformative capacity
			94	Gender employment gap	measuring transformative capacity
			101	Number of young farmers	measuring coping capacity
			132	Number of sites accessible by people with disabilities	measuring adaptative capacity
		Governance	5	Land cover change	measuring sensitivity
			29	National adaptation strategies	measuring adaptative capacity
			51	Land tenure system	measuring adaptative capacity
			102	Participation of Municipalities in rural development projects	measuring adaptative capacity
			103	Number of bottom-up projects presented by citizens	measuring transformative capacity
			104	Projects on landscape and CH included in the NEXT Generation EU	measuring transformative capacity
			115	Number of forestry consortiums	measuring coping capacity
		Intangible CH	65	Availability of products with designation of origin or geographical indications (PDO, PGI), traditional specialties guaranteed (TSG)	measuring adaptative capacity
			133	Annual number of festivals or cultural events connected to traditions/culinary practices/local products	measuring adaptative capacity
			134	Number of local associations connected to traditions/culinary practices/local products	measuring adaptative capacity

			135	Number of shops, restaurants and tourism facilities selling local products (0 Km)	measuring adaptative capacity
		Social value	73	Percentage of enterprises / establishments using a voluntary certification / labelling for environmental / quality / sustainability and/or Corporate Social Responsibility	measuring transformative capacity
	Human capital	Training	47	Farm business with owner/manager with full-time commitment/contract	measuring coping capacity
			66	Capacity building/ training activities/ mentoring opportunities promoted by institutions for improving cultural knowledge	measuring transformative capacity
			128	Participation rate in education & training	measuring coping capacity
			129	Farm manager with agricultural training	measuring adaptative capacity
		Education	13	Highly educated working age persons	measuring coping capacity
			16	Early leavers from education and training	measuring sensitivity
			59	Farm manager with agricultural studies	measuring adaptative capacity
	Financial capital	Economy	3	Employment rate	measuring coping capacity
			4	Unemployment rate	measuring sensitivity
			27	Environmental protection investments of total economy	measuring adaptative capacity
			30	Climate related economic loss	loss
			44	Total number of farm business	measuring coping capacity
			49	Agricultural unemployment rate	measuring sensitivity
			50	Social Security affiliation in Agriculture	measuring coping capacity
			61	Municipal budget	measuring adaptative capacity
			69	Resources allocated to public space and pathways maintenance, improvement and accessibility, including installation of equipment for cultural use	measuring adaptative capacity
			72	Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage	measuring adaptative capacity
			77	Employment rate in cultural sector	measuring adaptative capacity
			78	Percentage of Gross Domestic Product attributable to private and formal cultural production	measuring transformative capacity
			79	Exports of PDO (Protected Denomination of Origin) or PGI (Protected Geographical Indication) as a percentage of all regional sale	measuring transformative capacity

			88	Funds spent in initiatives aimed at raising awareness among tourists and the local population	measuring adaptative capacity
			90	Average housing prices	measuring sensitivity
			91	Annual income	measuring sensitivity
			105	Municipal financing for Cultural Heritage	measuring adaptative capacity
		Tourism	11	Tourism pressure (per 1000)	measuring sensitivity
			12	Tourist accommodation capacity	measuring coping capacity
			39	Tourism Carrying Capacity	measuring adaptative capacity
			68	Existence of adopted visitors' management plans that address seasonality of tourism and carrying capacity of properties	measuring transformative capacity
			75	Number of days in a year in which maximum tourism carrying capacity has been exceed	measuring sensitivity
			76	Net occupancy rate in accommodation per season (quarterly)	measuring coping capacity
			81	Houses used for official accommodation activities	measuring sensitivity
			82	Owned houses with summer use only	measuring sensitivity
Ecological system	Natural capital	Agriculture	42	Surface cultivated with vineyards	measuring adaptative capacity
			43	Surface cultivated with olive trees	measuring adaptative capacity
			45	Crops surface	measuring coping capacity
			48	Average hydric resources for crops.	measuring coping capacity
			53	Diversification of agricultural activities	measuring adaptative capacity
			54	Organic farming activities	measuring transformative capacity
			55	Area with arable crops	measuring coping capacity
			85	Percentage of abandonment of terraces on the total terraced area	measuring sensitivity
			87	Percentage of terraced vineyards on the total land used for viticulture	measuring sensitivity
			97	Permanent cultivations surface	measuring adaptative capacity
			99	Number of PDO/PGI agriculture firms	measuring adaptative capacity
			100	Number of Bio agriculture firms	measuring transformative capacity
		Green and blue infrastructure	107	Green areas of high ecological quality	measuring adaptative capacity
			109	Ecological diversity (Shannon-Evenness index)	measuring transformative capacity
			110	Nature Based recreation potential	measuring transformative capacity

			111	Habitat and species maintenance	measuring adaptative capacity
			112	Run-off retention/Flood control	measuring coping capacity
			113	Global climate regulation - Carbon sequestration	measuring coping capacity
			116	Forestry viability / Firebreak roads	measuring adaptative capacity
		Natural heritage	14	Quality of natural landscape based on Natura 2000 sites	measuring adaptative capacity
			56	Protected Areas Surface	measuring coping capacity
			120	Fire-ridden areas	damages
			130	Nationally designated areas	measuring coping capacity
			141	Diversity of landscape (number of landscape typologies)	measuring adaptative capacity
		Topography and morphology	19	Landslide susceptibility	measuring sensitivity
			23	Land Uses, Patterns, Clusters	measuring sensitivity
			24	Imperviousness	measuring sensitivity
			31	Suite of products (land use, population, street trees)	measuring sensitivity
			34	Affected areas due to an extreme event	damages
			35	Topography	measuring sensitivity
			36	Flood delineation	damages
			38	Degree of urbanisation	measuring sensitivity
			98	Precipitation variation	measuring sensitivity
			108	Dispersion of urban areas	measuring sensitivity
			119	Number of fire events in a considered time period	damages
Technical system	Built capital	Buildings	40	Settlements	measuring sensitivity
			41	Percentage of rented houses	measuring sensitivity
			64	Number of cultural facilities open to the public and aiming at promoting arts and culture per population	measuring adaptative capacity
			92	Number of properties	measuring coping capacity
		Energy	106	Production of biological energy	measuring transformative capacity
			124	Final energy consumption per capita in the agriculture sector	measuring sensitivity
			125	Final energy consumption per land area in the agriculture sector	measuring sensitivity
			126	Energy consumption from renewable carriers for space heating, hot water and cooling	measuring coping capacity

			127	Share of energy from renewable carriers for space heating, hot water and cooling	measuring adaptative capacity
		Infrastructure	17	Available beds in hospitals	measuring coping capacity
			25	Internet access	measuring coping capacity
			26	Classification as inner periphery	measuring sensitivity
			28	Physicians or doctors	measuring coping capacity
			74	Percentage of cultural facilities and sites accessible by public transport or other environmentally friendly transport or cycle tracks	measuring transformative capacity
			95	Number of strategic buildings	measuring coping capacity
			96	Number of emergency operators	measuring coping capacity
			122	Time distance from the main city	measuring sensitivity
		Tangible CH	22	Historical building stock	measuring sensitivity
			62	Heritage density: Number of designated or formally listed natural and cultural sites and intangible heritage per area	measuring sensitivity
			63	Existence of sites with recognised international designation (WHS, GIAHS, Capital of Culture, Cultural route)	measuring coping capacity
			70	Number of endangered cultural and natural heritage sites	measuring sensitivity
			123	Conservation index of historical rural architectural heritage	measuring coping capacity

4 Hazards and stressors characterization and climate scenarios

4.1 Hazard definition

In the context of the RescueME project, **hazard** is defined following the (IPCC, 2012) report, given as [*the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources*.]

These hazardous events can be extreme and non-extreme physical events, and can originate from natural, socio-natural or purely anthropogenic causes. Socio-natural hazards are generated from human degradation or transformation of the physical environment. A geographic area can be affected by one, or a combination of such events, occurring at the same or at different times (IPCC, 2012).

The characterization of natural hazards is seen as preparatory action integral to the process of a vulnerability and risk assessment, and for resilience enhancing. As presented in Table 3 as derived from the SHELTER Project, **hazards** are described by **magnitude, frequency** and **duration.**

There is a large body of literature addressing the (natural) hazard classification and assessment, most of them converging in the idea to classify the hazards according to their particular origin, being geodynamic hazards, hydrological, atmospheric, and biological (ICSU - LAC, 2010). For the same authors socio-natural hazards are seen as a latent threat associated with the probable occurrence of physical phenomena, whose intensity is related to processes of environmental deterioration, coming from human interventions (e.g., floods and landslides). Therefore, the socio-natural hazards are produced at the interface between nature and human activities, and the new hazards related to global climate change symbolise the most extreme example of socio-natural hazards.

According to (Dewan, 2013; IPCC, 2022), physical events become hazards where social elements or environmental resources are exposed to their potentially adverse impacts. Hazard is then defined as a threat or potential for adverse effects, but not the physical event

itself. It is a pre-existing condition that can become a disaster depending on exogenous (including global phenomena) and endogenous factors (related to anthropogenic activities). External and internal drivers can act in a combination or independently to make worse a particular hazard condition (Dewan, 2013; IPCC, 2022). Furthermore, natural hazards in the past were seen as elements of the physical environment which potentially could cause damage to humans but caused by forces totally external to him (Burton and Kates, 1964). Nowadays the consequences of human activities that cause environment degradation and climate change have been proven to be the origin of many natural disasters (Chandrappa *et al.*, 2011).

(Hov *et al.*, 2013) consider natural hazards as natural phenomena that have damaging consequences for people, society or ecosystems. Only in areas with a certain degree of vulnerability a natural hazard will result in a disaster. The authors also identify a categorisation of threats with four hazard families: geophysical, meteorological, hydrological and climatological. Each of these categories is further subdivided into main events and sub-perils. Geophysical hazards include earthquakes and derived events (for instance tsunamis), and volcanic eruptions. Meteorological hazards are comprised of storms and sub-categories as hurricanes, cyclones, snowstorms, etc. Hydrological hazards are all kinds of floods and wet mass movements as landslides. Climatological hazards include extreme temperatures, droughts and wildfires.

Possibly the most comprehensive classification of hazards (a.k.a. perils) is delivered in the IRDR Peril Classification and Hazard Glossary , 2014 report, which builds up on the idea to cluster the hazards into families, which are then further refined and broken down into specific hazards as depicted in Figure 12.

Figure 4 Peril classification at the Family, Main Event and Peril Levels. The association of perils with main events is solely a suggestion. Some perils may change their main event association based on the actual event and loss trigger.

Figure 12: Hazard classification as per IRDR, 2014

The IRDR classification has been taken as a basis for the hazard characterisation in the SHELTER Project and is presented in Table 11.

Table 11: The main hazard groups, determinants and types as defined in SHELTER. Source: SHELTER project

Hazard group	Main biophysical/weather/climate determinants	Hazard main type
Geophysical Originated from mass movement of solid earth.	Mass movement	**Earthquake**
		Landslide
		Subsidence
Meteorological Short-term or small-scale weather conditions (e.g., minutes to days).	Precipitation	Rainstorm (runoff)
	Wind	**Severe wind/storm**
	Temperature trends and patterns	**Heat wave**
		Extreme hot weather
		Cold wave
		Extreme cold weather
Climatological Long-term or large-scale atmospheric processes (e.g., intra seasonal to multi-decadal).	Water scarcity (lack of precipitation and or seasonal melt)	Drought
	Wildfire	**Forest fire and land fire**
Hydrological Mass movement of water influenced by meteorological	Flood	**Surface flood/runoff**
		River flood
		Coastal flood/ sea level rise
	Wave action	Storm surge
	Chemical change	Saltwater intrusion
		Ocean acidification
Biological Change in the way living organisms grow and thrive, which may lead to contamination and/or disease.	Insects and micro-organisms	Different diseases for humans, animals and plants anomalous growth of micro-organisms under extreme events (precipitation and extreme temperatures potentially affecting CNH structure/ materials

Those individual hazards can occur conjointly or in a cascade. Effective risk reduction is only possible if all significant threats are considered and analysed. The analysis of multiple hazards determines a variety of additional challenges due to different characteristics of processes involved. Furthermore, the presentation and visualisation of several hazards is a challenging task due to the quantity of information that must be displayed at the same time. Two approaches for multi-hazard evaluation are found in the current literature. One is based on depiction of different hazards in a specific area, while the second one is based on the thematic characterisation. Multi-hazard risk assessment should be seen not just as an analysis concerning the sum of individual hazards but rather as an analysis that considers various interaction between two or more individual hazards. Therefore, the main issues should be sought from interactions of different events (cascade effects). Even though there is a rising awareness of the importance of multi-hazard studies there is no universal definition of terminology and conceptual approaches available (Kappes *et al.*, 2012).

(Dewan, 2013) analysed the model for multi-hazard assessment proposed by (Greiving *et al.*, 2006). This model, referred to as Integrated Assessment of Multi-hazards Model, is based on three principles: it uses a multi-hazards perspective rather than a single hazard; it is only applicable for spatially relevant hazards (not applicable for disease epidemics for example); and it integrates hazards and vulnerability to determine risk while it is unable to recognize individual risk.

(Shi and Kasperson, 2015) developed multi-hazard risk maps using two different methods, each one considering eleven types of natural hazards. The first method, called Total Risk Index, estimates multiple risk weighting the risk maps of each individual hazard. The second method, Multi-hazard Risk Index, calculates multiple risk weighting based on the expected annual intensity of each hazard.

In the FP7 PEARL Project (2016), the multiple hazards have been analysed as a part of the causal loop analysis leading into a holistic framework for risk assessment in coastal areas. The results of the study applied at the St. Martin Island, demonstrated the necessity to combine physical models and approaches to assess multi hazard and the agent-based models (ABM) (Abebe, 2021).

In summary, a combination of two or more hazards has a great potential to case unexpected impacts and threats that are not easily identified through the analysis of individual hazards. However, the understanding of different processes and their interactions and cascades is still a challenge, and the number of studies addressing this kind of approaches is very limited. From the analysis of current literature concerning analysing of multi-hazards it can be concluded that most of the applied approaches are mainly concerned with estimation of individual hazards in isolation and the overall hazard is produced by summing the individual

parts altogether. As this may be easy to implement it certainly neglects the interaction among events, leading to the under estimation of the actual hazard level (see for example, (Kappes *et al.*, 2012).

In RescueME, all relevant hazard potentially or actually occurring in the R-Labscapes are taken into account and analysed as given in Section 4.2.

4.2 Method

Hazards

In order to characterise hazards in the R-Labscapes and beyond, the RescueME adopted a top down and bottom-up approach. In this way it is possible to optimise the scale and level of detail or hazard analysis and assessment.

From the **top-down** perspective, the hazards addressed in the literature review, have been processed and classified based on the types and available indicators. For that purpose, the methodology and set of indicators as given in the SHELTER Project have been used as a basis. But in order to scope and better streamline the actions in the R-Labscapes, the dominating hazards have been identified by the project team and the local stakeholders (**bottom up**).

In this way it is possible to focus on the key issues relevant for the development of the resilient strategies, still leaving the possibility to extend the hazards as needed in further analyses. In this process the related hazards or the ones occurring conjointly have been grouped and analysed. The hazard clusters are presented in Figure 13.

The clusters are given as follows:

- Too much water are describing all perils related to the excessive amount of water going beyond mere flooding, being landslides (fluvial) or coastal erosion (coastal).
- Not enough water lists all hazards that are associated with the water scarcity.
- Geohazards are dedicated to explore the earthquake related issues.
- Not enough people addresses anthropogenic hazards mainly associated with the loss of economic activities and incomes.
- Too many people groups all for the project relevant hazards and activities associated with the overpopulation or seasonal or local too high concentration of people.
- Anthropogenic influence list for the project relevant hazards associated with human activities.

- Other hazards contain the additional hazards that have been identified to date that do not fall under the banner of any of the previous hazards. They are currently mainly related to the diseases and pandemics. This list is not exhaustive.

By defining the **hazard clusters** as described above, the RescueME methodology extends the hazard classification developed in SHELTER and is intended to enable more focused approach on all relevant hazards placed in a cluster.
Moreover it has been identified that in a general case different key stakeholders are to be involved in the process for different hazard types e.g. for Too much water and not enough water or too many people, but the majority of the key stakeholders is shared by different hazards belonging to the same cluster (see also e.g. RECONECT Reports on stakeholder analyses in different Demonstration areas D2.1 and D4.1 and also the ongoing stakeholder analysis in RescueME).

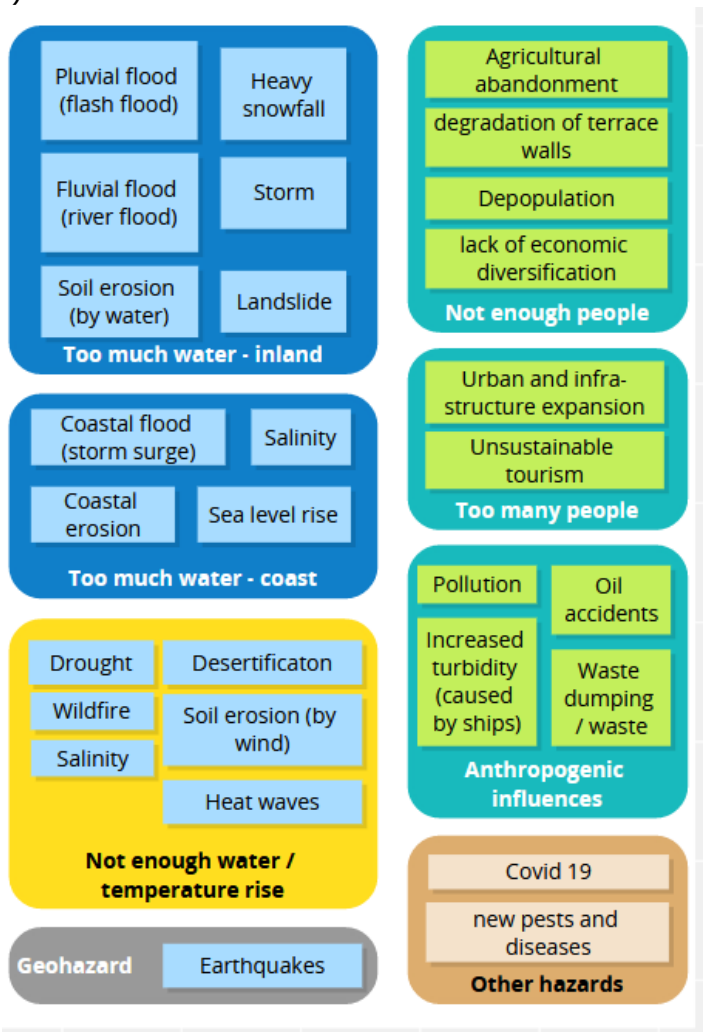

Figure 13 Classification and clustering of hazards in RescueME (Source: draft Fraunhofer Institute, unpublished (D1.2)) The colours of the boxes indicate the type of hazards considered; blue- flood related natural hazards; yellow- water scarcity related natural hazards; grey- geohazards; green- anthropogenic hazards; light brown- other hazards

The clustering approach is also in line with the findings of several H2020 Projects on the Implementation of nature-based solutions (NBS) including the project RECONECT, where the lack of clarity and scattered responsibilities have been identified as one of the key barriers for the uptake of NBS and developed climate adaptation strategies in general and hampered proper (Report D4.6 Barriers and Enablers of NBS- to be published in October/ November 2023).

It is however to emphasise that RescueME is still taking the holistic approach and the needs and interests of the R-labscapes are to be monitored, the hazard clustering is to be understood as a means to better structure and address the identified key hazards.

The hazard clusters identified by the R-Labscapes as the key ones are presented in Table 12.

Table 12 Type of hazard clusters addressed the RescueME R-Labscapes

RescueME Labscape	Hazard Group identified- focus
Portovenere, Cinque Terre & the Islands, Italy	(Hydrogeological risk)
Historical Irrigation System at l'Horta de València (LNV), Spain	Too much water- Pluvial flooding (Change in precipitation patterns)
Hamburg – Neuwerk in the National Park Hamburg Wadden Sea (HAM), Germany	Too much water- Coastal storm surge
Psiloritis UNESCO Global geopark IDEON, Greece	Not enough water / temperature rise- Heatwaves& Wildfires
Defensive system of Zadar, Croatia	Not enough water -Heatwaves

As presented in Table 12, the major hazards are related to the availability of water (too much or not enough) putting a strong focus on the assessment of water related hazards, that is occurring in the upcoming project phase (D1.3 - Policy report on Climate Change impacts on European Coastal Cultural Landscapes).

For those main hazards that will be further considered and processed in the project, a list of indicators has been developed, taking the list of indicators previously developed and tested in the SHELTER Project as the starting point. Those indicators have been reassessed and adjusted to the specific issues addressed by the R-Labscapes.

The list of indicators for the relevant hazards to be addressed in RescueME is given in the text below and included in Annex IV, it is a living document and is constantly updated based on the outcomes of the workshops on impact chains envisaged in T1.2 - ATLAS of European coastal heritage landscapes typologies and climate change impacts.

The major indicators assessed as relevant so far and that will be serving as a starting point are given in the following tables:

Table 13 Initial list of indicators assessed as potentially relevant for the R-labscapes(floods)

Too Much Water_ Inland:

Hazard	Indicators:
Fluvial Flood	1 Daily maximum precipitation corresponding to the selected flood probability 2 Distribution of the rainfall intensity over time, corresponding to the selected flood probability and a duration of the event 3 Torrentiality index (factor) 4 IDF (intensity duration frequency) curves 5 Flood area corresponding to the selected flood probability 6 Flood depth 7 Water velocity (in the flooded area) 8 Flood probability 9 Maximum annual river flow corresponding to the selected flood probability at the drainage point of the basin 10. Maximum annual river level corresponding to the selected flood probability at the drainage point of the basin 11. River basin concentration time 12. Basin Response Time 13. Ground water table
Pluvial	1. Daily maximum precipitation corresponding to the return period T 2. Hourly maximum precipitation corresponding to the return period 3. Distribution of the rainfall intensity over time, corresponding to the return period T and a duration of the event 4. Torrentiality index (factor) 5. IDF (intensity duration frequency) curves 6. Flood area corresponding to the return period T 7. Flood depth 8. Water velocity (in the flooded area)

	9.	Combinations of flood depth and water velocity in the flood area
	10.	Flood frequency: linked with the return period
	11.	Surface runoff
Coastal/ Estuarine Flooding	1.	Wind direction
	2.	Wind speed
	3.	Design storm surge
	4.	Discharge from external sources
	5.	External surges
	6.	Spring-neap (tide) cycle

Table 14 Initial list of indicators assessed as potentially relevant for the R-labscapes(droughts and wildfires)

Not Enough Water

Heat waves	1. Daily mean temperature
	2. Thermal shock
	3. Daily sun hours
	4. Mean relative humidity
	5. Daily humidity cycle shocks
	6. Relative humidity concentration
Wildfires	1. Annual Mean Temperature
	2. Mean Diurnal Range
	3. Isothermality
	4. Temperature Seasonality
	5. Max Temperature of Warmest Month
	6. Min Temperature of Coldest Month
	7. Temperature Annual Range
	8. Mean Temperature of Wettest Quarter
	9. Mean Temperature of Driest Quarter
	10. Mean Temperature of Warmest Quarter
	11. Mean Temperature of Coldest Quarter
	12. Annual Precipitation
	13. Precipitation of Wettest Month
	14. Precipitation of Driest Month
	15. Precipitation Seasonality (Coefficient of Variation)
	16. Precipitation of Wettest Quarter
	17. Precipitation of Driest Quarter
	18. Precipitation of Warmest Quarter
	19. Precipitation of Coldest Quarter
	20. Relative water content in the top few centimetres of soil

21. Fire weather index
22. Palmer Drought Severity Index

The list of indicators is not exhaustive, but it is taken as a basis, and it will be updated during the upcoming project activities. In a next step, those indicators will be discussed with the key stakeholders from the R-Labscapes, with the purpose to develop risk impact chains for each of the cases in the project, which will be reported in D1.2 - ATLAS of European coastal heritage landscapes typologies and CC impacts.

Climate Change scenarios

The development of resilience strategies implies the consideration of the drivers of future development such as climate change or changes in the land use patterns in order to develop solutions that can perform in a range of possible settings and future conditions.

There is a huge body of resources including modelling results, studies and publications on climate change and the fundamental effects of climate change on the future development of temperatures, sea level rise and on the development of meteorological variables. Scientifically validated findings are regularly summarized and updated in the **IPCC reports** and prepared in the form of climate scenarios.

A climate scenario is a plausible representation of future climate that has been constructed for explicit use in investigating the potential impacts of anthropogenic climate change (IPCC, 2014). Climate change scenarios highlight that different climate futures (and therefore hazard patterns and intensities) are possible depending on factors including greenhouse gas emissions (Kos et al., 2021).

The climate scenarios are related to the Representative Concentration Pathway (RCP) that are describing four different 21st century pathways of greenhouse gas (GHG) emissions and atmospheric concentrations, air pollutant emissions and land use (IPCC, 2023b).
They include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario which anticipate very high GHG emissions (RCP8.5). Scenarios without additional efforts to constrain emissions ('baseline scenarios') lead to pathways ranging between RCP6.0 and RCP8.5. RCP2.6 is representative of a scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures (IPCC, 2023b) .

According to the current findings of the IPCC (2023) and considering the RCPs as given above, sea level will rise globally on average by 2100 between about 30cm (lower limit RCP2.6) and about 110cm (upper limit RCP8.5), depending on the emissions scenario

considered Figure 13 and Figure 14. It is also certain that sea level rise will continue well beyond the year 2100 (IPCC, 2023b), with values of several meters expected depending on the time horizon and the emissions scenario used, but those predictions are highly uncertain (see also Figure 13). This will result in considerable challenges for managing natural hazards including the ones in coastal regions, such as the ones the RescueME R-Labscapes are located in.

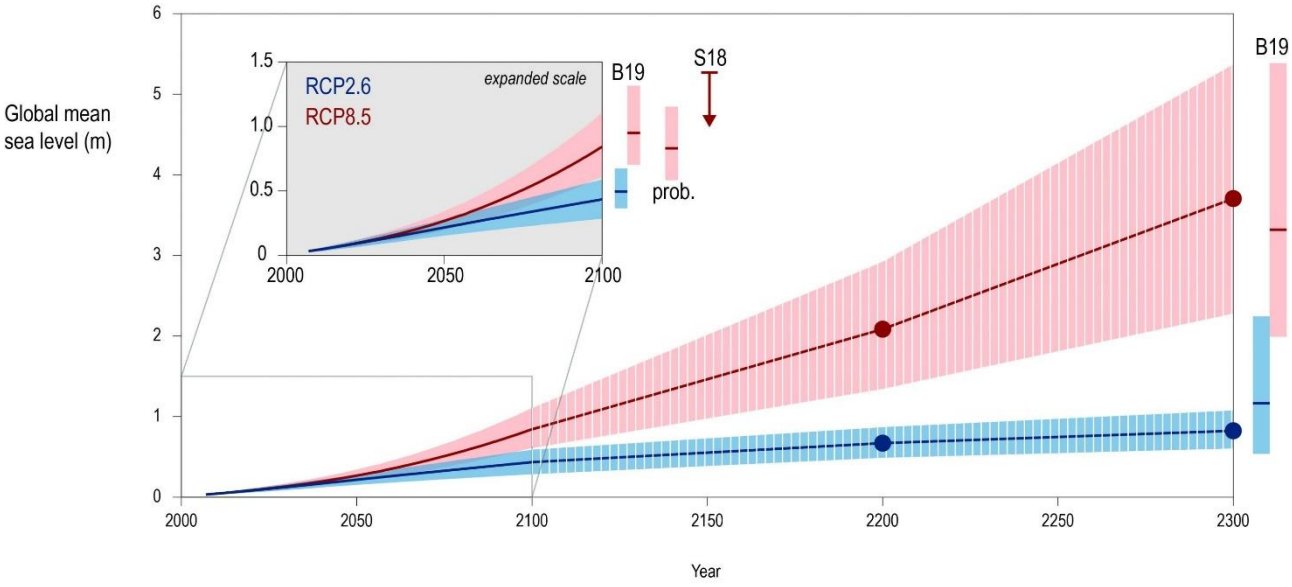

Figure 14 Projected sea level rise (SLR) until 2300. The inset shows an assessment of the likely range of the projections for RCP2.6 and RCP8.5 up to 2100 (medium confidence). Projections for longer time scales are highly uncertain but a range is provided (4.2.3.6; low confidence). (IPCC 2023)

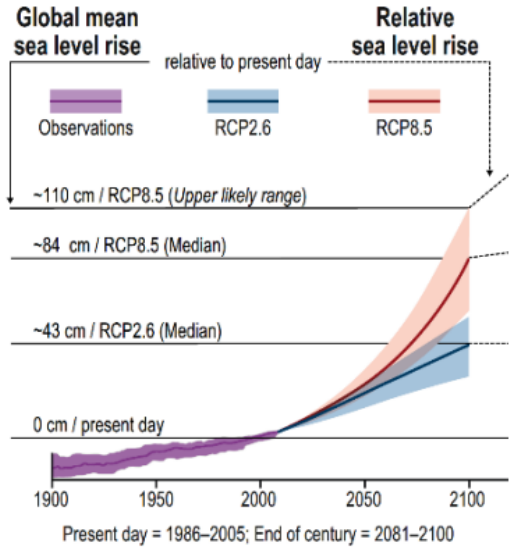

Figure 15 Mean Sea Level Rise till 2100 (IPCC, 2019/2023)

Detailed analysis of hazard could allow a better informed and science-based decisions regarding the definition of adaptation measures and resilience strategies and actions. However, some responses can also be developed to reduce exposure and vulnerability to hazards, by applying assumptions based on qualitative approaches, local knowledge, expert knowledge relying on data available.

The selection of the appropriate RCP on RescueME has been an iterative process also taking into account the RPCs and approaches used for climate change adaptation in R-labscapes, so that the activities in RescueME can be mainstreamed into their practices and further, into policies. In this process the contact and exchange with the key stakeholders in those areas has been pursued (see e.g. TideelbeKlima Project(in German) funded by the German Ministry of Environment UBA, which outcomes including the hazard assessment of the Elbe Estuary/ North Sea serve as a direct input into RescueME).

Considering the natural hazards analysed in RescueME and the current activities and approached followed , we are suggesting the following future scenarios and time horizons, in relation to climate scenarios and RCPs:

– RCP 8.5 [1](mandatory)
– RCP 4.5 (optional if resources available)
- RCP 2.6 [2] (not further considered)

In relation to the time periods for the climate scenarios we use the following:

- Near future: 2023-2050 (optional if resources available)
- **Mid-range century: 2051-2100 (focus)**
- Outlook: 2101-2200 (rough estimation where possible and if resources available)

It has been argued in the R-labscapes that by adopting the mid-range century span it is possible to explore the perspectives of the strategies proposed for the R-labscapes, which the Authorities there are attempting to do for other climate adaptation strategies.

Adopting the Mid-range century time span is also in line with the project objectives as it contributes to the robustness of the resilient strategies to be developed that should function in a span of possible futures considering the uncertainties of the RCPs.

[1] RCP 8.5 refers to the concentration of carbon that delivers global warming at an average of 8.5 watts per square meter across the planet. The RCP 8.5 pathway delivers a temperature increase of about 4.3˚C by 2100, relative to pre-industrial temperatures.
[2] RCP 8.5 is often contrasted with RCP 2.6, which would deliver a total warming of about 1.8˚C by 2100.

At the same time, the Outlook -2200 has been found to be too uncertain (as also stated in the IPCC 2023 (and will be taken into account only if the resources allow).

Still, the timelines may be adjusted and further harmonized based on the ongoing activities and time horizons deployed and used on other activities in the R-Labscapes and global findings and updates of the IPCC report during the project lifetime.

5 Resilience assessment framework

The framework developed for the CL characterization has been built considering further development of the RescueME project and it will be the basis for the definition of measures and solutions that will guide Cultural Landscapes towards the implementation of transformative resilience strategies (WP2 – Transformative Resilience Strategies).

Given that indicators have been proposed considering both the European and the local level, the work presented in this document serves as a starting point for building the Atlas of European coastal heritage landscapes typologies (Task 1.2 - 2 ATLAS of European coastal heritage landscapes typologies and climate change impacts) and the local resilience baseline assessments for each R-Labscape (Task 4.2 - Co-creation of resilience baseline and Impact Chains).

The Atlas will cluster cultural and coastal landscapes according to their similarities and values, as well as the hazards and stressors they face. The typologies, at European level, will be based on the RescueME framework and those selected indicators for which data are available at NUTS3 level.
For each of the five capitals identified in the framework (natural, social, financial, human and built capital, Figure 10), resilience indicators will be combined into one “capital indicator”. Quantitative indicator data will be statistically analysed, to balance the weighting of the individual indicators that make up the capital indicator. An example would the employment and unemployment rate, which clearly correlate, so that only one of the two indicators would be chosen for the typology. In addition, categorial indicators, such as land use, will be integrated into the typology. This assessment will allow the identification of types of European heritage landscapes. In addition, the hazard indicators identified (see Section 4) will be used to classify European coastal heritage landscapes according to hazard types. Regions that are exposed to similar hazards will be clustered.

The clustering of European heritage landscapes according to the RescueME framework capitals and the hazard types they face will serve as entry point for the decision support system that will be developed in Task 3.4 - One stop shop for resilience in cultural landscapes & Incremental SDSS.

At the local level, in order to build the resilience baseline assessment of the R-Labscapes, the identified indicators will be complemented by a qualitative analysis through surveys. In

this case, as each R-Labscape has different challenges and characteristics, the more suitable indicators will be selected and weighting factors among the different capitals and indicators will be discussed and agreed through co-creation exercises with the objective of defining the most appropriate resilience measures to be implemented.

Of the 115 indicators shortlisted, 68 of them have associated a data source available at European level and will therefore used as a basis for the Atlas as well as for local resilience baseline, while 47 are associated to local data sources, where information should be collected locally and will therefore be addressed in the local resilience baseline assessment in each case.
Table 15 shows the data availability (European or local) for each shortlisted indicator. More information on data source is available in Annex III.

Table 15: Data availability (EU or local level) for each indicator

ID	Indicator name	EU level	Local level
1	Population Density	X	
2	Population change	X	
3	Employment rate	X	
4	Unemployment rate	X	
5	Land cover change	X	
6	Share of population aged 20 to 39 years (in %)	X	
7	Share of population aged >65 years (in %)	X	
8	Young-age dependency	X	
10	Net migration rate (per 1000)	X	
11	Tourism pressure (per 1000)	X	
12	Tourist accomodation capacity	X	
13	Highly educated working age persons	X	
14	Quality of natural landscape based on Natura 2000 sites	X	
16	Early leavers from education and training	X	
17	Available beds in hospitals	X	
19	Landslide susceptibility	X	
22	Historical building stock	X	
23	Land Uses, Patterns, Clusters	X	
24	Imperviousness	X	
25	Internet access	X	
26	Classification as inner periphery	X	
27	Environmental protection investments of total economy	X	
28	Physicians or doctors	X	
29	National adaptation strategies	X	
30	Climate related economic loss	X	

31	Suite of products (land use, population, street trees)	X	
32	Lone-pensioner households	X	
33	People born in another country	X	
34	Affected areas due to an extreme event	X	
35	Topography	X	
36	Flood delineation	X	
38	Degree of urbanisation	X	
39	Tourism Carrying Capacity		X
40	Settlements	X	
41	Percentage of rented houses		X
42	Surface cultivated with vineyards		X
43	Surface cultivated with olive trees		X
44	Total number of farm business		X
45	Crops surface		X
46	Farm business with owner/manager over 65 years old		X
47	Farm business with owner/manager with full-time commitment/contract		X
48	Average hidric resources for crops		X
49	Agricultural unempoyment rate	X	
50	Social Security affiliation in Agriculture		X
51	Land tenure system		X
53	Diversification of agricultural activities		X
54	Organic farming activities		X
55	Area with arable crops		X
56	Protected Areas Surface		X
58	Parity in farm managers		X
59	Farm manager with agricultural studies		X
61	Municipal budget		X
62	Heritage density: Number of designated or formally listed natural and cultural sites and intangible heritage per area	X	
63	Existence of sites with recognised international designation (WHS, GIAHS, Capital of Culture, Cultural route)	X	
64	Number of cultural facilities open to the public and aiming at promoting arts and culture per population		X
65	Availability of products with designation of origin or geographical indications (PDO, PGI), traditional specialties guaranteed (TSG)	X	
66	Capacity building/ training activities/ mentoring opportunities promoted by institutions for improving cultural knowledge		X
68	Existence of adopted visitors' management plans that address seasonality of tourism and carrying capacity of properties		X
69	Resources allocated to public space and pathways maintenance, improvement and accessibility, including installation of equipment for cultural use		X

70	Number of endangered cultural and natural heritage sites	X	
72	Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage		X
73	Percentage of enterprises / establishments using a voluntary certification / labelling for environmental / quality / sustainability and/or Corporate Social Responsibility		X
74	Percentage of cultural facilities and sites accessible by public transport or other environmentally friendly transport or cycle tracks		X
75	Number of days in a year in which maximum tourism carrying capacity has been exceed		X
76	Net occupancy rate in accommodation per season (quarterly)	X	
77	Employment rate in cultural sector	X	
78	Percentage of Gross Domestic Product attributable to private and formal cultural production	X	
79	Exports of PDO (Protected Denomination of Origin) or PGI (Protected Geographical Indication) as a percentage of all regional sale	X	
81	Houses used for official accommodation activities		X
82	Owned houses with summer use only		X
85	Percentage of abandonment of terraces on the total terraced area		X
87	Percentage of terraced vineyards on the total land used for viticulture		X
88	Funds spent in initiatives aimed at raising awareness among tourists and the local population		X
90	Average housing prices	X	
91	Annual income		X
92	Number of properties		X
93	Households with one or more retired persons as a percentage of total households	X	
94	Gender employment gap	X	
95	Number of strategic buildings	X	
96	Number of emergency operators		X
97	Permanent cultivations surface	X	
98	Precipitation variation	X	
99	Number of PDO/PGI agriculture firms		X
100	Number of Bio agriculture firms		X
101	Number of young farmers	X	
102	Participation of Municipalities in rural development projects		X
103	Number of bottom-up projects presented by citizens		X
104	Projects on landscape and CH included in the NEXT Generation EU		X

105	Municipal financing for Cultural Heritage		X
106	Production of biological energy	X	
107	Green areas of high ecological quality	X	
108	Dispersion of urban areas	X	
109	Ecological diversity (Shannon-Evenness index)	X	
110	Nature Based recreation potential	X	
111	Habitat and species mantainance	X	
112	Run-off retention/Flood control	X	
113	Global climate regulation - Carbon sequestration	X	
115	Number of forestry consortiums	X	
116	Forestry viability / Firebreak roads	X	
119	Number of fire events in a considered time period	X	
120	Fire-ridden areas	X	
122	Time distance from the main city		X
123	Conservation index of historical rural architectural heritage		X
124	Final energy consumption per capita in the agriculture sector	X	
125	Final energy consumption per land area in the agriculture sector	X	
126	Energy consumption from renewable carriers for space heating, hot water and cooling	X	
127	Share of energy from renewable carriers for space heating, hot water and cooling	X	
128	Participation rate in eduction & training	X	
129	Farm manager with agricultural training	X	
130	Nationally designated areas	X	
132	Number of sites accessible by people with disabilities		X
133	Annual number of festivals or cultural events connected to traditions/culinary practices/local products		X
134	Number of local associations connected to traditions/culinary practices/local products		X
135	Number of shops, restaurants and tourism facilities selling local products		X
141	Diversity of landscape (number of landscape typologies)		X
TOTAL		**68**	**47**

6 Conclusions

The RescueMe Actionable Resilient Historic Landscape Framework aims to provide guidance to Cultural Landscapes in their transformation towards a more resilient and inclusive environment, grounded in a GLOCAL strategy that harmonises both global and local factors and approaches. It combines top-down and bottom-up methodologies to ensure the incorporation of local needs and context and facilitates the potential for replication.

To enable the implementation of the Framework among stakeholders, including heritage and environmental managers, local authorities, practitioners and owners, RescueME extends and adapts the standard CWA 17727:2022 to Cultural Landscapes, making the CWA more broadly applicable by involving different perspective and skills from various domains. The activities to complete the overall standardization process will follow during the project duration.

Even if the impacts of hazards and climate change on cultural heritage are worldwide acknowledged and recognized, their quantification is still a challenge, especially in Cultural Landscapes, where the interactions between nature and humans are still under-researched. As resilience is a theoretical concept, to be operational for decision-makers, the framework must provide observable and measurable components. RescueME proposes an assessment methodology that builds upon the outcomes of the previous SHELETER, ARCH and RURITAGE projects, providing a set of indicators that evaluate the resilience and impacts of climate change and hazards on Cultural Landscapes based on the Community Capitals Framework.

On the one hand, the European top-down approach will set the basis for the development of an Atlas of European coastal heritage landscape typologies, in which indicators available at NUTS3 level will be selected and statistically analysed. On the other hand, the local bottom-up approach served to identify those indicators that are specific of the R-Labscapes contexts and level or need a downscaling. This approach will serve as a basis for the local resilience baseline assessments and will seek to identify specific measures and strategies that can enhance adaptive resilience at the local level. By combining these top-down and bottom-up perspectives, RescueME aims to provide a comprehensive understanding of how CC and natural hazards affect cultural heritage and how best to prepare for and respond to these challenges.

For the scope of the project we are adopting the RCP 8.5. focusing on the mid-range century 2051-2100 timespan, being in line with the other relevant ongoing activities and strategies for climate adaptation in the R-Labscapes. Still, the other RCPs and timespans may be

considered where assessed relevant. The presented framework will be tested on the R-Labscapes and as such may be improved based on the findings and feedback obtained during the process.

7 References

Abebe, Y.A. (2021), *Modelling Human-Flood Interactions*, *Modelling Human-Flood Interactions*, available at:https://doi.org/10.1201/9781003160045.

Burton, I. and Kates, R.W. (1964), "The Perception of Natural Hazards in Resource Management", *Natural Resources Journal*.

Chandrappa, R., Gupta, S. and Kulshresha, U.C. (2011), *Coping with Climate Change: Principles Ad Asian Context*, *Springer-Verlag Berlin Heidelberg*, Vol. 1.

Cullen-Unsworth, L.C., Hill, R., Butler, J.R.A. and Wallace, M. (2012), "A research process for integrating Indigenous and scientific knowledge in cultural landscapes: Principles and determinants of success in the Wet Tropics World Heritage Area, Australia", *Geographical Journal*, Vol. 178 No. 4, available at:https://doi.org/10.1111/j.1475-4959.2011.00451.x.

Deubelli, T.M. and Mechler, R. (2021), "Perspectives on transformational change in climate risk management and adaptation", *Environmental Research Letters*, Vol. 16 No. 5, p. 053002.

Dewan, A.M. (2013), *Floods in a Megacity: Geospatial Techniques in Assessing Hazards, Risk and Vulnerability*, *Floods in a Megacity: Geospatial Techniques in Assessing Hazards, Risk and Vulnerability*, available at:https://doi.org/10.1007/978-94-007-5875-9.

Dudley, N. (2008), *Guidelines for Applying Protected Area Management Categories*, *Guidelines for Applying Protected Area Management Categories*, available at:https://doi.org/10.2305/iucn.ch.2008.paps.2.en.

Egusquiza, A., Gandini, A., Garcia, G., Garcia, I., Garmendia, L., Quesada, L., Santagelo, A., *et al.* (2020), *SHELTER Project D2.2: HA Systemic Resilience Assessment and Monitoring Framework*.

Egusquiza, A., Gandini, A., Usobiaga, E. and Barrientos, F. (2018), *RURITAGE Project D4.1: KPIs Definition and Evaluation Procedures*.

Egusquiza, A., Gandini, A. and Zubiaga, M. (2019), *SHELTER Project D2.1: HA Resilience Structure*.

Eisenmenger, N., Giljum, S., Lutter, S., Marques, A., Theurl, M.C., Pereira, H.M. and Tukker, A. (2016), "Towards a conceptual framework for social-ecological systems integrating biodiversity and ecosystem services with resource efficiency indicators", *Sustainability (Switzerland)*, Vol. 8 No. 3, available at:https://doi.org/10.3390/su8030201.

Emery, M. and Flora, C. (2006), "Spiraling-Up: Mapping Community Transformation with Community Capitals Framework", *Community Development*, Vol. 37 No. 1, available at:https://doi.org/10.1080/15575330609490152.

Eppich, R. (Ed.). (2014), *Cultural Heritage, Landscape & Rural Development. Good Practice, Methodology, Policy Recommendations & Guidelines for Rural Communities*, available at: http://www.historic-towns.org/wp-content/uploads/2018/09/Cultural-Heritage-Landscape-and-Rural-Development.pdf.

Flora, C.B. (2015), "Social Capital and Community Problem Solving: Combining Local and Scientific Knowledge to Fight Invasive Species Cornelia", *Statewide Agricultural Land Use Baseline 2015*, Vol. 1.

García, M.A., Yagüe, J.L., de Nicolás, V.L. and Díaz-Puente, J.M. (2020), "Characterization of globally important agricultural heritage systems (GIAHS) in Europe", *Sustainability (Switzerland)*, Vol. 12 No. 4, available at:https://doi.org/10.3390/su12041611.

Greiving, S., Fleischhauer, M. and Lückenkötter, J. (2006), "A methodology for an integrated risk assessment of spatially relevant hazards", *Journal of Environmental Planning and Management*, Vol. 49 No. 1, available at:https://doi.org/10.1080/09640560500372800.

Henning, M., Herrmann, P., Zimmermann, T., Meier, M., Pietsch, M. and Schmidt, C. (2021), "A scenario and monitoring based planning approach to strengthen the resilience of the

cultural landscape", *Journal of Digital Landscape Architecture*, Vol. 2021 No. 6, available at:https://doi.org/10.14627/537705009.
Hov, Ø., Cubasch, U., Fischer, E., Höppe, P., Iversen, T., Kvamstø, N., Kundzewicz, Z., *et al.* (2013), *Extreme Weather Events in Europe Preparing for Climate Change Adaptation*.
"ICOMOS-IFLA Inventory form". (n.d.). , available at: https://www.iflaclc.org/inventory/documentation.html.
ICSU - LAC. (2010), "Understanding and Managing Risk Associated with Natural Hazards: An Integrated Scientific Approach in Latin America and the Caribbean", in Cardona, O.D., Bertoni, J.C., Gibbs, T., Hermelin, M. and Lavell, A. (Eds.), *Science for a Better Life: Developing Regional Scientific Programs in Priority Areas for Latin America and the Caribbean. Volume 2*, p. 88.
IPCC. (2012), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, edited by Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., et al., Cambridge University Press.
IPCC. (2014), *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, *Core Writing Team, R.K. Pachauri and L.A. Meyer*, available at:https://doi.org/10.1017/CBO9781107415324.004.
IPCC. (2022), *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by Pörtner, H.O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., et al., Cambridge., Cambridge, UK and New York, NY, USA, available at:https://doi.org/10.1017/9781009325844.
IPCC. (2023a), "Glossary", in Möller, V., R., van Diemen, J.B.R., Matthews, C., Méndez, S., Semenov, J.S., Fuglestvedt and Reisinge, A. (Eds.), *Climate Change 2022 – Impacts, Adaptation and Vulnerability*, Cambridge University Press, pp. 2897–2930.
IPCC. (2023b), "Sixth Assessment Report (AR6) Synthesis Report: Climate Change 2023", *An Assessment of the Intergovernmental Panel on Climate Change*.
Jones, M. (2003), "The Concept of Cultural Landscape: Discourse and Narratives", available at:https://doi.org/10.1007/978-94-017-0189-1_3.
Kaposi, I. and Al-Shammari, S. (2021), "Serial Readers United: Independent Bookstore Cultures in Kuwait", *Middle East Journal of Culture and Communication*, Vol. 14 No. 3, available at:https://doi.org/10.1163/18739865-20219102.
Kappes, M.S., Keiler, M., von Elverfeldt, K. and Glade, T. (2012), "Challenges of analyzing multi-hazard risk: A review", *Natural Hazards*, available at:https://doi.org/10.1007/s11069-012-0294-2.
Leardini, A.C. and Serventi, S. (2016), "The cultural landscape of food: The infrastructure resilience of Via Emilia", *Sustainable Urban Agriculture and Food Planning*, available at:https://doi.org/10.4324/9781315646039-9.
Lee, K.C. and Yan, S.Y. (2019), "Participatory planning and monitoring of protected landscapes: a case study of an indigenous rice paddy cultural landscape in Taiwan", *Paddy and Water Environment*, Vol. 17 No. 3, available at:https://doi.org/10.1007/s10333-019-00750-1.
Lombardini, G. and Scorza, F. (2016), "Resilience and smartness of coastal regions. A tool for spatial evaluation", *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, Vol. 9788, available at:https://doi.org/10.1007/978-3-319-42111-7_42.
Milde, K., Lückerath, D. and Ullrich, O. (2020), *ARCH Project D7.3: ARCH Disaster Risk Management Framework*.
Mitchell, N., Rössler, M. and Tricaud, P.-M. (2009), *World Heritage Cultural Landscapes: A Handbook for Conservation and Management*, *World Heritage Papers 26*.
Moore, N. and Whelan, Y. (2016), *Heritage, Memory and the Politics of Identity: New Perspectives on the Cultural Landscape*, *Heritage, Memory and the Politics of Identity:*

New Perspectives on the Cultural Landscape, available at:https://doi.org/10.4324/9781315586694.
"NPS Cultural Landscapes 101". (n.d.). , available at: https://www.nps.gov/articles/cultural-landscapes-101.htm.
Osman, A. (2022), "Empirical measure of cultural sustainability", *Applied Geography*, Vol. 145, available at:https://doi.org/10.1016/j.apgeog.2022.102745.
Palazzo, E. and Bardsley, D.K. (2022), "Adaptive mechanisms in a continuing landscape: assessing biocultural diversity as a form of resilience", *Journal of Cultural Heritage Management and Sustainable Development*, Vol. 12 No. 4, available at:https://doi.org/10.1108/JCHMSD-09-2020-0139.
Peña-Alonso, C., Hernández-Calvento, L., Pérez-Chacón, E. and Ariza-Solé, E. (2017), "The relationship between heritage, recreational quality and geomorphological vulnerability in the coastal zone: A case study of beach systems in the Canary Islands", *Ecological Indicators*, Vol. 82, available at:https://doi.org/10.1016/j.ecolind.2017.07.014.
Ravankhah, M., Schmidt, M. and Will, T. (2021), "An indicator-based risk assessment framework for World Heritage sites in seismic zones: The case of 'Bam and its Cultural Landscape' in Iran", *International Journal of Disaster Risk Reduction*, Vol. 63, available at:https://doi.org/10.1016/j.ijdrr.2021.102405.
Shi, P. and Kasperson, R. (Eds.). (2015), *World Atlas of Natural Disaster Risk*, Springer Berlin Heidelberg, Berlin, Heidelberg, available at:https://doi.org/10.1007/978-3-662-45430-5.
Tekken, V., Spangenberg, J.H., Burkhard, B., Escalada, M., Stoll-Kleemann, S., Truong, D.T. and Settele, J. (2017), "'Things are different now': Farmer perceptions of cultural ecosystem services of traditional rice landscapes in Vietnam and the Philippines", *Ecosystem Services*, Vol. 25, available at:https://doi.org/10.1016/j.ecoser.2017.04.010.
Tudor, C. (2014), "An Approach to Landscape Character Assessment", *Natural England*, No. October.
Tudorie, C.M., Vallés-Planells, M., Gielen, E. and Galiana, F. (2020), "Assessing the performance of urban green infrastructure: The case study of benicalap district, valencia, spain", *WIT Transactions on Ecology and the Environment*, Vol. 243, available at:https://doi.org/10.2495/UA200081.
Turchi, A., Lumino, R., Gambardella, D. and Leone, M.F. (2023), "Coping Capacity, Adaptive Capacity, and Transformative Capacity Preliminary Characterization in a 'Multi-Hazard' Resilience Perspective: The Soccavo District Case Study (City of Naples, Italy)", *Sustainability*, Vol. 15 No. 14, p. 10877.
UNESCO. (1992), *Revision of the Operational Guidelines for the Implementation of the World Heritage Convention*, available at: https://whc.unesco.org/en/documents/1597.
UNESCO World Heritage Centre. (2008), "Operational Guidelines for the Implementation of the World Heritage Convention", *Operational Guidelines for the Implementation of the World Heritage Convention*, No. July.
Villodre, M., Arnaiz-Schmitz, C. and Schmitz, M.F. (2023), "Landscape conservation in the natural-rural interface. A social-ecological approach in Natural Parks of Andalusia (Spain)", *Landscape Ecology*, available at:https://doi.org/10.1007/s10980-023-01699-7.
Yodsurang, P., Uekita, Y. and Shimizu, I. (2022), "Water-Based Settlement and the Loss of Community Water Resilience", *Interiority*, Vol. 5 No. 2, available at:https://doi.org/10.7454/in.v5i2.210.

Annex I: Proposed changes to Standard CWA 17727:2022

TOPICS		CEN/WS ARCH	RescueMe proposal
Scope	**Focus**	urban areas	Include landscapes (urban and rural) and larger territories
	Hazards	climate change	Include also anthropogenic stresses, e.g. unsustainable tourisms, etc.
		DRM+CCA (Disaster Risk Management and Climate Change Adaptation)	Include sustainable development goals (SDG)
		city/community and historic area levels	regional / local level
Definitions	**Cultural landscapes**	Not included	In RescueME, we understand **Cultural Landscapes** as "landscapes whose character is the result of the historic action and interaction of natural and human factors with significant cultural significance for the communities that live in them and intrinsic resilience".
	Territory	Not included	"*complex set of interdependent systems: social-cultural, economic and environmental, which change with time and are interconnected through complex networks. This set of systems is physical, has a spatial territory and is managed via complementing governance mechanisms, and its sub-systems provide essential functions, identity and structure to each other*"
	Intangible heritage	Not included	Proposal: traditions or living expressions inherited from our ancestors and passed on to our descendants, such as oral traditions, performing arts, social practices, rituals, festive events, knowledge and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts (UNESCO)
	Ecosystem services	Not included	Ecosystem services. Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits (MEA, 2005)

	Socio-ecological system	Not included	Redman et al. (2004) (p.163) defined a SES as 'A coherent system of biophysical and social factors that regularly interact in resilient, sustained manner'. The socio-ecological system may also be understood according to the concept defined by Martín-Lopez et al. (2012) as bio-geo-physical units that are associated with one or more social systems delimited by stakeholders and institutions (Glaser et al., 2008)
Steps	**General information**		including traditional, local knowledge into resilience building (not just the other way around) a note on how to tackle issues of cross-border CLs
		natural hazards	To include anthropogenic hazards, tourism and ecosystem services

Annex II- Keywords extraction for RescueME taxonomy

1. Recommendation On The Historic Urban Landscape (UNESCO, 2011)		2. Landscape Convention (Council of Europe, 2000)		3. Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO, 2003		5. Convention On The Protection Of The Underwater Cultural Heritage (UNESCO, 2001)		7. Principles For The Preservation Of Historic Timber Structure (ICOMOS, 1999)		8. Charter On The Built Vernacular Heritage (ICOMOS, 1999)	
Extracted Term	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**
'urban heritage'	**0.7141**	**'europe landscape'**	**0.708**	**'heritage risk'**	**0.6399**	**'heritage underwater'**	**0.643**	+G156:K195historic timber'	0.672	**'vernacular heritage'**	**0.6928**
'concerning heritage'	0.6649	**'european landscapes'**	**0.6802**	**'heritage disasters'**	**0.6301**	**'underwater cultural'**	**0.6327**	**'timber structures'**	**0.656**	**'built vernacular'**	**0.6391**
'heritage conservation'	**0.6562**	'landscapes europe'	0.6794	**'risk heritage'**	**0.6144**	**'conservation underwater'**	**0.5815**	**'timber structure'**	**0.6387**	**'vernacular building'**	**0.629**
'heritage sustainable'	**0.6517**	'concerning landscape'	0.6046	**'disasters heritage'**	**0.6086**	'underwater archaeology'	0.5757	'timber obtained'	0.6079	**'vernacular structure'**	**0.6246**
'setting heritage'	0.6424	'acknowledging landscape'	0.5815	**'heritage conservation'**	**0.5702**	'concerning underwater'	0.5749	**'historic structures'**	**0.5999**	**'vernacular structures'**	**0.6146**
'landscape heritage'	**0.6257**	'landscape important'	0.5756	'heritage policies'	0.5574	'convention underwater'	0.5731	'timber struct'	0.5875	**'vernacular buildings'**	**0.614**
'urban conservation'	**0.6231**	**'landscape means'**	**0.5553**	'disasters risk'	0.5532	'respect underwater'	0.5592	'timber material'	0.5794	**'vernacular architecture'**	**0.609**
'historic urban'	**0.6221**	'landscapes constitute'	0.551	'heritage strategic'	0.5494	'protect underwater'	0.5535	'timber cultural'	0.5727	**'building traditional'**	**0.5495**
'monumental heritage'	0.6201	'conferring landscape'	0.545	'heritage concerns'	0.545	'preserve underwater'	0.5502	**'historic structure'**	**0.5701**	**'traditional building'**	**0.549**
'conservation urban'	0.6061	'landscape global'	0.5429	'disaster risks'	0.5439	'heritage unesco'	0.5492	'appropriate timber'	0.5542	**'heritage important'**	**0.5414**
'urban landscapes'	**0.606**	'specific landscape'	0.5421	'disaster risk'	0.5435	'significance underwater'	0.5483	'storic timber'	0.5419	'utilisation vernacular'	0.5354
'heritage preservation'	**0.6049**	'landscape convention'	0.5394	'disasters policies'	0.5414	'management underwater'	0.5459	'replacement timber'	0.5295	'heritage'	0.5309
'urban historical'	0.6028	'define landscape'	0.5392	'strengthen disaster'	0.54	'preservation underwater'	0.5441	'species wood'	0.5285	'vernacular arch'	0.5286
'urban landscape'	**0.5997**	'landscapes considered'	0.5382	'heritage threatened'	0.5363	'protection underwater'	0.5375	'timber compatible'	0.5202	'cultural architectural'	0.526
'natural heritage'	0.597	'assess landscapes'	0.5364	'concern heritage'	0.5281	**'unesco convention'**	**0.5354**	'timber appropriate'	0.5201	'fundamental vernacular'	0.52
'heritage historic'	0.5948	'landscapes landscape'	0.5352	**'disaster prevention'**	**0.5206**	'importance underwater'	0.5324	**'traditiona woodwork'**	**0.5169**	**'vernacular recognised'**	**0.5197**

'cultural heritage'	**0.5867**	'landscapes identified'	0.5347	'heritage danger'	0.5161	**'research underwater'**	**0.5309**	'partially timber'	0.5142	'heritage man'	0.5095
'heritage humanity'	0.5834	**'landscapes territory'**	**0.5317**	'disaster reduction'	0.514	'access underwater'	0.5308	'timber'	0.5122	'associated vernacular'	0.5079
'heritage constitute'	0.5795	'landscape management'	0.5303	'risks disasters'	0.5099	**'appreciation underwater'**	**0.5307**	'repair timber'	0.5105	'heritage occupies'	0.5046
'heritage structure'	0.5775	'landscape matters'	0.5288	'properties disasters'	0.5083	**'preserving underwater'**	**0.5262**	'historic material'	0.5048	'established cultural'	0.5044
'heritage values'	**0.5753**	'landscapes article'	0.5277	'disasters preserve'	0.5072	'article underwater'	0.5227	**'preservation structures'**	**0.4966**	**'vernacular fundamental'**	**0.4989**
'heritage exceptional'	0.5741	'landscapes role'	0.5276	'disaster proposals'	0.5068	'site underwater'	0.5222	**'structure craftsmanship'**	**0.4869**	'heritage depend'	0.4984
'heritage ensuring'	0.5718	'promote landscape'	0.5245	**'disasters mitigating'**	**0.5038**	**'heritage responsibility'**	**0.5145**	'heritage resources'	0.4849	'vernacular'	0.4751
'cultures urban'	0.5717	'conservation european'	0.5239	**'reducing disasters'**	**0.5037**	'relating underwater'	0.511	'stores timber'	0.4814	'conserve cultural'	0.4679
'urban cultures'	0.5702	'landscape quality'	0.5222	'disasters importance'	0.5025	'definition underwater'	0.511	**'preservation historic'**	**0.4807**	'unworthy heritage'	0.461
'integrated heritage'	0.5655	'identify landscapes'	0.5217	'concern disaster'	0.4991	**'vulnerability underwater'**	**0.5021**	'historic forest'	0.4806	'maintaining traditional'	0.4585
'heritage climate'	**0.5645**	**'landscape policy'**	**0.519**	'incorporate disaster'	0.498	'discoveries underwater'	0.4988	'conservation historic'	0.478	'transformation vernacular'	0.4572
'heritage structures'	0.5626	**'landscape policies'**	**0.5173**	**'reduce disaster'**	**0.4976**	'danger underwater'	0.4939	'conservation heritage'	0.4749	'traditions intangible'	0.4507
'urban values'	**0.562**	'landscape considerations'	0.5129	**'risks disaster'**	**0.4959**	'unesco paris'	0.4924	'qualities wood'	0.4736	'structure traditional'	0.4486
'heritage integrated'	**0.5601**	'landscape regional'	0.5123	**'disaster procedures'**	**0.4946**	'affecting underwater'	0.4859	'wood methods'	0.4577	'vernacular forms'	0.4479
'heritage'	0.5595	'landscape appraisal'	0.512	'reduce disasters'	0.4937	'unesco'	0.4817	'wood used'	0.4463	**'integral cultural'**	**0.4429**
'values urban'	**0.5574**	'instituted landscape'	0.51	'heritage properties'	0.4932	'discovery underwater'	0.4769	'woodwork'	0.431	**'principles vernacular'**	**0.4366**
'heritage resources'	**0.5573**	'landscape'	0.5096	'mitigate disasters'	0.4925	'conference unesco'	0.4765	'woodwork joints'	0.4283	'established building'	0.4336
'definition urban'	0.5546	'landscape proved'	0.5061	'practices disaster'	0.4921	'underwater archaeologist'	0.4765	'preservation development'	0.4194	'conserve traditional'	0.4334
'heritage including'	0.5546	'landscape areas'	0.5057	'heritage values'	0.4913	'recovered underwater'	0.4736	'structures 1999'	0.4172	'building'	0.4306
'landscape historic'	0.5539	'landscapes _____'	0.5051	**'vulnerability heritage'**	**0.4895**	'exploitation underwater'	0.4698	'structure catalogued'	0.4138	'cultural identity'	0.4291
'urban identity'	**0.5539**	**'governing landscape'**	**0.5043**	**'heritage resource'**	**0.487**	'affect underwater'	0.4676	'buildings constructions'	0.4131	'diversity vernacular'	0.4232
'transforming urban'	**0.5538**	'landscape programmes'	0.5031	'heritage issues'	0.4865	'link underwater'	0.4662	'wood appropriate'	0.4106	'approaches vernacular'	0.4219
'characteristics heritage'	0.5521	'consideration landscape'	0.5024	'properties disaster'	0.4861	'heritage activities'	0.4646	'preservation conservation'	0.4089	'cultural'	0.4186
'landscape urban'	**0.5502**	'granting landscape'	0.5024	'include disaster'	0.486	'disposition underwater'	0.4605	'cultural heritage'	0.4077	'society althou'	0.4177
'maintain urban'	0.5489	'european community'	0.5015	**'risk disasters'**	**0.4851**	'location underwater'	0.4597	'surface wooden'	0.4059	'conservation built'	0.4176
'safeguard heritage'	**0.5486**	'surroundings landscape'	0.5013	'disaster preparedness'	0.4846	'inventory underwater'	0.4541	'components historic'	0.4014	'work vernacular'	0.4166

'heritage comprises'	**0.5433**	'landscape justified'	0.5011	**'protection heritage'**	**0.4819**	'recovery underwater'	0.4528	'significance historic'	0.3987	'construction'	0.4165
'traditional urban'	0.5432	'landscapes issues'	0.4969	'ensure disaster'	0.4814	'unesco means'	0.4518	'preservation work'	0.3966	'understood traditions'	0.4159
'urbanization'	0.5401	'implement landscape'	0.4963	'consideration disaster'	0.4807	'impact underwater'	0.451	'repair historic'	0.3957	'values vernacular'	0.4132
'heritage assets'	**0.5399**	'landscape question'	0.4917	'concerned heritage'	0.4801	'considered underwater'	0.4495	'sustainable preservation'	0.392	'cultural landscape'	0.4105
'urbanization proceeding'	0.5397	'landscapes'	0.4916	'heritage concerned'	0.4789	'possession underwater'	0.4488	'craftsmanship construction'	0.3919	'reuse vernacular'	0.41
'heritage emphasis'	0.5381	'landscape _____'	0.4893	'heritage property'	0.4774	'sea convention'	0.4476	'including structural'	0.3915	'vernacular especially'	0.4089
'heritage contemporary'	**0.537**	'aware landscape'	0.4874	'risks properties'	0.4743	'protection heritage'	0.4453	'structures make'	0.3901	'culture'	0.4088
'deterioration urban'	0.5322	**'recognise landscapes'**	**0.4853**	'disasters advance'	0.4725	'enhancement underwater'	0.4441	'fabric historic'	0.3901	'buildings'	0.4082

9. The Burra Charter (ICOMOS, 2013)		10.Measures To Promote The Integrated Conservation Of Historic Complexes Composed Of Immoveable And Moveable Property (Council of Europe, 1998)		11. NARA document on authenticity (ICOMOS, 1994)		12. Charter For The Protection And Management Of The Archaeological Heritage (ICOMOS, 1990)		14. Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO, 1972)		15. Washington Charter- Charter For The Conservation Of Historic Towns And Urban Areas (ICOMOS, 1987)	
Extracted Term	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**
'icomos org'	0.584	**'heritage europe'**	**0.5361**	'heritage nara'	0.6555	**'protection archaeological'**	**0.6825**	**'heritage protection'**	**0.5867**	'charter conservation'	0.5561
'icomos incorporated'	0.5802	**'heritage policies'**	**0.5063**	'constitute heritage'	0.6083	**'archaeological heritage'**	**0.6513**	'heritage nations'	0.5718	**'historic urban'**	**0.5163**
'icomos australia'	0.5702	'heritage constitutes'	0.5061	**'cultural heritage'**	**0.5815**	**'protection archaeologic'**	**0.6206**	**'protection heritage'**	**0.5393**	**'historic areas'**	**0.515**
'australia icomos'	0.5683	'council europe'	0.4946	**'heritage values'**	**0.5794**	'protection archaeolog'	0.6171	'heritage defined'	0.5366	**'town conservation'**	**0.5055**
'icomos charter'	**0.5608**	**'architectural heritage'**	**0.4783**	'heritage obliges'	0.571	'ensure archaeological'	0.5978	**'world heritage'**	**0.5231**	'restoration monuments'	0.4992
'icomos australian'	0.5442	'defines monuments'	0.4774	'cultures heritage'	0.5612	'dealing archaeological'	0.5973	'heritage mankind'	0.5205	**'venice charter'**	**0.4955**
'icomos members'	0.5367	**'heritage conservation'**	**0.4773**	'world heritage'	0.5607	'archaeological investigation'	0.5905	'heritage constitutes'	0.5203	**'charter venice'**	**0.4865**
'belonging icomos'	0.5313	'european convention'	0.4549	'heritage concerns'	0.5588	'respect archaeological'	0.5854	'heritage world'	0.5186	'urban development'	0.4813
'icomos international'	0.5303	'europeanheritage considering'	0.4497	'heritage humankind'	0.5576	**'management archaeological'**	**0.5831**	'natural heritage'	0.5172	'council monuments'	0.4777
'committee icomos'	0.5252	'statute council'	0.4474	'heritage wo'	0.5555	'understanding archaeologic'	0.5772	'heritage activities'	0.5163	**'conservation historic'**	**0.4768**
'icomos practice'	0.5185	**'heritage cultural'**	**0.4473**	'heritage inventories'	0.5551	'archaeological authority'	0.5715	'heritage monuments'	0.5124	'history charter'	0.4748
'icomos documents'	0.5172	**'heritage integrated'**	**0.4466**	'heritage understood'	0.5389	**'conservation archaeological'**	**0.5708**	'cultural heritage'	0.5109	**'historic towns'**	**0.4737**

'icomos icomos'	0.5127	**'europe committee'**	**0.4398**	cultural lanscape	0.5383	'protection archae'	0.5699	'heritage national'	0.5059	**'restoration towns'**	**0.4733**
'members icomos'	0.5119	'heritage situated'	0.4322	'heritage convention'	0.5347	'archaeological'	0.5676	'heritage article'	0.5028	**'historic centres'**	**0.473**
'icomos acts'	0.5088	**'cultural heritage'**	**0.4311**	**'heritage management'**	**0.5319**	'archaeological evaluation'	0.5673	'heritage increasingly'	0.4999	'buildings preserved'	0.4725
'icomos primarily'	0.504	'europe defines'	0.4294	'heritage'	0.5289	'monuments archaeological'	0.5663	'threatening heritage'	0.4992	**'urban communities'**	**0.4674**
'icomos formed'	0.4997	'europe cultural'	0.4259	**'heritage conservation'**	**0.5286**	'archaeological remains'	0.5657	'heritage property'	0.4983	**'monuments'**	**0.4616**
'required icomos'	0.4994	**'moveable heritage'**	**0.4253**	'heritage respected'	0.5237	'investigation archaeological'	0.5641	'heritage comprehensive'	0.4978	'definitions urban'	0.459
'icomos'	0.4993	'moveablecultural heritage'	0.4203	'japan nara'	0.5231	'aeological heritage'	0.5625	'heritage appropriate'	0.4928	**'historic area'**	**0.4567**
'decisions icomos'	0.4953	'heritage considering'	0.4203	'heritage properties'	0.5151	'applicable archaeological'	0.5611	'heritage outstanding'	0.4886	'preservation cultural'	0.4547
'sites icomos'	0.4949	'practices europe'	0.4167	'nara japan'	0.5097	'maintenance archaeological'	0.5602	'conservation presenta'	0.4877	'international charter'	0.45
'icomos include'	0.4931	'heritage create'	0.4081	'nara document'	0.5084	'th archaeological'	0.5601	**'heritage natural'**	**0.4864**	'towns historic'	0.4485
'activities icomos'	0.4839	'restoration monuments'	0.4047	**'legitimacy cultural'**	**0.5044**	'article archaeological'	0.5573	'recognize heritage'	0.4846	**'history architecture'**	**0.4464**
'unesco'	**0.4672**	**'conservation moveablecultural'**	**0.3938**	'heritage absolute'	0.5043	**'preserving heritage'**	**0.551**	**'conservation nature'**	**0.4777**	'preservation archaeological'	0.4463
'icomos especially'	0.4669	'monuments buildings'	0.3906	'authenticity monuments'	0.5037	'violations archaeological'	0.55	'heritage threatened'	0.4754	**'urban cultures'**	**0.4379**
'unesco particularly'	0.466	**'built heritage'**	**0.3856**	'heritage diversity'	0.5035	'objective archaeological'	0.5499	'heritage function'	0.4747	'residents conservation'	0.4359
'linked unesco'	0.4652	**'monuments'**	**0.3806**	**'nature heritage'**	**0.5002**	'protection heritage'	0.546	'restoration cultural'	0.4722	'development urban'	0.4348
'2013 icomos'	0.4557	'protectedhistoric complex'	0.3759	'ttributed heritage'	0.4991	'heritage management'	0.5456	'conservation protection'	0.4689	'residents historic'	0.4306
'unesco principal'	0.4501	'europeanheritage'	0.3735	'heritage ability'	0.4974	'application archaeological'	0.545	'heritage referred'	0.4648	'planning conservation'	0.4286
'icomos web'	0.4406	'europe achieve'	0.3694	**'value cultural'**	**0.4959**	'heritage investigation'	0.545	'assuring conservation'	0.4643	'urban areas'	0.4271
'committee australia'	0.4288	'heritage'	0.3662	'cultural value'	0.4872	'surviving archaeological'	0.5447	'heritage list'	0.4607	'washington charter'	0.4252
'org australia'	0.4209	'requirements conservation'	0.3628	'diversity heritage'	0.4864	'archaeological knowledge'	0.5435	'heritage'	0.4603	'conservation plans'	0.4243
'international council'	0.4098	'preservation protected'	0.3605	'heritage list'	0.4853	'principle archaeological'	0.543	**'heritage committee'**	**0.4585**	'documented conservation'	0.4239
'australian national'	0.4039	'cultural property'	0.3586	'history cultural'	0.4838	'archaeological excavations'	0.5429	'conservation natural'	0.4581	'monuments sites'	0.4239
'heritage committee'	**0.4029**	'legislation governingmonuments'	0.3574	'unesco'	0.4807	'standards archaeological'	0.5427	'heritage situated'	0.4581	**'impact urban'**	**0.4196**
'icomos october'	0.4024	'protected historic'	0.3546	'nara'	0.4777	'arch aeological'	0.5426	'heritage supply'	0.457	'charter concerns'	0.4189
'international organisation'	0.3999	'common europeanheritage'	0.3498	'authenticity conservation'	0.4768	'archaeological evidence'	0.542	'heritage shall'	0.4557	'urban patterns'	0.4185
'1972 unesco'	0.3954	'cultural objects'	0.343	'common heritage'	0.4738	'archaeological site'	0.5323	'impoverishment heritage'	0.4541	'buildings defined'	0.4185

'field icomos'	0.3925	'protect historic'	0.3427	'unesco iccrom'	0.4621	'heritage study'	0.5318	'cultural property'	0.4513	'historic town'	0.4147
'indigenous heritage'	0.3915	'diversity europe'	0.3421	**'cultural values'**	**0.4607**	'academic archaeological'	0.5291	'heritage mentioned'	0.4496	'buildings'	0.4128
'heritage charter'	0.3867	'conservation historic'	0.3401	'participants nara'	0.4603	'archaeolog ical'	0.5289	**'heritage danger'**	**0.4472**	'objectives conservation'	0.4111
'australian landscape'	0.3845	'monuments sites'	0.337	'requires heritage'	0.4592	'protection archaeol'	0.5284	'conservation'	0.4426	'area conservation'	0.4082
'icomos 27'	0.3785	'protectedhistoric'	0.3339	'heritage know'	0.4591	'heritage heritage'	0.5275	'nations convention'	0.4413	'safeguard heritage'	0.4078
'icomos 19'	0.3761	'responsibility historiccomplexes'	0.3334	'ion cultural'	0.4573	'heritage constitute'	0.5258	'science conservation'	0.4405	'conservation plan'	0.4071
'scientific committees'	0.3757	'heritage lies'	0.333	**'authenticity judgements'**	**0.4548**	'archaeological techniques'	0.5255	'preservation'	0.4377	'affecting historic'	0.4033
'paris icomos'	0.3748	'international conservation'	0.3301	'fundamental cultural'	0.4545	'dealing heritage'	0.5241	'heritage recommending'	0.4304	'studies conservation'	0.4021
'icomos moscow'	0.3747	'europe considering'	0.3276	'list nara'	0.4536	'chaeological heritage'	0.5239	'international convention'	0.4299	'heritage'	0.3956
'participate conservation'	**0.3742**	'council'	0.3273	**'conservation cultural'**	**0.4534**	'heritage constitutes'	0.5215	'heritage encourage'	0.4234	'determine buildings'	0.3936
'heritage conservation'	**0.3739**	'preservation'	0.3265	'consideration authenticity'	0.4499	'archaeologic al'	0.5207	'conserve identify'	0.42	'heritage security'	0.3928
'implemented australia'	0.372	'legislation given'	0.3251	'cultural properties'	0.4495	'heritage principle'	0.5178	'identify heritage'	0.4193	'towns protected'	0.391

16. Charter of Athens (CIAM, 1933)		**17. Charter For The Interpretation And Presentation Of Cultural Heritage Sites (ICOMOS, 2008)**		**18.The Icomos Charter On Cultural Routes**		**19. International Charter for Cultural Heritage Tourism (ICOMOS, 2022)**		**20. ICOMOS Guidelines On Fortifications And Military Heritage (ICOMOS, 2021**		**21. Principles For The Conservation Of Wooden Built Heritage (ICOMOS, 2017)**	
Extracted Term	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**
athens charter'	0.6192	**'heritage contexts'**	**0.5628**	'conservation cultural'	0.5863	**'tourism charter'**	**0.6425**	**'fortifications heritage'**	**0.7413**	**'wooden heritage'**	**0.5434**
'charter athens'	0.6049	**'heritage interpretation'**	**0.5601**	**'conservation territorial'**	**0.5184**	**'tourism heritage'**	**0.623**	**'heritage fortifications'**	**0.729**	'conservation wooden'	0.517
'design athens'	0.5795	'heritage conservation'	0.5539	**'et conservation'**	**0.5117**	**'heritage tourism'**	**0.6207**	**'historic fortifications'**	**0.7081**	'wooden architecture'	0.5107
'athens 1933'	0.5078	'significance heritage'	0.5436	**'ethics conservation'**	**0.5087**	**'tourism sustainability'**	**0.5947**	**'fortifications historic'**	**0.6974**	'built heritage'	0.5096
'entitled athens'	**0.4909**	**'site heritage'**	**0.5372**	'itineraires culturels'	0.5067	'tourism recognizing'	0.5754	'fortifications cultural'	0.6967	'significance wooden'	0.5046
'architecture moderne'	**0.4871**	**'heritage sites'**	**0.5348**	'conservation et'	0.5038	'tourism charters'	0.5744	**'constructed fortifications'**	**0.6797**	'historic wooden'	0.5013
'architecture document'	0.4853	**'heritage cultural'**	**0.534**	**'preserve cultural'**	**0.4807**	'tourism cultural'	0.5713	**'built fortifications'**	**0.6759**	'buildings wooden'	0.499
'athenes athens'	0.483	'informing heritage'	0.5325	'conservation ce'	0.48	'tourism sustains'	0.5636	**'buildings fortifications'**	**0.6757**	'wooden buildings'	0.487

'athens'	0.4823	'organisation heritage'	0.5308	**'generated heritage'**	**0.4776**	**'cultural tourism'**	**0.5609**	**'fortifications use'**	**0.669**	**'wooden structures'**	**0.4853**
'architecture took'	0.4678	'patrimoniaux icomos'	0.521	'understanding heritage'	0.4774	'tourism sustainable'	0.5574	**'fortifications built'**	**0.665**	'heritage buildings'	0.4849
'built heritage'	0.4611	**'cultural heritage'**	**0.5158**	'conservation considers'	0.4737	**'heritage sustainable'**	**0.5538**	'structures fortifications'	0.6646	**'wooden built'**	**0.4828**
'preservation buildings'	0.4533	**'heritage site'**	**0.5134**	'routes cultural'	0.4711	**'sustainable tourism'**	**0.5517**	**'fortifications military'**	**0.6632**	'historic structures'	0.4794
'structures historic'	**0.4385**	**'culturels patrimoniaux'**	**0.5033**	'conservation les'	0.4708	'tourisme responsable'	0.5465	**'developed fortifications'**	**0.6611**	'historic timber'	0.4789
'architecture 92'	0.4377	'communities heritage'	0.5018	'heritage cultural'	0.4703	'culturel tourisme'	0.544	**'fortifications designed'**	**0.661**	'constructing historic'	0.4686
'modern architecture'	**0.4346**	**'collaboration heritage'**	**0.4986**	**'heritage values'**	**0.4687**	'heritage conservation'	0.5425	'applicable fortifications'	0.6601	'structures historic'	0.4656
'architecture'	0.4262	'heritage forms'	0.479	'conservation development'	0.4677	'affecting tourism'	0.5396	**'fortifications communities'**	**0.6601**	'structure historic'	0.463
'historic monuments'	**0.4234**	'heritage considered'	0.4778	**'research conservation'**	**0.4675**	'tourisme culturel'	0.5389	**'surviving fortifications'**	**0.6569**	'historic structure'	0.4629
'buildings constructed'	0.4141	**'sites patrimoniaux'**	**0.477**	'heritage integrated'	0.4669	'issues tourism'	0.538	'fortifications'	0.6566	'heritage purpose'	0.4627
'heritage emphasizes'	0.401	'considered heritage'	0.4751	'cultural routes'	0.4632	'international tourism'	0.5377	**'plans fortifications'**	**0.6566**	**'timber structures'**	**0.4606**
'historic areas'	0.3945	**'material heritage'**	**0.4739**	'culturels intangibles'	0.4625	'refers tourism'	0.5352	'fortifications integrated'	0.6538	'wood constructions'	0.4573
'urbanism importance'	0.3894	**'conservation cultural'**	**0.472**	'culturels doivent'	0.4615	'tourism development'	0.5347	**'communities fortifications'**	**0.6515**	'importance wooden'	0.4472
'construction historic'	0.3881	'complex archaeological'	0.4675	'heritage assets'	0.461	'tourism tourism'	0.5347	'defend fortifications'	0.65	'principles preservation'	0.4469
'fine architecture'	0.3854	'heritage impact'	0.4665	**'cultural heritage'**	**0.4609**	'tourism 2021'	0.5345	**'characteristics fortifications'**	**0.6496**	'wood structures'	0.4424
'architect'	**0.3835**	**'culturel icomos'**	**0.4654**	'heritage content'	0.4607	**'tourism involving'**	**0.5344**	'fortifications necessity'	0.6494	'heritage provides'	0.4422
'architectur al'	0.3813	'heritage professionals'	0.4649	'values heritage'	0.4603	'conservation tourism'	0.5306	**'population fortifications'**	**0.6493**	'intangible heritage'	0.4332
'monuments'	0.3775	**'connected heritage'**	**0.4637**	'sciences conservation'	0.4594	**'heritage resilience'**	**0.5279**	'interpret fortifications'	0.6489	'building historical'	0.4287
'al heritage'	0.3763	**'importance heritage'**	**0.4612**	**'la conservation'**	**0.4589**	'manage tourism'	0.5276	'fortifications include'	0.647	'preservation historic'	0.4265
'architecture individual'	0.375	'design heritage'	0.456	'cultural route'	0.4585	'tourism stakeholders'	0.5268	'fortifications territorial'	0.6434	'timber materials'	0.4262
'urban unity'	0.3726	'heritage'	0.4527	'intangible heritage'	0.4567	'promoting heritage'	0.5257	'interventions fortifications'	0.6432	'heritage relation'	0.4222
'heritage'	0.3718	'scientifique icomos'	0.4489	**'heritage innovation'**	**0.4545**	'tourism constituted'	0.5244	'value fortifications'	0.6362	'heritage reinforcement'	0.4217
'city dwelling'	0.3717	'environmental archaeological'	0.4469	'route cultural'	0.4538	'ensure tourism'	0.5239	'values fortifications'	0.6358	'construction principles'	0.4206
'monuments provides'	0.369	'patrimoniaux devraient'	0.4458	**'cultural landscapes'**	**0.4534**	**'impacts tourism'**	**0.5237**	'fortifications surrounding'	0.6351	'heritage values'	0.4203
'urban development'	0.3657	'patrimoniaux doivent'	0.4425	'culturels associe'	0.4514	'maintaining heritage'	0.5225	'needs fortifications'	0.6346	'heritage associated'	0.4193
'surrounding historic'	0.3648	'culturels traditionnels'	0.4409	'communities heritage'	0.4505	'regenerative tourism'	0.5224	'fortifications appropriate'	0.6345	'concerning building'	0.4175

'heritage includes'	**0.3632**	'archaeological site'	0.4404	'associative heritage'	0.4498	'heritage management'	0.5216	**'building fortification'**	**0.6334**	'wooden elements'	0.4148
'buildings protected'	0.3603	'des monuments'	0.4384	'cultural properties'	0.4451	'tourism management'	0.521	'definitions fortifications'	0.6315	'construction structural'	0.4125
'urban complex'	0.3596	'element heritage'	0.4345	'leur conservation'	0.4442	'tourism enables'	0.5208	'similar fortifications'	0.631	'heritage recognize'	0.4104
'potential heritage'	0.3591	'patrimoniaux important'	0.4333	'cultural assets'	0.442	'tourism 2022'	0.5205	'fortifications respective'	0.6289	'heritage traditional'	0.4071
'heritage value'	0.3571	'archaeological'	0.4332	'heritage properties'	0.4419	'tourists tourism'	0.5198	'typology fortifications'	0.6273	'heritage refer'	0.4035
'buildings'	0.3516	'patrimoniaux et'	0.4329	**'heritage exist'**	**0.4405**	'preservation cultural'	0.5173	'fortifications indispensable'	0.6267	'heritage cultural'	0.4035
'cities studied'	0.347	'histoires locales'	0.4294	'diversite culturelle'	0.4398	'demonstrated tourism'	0.5172	'location fortifications'	0.626	'heritage adopted'	0.4025
'renovating cities'	0.3446	'patrimoniaux des'	0.4278	'various heritage'	0.4397	'responsible tourism'	0.5155	'fortifications defensive'	0.625	'aspects wooden'	0.4004
'city consideration'	0.341	'traditions culturelles'	0.4259	'conservation usage'	0.4393	'tourism use'	0.515	'fortifications educational'	0.6247	'cultural heritage'	0.3987
'special monumental'	0.3403	'icomos charters'	0.4239	'conservation des'	0.439	'tourism'	0.5127	'set fortifications'	0.6239	'conservation monuments'	0.3984
'architectur'	0.3395	'icomos se'	0.4237	**'et culturels'**	**0.4386**	'impacts heritage'	0.5121	'fortifications seen'	0.6191	'heritage world'	0.3978
'urbanism'	0.336	'conservation authenticite'	0.4234	'culturels cultural'	0.4376	'tourism provide'	0.5108	'conflict fortifications'	0.6152	'protection wooden'	0.3972
'new structures'	0.3343	'et patrimoniaux'	0.4205	'heritage provide'	0.4375	'tourism refers'	0.5108	'sites fortifications'	0.6146	'structures built'	0.3971
'community buildings'	**0.3342**	'patrimoniaux introduction'	0.4198	**'forming cultural'**	**0.4375**	'tourisme doivent'	0.5091	'fortifications typical'	0.6133	'conservation building'	0.3935
'charter 1933'	**0.3327**	'patrimoniaux objectives'	0.418	'heritage dynamically'	0.4362	'conservation heritage'	0.5074	'fortifications reused'	0.61	'built structure'	0.3935
'city plan'	0.3324	'une icomos'	0.4177	'culturels internationaux'	0.4341	'tourism sector'	0.5074	'fortifications responds'	0.6096	'completion wooden'	0.3925

22. Salalah Guidelines For The Management Of Public Archaeological Sites (ICOMOS, 2017)		23. IFLA Document On Historic Urban Public Parks (ICOMOS, 2017)		24. IFLA Principles Concerning Rural Landscapes As Heritage (ICOMOS, 2017)		25. Valletta Principles (ICOMOS, 2011)		26. Dublin Principles (ICOMOS, 2011)		27. Historic Gardens (ICOMOS, 1982)	
Extracted Term	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**	**Extracted Term**	**Importance**
'guidelines archaeological'	0.6862	**'historic parks'**	**0.5283**	**'landscapes biocultural'**	**0.6062**	**'human settlements'**	**0.5635**	**'industrial heritage'**	**0.5674**	**'historic gardens'**	**0.6236**
'management archaeological'	0.6029	**'public parks'**	**0.5072**	**'cultural landscape'**	**0.5824**	'urbanisme glementaire'	0.5616	**'heritage industrial'**	**0.5671**	**'historic garden'**	**0.6**
'visit archaeological'	0.602	**'parks historic'**	**0.5052**	**'cultural landscapes'**	**0.5696**	'urbanisme sauvegarde'	0.5458	**'heritage structures'**	**0.5551**	'gardens florence'	0.5506
'ensure archaeological'	0.5994	'parks definitions'	0.4889	**'agrarian heritage'**	**0.5504**	'inhabitants help'	0.5367	'archaeological sites'	0.5531	**'gardens preservation'**	**0.544**
'archaeological sites'	0.5921	'urban parks'	0.4796	**'rural landscapes'**	**0.5406**	'nagements urban'	0.5283	'landscapes dublin'	0.5383	**'preservation gardens'**	**0.5017**

'aintaining archaeological'	0.5897	'historic promenades'	0.4632	**'landscapes rural'**	**0.5402**	'et urbanistes'	0.5133	'sites heritage'	0.5318	'monument historic'	0.5008
'visiting archaeological'	0.5891	'parks constitute'	0.4617	**'rural landscape'**	**0.534**	'conceptualizing townscape'	0.5047	'archaeological'	0.5259	**'monument preservation'**	**0.4976**
'accessible archaeological'	**0.5875**	'park management'	0.4589	**'landscapes respect'**	**0.5312**	'villages historiques'	0.504	'heritage sites'	0.523	'gardens article'	0.4915
'advises archaeological'	0.5794	**'historic urban'**	**0.4488**	**'indigenous communities'**	**0.5306**	'urbanisme comprenant'	0.5027	'tangible heritage'	0.5191	'garden architectural'	0.4914
'archaeological resource'	**0.5786**	'parks public'	0.4424	**'nvironmental cultural'**	**0.5284**	'town archaeological'	0.4961	'dublin principles'	0.5118	'oric gardens'	0.4866
'archaeological site'	**0.5746**	**'parks values'**	**0.4345**	**'landscapes conservation'**	**0.5278**	'towns le'	0.4923	**'historical archaeological'**	**0.5091**	'gardens practical'	0.4786
'public archaeological'	0.5736	'public park'	0.4316	**'landscapes recognised'**	**0.5214**	'cities changes'	0.4921	'heritage purposes'	0.5089	'gardens paramount'	0.4722
'use archaeological'	0.5698	'parks accrue'	0.4288	**'landscapes development'**	**0.5198**	**'inhabitants'**	**0.4904**	'active archaeological'	0.5064	'florence charter'	0.4636
'archaeological resources'	0.5598	'parks municipalities'	0.4281	**'landscapes resource'**	**0.5176**	**'communities inhabited'**	**0.4873**	**'intangible heritage'**	**0.5044**	'gardens subsequently'	0.4572
'archaeological heritage'	**0.5596**	'parks publicly'	0.4276	**'landscapes initiative'**	**0.5175**	'directives urbanisme'	0.4846	'offers archaeological'	0.5015	**'preservation historic'**	**0.4544**
'apply archaeological'	0.5544	'historic public'	0.4254	'landscapes status'	0.5134	'local inhabitants'	0.4823	'archaeological investigation'	0.5006	'gardens provided'	0.452
'evaluate archaeological'	0.5491	'historic streets'	0.4233	'landscapes vital'	0.5121	**'historic areas'**	**0.4801**	'conservation heritage'	0.496	'considered monument'	0.4501
'disciplines archaeological'	0.5486	'preservation parks'	0.4232	**'sustainability rural'**	**0.5103**	'towns une'	0.4795	'places heritage'	0.4955	'garden designed'	0.4436
'archaeological experts'	0.5482	'park environment'	0.421	**'biocultural sustainability'**	**0.5102**	**'historic towns'**	**0.4788**	'monuments et'	0.4937	'gardens'	0.4432
'archaeological parks'	0.5481	'park used'	0.4189	'landscapes internationally'	0.5097	'valletta principles'	0.4787	'heritage associated'	0.487	**'historic heritage'**	**0.4387**
'open archaeological'	0.5461	'parks important'	0.4184	**'landscape heritage'**	**0.5085**	**'townscape architectural'**	**0.4777**	'heritage heritage'	0.4847	'ilar gardens'	0.438
'contain archaeological'	0.5432	'infrastructure parks'	0.4154	**'agricultural heritage'**	**0.5082**	'urbanisme'	0.4773	'heritage developed'	0.4831	'venice charter'	0.4367
'evaluation archaeological'	0.5387	'existing park'	0.4146	**'rural heritage'**	**0.5073**	'urbanistes'	0.4753	'making heritage'	0.4819	'garden constituent'	0.4366
'concept archaeological'	0.5368	'park constitutes'	0.4142	'landscapes necessitates'	0.5067	**'urban conservation'**	**0.475**	'heritage significance'	0.4802	'gardens suitable'	0.4353
'archaeological'	**0.5354**	'parks built'	0.4138	'landscapes associated'	0.505	'settlements'	0.4726	'heritage important'	0.4795	'gardens landscapes'	0.4353
'archaeological research'	0.5324	'parks composition'	0.4105	**'diversity agricultural'**	**0.5044**	'document urbanisme'	0.4723	'des monuments'	0.4775	'article monument'	0.4321
'archaeological remains'	0.5292	'parks settings'	0.4092	**'nature landscapes'**	**0.5022**	'areas villes'	0.4711	'heritage use'	0.4743	'type gardens'	0.4303
'possess archaeological'	0.5286	'views parks'	0.4064	'agrarian'	0.4995	'urban areas'	0.4689	'principes dublin'	0.4743	'garden preserved'	0.4281
'resources archaeological'	0.528	'parks typically'	0.4047	**'maintaining landscape'**	**0.4992**	'inhabitants les'	0.4688	'heritage intrinsic'	0.4716	'monument article'	0.4196
'archaeological features'	0.52	'urban public'	0.398	'landscapes provide'	0.499	'urban ecosystem'	0.4667	'monuments sites'	0.4591	'architects gardeners'	0.4193
'archaeological park'	0.5195	'park denote'	0.3972	**'rural cultural'**	**0.4981**	'growing cities'	0.4656	'archaeological evidence'	0.4583	'gardens depends'	0.4177

'modified archaeological'	0.5168	'parks created'	0.3953	'landscapes heritage'	0.4977	'urban environment'	0.4634	'located heritage'	0.4568	'considered historic'	0.4159
'recognized archaeological'	0.5152	'development historic'	0.3948	'landscapes contribute'	0.4933	'valletta'	0.4627	'heritage ticcih'	0.4546	'composition historic'	0.4157
'conservation archaeological'	0.5136	'historic sites'	0.3927	'heritage rural'	0.4915	'populations entre'	0.4627	'histoire industrielle'	0.4535	'gardens meeting'	0.414
'plan archaeological'	0.512	'viewpoints historic'	0.3906	'landscapes 2014'	0.4899	'understanding urban'	0.4622	'ensure heritage'	0.4524	'historic site'	0.4139
'mitigation archaeological'	0.5118	'historic gardens'	0.3893	'nature culture'	0.4895	'analysis urban'	0.4612	'process heritage'	0.449	'gardens subjected'	0.4111
'concerned archaeology'	0.5103	'parks essential'	0.3878	'landscapes charter'	0.4895	'historic urban'	0.4608	'heritage documentation'	0.446	'article historic'	0.4072
'preservation archaeological'	0.51	'park understood'	0.3863	'unesco ecommendation'	0.4892	'urbanistes dans'	0.4603	'heritage international'	0.4454	'principles venice'	0.402
'irremediable archaeological'	0.5079	'buildings introduction'	0.386	'landscapes world'	0.4885	'historic cities'	0.4601	'heritage consists'	0.4445	'gardens large'	0.3963
'stewardship archaeological'	0.5079	'conservation historic'	0.3844	'land conservation'	0.4878	'villes principalement'	0.4593	'heritage particularly'	0.4414	'use historic'	0.3957
'threaten archaeological'	0.5068	'park conditions'	0.3835	'maintain landscape'	0.4867	'areas nature'	0.4586	'heritage dimensions'	0.437	'visits historic'	0.3937
'archaeology world'	0.5057	'concepts promenade'	0.3828	'landscape involved'	0.4858	'displacement communities'	0.4548	'world heritage'	0.4364	'maintenance historic'	0.3915
'protection archaeological'	0.5047	'historic features'	0.3803	'cultural environmental'	0.4852	'urban patterns'	0.4546	'ou industrielles'	0.4346	'gardens shall'	0.3887
'significant archaeological'	0.5027	'inhabitants park'	0.3797	'local indigenous'	0.4845	'inhabited historic'	0.454	'heritage'	0.4332	'living monument'	0.3878
'heritage sites'	0.5016	'parks inhabitants'	0.3782	'rural cultures'	0.4843	'regions towns'	0.4539	'conservation industrial'	0.433	'gardens world'	0.3872
'ation archaeological'	0.5004	'concept park'	0.3772	'heritage landscape'	0.4834	'resource urban'	0.4537	'constructions aires'	0.4329	'small gardens'	0.3826
'archaeological material'	0.4982	'parks adversely'	0.3772	'landscape today'	0.483	'preserve urban'	0.4526	'heritage source'	0.4313	'ervation gardens'	0.3822
'value archaeological'	0.4948	'urban installations'	0.3767	'landscape purpose'	0.4806	'territoriale'	0.4518	'proper heritage'	0.4288	'monument'	0.3821
'framework archaeological'	0.4947	'park parks'	0.3716	'landscape initiative'	0.4798	'heritage changement'	0.4499	'monuments'	0.428	'historians architects'	0.3801
'information archaeological'	0.4934	'outside parks'	0.3697	'landscapes considering'	0.4788	'environnementaux sociaux'	0.4492	'constructions sites'	0.4274	'relating garden'	0.3793

Annex III – List of resilience indicators

INDICATORS DEFINITION											DATA SOURCE					
ID #	**Measuring objective**	**System dimension**	**Capitals**	**Key elements**	**Indicator name**	**Description and purpose**	**Parameters**	**Calculation method**	**Unit**	**Update peridicity**	**EU Level**	**Link to source**	**Reference years or time period available**	**Geographic level**	**Geograohical coverage**	**Update frequency**	**Local Level**
1	measuring sensitivity	Social system	Social capital	Demographics	Population Density	Assess the number of people living in a unit area and its evolution over time (areas affected by depopulation)	A) Population B) Area	A/B	Number/km2	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/DEMO_R_D3DENS__custom_2790211/bookmark/table?lang=en&bookmarkId=d1a9a590-0543-45b0-ab08-805a3fea0b5e	2007-2022	NUTS3	EU-27	Annual	statistics office, population census
2	measuring sensitivity	Social system	Social capital	Demographics	Population change	Annual change in the resident population, aiming to demonstrate fluctuations in population: Contribution of natural change and net migration (and statistical adjustment) to population change	A) Population year n B)Live births C) Deaths D) Population year n+1	Total change: D-A Natural change: B-C Net migration and statistical adjustment: Total change - natural change	Number	Yearly	Eurostat	https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_and_population_change_statistics#Population_change_at_national_level	2013-2022		EU-27	Annual	statistics office, population census
3	measuring coping capacity	Social system	Financial capital	Economy	Employment rate	Number employed as a proportion of the working-age population	A) Number of employed people B) Labour force	(A/B)*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/web/lfs/database	1989-2022		EU27+ 3EFTA + 4 EU candidate countries	quarterly and annual data	
4	measuring sensitivity	Social system	Financial capital	Economy	Unemployment rate	Number of people unemployed as a percentage of the labour force.	A) Labour force B) Unemployed persons	(A/B)*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/web/lfs/database	2011 - 2022		EU27+ 3EFTA + 4 EU candidate countries	quarterly and annual data	

5	measuring sensitivity	Social system	Social capital	Governance	Land cover change	CORINE land cover	Spatial information on different classes of physical coverage	N/A	Classification	Yearly	Copernicus Land Monitoring Service	https://land.copernicus.eu/global/products/lc	2015-2019	100m	EU-27	Annual	
6	measuring sensitivity	Social system	Social capital	Demographics	Share of population aged 20 to 39 years (in %)	% of population between 20 and 39 years. Matches the prime reproductive age, the younger working age population and the peak age group at which migration occurrs (Reference: ESPON DEMIFER)	A) population in age group 20-39 B) total population	A/B*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/demo_r_pjangrp3/default/table?lang=en	2014-2022	NUTS3	EU-27	Annual	
7	measuring sensitivity	Social system	Social capital	Demographics	Share of population aged >65 years (in %)	% of population 65 years or older. A high share of elderly is connected with additional expenditures and less revenues for the social system, because of a higher share of economically inactive people (Reference: ESPON DEMIFER)	A) population in age group 65+ B) total population	A/B*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/demo_r_pjangrp3/default/table?lang=en	2014-2022	NUTS3	EU-27	Annual	
8	measuring sensitivity	Social system	Social capital	Demographics	Young-age dependency	Ratio between population aged 0-14 years to 15-64 (Reference: ESPON TITAN)	A) population in age group 0-14 years B) tpopulation in age group 15-64 years	A/B*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/DEMO_RPJANIND3__custom_5806973/default/table?lang=en	2014-2022	NUTS3	EU-27	Annual	
10	measuring sensitivity	Social system	Social capital	Demographics	Net migration rate (per 1000)	The ratio of the net migration during the year to the average population in that year. The value is expressed per 1000 inhabitants. (Reference: ESPON ATTREG)			per 1000 inhabitants	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/DEMO_RGIND3__custom_5785996/default/table?lang=en	2017 - 2020/2021	NUTS3	EU-27	Annual	
11	measuring sensitivity	Social system	Financial capital	Tourism	Tourism pressure (per 1000)	Ratio of total number of tourists arrived at any types of accommodation by 1,000 head of	A) total population B) Arrivals at tourist accommod	B/(A/1000)	per 1000 inhabitants	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/tour_occ_arn2/default/table?lang=en	2012 - 2021	NUTS2	EU-27	Annual	

						population. (Reference: ESPON ATTREG)	ation establishments									
12	measuring coping capacity	Social system	Financial capital	Tourism	Tourist accommodation capacity	Total number of bed places. (Reference: ESPON ATTREG)			Number	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/tour_cap_nuts3/default/table?lang=en	2007 - 2011	NUTS3	EU-27	Annual	
13	measuring coping capacity	Social system	Human capital	Education	Highly educated working age persons	Average proportion of people aged 15 and above with tertiary education (level 5-8) (Reference: ESPON ATTREG)	A) Population in age group 15-65 years with tertiary education B) Population in age group 15-65 years	A/B*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/lfst_r_lfe2eedu/default/table?lang=en	2017 - 2021	NUTS2	EU-27	Annual	
14	measuring adaptative capacity	Ecological system	Natural capital	Natural heritage	Quality of natural landscape based on Natura 2000 sites	Perc. share of Natura 2000 sites within the NUTS2 or NUTS3 region (Reference: ESPON ATTREG)	A) area of NUTS2 or NUTS3 region B) area of NATURA 2000 sites within the NUTS2 or NUTS3 region	A/B*100	Percent	Yearly	EEA	https://www.eea.europa.eu/data-and-maps/data/natura-14	2011-2021	1:100000	EU-27	Annual	
16	measuring sensitivity	Social system	Human capital	Education	Early leavers from education and training	Percentage of early leavers from education and training, age group 18-24	A) Population age group 18-24 with highest level of education or training attained ISCED 0, 1, 2 or 3c short and respondents declared not having received any education or training	A/B*100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/edat_lfse_16/default/table?lang=en	2017 - 2021	NUTS2	EU-27	Annual	

							in the four weeks preceding the survey B) Total population age group 18-24										
17	measuring coping capacity	Technical system	Built capital	Infrastructure	Available beds in hospitals	Number of hospital beds per 100 000 inhabitants (Reference: ESPON TITAN)	A) Number of hospital beds in NUTS2 region B) population in NUTS2 region	A/(B/100 000)	per 100 000 inhabitants	Yearly	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/hlth_rs_bdsrg/default/table?lang=en	2017 - 2021	NUTS2	EU-27	Annual	
19	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Landslide susceptibility	European Landslide Susceptibility Map version 2 (ELSUS v2)	The map has been produced by regionalizing the study area based on elevation and climatic conditions, followed by spatial multi-criteria evaluation modelling using pan-European slope angle, shallow sub-surface lithology, and land cover spatial datasets as the main landslide conditioning factors. In addition, the location of over 149,000			irregular	JOINT RESEARCH CENTRE European Soil Data Centre (ESDAC)	https://esdac.jrc.ec.europa.eu/content/european-landslide-susceptibility-map-elsus-v2	2018	1:200 000	EU-28 except Malta	irregular	

							landslides across Europe, provided by various national organizations or collected by the authors, has been used for model calibration and map validation										
22	measuring sensitivity	Technical system	Built capital	Tangible CH	Historical building stock	Approximated by the ratio between the number of dwellings built before 1919 and the total number of dwellings (Reference: ESPON HERIWELL)	A) number of dwellings build before 1919 B) total number of dwellings	A/B*100	Percent	irregular	Eurostat	https://ec.europa.eu/eurostat/web/population-demography/population-housing-censuses/information-data	2011, 2021	NUTS3	EU-27	irregular	
23	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Land Uses, Patterns, Clusters	CORINE Land Cover: inventory of land cover in 44 classes	Classification in 44 different land cover classes (artifical surfaces, agricultural areas, forest & seminatural areas, wetlands, water bodies)		Classification	Every six years	Copernicus Land Monitoring Service	https://land.copernicus.eu/pan-european/corine-land-cover	2000, 2006, 2012, 2018	1:250 000	EU-27	Every six years	
24	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Imperviousness	Imperviousness maps, either as status layers (impervious density and impervious built-up) or change layers	Impervious density: percentage of sealed area; impervious built-up: binary product and sub-group of sealed areas		Percent	From 2006 to 2018 every 3 years	Copernicus Land Monitoring Service	https://land.copernicus.eu/pan-european/high-resolution-layers/imperviousness	2006, 2009, 2012, 2015, 2018	10m and 100m pixel size for 2018 product	EU-27	Every 3 years until 2018	

25	measuring coping capacity	Technical system	Built capital	Infrastructure	Internet access	access to and use of ICTs by individuals/household (household survey). Considers households having at least one member in the age group 16 to 74 years old (based on INFORM risk index indicators)			Percent	annually since 2002	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_in_h/default/table?lang=en	2002-2023	NUTS 1 and NUTS 2	EU-27	yearly	
26	measuring sensitivity	Technical system	Built capital	Infrastructure	Classification as inner periphery	Based on ESPON PROFECY method either as "lack of access", "poor economic potential" or "combination of both"	various		Classification	static	ESPON Profecy	https://database.espon.eu/search/?f=topics_exact:Territorial%20Structures%20and%20Land%20Use	depending on data set between 2000 and 2016	grid, 2.5 x 2.5 km	EU-27	static	
27	measuring adaptative capacity	Social system	Financial capital	Economy	Environmental protection investments of total economy	Environmental protection expenditure accounts (EPEA) describe, in a way consistent with the European System of Accounts (ESA), transactions related to prevention, reduction and elimination of pollution and of any other degradation of the environment.			million euro	annually	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/env_ac_epite/default/table?lang=en	2012-2021	NUTS0	EU-27	Annual	
28	measuring coping capacity	Technical system	Built capital	Infrastructure	Physicians or doctors	number of physicians or medical doctors per hundred thousand inhabitants (access to healthcare based on INFORM risk index indicators)			per thousand inhabitants	annually	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/tgs00062/default/table?lang=en	2010-2021	NUTS2	EU-27	annual	
29	measuring adaptative capacity	Social system	Social capital	Governance	National adaptation strategies	developing and implementing national adaptation strategies (NASs) and plans (NAPs)(based on risk data hub)	adoption of NAS and NAPs	Member States report to the Commission information on their national adaptation actions	number	every two years since 2021	ClimateAdapt	https://climate-adapt.eea.europa.eu/en/countries-regions/countries	2021	NUTS0	EU-27	bi-annually	
30	loss	Social system	Financial capital	Economy	Climate related economic loss	The indicator measures the economic losses from weather and climate-related events. Weather and climate-related events are defined as			million euro	annually	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/cli_iad_loss/default/table?lang=en	2011-2020	NUTS0	EU-27	annual	

						meteorological events (storms), hydrological events (floods, mass movements) and climatological events (heatwaves, cold waves, droughts, forest fires).											
31	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Suite of products (land use, population, street trees)	Integration of several Copernicus data (land cover, population estimates, street trees)	Qualitative classes		Classification	From 2006 to 2018 every 6 years	Copernicus Land Monitoring Service	https://land.copernicus.eu/local/urban-atlas	2006, 2012, 2018	0,25 ha in urban areas, 1 ha in rural areas	EU-27	Every 6 years until 2018	
32	measuring sensitivity	Social system	Social capital	Demographics	Lone-pensioner households	Dataset on proportion of lone-pensioner households (older people living alone)	Older people living alone		Percent	not planned	EEA	https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/872ebd21-e550-427f-a5fd-d43097f016c5	2014	1:100 000	EU-27	not planned	
33	measuring sensitivity	Social system	Social capital	Demographics	People born in another country	People born in a different country to the country of residence may be more vulnerable to climate-related hazards (e.g. language knowledge, familiarity with the area and the specificity of climate related hazards; often live in rented accomodation)	People born in a different country to the country of residence		Percent	not planned	EEA	https://sdi.eea.europa.eu/catalogue/srv/eng/catalog.search#/metadata/b636bcdb-93bb-49f0-bec3-9e0275b561ee	2014	1:100 000	EU-27	not planned	
34	damages	Ecological system	Natural capital	Topography and morphology	Affected areas due to an extreme event	Rappid Mapping as part of the Copernicus Emergency Management Service (CEMS) provides geospatial information within hours or days from the activation in support of emergency management activities immediately following a disaster.	Standards products contain: identification of most affected areas, geographical extent, severity of damage		.-	Service is provided on demand	Copernicus Emergency Management Service (CEMS)	https://emergency.copernicus.eu/mapping/ems/emergency-management-service-mapping	-	-	EU-27	Service is provided on demand	
35	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Topography	EU-DEM v1.0 is a digital surface model (DSM) of EEA39 countries representing the first surface as illuminated by the sensors. Can by used e.g. for river analyses,	Digital elevation		not mentioned, presumably elevation in m	not mentioned	Copernicus Land Monitoring Service	https://land.copernicus.eu/imagery-in-situ/eu-dem	-	Pixel size 25 m	EU-27	not mentioned	

						flood modelling, flood risk management.											
36	damages	Ecological system	Natural capital	Topography and morphology	Flood delineation	The flood delineation product provides a comprehensive assessment of the flood event. The product is directly derived from image data acquired as soon as possible after the emergency event and consists of an observed water extent.	Observed water extent	Derived from the best available SAR (VHR and HR) with optical sources as support, if needed	Flood delineation, water depth, normal water levels	Service is provided on demand	Copernicus Emergency Management Service (CEMS)	https://emergency.copernicus.eu/mapping/ems/p04-flood-delineation	-	1:25 000	EU-27	Service is provided on demand	
38	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Degree of urbanisation	This dataset presents the refined version of the degree of urbanisation of European countries. The degree of urbanisation relies on a population grid to classify local units. The final classes of the refined degree of urbanisation dataset are six, namely 1) cities, 2) towns, 3) suburbs, 4) villages, 5) dispersed rural areas and 6) mostly uninhabited areas. The temporal reference is set between 2011 and 2012 because of the main inputs, the GEOSTAT population grid 2011 and the European Settlement Map 2012 from Copernicus.	GEOSTAT population grid 2011 and the European Settlement Map 2012 from Copernicus.		Classification	static	EEA	https://www.eea.europa.eu/en/datahub/datahubitem-view/a5857b35-9d27-4d42-94b7-4d141ee5b550	2011/2012	grid, 1 x 1 km	EU-28 + others	not planned	
39	measuring adaptative capacity	Social system	Financial capital	Tourism	Tourism Carrying Capacity	Tourism Carrying Capacity" is defined by the World Tourism Organization as "The maximum number of people that may visit a tourist destination at the same time, without causing destruction of the physical, economic,	Mix of 5 quali/quantitative indicators. we used an advanced methodology beyond the WTO one, since				N/A						Local sources: administrative data

						socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction	the complexity of the site.										
40	measuring sensitivity	Technical system	Built capital	Buildings	Settlements	the objective of the "Global Urban Footprint" (GUF) project is the worldwide mapping of settlements with unprecedented spatial resolution of 0.4 arcsec (~12 m)	Classification of Land Cover into "Urban Areas", "Land Surface", "Water"		Classification	static	German Earth Observation Center	https://www.dlr.de/eoc/en/desktopdefault.aspx/tabid-9628/16557_read-40454/	2011/2012	0.4 arc seconds (~12 m, near the equator)	Global	not planned	
41	measuring sensitivity	Technical system	Built capital	Buildings	Percentage of rented houses	measures the loss of seasonal social capital			Percent	Yearly	N/A						Local sources: administrative data
42	measuring adaptative capacity	Ecological system	Natural capital	Agriculture	Surface cultivated with vineyards	one of the main attributes of the UNESCO landscape, measure the variation of its presence			Hectares	Yearly	N/A						Local sources: administrative data
43	measuring adaptative capacity	Ecological system	Natural capital	Agriculture	Surface cultivated with olive trees	one of the main attributes of the UNESCO landscape, measure the variation of its presence			Hectares	Yearly	N/A						Local sources: administrative data
44	measuring coping capacity	Social system	Financial capital	Economy	Total number of farm business	Total number of farm business (agriculture or agriculture+livestock) per municipality.	Number of farm business registered in the census.	N/A	Number	10 years	N/A						National Agrarian Census
45	measuring coping capacity	Ecological system	Natural capital	Agriculture	Crops surface	Crops surface per municipality. Included land uses: farm lands (TA,TH, IV) and permanent crops (CF, CS, CV, FF, OC, CI, FY, FS, FL, FV, OV, OF, VI, VF, VO). Excluded: Pastures (PS, PR, PA) , Forests (FO), Non agricultural surfaces (...) and Others (...).		N/A	Hectares	10 years (agrarian census) Yearly (SIGPAC)	N/A						National Agrarian Census
46	measuring sensitivity	Social system	Social capital	Diversity	Farm business with owner/manager	Number of farm business with owner/manager over 65, in relation to the		(Number of farm business with owner-manager over	Percent	10 years	N/A						National Agrarian Census

					over 65 years old	total number of farm business per municipality.		65/Total number of farm business in the municipality)* 100									
47	measuring coping capacity	Social system	Human capital	Training	Farm business with owner/manager with full-time commitment/contract	Number of farm business with owner/manager with full-time commitment/contract throughout the year, in relation to to the total number of farm business per municipality.		(Number of farm business with owner-manager full-time commitment/contract / Total number of farm business in the municipality)* 100	Percent	10 years	N/A						National Agrarian Census
48	measuring coping capacity	Ecological system	Natural capital	Agriculture	Average hydric resources for crops	Total municipal hidric resources in relation to the crops' surface.	A) Municipal hidric resources B) Crops' surfaces at municipoal level	∑ for each kind of crop: (Hidric resources per crop*Crop surface)/Total crop's surface by municipalty	m3/ha/ year	Yearly	N/A						Ministry of environment
49	measuring sensitivity	Social system	Financial capital	Economy	Agricultural unemployment rate	Number of job seekers (unemployed) in the agricultural sector per municipality, related to the total number of people afiliated to the agricultural sector (active an unemployed)	A) Number of unemployed people in the agricultural sector at municipal level. B) Number of people affiliated to the agricultural sector at municipal level.	(Number of unemployed in the agricultural sector/Number of unemployed in the agricultural sector + Number of affiliated to the agricultural sector) * 100	Percent								CNAE (National Clasificati on for Economic Activities)
50	measuring coping capacity	Social system	Financial capital	Economy	Social Security affiliation in Agriculture	Number of people affiliated to Social Security in the agriculture sector per municipality related to the total number of affiliated people (agriculture, industry,		(Number of people affiliated to Social Security in the agriculture sector/ Number of	Percent	Every 3 months	N/A						Social Security National Treasury

						construction and services).		people affiliated to Social Security) * 100.									
51	measuring adaptative capacity	Social system	Social capital	Governance	Land tenure system	Area owned out of the total per municipality.	A) Area owned B)Total area by municipality	Surface of land registered as property / Total surface of the municipality*100	Percent	10 years	N/A						National Agrarian Census
53	measuring adaptative capacity	Ecological system	Natural capital	Agriculture	Diversification of agricultural activities	Number of farms with mixed activity: agriculture + livestock in relation to the total number of farms by municipality.		(Number of farms with mixed activity: agriculture + livestock / Total number of farms in a municipality)* 100	Percent	10 years	N/A						National Agrarian Census
54	measuring transformative capacity	Ecological system	Natural capital	Agriculture	Organic farming activities	Number of organic farms in relation to the total number of farms by municipality.		(Number of organic farms/Total number of farms in a municipality)* 100	Percent	10 years	N/A						National Agrarian Census
55	measuring coping capacity	Ecological system	Natural capital	Agriculture	Area with arable crops	Percentage of arable crops (cereals for grain, pulses, tubers, industrial crops, flowers and ornamentals, fodder crops, vegetables, nurseries) in relation to total crops (arable crops + other crops)		(Suface of arable crops/Surface of total crops) * 100	Percent	10 years	N/A						National Agrarian Census
56	measuring coping capacity	Ecological system	Natural capital	Natural heritage	Protected Areas Surface	Percentage of protected agricultural areas (PAT Huerta. Protected levels 1-3: H1, H2 and H3) in relation to the total agricultural surface of the municipality.		(Agricultural surface with some kind of protection/Total agricultural surface by municipality) *100	Percent		N/A						SIGPAC + Territorial Action Plan Huerta (Huerta Law)
58	measuring transformative capacity	Social system	Social capital	Diversity	Parity in farm managers	Difference between both sexes considering farm managers.		Formula: 0.5-((0.5 - ABS(0.5 - WOMEN /	.-	10 years	N/A						National Agrarian Census

								(WOMEN + MEN)))/0.5)									
59	measuring adaptative capacity	Social system	Human capital	Education	Farm manager with agricultural studies	Number of farms with a trained farm manager (profesional agrarian studies, university agrarian studies, and others) related to the total numer of farms in the municipality.		(Number of farms with a trained farm manager/ total numer of farms in the municipality)* 100	Percen t	10 years	N/A						National Agrarian Census
61	measuring adaptative capacity	Social system	Financial capital	Economy	Municipal budget	Municipal budget in relation to the number of inhabitants of each municipality.	A) Municipal budget B) Number of inhabitants of the municipality	(Municipal Budget/Numb er of inhabitants of the municipality)* 100	Percen t	Yearly	N/A						Ministry of Territory and Public Funtions.
62	measuring sensitivity	Technical system	Built capital	Tangible CH	Heritage density: Number of designated or formally listed natural and cultural sites and intangible heritage per area	The indicators offers a generic picture on the measures taken by public authorities to protect, safeguard and manage heritage through their inclusion and recognition in inventories, lists or registers.	A)Number of natural heritage sites B)Number of tangible cultural heritage sites (buildings, monuments , group of buildings/co mplex, assets, route, etc.) C)Number of intangible heritage D) Total Area	(A + B + C) / D	Numbe r/km2	5 years	UNESC O National & Regional /Local Cultural Heritage Departm ents National & Regional /Local Environ ment Departm ents National/ Regional Statistics Office						
63	measuring coping capacity	Technical system	Built capital	Tangible CH	Existence of sites with recognised international designation (WHS, GIAHS, Capital of Culture, Cultural route)	Contributes to assess the attractive feature of the designated site according to well-established brands based on the authentic value of culture and heritage	A)World Heritage Sites B)Globally Important Agricultural Heritage Systems C)European	A+B+C+D+E	Numbe r	5 years	UNESC O (WHS) United Nations-FAO (GIAHS) Europea n Commis	https://eu-commission.maps.arcgis.com/apps/MapJournal/index.html?appid=e3e538d4e4b743c8a6bc7a363fbc2310			Global		

							Capital of Culture D)Cultural Route E)Others				sion (CC) Council of Europe (CR)						
64	measuring adaptative capacity	Technical system	Built capital	Buildings	Number of cultural facilities open to the public and aiming at promoting arts and culture per population	Contributes to measure the cultural infrastructure in relation to the population and how the destination offers diverse cultural participation opportunities.	A) Number of museums and art galleries B) Number of cinema C) Number of music venues (concert halls, clubs, etc.) D) Number of theatres E) Number of libraries or archives F) Number of exhibition halls G) Number of conference or conventions centres H) Others I) Total population	(A+B+C+D+E+G+H) / I	Facilities per population	Yearly	N/A						National, regional and local sources: administrative data, information systems for culture when available
65	measuring adaptative capacity	Social system	Social capital	Intangible CH	Availability of products with designation of origin or geographical indications (PDO, PGI), traditional specialties guaranteed (TSG)	The indicators offers a generic picture on the measures taken to protect the names of specific products and to promote their unique characteristics, linked to their geographical origin as well as traditional know-how.	A) Protected Designation of Origin B) Protected Geographical Indication C) Traditional Specialties Guaranteed	May be qualitative (scale): 1) No products potentially subject of designation available in the area 2) Products are available but no designation in place	Number	Yearly	EU geographical indications register	https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/					

								3) Products are available and under designation process 4) Products with designation exist and are identified by a consolidated brand"									
66	measuring transformative capacity	Social system	Human capital	Training	Capacity building/ training activities/ mentoring opportunities promoted by institutions for improving cultural knowledge	This indicator aims to assess the way in which cultural knowledge awareness is considered as part of local communities' involvement and stakeholders' engagement	Qualitative assessment based on multiple choice scale on training opportunities for improving cultural knowledge	1) No training or capacity building program on the topic exist 2) Some training and capacity building initiatives are under development or exist as ad hoc content provision 3) Some training and capacity building initiatives exist but is specific to some heritage 4) Training and capacity building initiatives is available for all heritage and involves all relevant stakeholders and the whole community	Number	Yearly	N/A						National, regional and local sources: administrative data, information systems for culture when available, Ministries, Educational institutions and training centers
68	measuring transformative capacity	Social system	Financial capital	Tourism	Existence of adopted visitors' management plans that address	The World Heritage Committee acknowledge the increase of properties negatively affected by	Qualitative (scale): 1) No visitor management plan		Number	Yearly	N/A						National, regional and local sources: administr

					seasonality of tourism and carrying capacity of properties	inadequate visitor management and tourism infrastructure development (Decision of the World Heritage Committee 42 COM 7-2018) and requests the development of Visitor Management Plans that assess appropriate carrying capacity of properties for visitors and address the issue of unregulated tourism. Despite the decision is related to World Heritage Sites, it can be applicable to destinations with cultural and heritage site, contributing to a stronger management of the area..	(VMP) exists 2) VMP exists but does not address seasonality of tourism and carrying capacity 3) VMP exists that addresses seasonality and carrying capacity, but it has not yet been implemented 4) VMP exists, fully cover the specific problematic of the area and is continuously monitored									ative data, information systems for culture when available
69	measuring adaptative capacity	Social system	Financial capital	Economy	Resources allocated to public space and pathways maintenance, improvement and accessibility, including installation of equipment for cultural use	Aims to monitor the amount of actual public spending on public space and pathway maintenance and improvement, as part of the quality of the environment and citizens wellbeing	Expenditure for space and pathways maintenance and improvement		euro/year	Yearly	N/A						National, regional and local sources: administrative data
70	measuring sensitivity	Technical system	Built capital	Tangible CH	Number of endangered cultural and natural heritage sites	Aims to assess the evolution of the number of endangered cultural and natural sites for which urgent and counteractive measures are needed. Threats can be associated to	A) Number of historic buildings, monuments or sites in bad state of conservation or		Number	Yearly	WHC in danger Europanostra	https://whc.unesco.org/en/danger/#:~:text=The%2055%20properties%20which%20the,(4)%20of%20the%20Convention. https://www.europanostra.org/11-european-heritage-sites-shortlisted-for-the-7-most-					Additional local sources

						climate change, pollution, demographic changes, abandonment, among others	included in endangered lists					endangered-programme-2023/					
72	measuring adaptative capacity	Social system	Financial capital	Economy	Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage	The number of expenditures devoted to preserving, protecting and conserving cultural and natural heritage. It measures the financial action by public authorities, the site level, alone or in partnership with civil society organizations (CSO) and the private sector, to protect and safeguard cultural and natural heritage. It has a direct impact on safeguarding heritage. This indicator is a proxy to measure the Target. (Source: Culture 2030 (UNESCO, 2019)	A) Expenditure spent on the preservation (Exp_PU+Expe_Pr) B) Population	A/B	Euro	Yearly	N/A						UNESCO data: UIS National and local sources: National Statistical Institutes, Administrative data, Specific national surveys and Information systems for culture when available
73	measuring transformative capacity	Social system	Social capital	Social value	Percentage of enterprises / establishments using a voluntary certification / labelling for environmental / quality / sustainability and/or Corporate Social Responsibility	It looks to measure how local enterprises and establishments face environment maintenance in their daily activities.	A) Number of enterprises using a voluntary certification for the environmental quality B) Total number of enterprises in the area	A / B * 100	Percent	Yearly	N/A						Local sources: administrative data
74	measuring transformative capacity	Technical system	Built capital	Infrastructure	Percentage of cultural facilities and sites accessible by public transport or other environmentally friendly transport or cycle tracks	This indicator aims to monitor the green infrastructure and transportation facilities in a site, which will lead to a more sustainable tourism activity.	A) Number of cultural facilities accessible by bike/scooter /public transport B) Number of built cultural heritage	(A + B) / C * 100	Percent	Yearly	N/A						Local sources: administrative data (culture, torusim)

							sites accessible by bike/scooter /public transport C) Total cultural facilities and heritage sites										
75	measuring sensitivity	Social system	Financial capital	Tourism	Number of days in a year in which maximum tourism carrying capacity has been exceed	The indicator aims to measure the sustainability of the tourist presence, aiming to address mass presence of tourists which, in the long-term, would definitely damage the environment.	Carrying capacity needs to be defined per site A) Counting times, the carrying capacity is exceeded can be done either manually, either via ICT tools	A	Numbe r	Yearly	N/A						Local sources: administr ative data
76	measuring coping capacity	Social system	Financial capital	Tourism	Net occupancy rate in accommodation per season (quarterly)	It measures the volume of occupancy in accommodation per year or quarterly. It is useful to cope with seasonality	1) Occupation rate / monthly/qu arterly	The occupancy rate of bed places in reference period is obtained by dividing the total number of overnight stays by the number of the bed places on offer (excluding extra beds) and the number of days when the bed places are actually available for use (net of seasonal	Percen t	Yearly	Eurostat	https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tourism_statistics_-_annual_results_for_the_accommodation_sector#:~:text=Comparing%20the%20capacity%20data%20in,percentage%20points%20compared%20with%202019.					

								closures and other temporary closures for decoration, by police order, etc.). The result is multiplied by 100 to express the occupancy rate as a percentage.									
77	measuring adaptative capacity	Social system	Financial capital	Economy	Employment rate in cultural sector	It represents the percentage of people employed in cultural occupations - in the cultural and creative sectors and cultural occupations of overall employment for the latest year. This indicator aims to assess the role of culture as an "employer" at the national and local level as well (Culture 2030, 2019).	A) Total number of people employed in cultural occupations according to the selected International Standard Classification of Occupations (ISCO) codes or ISIC codes) https://ilostat.ilo.org/ ""Persons working in economic activities that are deemed cultural, irrespective of whether the person is employed in a cultural occupation. It also covers persons with a cultural	(CEIsco (A) / EP (B)) * 100	Percent	Yearly	Eurostat	https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics_-_cultural_employment					

							occupation, irrespective of whether they are employed in a cultural economic activity. Cultural employment is defined in terms of the statistical classification of economic activities in the European Community (NACE Rev. 2) and by the international standard classification of occupations (ISCO)- Eurostat" B) EP is the total number of the employed population.										
78	measuring transformative capacity	Social system	Financial capital	Economy	Percentage of Gross Domestic Product attributable to private and formal cultural production	It assesses the overall contribution of the culture sector to the economy in a given territory. One limitation of this indicator is that it is not able to take into account all cultural activities, that is, the informal and unpaid ones. It aligns with the international classification of the Framework for Cultural	A) GVA is (GDP + subsidies – (direct, sales) taxes) B) GDP	Add the values obtained using the ISIC statistic codes include in the UIS Framework for Cultural Statistics (UNESCO-UIS 2009, pp. 52-64) then compare this	Percent	Yearly	International Standard Industrial Classification (ISIC), or compatible business output data. UNESCO FCS:						

						Statistics. (Culture 2030, 2019).		sum with the gross domestic product (GDP) of the local economy.			The indicator is now applied to all codes identified as part of the culture and creative economy to offer a disaggregation of the results by all cultural domains						
79	measuring transformative capacity	Social system	Financial capital	Economy	Exports of PDO (Protected Denomination of Origin) or PGI (Protected Geographical Indication) as a percentage of all regional sale	Exports of cultural goods (as expressions of culture are exported reflecting both the economic demand, the international profile of the site) that have obtained PDO and PGI registration. It measures the contribution of the local products or processes to the regional economic development. (REF: https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/quality-schemes-explained_en)	A) Exports of PDO, PGI B) All regional sales	A/B * 100	Percent	Yearly	UNESCO data: UIS National or local sources: COMTRADE database (comtrade.un.org).	https://ec.europa.eu/commission/presscorner/detail/en/IP_20_683					
81	measuring sensitivity	Social system	Financial capital	Tourism	Houses used for official accommodation activities	used to measure the depopulation, seasonality of residents, and loss of human capital			n, %	Yearly	N/A						Local sources: administrative data
82	measuring sensitivity	Social system	Financial capital	Tourism	Owned houses with summer use only	used to measure the depopulation, seasonality of residents,			n, %	Yearly	N/A						Local sources: administrative data

						and loss of human capital											
85	measuring sensitivity	Ecological system	Natural capital	Agriculture	Percentage of abandonment of terraces on the total terraced area	maintenance of site values (agriculture/terraces)			Percent	Yearly	N/A						Local sources: administrative data
87	measuring sensitivity	Ecological system	Natural capital	Agriculture	Percentage of terraced vineyards on the total land used for viticulture	maintenance of site values (agriculture)			Percent	Yearly	N/A						Local sources: administrative data
88	measuring adaptative capacity	Social system	Financial capital	Economy	Funds spent in initiatives aimed at raising awareness among tourists and the local population	awareness of site values and weaknesses			euro/year	Yearly	N/A						Local sources: administrative data
90	measuring sensitivity	Social system	Financial capital	Economy	Average housing prices	Annual change in house prices.	A) Price per squaremeter B) Number of sold properties	A/B	Number/km2		National/ Regional	https://ec.europa.eu/eurostat/databrowser/view/tipsho40/default/table?lang=en					
91	measuring sensitivity	Social system	Financial capital	Economy	Annual income	Annual income rate among residents	A) Income by population B) Number of inhabitants	A/B	Euro	Yearly	N/A	https://ec.europa.eu/eurostat/databrowser/view/earn_nt_net/default/table?lang=en					Local sources: administrative data
92	measuring coping capacity	Technical system	Built capital	Buildings	Number of properties	Total number of properties (including new built)	Total		Number	10 years	N/A						Local sources: administrative data
93	measuring sensitivity	Social system	Social capital	Demographics	Households with one or more retired persons as a percentage of total households				Percent		Eurostat	ec.europa.eu/eurostat/databrowser/view/HBS_CAR_T311__custom_6130248/default/table?lang=en					
94	measuring transformative capacity	Social system	Social capital	Diversity	Gender employment gap	The indicator measures the difference between the employment rates of men and women aged 20 to 64			Percent		Eurostat	https://ec.europa.eu/eurostat/cache/metadata/en/sdg_05_30_esmsip2.htm					

95	measuring coping capacity	Technical system	Built capital	Infrastructure	Number of strategic buildings	It measures the number of buildings of strategic relevance (i.e. schools, gym, hospitals, …) to host exposed elements during post-disaster phase.	Strategic Buildings	Total sum	Number	10 Years	Regional and Local Geo-catalogs, OpenStreetMap			NUTS 3	Global		Regional and Local geocatalog, OpenStreetMap Data
96	measuring coping capacity	Technical system	Built capital	Infrastructure	Number of emergency operators	It counts the number of operators involved in emergency situations (i.e. civil protection, fire-fighters, rescuers, …)	Emergency operators	Total sum	Number	Yearly	N/A			NUTS 3	Europe	Yearly	Regional Authority (e.g. Portugal CCDR-N)
97	measuring adaptative capacity	Ecological system	Natural capital	Agriculture	Permanent cultivations surface	It includes the mediterranean cultivations , such as almonds, olive trees and vineyards. This indicator contributes to measure the elements that characterize both agriculture tradition and landscape composition.	A) Almonds trees surface, B)Olive trees surface, C)Vineyards surface, D) Cork, ...	A+B+C	Hectares	Yearly	Copernicus Corine Land Cover			NUTS 2, NUTS 3	Europe	3 Years	Regional Authority geo-catalog
98	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Precipitation variation	It measures the variation of precipitation in a defined time period (e.g. 1988-2012)	A) Precipitation at time 0, B)Precipitation at time 1	PV(Tn)-Pv(t1)	mm/year	10 Years	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/env_wat_res/default/table?lang=en	2012-2020	NUTS3	Europe	Yearly	National and regional environmental Authorities (e.g. IT ISPRA, ARPA)
99	measuring adaptative capacity	Ecological system	Natural capital	Agriculture	Number of PDO/PGI agriculture firms	The indicator counts the agriculture firms that produce excellences of EU agriculture food production (Protected Designation Origin, Protected Geographical Indication)	PDO/PGI agriculture firms	Total sum	Number	10 Years	N/A					10 Years	National Agriculture Census
100	measuring transformative capacity	Ecological system	Natural capital	Agriculture	Number of Bio agriculture firms	The indicator counts the bio agriculture firms in the considered territory	Bio agriculture firms	Total sum	Number	10 Years	N/A		2010-2020, every 10 Years			10 Years	National Agriculture Census
101	measuring coping capacity	Social system	Social capital	Diversity	Number of young farmers	It counts the number of young farmers (21-36 y.o.). They represent a generational renovation between the inheritance	Young farmers	A) Count, B) PDO-PGI firms/total agriculture firms	Number	6 Years	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/EF_M_FARMANG__custom_6129620/default/table?lang=en	2010-2020, every 10 Years			6 Years (programming period)	National/ Regional lists for accessibility to program

						of traditions and innovations.											mes funding
102	measuring adaptative capacity	Social system	Social capital	Governance	Participation of Municipalities in rural development projects	It considers the Municipalities participation in projects in the context of rural development programs (e.g. LEADER, INTERREG, national programs not included in the previous ones)	Participation in rural development projects: A) LEADER programmes	Total sum	Number	6 Years	N/A					6 Years (programming period)	National lists
103	measuring transformative capacity	Social system	Social capital	Governance	Number of bottom-up projects presented by citizens	The indicator refers to initiatives led by citizens in increasing the quality of urban and rural life	Citizens bottom-up projects	Total sum	Number	3 Years	N/A						Local sources: administrative data
104	measuring transformative capacity	Social system	Social capital	Governance	Projects on landscape and CH included in the NEXT Generation EU	It counts the projects presented to achieve the NEXT Generation EU for Recovery and Resilience	NEXT Generation EU Projects	Total sum	Number	Yearly	N/A		2021-Ongoing	European, National, Regional, Provincial, Local	Europe	Yearly* until the exinction of the fund	Regional lists
105	measuring adaptative capacity	Social system	Financial capital	Economy	Municipal financing for Cultural Heritage	It extracts from f the municipal budget finalised to conserve, preserve, valorise and manage cultural assets	Municipal financing for Cultural Heritage	Euro	euro/year	Yealry	N/A						Municipality website
106	measuring transformative capacity	Technical system	Built capital	Energy	Production of biological energy	The indicator measures the bio-energy produced by a Landscape Unit	A) BTC values (Mcal/sqm*y), B) Biotopes surface (sqm)	Summarizing the product of the surfaces of the j-th biotopes of the i-th LU with the related BTC value	Dimensionless [0, 1]	2-3 Years	Corine Land Cover by Copernicus Project						Parameter computed after Ingegnoli (2002) and Gobattoni et al. (2011). Regional geo-catalog for surfaces
107	measuring adaptative capacity	Ecological system	Natural capital	Green and blue infrastructure	Green areas of high ecological quality	It considers the incidence of green areas with BTC index higher than 2,4 Mcal/m2 * year (the value depends on the EU	A) Biotopes surface with BTC greater than 2.4 Mcal/sqm*y	A/B	Dimensionless [0, 1]	2-3 Years	Corine Land Cover by Copernicus Project						Computed after Gobattoni et al., (2011) Regional

						bioregion) with respect to the total surface of the LU.	, B) Total surface of the LU										geo-catalog for surfaces
108	measuring sensitivity	Ecological system	Natural capital	Topography and morphology	Dispersion of urban areas	It measures urban fragmentation that impact negatively on landscape ecology connectivity	A) Perimeter of the LU, B)Perimeter of urban fabric	A/B	Dimensionless [0, 1]	2-3 Years	Corine Land Cover by Copernicus Project						Computed after Gobattoni et al., (2011) Regional geo-catalog for surfaces
109	measuring transformative capacity	Ecological system	Natural capital	Green and blue infrastructure	Ecological diversity (Shannon-Evenness index)	It considers the degree of heterogeneity of landscape-ecological mosaic. When the value is near to 1, it means the landscape composition is homogeneous and this favours the continuity and conservation, whereas when the value is near to 0 this means there is a high landscape diversity	Shannon-Evenness index	Shannon-Evenness equation adapted by Finotto (2011) for ecologicl planning studies	Dimensionless [0, 1]	2-3 Years	Corine Land Cover by Copernicus Project	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=mapview					Computed after Finotto (2011), Regional geo-catalog for surfaces
110	measuring transformative capacity	Ecological system	Natural capital	Green and blue infrastructure	Nature Based recreation potential	It descibes the use and potential for nature based recreation	Share of 'areas for daily recreation'	Extent of service providing areas: 'areas for daily recreation' (high opportunities for recreation and close to urban areas and roads, ha)	Percent	N/A	Ecosystem Account map	https://ecosystem-accounts.jrc.ec.europa.eu/map	2012				
111	measuring adaptative capacity	Ecological system	Natural capital	Green and blue infrastructure	Habitat and species maintenance	It describes habitat suitability and specieis hotspots based on ecological conditions and parameter and it is further assessed through monetary value	Willingness to pay of households for maintaining current habitat and species maintenance service areas 2018	The biophysical modelling of habitat suitability was run for two different points in time – 2000 and 2012 – to assess	Euro		Ecosystem Account map	Raw data: https://data.jrc.ec.europa.eu/dataset/4cbd7c1e-6512-4ebe-8ca5-e08209cc3efb; Map: https://ecosystem-accounts.jrc.ec.europa.eu/map	2000-2018		Regional, Provincial, Local		

							(€/100 km2) + stated preference survey	changes over this period									
112	measuring coping capacity	Ecological system	Natural capital	Green and blue infrastructure	Run-off retention/Flood control	1) Curve Number method to determine the amount of runoff as function of the land cover and hydrogeological soil characteristics 2) Correction by imperviousness 3) Slope adjustment 4) Semi-natural, land covers, riparian zones	A) Hydrogeological characteristics, B) Land use categories and associated curve numbers C) Impervious area	ArcView GIS extension by Halley et al.	Dimensionless [0, 1]	2-3 Years	Corine Land Cover by Copernicus Project	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=mapview; https://ecosystem-accounts.jrc.ec.europa.eu/map					Regional and Basin authorities geo-catalogs
113	measuring coping capacity	Ecological system	Natural capital	Green and blue infrastructure	Global climate regulation - Carbon sequestration	It describes the value of ecosystem accounts of C sequestration as a proxy of global climate regulation	CO2 uptake per diverse type of land use (ecosystem types)		euro/km2	N/A	Ecosystem Account map	https://ecosystem-accounts.jrc.ec.europa.eu/map			Regional, Provincial, Local		
115	measuring coping capacity	Social system	Social capital	Governance	Number of forestry consortiums	It indicates the presence of consortiums of forestry management. their presence and intervention on the land is important both to limit fire and flood risk and to dominate pest species that can compromise agricultural areas.	Forestry consortiums	Total sum	Number	Yearly	Corine Land Cover by Copernicus Project	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=mapview			Regional, Provincial, Local	Yearly	Regional forestry planning
116	measuring adaptative capacity	Ecological system	Natural capital	Green and blue infrastructure	Forestry viability / Firebreak roads	It measures the lenght of forestry roads for fire rpevention and management	Forestry viability / Firebreak roads	Total lenght	Linear Kilometers	5 Years	Corine Land Cover by Copernicus Project	https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=mapview					OpenStreetMap Data
119	damages	Ecological system	Natural capital	Topography and morphology	Number of fire events in a considered time period	It counts the fire events happened in a defined territory	Fire events	Total sum	Number	Yearly	EFFIS - European Forest Fire Information System	https://effis.jrc.ec.europa.eu/apps/effis.statistics/estimates	2006-2022				Regional geo-catalog

120	damages	Ecological system	Natural capital	Natural heritage	Fire-ridden areas	It measures hectares of forests that have been destroyed by fires in the last year.	Fire-ridden areas	Total surface	Hectares	Yearly	EFFIS - European Forest Fire Information System	https://effis.jrc.ec.europa.eu/apps/effis.statistics/estimates	2006-2022		Regional, Provincial, Local	Yearly	Regional geo-catalog
122	measuring sensitivity	Technical system	Built capital	Infrastructure	Time distance from the main city	Average time distance from the main pole by considering different vehicles (car, bike, train, feet, cruise,…)	Time distance by A) car, B) bike, C) train, D) cruise, ….	Average sum	Minutes	Static	N/A			Global			Google Maps
123	measuring coping capacity	Technical system	Built capital	Tangible CH	Conservation index of historical rural architectural heritage	Allows you to quickly determine the degree of conservation of historical rural architectural heritage	A) Num buildings in good state of conservation B) Num buildings in moderate degradation or partially renovated C) Num buildings in poor state of conservation	(1*A)+(0,5*B)+(0,25*C)/SUM(A:C)	Number	3 years	N/A						Local sources: administrative data
124	measuring sensitivity	Technical system	Built capital	Energy	Final energy consumption per capita in the agriculture sector	This indicator is calculated by dividing the final energy consumption in the agriculture sector by the number of inhabitants	A) Energy consumption in the agricultural sector MWh B) Number of inhabitants	A / B * 100	MWh/capita	irregular	ESPON LOCATE	https://database.espon.eu/project-data-package/971/	2002, 2012	NUTS3	EU 27	irregular	
125	measuring sensitivity	Technical system	Built capital	Energy	Final energy consumption per land area in the agriculture sector	This indicator is calculated by dividing the final energy consumption in the agriculture sector by the area of the region	A) Energy consumption in the agricultural sector MWh B) agricultural land ares (km^2)	A / B	MWh/km 2	irregular	ESPON LOCATE	https://database.espon.eu/project-data-package/971/	2002, 2012	NUTS3	EU 27	irregular	

126	measuring coping capacity	Technical system	Built capital	Energy	Energy consumption from renewable carriers for space heating, hot water and cooling	energy consumption for space heating, cooling and hot water; seperated into residential buildings, private service sector and public buildings			MWh/capita	irregular	ESPON LOCATE	I requested the data from ESPON, will add link as soon as available	2002, 2012, 2018	NUTS3	EU27	irregular	
127	measuring adaptative capacity	Technical system	Built capital	Energy	Share of energy from renewable carriers for space heating, hot water and cooling	share of total energy use for space heating, cooling and hot water; seperated into residential buildings, private service sector and public buildings			Percent	irregular	ESPON LOCATE	I requested the data from ESPON, will add link as soon as available	2002, 2012, 2018	NUTS3	EU27	irregular	
128	measuring coping capacity	Social system	Human capital	Training	Participation rate in education & training	% of the population aged 25 to 64 participating in formal and non-formal education and training in the last 4 weeks	% of the population aged 25 to 64 participating in formal and non-formal education and training in the last 4 weeks		Percent	annual	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/TRNG_LFSE_04/default/table?lang=en&category=educ.educ_part.trng.trng_lfs_4w0	2018-2022	NUTS2	EU27	annual	
129	measuring adaptative capacity	Social system	Human capital	Training	Farm manager with agricultural training	share of farm managers with basic or full agricultural training	% of farm managers		Percent	irregular	Eurostat	https://ec.europa.eu/eurostat/databrowser/view/EF_MP_TRAINING__custom_7388968/default/bar?lang=en	2005 - 2020	NUTS2	EU27	irregular	
130	measuring coping capacity	Ecological system	Natural capital	Natural heritage	Nationally designated areas	protected areas under national laws. This contains more protected areas than NATURA2000 and in addition point data	% of NUTS3 (or other) region that is protected	area of NUTS3 (or other region) in m² / protected area in m²	Percent		EEA	https://www.eea.europa.eu/en/datahub/datahubitem-view/f60cec02-6494-4d08-b12d-17a37012cb28	last data from 2023	NUTS 3 and finer (vector data)	EU27	annual	
132	measuring adaptative capacity	Social system	Social capital	Diversity	Number of sites accessible by people with disabilities	Assess the number and proportion of existing public/governmental buildings and open space/cultural sites and facilities that meet accessibility standards.	Accessible public buildings/open spaces and cultural sites		Number	3 years	N/A						Local sources: administrative data
133	measuring adaptative capacity	Social system	Social capital	Intangible CH	Annual number of festivals or cultural events connected to traditions/culinary practices/local products	Assess the number of festival and cultural events connected to traditions/culinary practices/local products	Festival and cultural events connected to traditions/culinary		Number	Yearly	N/A						Local sources: administrative data

							practices/local products										
134	measuring adaptative capacity	Social system	Social capital	Intangible CH	Number of local associations connected to traditions/culinary practices/local products	Assess the number of local associations connected to traditions/culinary practices/local products	Local associations connected to traditions/culinary practices/local products		Number	Yearly	N/A						Local sources: administrative data
135	measuring adaptative capacity	Social system	Social capital	Intangible CH	Number of shops, restaurants and tourism facilities selling local products	Assess the number of shops, restaurants and tourism facilities selling local products	Number of shops, restaurants and tourism facilities selling local products		Number	Yearly	N/A						Local sources: administrative data
141	measuring adaptative capacity	Ecological system	Natural capital	Natural heritage	Diversity of landscape (number of landscape typologies)	Assess the number of landscape typologies that are present in the cultural landscape	Landscape typologies		Number		N/A						Local sources: administrative data

Annex IV – List of Hazard indicators

Too Much Water_Inland

	Indicators	Description	Data unit	Main Data Requirement
Fluvial Flood	1 Daily maximum precipitation corresponding to the selected flood probability	Daily maximum precipitation in mm corresponding to the selected flood probability. A river flood occurs when a river overspills its banks; that is, when its flow can no longer be contained within its channel.	mm/day	Daily precipitation data (mm/day) from meteorological departments if any meteorological stations exist in the asset area (if applicable, GIS data should be provided)
	2 Distribution of the rainfall intensity over time, corresponding to the selected flood probability and a duration of the event	Distribution of the rainfall intensity over time, corresponding to the selected flood probability and a duration of the event	mm/hour	Rainfall data in mm and its distribution over time from meteorological departments (if applicable, GIS data should be provided)
	3 Torrentiality index (factor)	The Index of torrentiality expresses the relationship between the hourly precipitation intensity and corrected daily mean therefore the intensity of an event. Its value is determined in function of the geographical area.	Hourly precipitation intensity/ daily mean	Hourly precipitation in mm Daily mean precipitation in mm These data can be obtained from meteorological departments and specific in-situ measurements (if applicable, GIS data should be provided)
	4 IDF (intensity duration frequency) curves	Intensity distribution of the precipitation over time Duration of the event hours Frequency Return period T5, T10, T25, T50, T100, T500	Intensity/duration	Intensity: distribution of the precipitation in mm over time in hours Duration of the event in hours Frequency Return period T5, T10, T25, T50, T100, T500 (if applicable, GIS data should be provided)
	5 Flood area corresponding to the selected flood probability	Frequency of flooding event and exposed area, in different return periods T5, T10, T25, T50, T100, T500. Mainly for fluvial flooding but not exclusively T5, T10, T25 also relevant for pluvial Flood area for the selected flood frequency (mean statistical/historic data)	m2- km2 or ha	Type of asset Name/ID Location/Coordinates Address City/District GIS data: Grid raster (resolution) Flood area for the selected asset

	6 Flood depth	Flood depth corresponding to selected frequency (mean statistical/historical data)	cm - m	Type of asset Name/ID Location/Coordinates Address City/District Topology Estimated flood depth for the selected asset as Grid raster (resolution)
	7 Water velocity (in the flooded area)	Water capability to cause damage to exposed people, infrastructures, services, buildings in case of flood event. Very relevant in combination of flood depth	m/s	Type of asset Name/ID Location/Coordinates Address City/District Topology Estimated water velocity for the selected asset as Grid raster (resolution)
	8 Flood probability	Low probability - 100 to 500 yrs Med probability - 10 to 100 yrs High probability - 0 to 10 yrs	Unitless	Flood probability can be selected by the user for the selected asset. User can select relevant flood probability if they have return period data. These can be considered related concepts.
	9 Maximum annual river flow corresponding to the selected flood probability at the drainage point of the basin	Determining the river flow to assess the intensity of a flood event Peak flow annual maxima for different return periods, to inform early warning systems	m3/s	Flow data from the outlet of the basin (if a sampling point at that location is present) There should be continuous flow measurement to get maximum river flow data Type of asset Name/ID Location/Coordinates Address City/District Maximum annual river flow for the selected asset as Grid raster (resolution)
	10. Maximum annual river level corresponding to the selected flood probability at the drainage point of the basin	Intensity of flooding event based on the maximum level of the water in the flood event	m	Type of asset Name/ID Location/Coordinates Address City/District

				Maximum annual river level for the selected asset as Grid raster (resolution)
	11. River basin concentration time	It is the minimum time needed from the beginning of the rainfall so that the entire surface of the basin is providing runoff at the point of drainage	Minutes -hours	It is obtained by calculating the longest travel time from any point in the basin to the point of drainage, by the different formulations. Data requirement may change depending on the equation used. However, at the end, concentration time for the selected asset has to be provided. (if applicable, GIS data should be provided)
	12. Basin Response Time	Hydrologic lead time is an important factor in many water resources engineering applications. It is the response time of a watershed to runoff-producing rainfall	minutes or hours	There are different equations for the calculation of basin response time. Data requirement may change depending on the equation used. However, at the end, response time for the selected asset has to be provided. (if applicable, GIS data should be provided)
	13. Ground water table	Ground water table given as a spatial information	m	.shp file with the groundwater level
Pluvial	1. Daily maximum precipitation corresponding to the return period T	Daily maximum precipitation in mm corresponding to the selected flood probability.	mm/day	Daily precipitation data (mm/day) from meteorological departments if any meteorological stations exist in the asset area (if applicable, GIS data should be provided)
	2. Hourly maximum precipitation corresponding to the return period 3. Distribution of the rainfall intensity over time, corresponding to the return period T and a duration of the event	Hourly maximum precipitation in mm corresponding to the selected flood probability.	mm/day	Hourly precipitation data (mm/day) from meteorological departments if any meteorological stations exist in the asset area (if applicable, GIS data should be provided)
	4. Torrentiality index (factor)	the ratio between the expected maximum hourly (I1) and mean daily (ID) precipitation intensity	mm/hour	

	5. IDF (intensity duration frequency) curves	Intensity distribution of the precipitation over time Duration of the event hours Frequency Return period T5, T10, T25, T50, T100, T500	Intensity/duration	Intensity: distribution of the precipitation in mm over time in hours Duration of the event in hours Frequency Return period T5, T10, T25, T50, T100, T500 (if applicable, GIS data should be provided)
	6. Flood area corresponding to the return period T	Frequency of flooding event and exposed area, in different return periods T5, T10, T25, T50, T100, T500. Mainly for fluvial flooding but not exclusively T5, T10, T25 also relevant for pluvial Flood area for the selected flood frequency (mean statistical/historic data)	m2- km2 or ha	Type of asset Name/ID Location/Coordinates Address City/District GIS data: Grid raster (resolution) Flood area for the selected asset
	7. Flood depth	Water capability to cause damage to exposed people, infrastructures, services, buildings in case of flood event. Very relevant in combination of flood depth	m	GIS data: Raster
	8. Water velocity (in the flooded area)	Water capability to cause damage to exposed people, infrastructures, services, buildings in case of flood event. Very relevant in combination of flood depth	m/s	Type of asset Name/ID Location/Coordinates Address City/District Topology Estimated water velocity for the selected asset as Grid raster (resolution)
	9. Combinations of flood depth and water velocity in the flood area	Combined values indicating the depth and velocitiy of a flood event with certaing probability		Com of 7 and 8
	10. Flood frequency: linked with the return period	Low probability - 100 to 500 yrs Med probability - 10 to 100 yrs High probability - 0 to 10 yrs	Unitless	Flood probability can be selected by the user for the selected asset. User can select relevant flood probability if they have return period data. These can be considered related concepts.
	11. Surface runoff	The portion fo discharge that is runing off the ruface.	m3/s	Timeseries of discharges for the relevant period of time and/or relevant annualities
	1. Wind direction	Direction of wind in		Spatial distribution of the wind direction/time series

Coastal/ Estuarine Flooding	2. Wind speed/wind gust	Wind speed/wind gust	m/s	Time series
	3. Design storm surge		m3/s	
	4. Discharge from external sources	Discharges from rivers or other sources relevant for the hazard assessment	m3/s	Timeseries of discharges for the relevant period of time and/or relevant annualities
	5. External surges	Wave entering a marginal sea from a deep sea that is meteorologically induced	m	Timeseries
	6. Spring-neap (tide) cycle	Spring-'springing forth' of the tide during new and full moon. Neap- period of moderate tides when the sun and moon are at right angles to each other.	m	timeseries of the relevant spring neap period
	7. Flood frequency: linked with the return period	Low probability - 100 to 500 yrs Med probability - 10 to 100 yrs High probability - 0 to 10 yrs	Unitless	Flood probability can be selected by the user for the selected asset. User can select relevant flood probability if they have return period data. These can be considered related concepts.
	8. Flood depth	Water capability to cause damage to exposed people, infrastructures, services, buildings in case of flood event. Very relevant in combination of flood depth	m	GIS data: Raster
	9. Flood area corresponding to the return period T	Frequency of flooding event and exposed area, in different return periods T5, T10, T25, T50, T100, T500. Mainly for fluvial flooding but not exclusively T5, T10, T25 also relevant for pluvial Flood area for the selected flood frequency (mean statistical/historic data)	m2- km2 or ha	Type of asset Name/ID Location/Coordinates Address City/District GIS data: Grid raster (resolution) Flood area for the selected asset

Not Enough Water

	Indicators	Description	Data unit	Main Data Requirement
Heatwaves	Daily mean temperature	Daily mean Temperature en degrees Celsius. Mean: mean 24h (T1 . . . Tn) hourly; T = daily mean	°C	Hourly temperature for a daily period
	Thermal shock	Thermal shock in a day. Difference between daily max and min temperatures: [Tmax-Tmin] in a day	°C	Daily max and min temperatures
	Daily sun hours	According to WMO (2003), sunshine duration during a given period is defined as the sum of that sub-period for which the direct solar irradiance exceeds 120 W m–2. Is calculated with: Number of hours in a day for which the direct solar irradiance exceeds 120 W m–2	hours	Hours for which the direct solar irradiance exceeds 120 W m–2 in a day
	Mean relative humidity	Daily Relative Humidity mean: Mean: mean 24h (RH1 . . . RHn) hourly; T = daily mean	%	Hourly Relative Humidity in %
	Daily humidity cycle shocks	Daily humidity cycle shocks. Number of relative humidity cycles in which the difference is higher than 25%: [RH(n)-RH(n+1)>25%]	number of cycles	Frequent RH data
	Relative humidity concentration	Cycles of Relative humidity in which concentration is higher than 75%: [nRH>75%]	number of cycles	Frequent RH data
Wildfire	Annual Mean Temperature		degrees celsius	Temperature (celsius) mean annual
	Mean Diurnal Range		degrees celsius	Range (celsius) diurnal mean
	Isothermality		degrees celsius	Isothermality (celsius)
	Temperature Seasonality		degrees celsius	Seasonality (celsius) temperature
	Max Temperature of Warmest Month		degrees celsius	Month (celsius) warmest of temperature max
	Min Temperature of Coldest Month		degrees celsius	Month (celsius) coldest of temperature min
	Temperature Annual Range		degrees celsius	Range (celsius) annual temperature
	Mean Temperature of Wettest Quarter		degrees celsius	Quarter (celsius) wettest of temperature mean
	Mean Temperature of Driest Quarter		degrees celsius	Quarter (celsius) driest of temperature mean
	Mean Temperature of Warmest Quarter		degrees celsius	Quarter (celsius) warmest of temperature mean
	Mean Temperature of Coldest Quarter		degrees celsius	Quarter (celsius) coldest of temperature mean
	Annual Precipitation		mm	Precipitation (mm) annual

	Precipitation of Wettest Month	mm	Month (mm) wettest of precipitation
	Precipitation of Driest Month	mm	Month (mm) driest of precipitation
	Precipitation Seasonality (Coefficient of Variation)	percentage	Variation) (percentage) of coefficient seasonality precipitation
	Precipitation of Wettest Quarter	mm	Quarter (mm) wettest of precipitation
	Precipitation of Driest Quarter	mm	Quarter (mm) driest of precipitation
	Precipitation of Warmest Quarter	mm	Quarter (mm) warmest of precipitation
	Precipitation of Coldest Quarter	mm	Quarter (mm) coldest of precipitation
	Relative water content in the top few centimetres of soil	percentage	soil (percentage) of centimetres few top the in content water relative
	Fire weather index (a meteorologically based index used worldwide to estimate fire danger)	unitless	fuel moisture and wind on fire behaviour and spread
	Palmer Drought Severity Index	unitless	soil water balance estimates relative soil moisture conditions

Partners

.

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI ARCHITETTURA

cmcc
Centro Euro-Mediterraneo sui Cambiamenti Climatici

CONEXIONES improbables

DRAXIS
ENVIRONMENTAL TECHNOLOGIES

Fraunhofer
IAIS

Hamburg

ICLEI
Local Governments for Sustainability
EUROPE

LAS NAVES

LIÈGE université

FONDAZIONE links
PASSION FOR INNOVATION

MEEO
Meteorological Environmental Earth Observation

unesco
Porto Venere, Cinque Terre and islands (Palmaria, Tino and Tinetto)

PSILORITIS GEOPARK
unesco
Global Geopark

SISTEMA
ENVIRONMENTAL INFORMATION MINING

TUHH
Hamburg University of Technology

Contact us

www.resilientculturallandscapes.eu

AITZIBER EGUSQUIZA ORTEGA
PROJECT COORDINATOR
aitziber.egusquiza@tecnalia.com

ALESSANDRA GANDINI
TASK LEAD
alessandra.gandini@tecnalia.com

KATHERINE PEINHARDT
COMMUNICATIONS LEAD
Katherine.peinhardt@iclei.org

Follow us
LinkedIn: www.linkedin.com/company/rescuemeeu/
Twitter: twitter.com/RescueME_EU

Funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.