Deliverable 7.3.7
Hazard-Risk-Resilience Nexus in a cultural heritage-centered and socio-economic context

Transversal Spoke 7, Work Package 3, Task 3.4

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Executive summary

This document pertains to the extended partnership RETURN (multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate) and presents the results of the first deliverable within task 3.4 "*Hazard-Risk-Resilience Nexus in a CH-centered socio-economic context (art cities and cultural landscapes*", as part of Spoke 7 – TS3 – "Communities' resilience to risks: social, economic, legal and cultural dimensions". The deliverable provides a review of the state of the art of the inclusion of cultural heritage in community resilience and disaster risk reduction measures. Based on the results collected, we developed a theoretical framework and methodological recommendations to be used as blueprint to integrate the role of cultural heritage in hazard-risk- resilience discourse.

The deliverable is structured in two main parts:

PART I - LITERATURE REVIEW

This part provides a detailed overview of the guiding questions and approaches adopted for the systematic literature review, as well as a detailed discussion of the results collected. The systematic review aims to contribute to a better understanding of how cultural heritage can be included in the hazard-risk-resilience nexus, by identifying available approaches, frameworks, and models. To achieve this objective, we have followed the systematic review approach focusing our analysis on the interactions among three main key concepts: *heritage, community* and *resilience*. For all three of these aspects, we have firstly investigated the ways it has been conceptualized in the literature. In a second step we investigated the interrelations among these three concepts in a multi-hazard context.
This analysis led to outlining the way specific types of heritage contribute to identified multiple spheres of community resilience to disaster risk. The literature analysis underscores key findings. The totality of papers defines *community* as the group of individuals linked to a given area exposed to and affected by natural hazard, although in some cases other types of *community* were addressed. Similarly, we have found a consensus in the identification of a common cultural background as key prerequisite for creating a strong sense of belonging, trust, and commitment of community members. A strong and close community is unanimously seen as decisive factor to foster resilience and improve management as well as response to natural hazards. At the same time, there is a shared perception that the recognition of the proactive role of community in disaster risk management and in recovery and resilience strategies is still limited. Finally, cultural heritage is identified as a determinant factor bridging community towards resilience. As such, the study allowed to identify different types of heritage in relation to their contribution to four main spheres of community risk resilience that resulted from the literature.

PART II - THEORETICAL FRAMEWORK AND APPLICATION GUIDELINES

The framework surges from the need of acknowledging and systematizing the dynamics that regulate the contribution that cultural heritage and local technical and traditional knowledge provide to community resilience to disaster risk in a multi-hazard context. The results and considerations presented in the systematic literature review allowed to better visualize the relationship between resilience, cultural heritage, and community. Upon the identification of four main resilience spheres in which cultural heritage is found to play a key role, the study deepened the topic by further identifying related key specific resilience outputs, to which cultural heritage contributes. The activation of these outputs in relation to specific cultural heritage types is dependent on specific actions of interaction performed by the community in relation with their cultural heritage. These actions have also been included in the framework.

1. Introduction

This document presents the results related to the activities developed within the Work Package (WP) 3 Task 4 of the Transversal Spoke 3 (Spoke 7) of the RETURN Project (multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate)

Transversal Spoke 3 “Communities' Resilience to Risks: social, economic, legal and cultural dimensions" focuses on and investigates community resilience, with the aim to improve perception of risk at all levels, considering the interactions among all the elements that constitutes risk. The Spoke supports preparedness and community resilience to disaster risks through information, education, training, and participatory approaches, while also defining technological, methodological, and political measures for risk mitigation, preserving cultural and natural heritage.

Within this Spoke, the main objective of WP3 is to investigate the exposure, vulnerability, but also the role of cultural heritage in a multi-hazard context. Within this context the activities of task 4 specifically focus on the role that cultural heritage (both tangible and intangible) plays within communities, influencing their resilience to risks.

Cultural heritage can play a fundamental role in guiding the realm of risk perception, risk awareness and risk behaviour, both in urban and rural social-ecological systems. For this reason, in addition to efforts towards reducing risks to exposed and vulnerable heritage (addressed in the previous tasks 3.1, 3.2 and 3.3 within WP 3 on “Multi-risk assessment for Cultural Heritage and role of cultural heritage on resilience”), it is crucial that the role played by heritage as a driver of community resilience is also adequately investigated.

This deliverable explores this aspect, and sheds lights on the Nexus connecting cultural heritage with the Hazard-Risk-Resilience discourse, emphasizing on the values held in cultural heritage and their transmission to future generations for disaster risk reduction and climate change adaptation purposes.

1.1 Community resilience and the role of cultural heritage

Over the last decades, natural hazards have represented one of the biggest causes for loss and damage worldwide, whose impacts are constantly exacerbated by the fast increase of climate change-related impacts and increasing vulnerabilities due to anthropogenic changes. As part of the efforts towards improving communities’ resilience, the disaster risk reduction field has increasingly recognized the importance of understanding how individuals and communities respond and perceive risks (Hadlos et al., 2022). Over the last decades there has been growing awareness about the need for recognition of the role that local knowledge and expressions of cultural heritage play in guiding disaster risk reduction measures and practices in communities exposed to risks (Fontanella Pisa, 2023).

Communities living in hazard-prone areas are likely to have a long history of being exposed to frequent hazards over centuries of human-nature interactions, generating context-specific knowledge on their risk landscape (UNDRR and ICCROM, 2022). Disasters have therefore marked the history of several places and their inhabitants (Garcia et al., 2021), leading to the development of ad-hoc measures and traditions in response (Ghani, 2020). Many cultural cities and/or cultural landscapes are shaped by centuries of interaction between disasters and heritage, which lessons are retained in societies' memory (Garcia et al. 2021; Garnier, 2019).

Knowledge of past events is hence essential for setting up strategies to protect those communities exposed to specific hazards (Garnier, 2019), and it contributes both to understanding disaster risks (Priority for Action 1; UNIDSDR, 2015) as well as a tool to invest in enhancing disaster resilience (Priority for Action 3; UNISDR, 2015). These places and the values they represent are at the key to community resilience as part of the identify of their people (Garcia et al., 2021). A focus on the multiple forms of expression of local knowledge can contribute greatly to understanding the role that local values play in influencing responses to disaster risks (Kakinuma et al., 2019), leading to the development of context-specific disaster risk reduction practices that are more likely to be adopted

and implemented by local actors.

The role of heritage in contribution to community resilience to disaster risks has gained popularity over the last decades (Jigyasu et al., 2013; UNDRR and ICCROM, 2022; Šakić Trogrlić et al., 2021; Tavares et al., 2021). Cultural heritage represents not only the past of its community, but it's also likely to determine its future based on the way it is institutionalized (Mekonnen et al., 2022). For example, there are several studies about the role that heritage played influencing the first response of communities during the Indian Ocean Tsunami on 26th December 2004 (Mercer et al., 2012) or the Great East Japanese Earthquake and Tsunami that hit Japan on 11th March 2011 (Fontanella Pisa, 2023). Probably the most popular example is that of the lullaby passed down in the Simeulue Island community (Banda Aceh, Indonesia), which transgenerational transmission made so that the community was able to properly respond when the earthquake occurred (Ahmad and Sayadi, 2011; McAdoo et al., 2006; Rahman and Munadi, 2019; Rahman, Sakurai and Munadi, 2017; Rahman, Sakurai and Munadi, 2018). Cultural heritage has proven to have saved local populations' lives from the same tsunami also in the case of the Moken communities in Surin Island, Thailand, whereas tourists could not save themselves due to their lack of knowledge (Mercer et al., 2012).

1.2 Deliverable structure

As part of the Extended Partnership (EP) RETURN project, financed under the Italian PNRR funding scheme, this deliverable poses the focus on the role that cultural heritage plays towards those communities interacting with it, and their resilience to multi-hazard risks. This project deliverable contributes to this topic through a **theoretical framework** and **related methodological recommendations** to facilitate the integration of the role played by cultural heritage into the hazard-risk-resilience discourse, hence contributing to improving understanding on community resilience.

The deliverable unfolds through three main steps:

- systematic **literature review** (chapter 2.2)
- **analysis and discussions of literature review results** (chapter 2.3 & 2.4) and definition of existing interactions between resilience-heritage and communities at risk with considerations on:
    - heritage,
    - community, and
    - resilience.
- **development of a theoretical framework and methodological recommendations** (chapter 3) to facilitate resilience assessment acknowledging the risk-resilience-heritage nexus *(through workshop and consultation meetings)*

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2. The systematic literature review

The first step towards the achievement of the Deliverable 7.3.7 consisted in a systematic literature review directed at providing an overview of the state of the art on existing studies and literature linking cultural heritage to community resilience to natural hazards.

The systematic literature review initially resulted in 264 papers, further skimmed down to 24 papers that have been extensively analysed both quantitatively and qualitatively. The analysis primarily aimed at understanding the current state of the art of existing approaches towards building community resilience to risks through heritage. Secondly, we mapped the different conceptualizations of cultural heritage and resilience identified in the selected studies. This second level of analysis allowed us to further identify the different layers of knowledge, values, and functions reflected in the different types of heritage and that contribute to boosting community multi-risk resilience.

Preliminary results have confirmed that cultural heritage is increasingly recognized as critical to improving community resilience and community capacity while developing measures and plans to reduce disaster risks. Based on resulting identified approaches, we developed an assessment model framework building the nexus between cultural heritage and hazard-risk-resilience, emphasizing on the values held in cultural heritage and their transmission to future generations for disaster risk reduction and climate change adaptation purposes. The development of assessment methods includes participatory approaches to qualitatively assess the values of heritage for targeted local communities.

2.1 Research question & objectives

This literature review is guided by the following **research question**: *"How are the themes of community resilience and cultural heritage linked in a multi risk discourse?".*

The **main objective** of this review is to contribute to a better understanding of how cultural heritage can be included in the hazard-risk-resilience nexus, by identifying *available approaches, frameworks, and models*, for the delineation of a framework guiding researchers in the field.

This literature review further aims to achieve the following **sub-objectives (SO)**:

- **SO1:** Find supportive evidence explaining how cultural heritage can be linked to disaster risk reduction and community resilience building.
- **SO2:** Unpack the role of cultural heritage as enabler of community resilience to natural hazards.
- **SO3:** Map available methods and opportunities for stakeholder and community engagement to guide the hazard-risk-resilience nexus with heritage.
- **SO4:** Identify existing gaps in the literature that limit the nexus between heritage and community resilience approaches.

2.2 Literature review methodology

To ensure the highest level of consistency, reliability and replicability, the literature review process followed the systemic review approach, adapting PRISMA guidelines (Page et al. 2021) to the specific scope of our research. Following the steps outlined in PRISMA we have firstly identified the core keywords to compose the searching query. The query formulation consisted in an iterative process in which we combined most relevant keywords identified in key-literature available to the authors, investigating interconnections among: heritage, community, resilience and hazard (Fabbricatti, Boissenin, and Citoni 2020; Holtorf 2018). The final query was composed as following:

(((heritage) and (living or intangible or landscape or urban or place or cultur*)) and ((commun* or soci* or collect*) and (resilience)) and (disaster or risk or adaptation))

The literature review process consisted in four main operational blocks, each of them composed by multiple sub-tasks. Query formulation and article search was performed between 1st of August and 30th of August 2023 in the Scopus® database. Once identified the final query the papers search was performed in Scopus® database applying the research trough title, abstract and keywords (dated 30th August 2023). The papers retrieved underwent a three- step screening procedure to identify those papers that appropriately responded to the scope of the review. Most relevant inclusion and exclusion criteria used are mentioned above:

a) We first skimmed papers based on the type of publication, therefore excluding literature reviews and conference proceeding papers. Only papers in English language were considered. We also excluded papers that were not freely available (i.e. open access);
b) Secondly, we performed a screening of titles and abstracts focusing on two major content-related aspects:
    1) Papers approach towards the concept of resilience: As our aim was specifically to focus on the contribution of heritage to community resilience, we excluded those papers that were approaching resilience merely from a physical or structural point of view, analysing resilience of historical buildings or heritage sites. We also excluded papers that were approaching resilience from a medical point of view, as this aspect was out the scope of our analysis;
    2) Type of hazard addressed in the paper: Our core goal was to tailor the analysis only to community resilience to natural hazards; thus, we excluded those papers that studied response to and consequences of man-made hazards (e.g. deep marine or forestall pollution, explosions, etc.);
c) Thirdly we performed an in- depth reading of remaining papers to ensure a full pertinency and relevance to the scope and goals of the review.

The papers filtered by the skimming procedure represented the core literature of our analysis and were deeply analysed both quantitatively and qualitatively.

The quantitative analysis was conducted with an exploratory approach and aimed at recording: i) generic bibliographic and methodological information; ii) regional and geographical focus, iii) type of ecosystem analysed, iv) type of natural hazard analysed; v) phase of risk management cycle addressed in the paper; vi) how climate change was addressed.

Table 2.1 List of overarching topics used to analyse the selected papers

	Overarching topics		
	Community	**Resilience**	**Cultural Heritage**
Analysing criteria	Type of community*	Definition of resilience	Definition of cultural heritage
	Final beneficiaries / targeted community of the study	Role of resilience in the paper	Type of heritage addressed in the paper
	Stakeholders engaged in the research	Methods for analysing resilience + description	Heritage categorization (when mentioned)
	Methods to engage community	Static Vs dynamic connotation	Heritage role towards resilience
		Resilience framework used as reference and stage of application of the framework	Methods for heritage identification
		Dimensions of resilience mentioned	

The qualitative analysis constituted the core of our research effort and was developed implementing a content analysis approach (Peters et al. 2015; Snyder 2019). During this stage data were extracted and coded according to three main overarching topics reflecting the main components of the nexus under study: cultural heritage, community, and resilience.

For each of these overarching topics several analysing criteria and variables of study were identified, with the purpose of fully elucidate interconnections existing among these elements within the context of natural hazard response and community resilience. The full list of variables used for each topic are mentioned in table 2.1.

2.3 Results:

From the query research we retrieved 264 articles, 75 of them were first excluded because they did not match with the pre-defined selection criteria, resulting in 189 articles to be screened by title and abstract. The review of titles and abstracts excluded 156 articles that were not responding to the content inclusion criteria, identifying 33 articles eligible for the in-depth reading process. After a full text reading, 8 articles were excluded from the analysis because they were not fully pertinent to the scope of the review. The final poll constituted 24 papers.

The paragraphs below present the main results, starting from the most general considerations to the more specific findings concerning the way cultural heritage, community and resilience have been approached in the selected studies.

2.3.1 Regional and ecosystem focus

The majority of the 24 analysed studies addresses the link between heritage and disaster risk reduction/resilience in urban settings (11 papers out of 24), followed by a focus on mountainous ecosystems (8 papers out of 24). Some of the papers presented multiple case studies located in diverse ecosystems. Within the selected papers, there are 14 case studies in the Asian continent, and 5 focusing on European case studies. None of the selected papers addresses case studies in Africa. In terms of continental coverage, the continent most covered in the research is Asia. The table below shows a breakdown of number of studies for each of the represented countries in relation to the hazards they focus on.

Table 2.2 different countries and the type of natural disasters discussed

Country	Number of research mentioned in	Natural hazard discussed
China	5	Flood, earthquake, Tsunami and Landslide
		Flood and Typhoon
		No hazard specified
		Tropical disturbance
		Earthquake
Nepal	4	Earthquake (3 papers)
		Flood
India	3	Flood and earthquake
		Flood (2 Papers)
United Kingdom	3	
		Flood
Guatemala	1	Flood, volcanic activities, earthquake, fire, landslide and tropical disturbance.
Indonesia	1	Volcanic eruptions
New Caledonia	1	Tsunami
Japan	1	Earthquake
Iran	1	Flood
Bangladesh	1	Cyclones
Philippines	1	Tropical storms, dengue outbreaks and earthquakes
New Zealand	1	No specific hazard mentioned
Turkey	1	Earthquake

Greece	1	Drought
France	1	Flood
Italy	2	No hazard mentioned (both papers)

2.3.2 Heritage and resilience approached through different disciplines

Most of the analysed papers have a multidisciplinary nature. They involved several researchers specialized in two or more disciplines. Nonetheless, social sciences and environmental sciences dominated the scene, and represented the most covered disciplines in the reviewed papers. A total of 17 of the articles analysed have a connection with social sciences, followed by 11 studies whose authors' affiliations belonged to the environmental sciences. This category is followed by the field of energy, engineering, and art and humanities. The interdisciplinary collaboration seen in these papers explains why the numbers shown in the graphs add up to more than the actual number of papers analysed.

Almost all the studies used a qualitative approach to analyse their findings. Out of the 24 studies covered, 22 used qualitative while 2 used a mixed method.

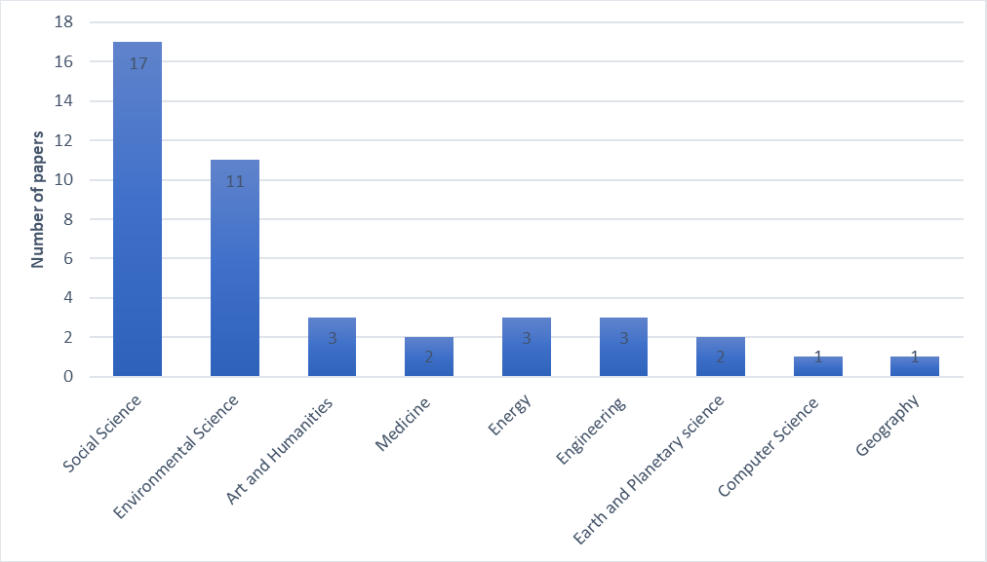

Figure 2.1 Distribution of research based on subject areas

2.3.3 Multi-hazard considerations and climate change

Among the most addressed hazards, water-related hazards are the most represented, immediately followed by earthquakes. There are four studies addressing hazards falling into the category of tropical disturbances (Huang, 2018; Ghani, 2020; Lin and Lin, 2020; Garcia, 2021), including typhoons and hurricanes. There are no studies addressing the link between heritage and community resilience in relation to GLOFs, nor avalanches. Only one paper mentions drought (Garnier, 2019). Six papers make no mention to any specific hazard, rather focusing on disaster risk reduction in general terms.

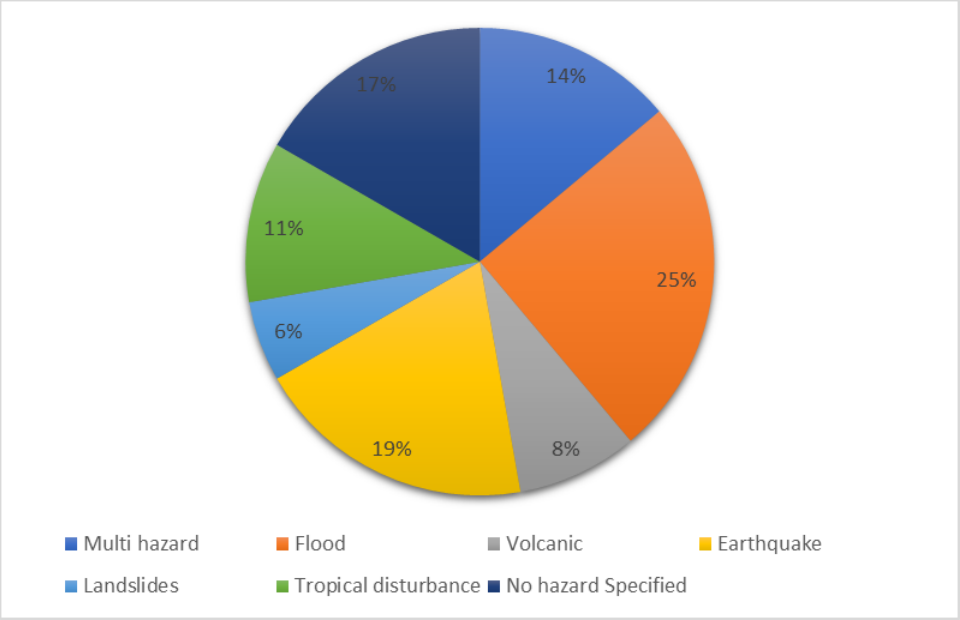

Figure 2.2 Pie chart showing the counting of addressed hazards in the selected papers

Most of the analysed papers do not associate their focus on disaster risk reduction to climate change-related dynamics. Only seven papers explicitly or implicitly mention climate change. It is explicitly mentioned in five papers while two papers imply about climate change in the background. An explicit mention of climate change, its effects, and ways of combatting its disastrous consequences was discussed in Lindner et al. (2021), also adopting IPCC definitions of resilience and implying a connection between the disaster risk reduction and climate change study spheres. Another study by Shirvani Dastgerdi and Kheyroddin (2023) sets out with the aim of tackling the direct and indirect effects of climate change on cultural landscapes using participatory approaches, inviting multi and inter disciplinary approaches.

Three out of the five papers explicitly mentioning climate change directly address flood hazards, aligning with the IPCC Report's results suggesting an increase in frequency and intensity of hydro-meteorological events (IPCC,2023). Tsunami (although more indirectly) and cyclones were the other hazards associated with climate change (Yavuz, Kentel and Aral, 2020; Tursina et al., 2021). The exacerbation of flooding events in correlation to climate change was explicitly mentioned in the works of McEwen, Jones and Robertson (2014). The authors highlight how trends in hydrological anomalies could become increasingly erratic given the threat of a looming change in climatic patterns. Climate change was not pronounced as such on papers that dealt with multi hazards. Out of five studies dealing with multiple hazards, only one mentioned climate change. Overall, it is fair to assume the discussion of climate change is lacking from most of the studies.

2.3.4 Defining *community*

Framing the concept of *community* as well as identifying its fundamental attributes were key steps in the formations of our analytical categories. Our conceptualization of community relied on and took as reference the definition of community developed with the framework of RETURN project, Work package 7.4.1., which disentangled the complexity of the concept *community* and identified three different definitions based on the nature of relationships and bonds tying community members (see table 2.3 and Annex 1).

Table 2.3 adopted categorization for defining 'community', adapted from deliverable 7.4.2. RETURN project

Type of community	**Community of place**	**Community of interest**	**Community of practice**

Definition	Group of individuals sharing a common physical or online space as primary basis of their connection and interaction.	groups of actors who establish a collective identity based on their shared concerns, purposes, and goals	heterogeneous group of actors which share a common interest or concern - the domain-, and collaborate to manage and address it
Definition reference	(Christenson & Jerry W, 1989)	(Briard & Carter, 2013; Henri & Pudelko, 2003)	(Etienne, 1998)
Other references	(Miller, 1992)	(Keller, 1992)	(Wasserman & Faust, 1994), (Reed et al., 2010)

We categorized the type of community addressed in the studies adopting the above- mentioned definitions. The majority of papers (n=18) describe community using the concept of *community of place*, so determining community as the group of individuals that live in proximity and within the boundaries of a given area that has been affected by a natural hazard. The conceptualization of community ties based on shared practices and values, i.e. community of practice, is adopted by 4 papers out 24. Specifically, all the conceptualizations that defined community based on practice refer specifically to religious practices and values. The identification of community based on interest, namely the identification of and the sense of belonging to a community given by shared purposes and goals, is adopted only by 2 papers out of 24. Interestingly in these two papers, goals and actions are oriented to the social improvement and community cohesion.

2.3.5 Type of stakeholders & way for stakeholder engagement

The studies collect data from a vast variety of stakeholders that differs according to the specific goal of the presented project, as well as the specificity given by the local context. Despite differences in addressed hazards and local contexts, there is an understanding common to all studies for which representatives belonging to the citizens network or local population are key stakeholders to be involved. Second most consulted stakeholders are representatives of local institutions, mainly municipal officers, city planners and officers involved in disaster risk management (Jones & Pappas, 2023; Wang & Zhu, 2022; Lindner et al., 2021; Lawangen & Roberts, 2023; Kano et al., 2022; Huang, 2018; Lin & Lin, 2020; Fabbricatti et al., 2020). Representatives from governmental or non-governmental organizations are also identified as important informants, especially if they are involved or played a role in response and/or recovery activities (Garcia 2021; Ghani 2020; Jones and Pappas 2023; Lin and Lin 2020). On the contrary, representatives of national governments have been very poorly involved in the analysed research projects and have been mentioned only in one paper out of 24 (Garcia, 2021). Experts or stakeholders related to the cultural or heritage sectors have been engaged only within those studies focusing on historical cities (Kano et al., 2022; Garcia, 2021; Fabbricatti et al., 2020).

When observing stakeholders' engagement methods, there is a predominance of action research methods, mainly interviews or semi-structured interviews (Wardekker et al., 2023; Jones & Pappas, 2023; Wang & Zhu, 2022; Lindner et al., 2021; Lawangen & Roberts, 2023; Sengupta, 2023; Kano et al., 2022; Kitamura, 2021; Huang, 2018; Johnson et al., 2018; Saul & Waterton, 2017; Pomeroy & Tapuke, 2016; Shinde, 2017). In six papers, stakeholders' engagement relies on Participatory Action Research methods, directly engaging stakeholders in the identification of the research objective and the supervision of the study (Baumann et al. 2021; Fabbricatti, Boissenin, and Citoni 2020; Garcia 2021; Lin and Lin 2020; Ryzewski and Cherry 2012). In four papers we have a combination of the two methodologies, where stakeholders actively contribute to the development of the study, but are also inquired with interviews for data collection (Kano, Tanaka, and Gota 2022; Lawangen and Roberts 2023; Lindner et al. 2021; Pomeroy and Tapuke 2016). Finally in three papers there is no engagement of stakeholders as the entire research is developed using quantitative methodologies (Minguez Garcia 2021; Shirvani Dastgerdi and Kheyroddin 2023) or based on archive documentation analysis (Garnier 2019).

All but two of the papers analysed clearly identifies who are the final beneficiaries or end users of research outcomes (Minguez Garcia 2021; Shirvani Dastgerdi and Kheyroddin 2023). 16 papers out of 24 identifies as final beneficiaries of research outputs the whole community (Wardekker et al., 2023; Jones & Pappas, 2023; Wang & Zhu, 2022; Lawangen & Roberts, 2023; Sengupta, 2023; Kano et al., 2022; Garcia, 2021; Garnier, 2019; Johnson et al., 2018; Fabbricatti et al., 2020; Pomeroy & Tapuke, 2016; Shinde, 2017).

Among the remaining papers, some address the outcomes of their studies to specific groups of the community hit by the hazard : the displaced community (Ghani 2020; Huang 2018; Kitamura 2021; Lin and Lin 2020), inhabitants of historical cities (Kano, Tanaka, and Gota 2022; Lindner et al. 2021) , and students(Ryzewski and Cherry 2012). While (L. McEwen, Jones, and Robertson 2014; Saul and Waterton 2017) identify as final beneficiaries a stakeholder category not linked with the local context and address their final recommendations and research outputs to the international community involved in DDR and decision-makers.

2.3.6 The role of cultural heritage in disaster risk management and for community resilience

The great majority of studies (n=12) relies on identification of heritage as defined by the community, whereas other papers (n=5) also rely on institution-led identification. Only 4 papers define and identify heritage solely based on institutional recognition, or on researchers' understanding. When addressing heritage in relation to community resilience, different types of heritage are identified. Whereas many papers simply focus on heritage in a broader and not defined context (e.g. Wardekker et al., 2023; Minguez Garcia, 2021; Lawangen & Roberts, 2023; Kitamura, 2021; Johnson et al., 2018; Pomeroy & Tapuke, 2016), both under the tangible and intangible point of view, other papers present heritage referring to the urban or cultural landscapes and the linkages that tie people and places together under urban spaces (Sengupta, 2023), historic cities (Lindner et al., 2021; Kano et al., 2022; Garcia, 2021), traditional villages (Wang & Zhu, 2022), old settlements and archaeological sites (Huang, 2018; Ryzewski & Cherry, 2012), and cultural landscapes (Shirvani Dastgerdi & Kheyroddin, 2023; L. J. McEwen et al., 2012). These places play a critical role in enhancing sense of belongingness and community identity, and their conservation is necessary for increasing community resilience. These sites enhance culture's significance as enabler of social recovery in post-disaster (Huang, 2018; Ryzewski & Cherry, 2012), also due to the memory of past experiences and knowledge shared within local communities (L. J. McEwen et al., 2012), and guiding adequate responses for all phases of the disaster risk management. Other papers regarded at the role played by memory transmission and past disasters (Garnier, 2019; L. McEwen et al., 2014). Disaster memories (L. McEwen et al., 2014) and historical documentation (Garnier, 2019) are enablers of memory transmission to future generations, facilitating the process of learning and adapting to changes based on past experiences. Past experiences of human-nature interaction are also at the roots of vernacular architectural knowledge, regarded by a few papers (Ghani, 2020; Johnson et al., 2018; Shinde, 2017) as critical to be considered in the build-back-better process in urban spaces, so to carefully choose materials and building locations.

Particular care towards traditions (Fabbricatti et al., 2020), festivals (Kitamura, 2021), livelihoods (Lin & Lin, 2020) and other identity-shaping activities (Jones & Pappas, 2023) is considered important to strengthen sense of belonginess and social cohesion, as intangible heritage represents part of community identity (Jones & Pappas, 2023; Kitamura, 2021; Lin & Lin, 2020; Pomeroy & Tapuke, 2016). Additionally, a focus on these more intangible types of heritage contribute also to economic sustainment (Kitamura, 2021; Lin & Lin, 2020) and as element for psychological relief (Kitamura, 2021). Community art (meaning any art form from murals to music, religious paintings, etc.) (Baumann et al., 2021) and religious heritage (such as temples or statues) (Saul & Waterton, 2017) are regarded for their potential to have positive impacts on mental health, in addition to improving social-cohesion and communicating risks through community-led practices.

The main roles of heritage towards community resilience to natural hazards are:

- ***Social cohesion:*** 20 papers (Wardekker et al., 2023; Jones & Pappas, 2023; Wang & Zhu, 2022; Minguez Garcia, 2021; Lindner et al., 2021; Lawangen & Roberts, 2023; Sengupta, 2023; Kano et al., 2022; Shirvani Dastgerdi & Kheyroddin, 2023; Baumann et al., 2021; Kitamura, 2021; Huang, 2018; Garcia,

2021; Lin & Lin, 2020; Fabbricatti et al., 2020; L. J. McEwen et al., 2012; Ryzewski & Cherry, 2012; Saul & Waterton, 2017; Pomeroy & Tapuke, 2016; L. McEwen et al., 2014)

- ***Improved coping capacities:*** 10 papers (Wardekker et al., 2023; Jones & Pappas, 2023; Lawangen & Roberts, 2023; Shirvani Dastgerdi & Kheyroddin, 2023; Ghani, 2020; Johnson et al., 2018; L. J. McEwen et al., 2012; Pomeroy & Tapuke, 2016; Shinde, 2017; L. McEwen et al., 2014)
- ***Economic income:*** 3 papers (Wardekker et al., 2023; Kitamura, 2021; Lin & Lin, 2020)
- ***Psychological relief:*** 3 papers (Baumann et al., 2021; Kitamura, 2021; Saul & Waterton, 2017)
- ***Lessons learned and build-back-better:*** 10 papers (Wardekker et al., 2023; Minguez Garcia, 2021; Kano et al., 2022; Shirvani Dastgerdi & Kheyroddin, 2023; Huang, 2018; Ghani, 2020; Garnier, 2019; Johnson et al., 2018; L. J. McEwen et al., 2012; Shinde, 2017)
- ***Early warning:*** 3 papers (Lawangen & Roberts, 2023; Garnier, 2019; Johnson et al., 2018)

The majority of studies sees the role of heritage towards community resilience as enabler of social-cohesion and identity building, critical for resilient communities, especially in a post-disaster scenario. Several other papers focus on the role of heritage for improved coping capacities and as vessels of lessons learned from past disasters, that can facilitate the build-back-better process. Heritage is nonetheless also addressed for its role as economic income, particularly important in a post-disaster reconstruction scenario, and as psychological relief, function generally associated with the social-cohesion role.

We analysed the disaster risk reduction phase in which the heritage-hazard-resilience nexus is explored. Only four papers focus on all phases of disaster risk management (Lawangen & Roberts, 2023; Garnier, 2019; L. J. McEwen et al., 2012; L. McEwen et al., 2014). These papers generally focus on community resilience in a broader sense. The role of heritage is also recognized in general, as an element that promotes citizens' engagement and that connects citizens with their place. Three studies do not emphasize on any disaster risk management phase (Jones & Pappas, 2023; Wang & Zhu, 2022; Ryzewski & Cherry, 2012). The majority of papers (Wardekker et al., 2023; Lindner et al., 2021; Sengupta, 2023; Kano et al., 2022; Shirvani Dastgerdi & Kheyroddin, 2023; Baumann et al., 2021; Kitamura, 2021; Huang, 2018; Ghani, 2020; Garcia, 2021; Lin & Lin, 2020; Fabbricatti et al., 2020; Saul & Waterton, 2017; Pomeroy & Tapuke, 2016; Shinde, 2017; L. McEwen et al., 2014) addresses the role of heritage for strengthening community resilience in the post-disaster and recovery phase. Of these, 4 studies (Wardekker et al., 2023; Sengupta, 2023; Shirvani Dastgerdi & Kheyroddin, 2023; Lin & Lin, 2020) also focus on the preparedness phase, highlighting the importance of linking these two phases. There were some explicit recommendations to invest into the Build Back Better phase while taking into consideration local knowledge and lessons learned from the past (e.g. Kitamura, 2021; Garcia, 2021), and expressed into cultural heritage such as vernacular architecture (e.g. Garcia, 2021). Heritage in the recovery process is also valued for its role in strengthening social cohesion (e.g. Lindner et al., 2021; Kano et al., 2022; Kitamura, 2021; Huang, 2018; Fabbricatti et al., 2020; L. McEwen et al., 2014), improving mental health (e.g. Kitamura, 2021), and reaffirming cultural identity (e.g. Jones & Pappas, 2023; Ghani, 2020; L. McEwen et al., 2014).

2.3.7 Resilience framed in the heritage-community resilience-hazard nexus

When analysing the conceptualization and role of the resilience, we encountered a multiplicity of definition and approaches. It is firstly important to highlight that only half of the analysed papers (n=12) provided a clear definition of resilience, clearly mentioning the dimensions and the attributes considered. In the majority of cases (n=7) the definition was taken from already existing frameworks or theories, in few cases (n=4) definition of resilience is linked and functional to the scope of the study and in one single cases it was based on and tied to features of traditional culture (Wang and Zhu 2022). Four papers provided no explicit definition of resilience, although there was reference of one or more resilience frameworks, and key features that benchmarked the conceptualization of the concept throughout the paper were mentioned.

In the remaining papers (n=8) no definition neither reference framework nor benchmarking characteristic were identified. Resilience was only named in the papers and remained a fuzzy concept detached from the local context and from the context of study.

The papers that explicitly defined resilience as well as those that relied on background frameworks used all different frameworks of reference. Nonetheless, despite that different frameworks were taken as reference and that each paper focused on a specific aspect of resilience, all the papers defined resilience adopting a socio-ecological conceptualization (Nikinmaa et al. 2020; Walker 2020). Resilience is defined as the capacity of a community to cope with external hazard/ stressors, adapt to change and recover from impactful event (i.e. such as "natural disaster").

Once investigated whether resilience was clearly defined, we focused on the role that resilience took throughout the papers and we recognized three main approaches:

(I) Final aim of the analysis, meaning that the studied aimed to assess the influence of the hazard on community resilience and identify which dimensions were mostly affected (Garcia 2021; Garnier 2019; Johnson et al. 2018; Kano, Tanaka, and Gota 2022; Lin and Lin 2020; L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014; Minguez Garcia 2021; Pomeroy and Tapuke 2016; Sengupta 2023; Wardekker, Nath, and Handayaningsih 2023);

(II) Background theory, meaning that the concept of resilience provided the framework under which the research has been conducted (Ghani 2020; Jones and Pappas 2023; Kano, Tanaka, and Gota 2022; Saul and Waterton 2017; Shirvani Dastgerdi and Kheyroddin 2023) or that is identified as a tool to achieve recovery community recovery (Huang 2018) These papers normally has as major goal the validation or implementation of a methodology.

(III) The third function combines the first two. This means that papers uses resilience as (i) background framework, and also as (ii) final aim of the study, investigating how disasters affect community resilience (Baumann et al. 2021; Fabbricatti, Boissenin, and Citoni 2020; Kitamura 2021; Shirvani Dastgerdi and Kheyroddin 2023). In these papers resilience serves as a sound theoretical concept but is also the object of the study and the goal that the community aims at.

Through the analytical process, further than analysing the definition and type of focus on resilience, we identified one or multiple dimensions of resilience addressed in each paper. These dimensions identified the elements on which communities rely to improve their abilities to cope and respond to natural hazards.

The dimensions of resilience addressed in the papers were:

- ***Social:*** **m**ost relevant aspects linked with social dimension includes: relevance of social networks and social bonds, community empowerment and community participation, social cohesion and community identity (Baumann et al. 2021; Fabbricatti, Boissenin, and Citoni 2020; Huang 2018; Johnson et al. 2018; Kano, Tanaka, and Gota 2022; Kitamura 2021; Lawangen and Roberts 2023; Lin and Lin 2020; Lindner et al. 2021; L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014; Minguez Garcia 2021; Pomeroy and Tapuke 2016; Ryzewski and Cherry 2012; Saul and Waterton 2017; Sengupta 2023; Wang and Zhu 2022; Wardekker, Nath, and Handayaningsih 2023)
- ***Economic****:* economic dimension mainly refer to the availability of economic and financial resources (Lindner et al. 2021; Wang and Zhu 2022; Wardekker, Nath, and Handayaningsih 2023)
- ***Health:*** elements of health dimension mainly relate to the mental and psychological wellbeing of affected community (Baumann et al. 2021)
- ***Cultural:*** most relevant elements related to cultural resilience are: traditional practices, knowledge and techniques for environmental management and building infrastructures; traditional knowledge related to disaster management; memorial and disaster memories; cultural values (Garnier 2019; Ghani 2020; Jones and Pappas 2023; Kano, Tanaka, and Gota 2022; Lindner et al. 2021; Saul and Waterton 2017; Shinde 2017; Shirvani Dastgerdi and Kheyroddin 2023)

- ***Ecological resilience:*** ecological resilience mainly related to landscape protection practices (Wang and Zhu 2022)

According to the scope of the research one or more the above-mentioned dimensions were addressed and stressed which specific aspects of resilience were relevant according to the context and the features of the community hit by the hazards.

2.4 Discussion

The results presented above allowed us to collect several relevant information and supporting evidence of the great variety of cultural heritage inclusion in community resilience processes to disaster risk. In the following chapter, the most relevant results are discussed in detail.

2.4.1 General considerations on the limitations and representativity of results

The first results allowed us to seek possible patterns in the geographical, ecosystem, or scientific field distribution of the analysed studies. We saw a strong representativity of studies located in Asian countries, which might be due to a strong awareness of the existing nexus between cultural heritage or community resilience. However, it must be noted that the study results might be influenced by the adopted methodology, limiting the accuracy of representativity of all available literature on the topic. For example, the choice of limiting the search to open-access English literature only, might represent a bias. Similarly, the decision to confine the systematic search within Scopus search system was dictated by the need to conform to one search query but might have also limited the number of available studies dedicated to the topic. This might also be at the roots of the lack of case studies focusing on African countries, and more extended research should be conducted in order to get an actual overview of the global representativity of those studies addressing cultural heritage in direct connection with community resilience. Another bias might be due to the defined search query. While the search query was the result of several tests in order to obtain an inclusive yet precise list of papers responding to the needs, it cannot be ignored that there might be many more studies addressing matters responding to the scope of this systematic review, but without the use of conventional terms linked to cultural heritage studies. Defining cultural heritage has become a great concern in the heritage studies field. As highlighted by Aleida Assmann (2019), the concept *cultural heritage* has always been very controversial and its definition unclear. It may include the realm of folklore, local traditions and practices, but in some cases, it might be strictly linked to history (Assmann, 2019). At the same time, the concept is also associated to landscape (Janssen et al., 2017). Because of the heterogeneity of definitions of heritage, it cannot be excluded that many studies focusing on these topics do not fall under a same set of keywords.

For what concerns the representativity of the scientific disciplines to which the authors of the selected studies belong, although potentially influenced by the selected search system (Scopus) and the other methodological choices mentioned above, the results indicated that the study of risk resilience and cultural heritage garnered a particular interest from the fields of social sciences and environmental studies. This result finds consistencies with a similar review on resilience from Cerè et al., (2017). It was also found that most of studies adopted qualitative methods. While this is not a surprising result, considering that qualitative techniques are commonly adopted in the social sciences (Mohajan, 2018), this result also confirms what the authors' disciplines analysis has already hinted, meaning that subject areas like engineering are less represented. This finding is not unexpected, as the field of cultural heritage is most commonly associated with the humanities and social sciences, but it also hints to a possible limit in the depth in which concepts of resilience might have been addressed. It was also seen that authors coming from the field of environmental sciences were the second most prominent, next to authors belonging to the social sciences. The concept of *resilience* historically has a strong role in the environmental sciences. The term *environmental resilience* goes back to 1973, when it was described by Holling (Cimellaro et al., 2016). This has given it the edge to be discussed and its theories to be built more than other resilience types. Even though this term has since evolved and is now widely represented in the social sciences (see Deeming et al., 2018), it may explain its wider representation in this field as well.

2.4.2 Considerations on the approach on climate change and multi-hazard

Over the last decades, climate-induced hazards have been increasing, and the field of disaster risk reduction and community resilience is increasingly linked with the field of climate change adaptation (Lei and Wang, 2014). However, not many of the reviewed papers directly refer to climate change. Heritage and community risk resilience are often connected through the role played by local knowledge resulting from past experiences and transmitted to future generations in form of heritage. Including climate change into this narrative would add to uncertainties, due to an uneven and unforeseen increase of frequency and magnitude of extreme events. Despite this consideration, many are the studies in the broader literature that confirm the role played by local knowledge and all its expressions in guiding climate change adaptation (e.g. Chanza and Musakwa, 2022).

However, even if it is common to cite climate change as a causative factor behind a disastrous flooding or related hydrological event occurring, there are also studies which are on the opposite spectrum. One such research is by (Ismail-Zadeh, 2022) which basically points out that climate change is not always the driver of disasters. The authors mention that although climate change affects natural processes and could tamper with hydrological cycles, it is not the main driver of disasters. Disasters are likely results of human inaction and lack of preventative mechanisms.

Interestingly, there is only one study mentioning droughts (Garnier, 2019), which might also be due to the fact that drought is not yet often associated to impacts beyond the agricultural sector, and the relationship between drought and heritage might be still under explored. When it comes to addressed hazards, the reason GLOFs have not been addressed might be due to the relatively recent occurrence of these hazards. In the literature (in general) there are several studies connecting local knowledge to risk perception in mountainous communities exposed to GLOFs (e.g. Allison, 2015), but this aspect is still not often associated to resilience building. 6 papers mention no specific hazard, which also indicates how sometimes the role of heritage in community resilience is addressed independently from a specific hazard. It would however be interesting to understand what role hazards play in influencing community resilience and the approach with heritage.

2.4.3 What mean when talking about community, specification of community of place

When framing the concept of community, the majority of papers firstly describe community using the concept of *community of place*, so determining community as the group of individuals that live in proximity and within the boundaries of a given area that has been affected by a natural hazard (Fabbricatti, Boissenin, and Citoni 2020; Garcia 2021; Garnier 2019; Ghani 2020; Johnson et al. 2018; Jones and Pappas 2023; Kitamura 2021; Lawangen and Roberts 2023; Lin and Lin 2020; Lindner et al. 2021; L. McEwen, Jones, and Robertson 2014; Pomeroy and Tapuke 2016; Ryzewski and Cherry 2012; Sengupta 2023; Shinde 2017; Wang and Zhu 2022; Wardekker, Nath, and Handayaningsih 2023). Nonetheless, it is important to highlight that after having framed the boundaries of community within the *community of place* all the papers stressed that a community can be considered as such only if baseline criteria are present, namely: shared culture, values, and local knowledge (Johnson et al. 2018; McEwen et al. 2012; Pomeroy and Tapuke 2016). Those aspects are crucial to create a sense of community among community members and are necessary prerequisites to increase community resilience and coping capacities to external stressors, such as natural hazards (Carmen et al. 2022; Fois and Forino 2014; Imperiale and Vanclay 2016). Literature analysed recognized that in order to create a strong community it is necessary to have a shared background of values and a common sense of belonging and commitment among community members (Fabbricatti, Boissenin, and Citoni 2020; Lin and Lin 2020; Sengupta 2023).

The existence of a tight community as necessary condition to react and adapt to challenges is also confirmed and made even more explicit within those papers that identify the community of reference as *community of interest* and *community of practice*. In the first the definition members are specifically identified as those that share a collective identity, while in the second one community is characterized by a strong commitment of members to improve collective wellbeing and adaptive capacity.

Despite the fact that a strong community is unanimously seen as decisive factor to foster resilience, among the authors there is a shared perception that the recognition of the role of community in disaster risk management and in recovery and resilience strategies is still very poor (Baumann et al. 2021; Lin and Lin 2020; Saul and Waterton 2017; Sengupta 2023).

2.4.4 Type of stakeholders & way for stakeholder engagement

At a general level, all the articles analysed involved more than one stakeholder for data collection, and in the totality of cases a central role was played by representatives of the community affected. This aspect is consistent with the results highlighting the core role of community in disaster response and with the need expressed by the majority of articles of engaging community members in the design of prevention and disaster response measures.

Nonetheless, despite that community engagement is claimed are crucial in all papers, only 6 out of 24 formally and fully engage community members in research activities and in the analysis of community resilience to natural hazards. This denotes one hand a contradiction from the theoretical point of view, as papers that claim for a direct engagement of the community struggle to implement it in their research and, on the other hand, stress the difficulties in co-designing risk prevention and hazard response measures with direct beneficiaries.

For what concerns type of stakeholders involved relevant considerations can be inferred. Stakeholders involved mainly belong to four groups of reference: (i) community representatives and local community members; (ii) representatives of local municipality; (iii) experts on disaster risk management and (iv) experts on cultural heritage.

However, none of the papers analysed consulted all the four groups of stakeholders. This aspect can be identified as a first indicator of the difficulties in fully engaging all the actors that act on and should be involved to properly create community resilience. Furthermore, only in 3 papers representative of the economic or private sectors were considered key actors. This indicates that the contribution of heritage to economic resilience and community development it is often overlooked and poorly considered. However, there is evidence, and our review has confirmed, of the important role of culture in fostering community economy in the aftermath of a disaster (Fabbricatti, Boissenin, and Citoni 2020; Kitamura 2021; Lin and Lin 2020).

For what concern governmental stakeholders, the focus generally at local level. Stakeholders engaged are representatives of local institutions and municipalities, while the Central or Regional governments seem not having a crucial role in the nexus community- resilience- heritage to respond to natural hazards. This highlights the key role that local institutions play in the aftermath of the disaster, as well as their core function as bridge between the local community and the central government (Adhikari et al. 2021; Mizutori 2020; Munene, Swartling, and Thomalla 2018) In this sense our literature review supported and provided practical examples of the policy recommendations highlighted in the Sendai Framework for Disaster Risk Reduction (SFDRR) according to local institutions and local authorities should be central in the identification of resilience measures (United Nations Office for Disaster Risk Reduction 2015).

On the other hand, lack of engagement of stakeholders at national level confine the role and potentialities of cultural heritage for resilience only at the local level, hindering the development of a national plan or strategy that could consistently include heritage as a key factor in risk and hazard management (Longworth 2014).

Experts on cultural / heritage sectors have been involved only if there was a formal recognition of the historical value of the city. Furthermore, their engagement is mainly related to the resilience of cultural heritage itself, and not for understanding the value of cultural heritage for community resilience. This consideration stresses once more that the role of heritage in DRR is considered mainly if there was a previous and formal recognition of the area as cultural site, and not for the potentiality that cultural heritage could have in prevention measures and or in fostering community resilience. To fully exploit this potentiality and in the view of correctly frame the role of cultural heritage in post- disaster community resilience and development, it is crucial to create synergies

between different disciplines and different experts to achieve a long- term and long-lasting resilience (Arefian et al. 2021; Polymenopoulou 2018) . Even if researchers have shown the benefits of this contamination, and more than one study (van Bavel et al. n.d.; L. McEwen, Jones, and Robertson 2014; Pereira et al. 2020; Sengupta 2023) mentioned the need of overcoming separations and clustering of knowledge at operational level there is still a strong lack of interdisciplinarity. This mismatch between theoretical and operational level is clearly perceived and stressed in this review by the poor collaboration among stakeholders pertaining to different spheres.

2.4.5 Unpacking cultural heritage for community resilience

In many papers there is recognized awareness of the need for integrated cultural heritage into recovery plans in order to build back better and improve community resilience (Garcia et al., 2021; Ghani, 2020; Baumann et al., 2021; UNDRR and ICCROM, 2022; Huang, 2019).

The relationship between community art, health, social cohesion, and community resilience is especially addressed in Baumann et al. (2021), which analyses the case study of post-earthquake Nepal (Baumann et al., 2021). Other studies, like Huang (2019), address the role that culture play as a dimension of social recovery, investigating the link between culture and sense of place, identify, values and networks in the process towards community resilience (Huang, 2019). The results showed that heritage plays different roles influencing community resilience at different phases of the disaster risk management cycle. Adopting the phases identified in Ishiwatari et al., (2021), it appears clear that the heritage field and relative stakeholders must be involved at all stages: prevention/mitigation, preparedness, immediate response, and recovery. A deeper understanding of the role that heritage can play at different phases of the disaster risk management cycle could lead to increased resilience, as it would allow to knowingly invest on heritage and heritage engagement in order to meet specific needs that could contribute to reaffirming cultural identity and social cohesion throughout all phases of disaster risk management, with a stronger potential to improve psychological well-being in a post-disaster recovery phase, or to enhance local capacities to prepare and react to disaster risks in the preparedness phase. Results have however highlighted that this aspect is still rather underrepresented, and more attention towards this should be encouraged in order to contribute to an appropriate implementation of the Sendai Framework for Disaster Risk Reduction (UNDRR, 2015). Despite this awareness, it is also commonly agreed that such aspect still fails to be a priority in disaster risk management (Huang, 2019). In most countries disaster risk management and cultural heritage are not connected (Garcia et al., 2021; Ghani, 2020; Huang, 2019) and there is lack of communication between specialists (Garcia et al., 2021). This can lead to exacerbated risks (Ghani, 2020). Environmental changes caused by disasters are inevitably bound to impact cultural heritage, and cultural heritage is connected to the realm of psychology of place and community livelihood (Huang, 2019). Nevertheless, this nexus hasn't become a priority in disaster risk management yet (Huang, 2019). There are many benefits for integrating cultural heritage into disaster risk management strategies and vice-versa, as it is presented in several studies (e.g. Garcia et al. 2021; Ghani, 2020; Baumann et al., 2021). Integrating disaster risk management and disaster risk reduction practices with cultural heritage conservation must be considered critical to protect both heritage and the community that lives it (Garcia et al., 2021; Ghani, 2020).

In reference to what the ARCH Project Deliverable 7.2 Report has adopted (Rebollo et al., 2020; p.7), we decided to also adopt the heritage classification provided by the ICOMOS Climate Change and Cultural Heritage Working Group in 2019 (ICOMOS, 2019). This classification was identified as the most appropriate based on the resulting heritage types that we found in our analysis and is therefore here adopted as convenient tool to unpack the complexity of different types of heritage.

This report categorizes heritage elements in six main groups:

- Moveable heritage;
- Archaeological resources;
- Buildings and structures;

- Cultural landscapes;
- Associated and traditional communities,
- Intangible heritage.

This categorization was adopted and adapted in correspondence with the resulting heritage types from the literature review, that see heritage divided as follows (table 2.4):

Table 2.4 adopted from Rebollo, V., at al. (2020), It showcases the various cultural heritage types identified in the systematic literature review (see column to the right) in relation to the categories presented by Rebollo et al. (2020) (first three columns).

Cultural Heritage Categories	Cultural Heritage Types	Examples of Heritage	Examples of Heritage from Papers
Moveable heritage	Works of monumental sculpture and painting	Paintings, sculptures, furniture, wall paints	- Community art (Baumann et al., 2021), - Religious art (Saul & Waterton, 2017)
Archaeological resources	Archaeological finds	Pottery, artefacts, inscriptions	-
	Archaeological materials	Bones, textiles, ceramic	-
	Archaeological sites	Tombs, caves	- Archaeological settlements; historical ruins (Ryzewski & Cherry, 2012)
	Archaeological monuments	Sacred places, temples, burial sites	- Religious / sacred buildings spaces (temples, churches, natural places, etc.) (Saul & Waterton, 2017)
Buildings and structures	Architecture (historic and monumental buildings)	Castles, theatres, churches, cathedrals	- Vernacular architecture and knowledge (Ghani, 2020; Johnson et al., 2018), - Vernacular architecture (Shinde, 2017),
	Groups of separate or connected buildings	Streets, warehouse complexes, harbours	- Vernacular architecture and knowledge (Ghani, 2020; Johnson et al., 2018), - Vernacular architecture (Shinde, 2017)
	Historical nuclei	Historic centres of towns and cities	- Historic settlement (Huang, 2018), - Vernacular architecture and knowledge (Ghani, 2020; Johnson et al., 2018), - Vernacular architecture (Shinde, 2017), - Traditional village / Historic or heritage cities, Historic settlement (Kitamura, 2021), - Traditional dwellings (Garcia, 2021)
Cultural landscapes	Parks/gardens	Parks, cemeteries, botanical gardens	-
	Combined works of nature and humankind	Agricultural landscapes, mining landscapes	- Traditional hydraulic system, drainage systems (Johnson et al., 2018), - Cultural landscape (human-nature relationship as consequences of past hazards) (L. J. McEwen et al., 2012; L. McEwen et al., 2014)
Associated and traditional communities	Traditional groups, communities and individuals	Indigenous peoples	- Social support systems, cultural technologies and innovations (Lawangen & Roberts, 2023), - Traditional social-organizational structure (Pomeroy & Tapuke, 2016)

Intangible heritage	Oral traditions and expressions	Proverbs, poems, tales	- Disaster storytelling (L. J. McEwen et al., 2012; L. McEwen et al., 2014; Pomeroy & Tapuke, 2016; Johnson et al., 2018), - Mitigating measures transmission (L. J. McEwen et al., 2012; L. McEwen et al., 2014; Pomeroy & Tapuke, 2016; Johnson et al., 2018)
	Performing arts	Theatre, music, dances	- Dances and festivals (Kitamura, 2021), - Traditional practices (Garcia, 2021)
	Social practices, rituals, festive events	Festivals, religious rituals, ceremonies	- Dances and festivals (Kitamura, 2021;), - Religious rituals (Wardekker et al., 2023), - Disaster rituals and events (Wardekker et al., 2023), - Festivals, traditional dwellings, traditional practices and events (Garcia, 2021) - Cultural events (Fabbricatti et al., 2020), - Rituals and community events/collective activities (Saul & Waterton, 2017; Wardekker et al., 2023; Baumann et al., 2021)
	Traditional craftsmanship (knowledge and skills)	Crafts, traditional agricultural techniques, masonry	- Traditional livelihoods incl. hunting/agricultural practices (Lin & Lin, 2020), - Technical local knowledge (hydraulic system, drainage systems) (Johnson et al., 2018), - Traditional land management (Shirvani Dastgerdi & Kheyroddin, 2023)
	Knowledge and practices concerning nature and universe	Traditional ecological wisdom, traditional healing systems	- Land management heritage (L. J. McEwen et al., 2012; L. McEwen et al., 2014), - Disaster storytelling (L. J. McEwen et al., 2012; L. McEwen et al., 2014; Pomeroy & Tapuke, 2016; Johnson et al., 2018), - Technical local knowledge (hydraulic system, drainage systems) (Johnson et al., 2018), - Indigenous early warning systems (Ghani, 2020), - Ecological local knowledge (Johnson et al., 2018), - Traditional land management (Shirvani Dastgerdi & Kheyroddin, 2023)

The table presented above (table 2.4) presents the categories identified by ICOMOS (2019) and adopted by Rebollo et al. (2021), while the last column to the right shows the examples of heritage identified in the analysed studies and placed into these categories accordingly.

While the adoption of such a classification system does not aim in anyway at defining “heritage” as a concept, it is important to clarify and unpack this complex concept for the sake of this research, hence why this table is provided. If allows to distinguish between physical cultural heritage and more intangible elements involving cultural practices and performances, but it also adequately represents the complex realm of the more intangible heritage stemming from human-nature relationships, from cultural landscapes to traditional ecological knowledge.

2.4.6 Sphere of resilience relevant for the community resilience- cultural heritage nexus

Although the totally of papers explicitly or implicitly define resilience as the final goal to achieve to be prepared and able to face natural hazards, not in all cases it is possible to clearly delineate which characteristics a community should developed to be resilient in the future. Thus, only basing our analysis only on the identification of resilience features would have been difficult clearly define which are the linkages that connects community resilience with cultural heritage. However, interpolating the resilience dimensions addressed in the

papers with multiple functions played by different heritage types we were able to determine four different spheres of community resilience in which cultural heritage could play a determinant role: (i) Social cohesion; (ii) Coping capacity; (iii) Wellbeing; and (iv) Economic support (table 2.5).

In several papers a strong and close community is identified as decisive factor to foster resilience and improve management and response to natural hazards (Baumann et al. 2021; Fabbricatti, Boissenin, and Citoni 2020; Huang 2018; Johnson et al. 2018; Minguez Garcia 2021; Pomeroy and Tapuke 2016). Social cohesion is thus seen as one of the main drivers for strengthening community response (L. McEwen, Jones, and Robertson 2014).

When analyzing the drivers that boost social cohesion, the role of culture and heritage is immediately highlighted as strategic. Sharing common cultural background and religious values, as well as being involved in informal networks and deeply rooted community practices will reinforce community cohesion, and consequently strengthen community resilience (Fabbricatti, Boissenin, and Citoni 2020; Garnier 2019; Kano, Tanaka, and Gota 2022; Shinde 2017).

The traditional social organization not only serve to boost social cohesion, but it also increase community wellbeing contributing to alleviating stress brought by experiencing a traumatic event (Saul and Waterton 2017; Wardekker, Nath, and Handayaningsih 2023). The reciprocal support given by mutual help practices helps, on one hand to establish routine continuity with the community life prior to the hazards and, on the other, serve as psychological relief and trauma grieving activity (Lawangen and Roberts 2023). Activities that contribute to the mental and emotional wellbeing of community members boost the collective capacity to overcome traumatic events, thus reinforcing resilience and coping capacity.

Cultural Heritage, in particular traditional ecological and technical knowledge, is highly contributing in developing concrete risk management, hazard prevention or mitigation practices (Jones and Pappas 2023; Kano, Tanaka, and Gota 2022; Lawangen and Roberts 2023; Shinde 2017; Shirvani Dastgerdi and Kheyroddin 2023). In this sense vernacular architecture likewise traditional environmental and landscape management practices provided effective practices and knowledge to boost community coping capacities(L. J. McEwen et al. 2012; Wang and Zhu 2022; Zhao et al. 2023). Traditional practices such as: drainage systems, cropping and planting techniques, building practices, hydrological and irrigation systems, and other traditional technologies and knowledge have been developed by community members through a process of experimentation and inter-generational learning (Johnson et al. 2018; L. J. McEwen et al. 2012). These practices are based on an in-depth knowledge of the local context and are tailored to the community needs. They thus provide effective and accepted measures that foster natural hazards prevention and disaster management, improving overall community resilience.

Cultural heritage has proved to be relevant also in providing resources to strength pre and post disaster situation. The official recognition of the value of culture and traditions could be valorised for example in the tourism industry. Traditional livelihood, both in terms of art crafts and performances could on one hand source for the economic development of the community , providing useful economic resource and also being source for the economic rehabilitation post disaster (Baumann et al. 2021; Kitamura 2021; Lin and Lin 2020; Wardekker, Nath, and Handayaningsih 2023).

Table 2.5 Sphere of resilience to which heritage contributes

Spheres of resilience	
The social cohesion sphere	Contribution to strengthening communities at an identity and cultural level
The wellbeing sphere	Contribution to psychological and physical wellbeing of individuals within a community
The coping capacity sphere	Contribution to the development of concrete disaster risk management practices

The economic support sphere	Contribution to strengthening the economic resilience of the community in a pre- or post- disaster situation

Conclusion

The study provided a useful overview of available literature and narratives bridging cultural heritage with community resilience in a multi-hazard context. Through an analysis of the relationship between communities, resilience and cultural heritage, it was possible to clarify patterns of interactions that could be adopted by researchers to improve the understanding of the role of heritage in disaster risk reduction.

More specifically, the systematic literature review allowed to respond to the proposed main objective and sub-objectives (SO). The study allowed to provide supporting evidence of the existing link between heritage and the spheres of disaster risk reduction and community resilience (SO 1). The analysed results offer an overview of the different ways heritage can contribute to building community resilience at various level. However, it has also revealed that the topic has been approached in a limited way so far, and many studies have highlighted the need for more inter- and transdisciplinary approaches on the matter. The role of cultural heritage as enabler of community resilience to natural hazards has been further unpacked (SO 2). We defined the role of cultural heritage towards what we conveniently conceptualized as the social cohesion sphere, the wellbeing sphere, the coping capacity sphere, and the economic support sphere. Upon defining these four spheres of community resilience to which heritage has demonstrated to contribute, the research also allowed to reflect on the elements and values of cultural heritage presented in the analysed studies.

This research also focused on mapping available methods and opportunities adopted in the available literature for stakeholders' and communities' engagement to guide the hazard-risk-resilience nexus with heritage (SO 3). We found out that many studies do not define clearly whom they are approaching, and what is the community of reference of their study. Nevertheless, several studies (e.g. Huang, 2019) invite a more proactive involvement of stakeholders belonging to both the cultural heritage and to the disaster risk management field, as it could benefit the operationalization of this nexus.

Last but not least, this study highlighted a variety of existing gaps in the literature, suggesting they could be at the roots of limiting the nexus between heritage and community resilience processes (SO 4). Findings highlighted that those studies addressing risk resilience from a disaster risk reduction point of view, referred to the role played by cultural heritage only in a very superficial way, without deepening the discourse. At the same time, those studies more versed towards cultural heritage management, would refer to "resilience" as a general concept, without allowing for a deeper focus on how the two fields could be related to one another. It can be argued that these results are not surprising, and that it is a common problem to contemporary research in several fields. Thus, considering the status quo, we would like to use these results as a starting point to develop a theoretical framework for future researchers to fill this scientific gap and bridge these two realms.
Another gap identified is related to the link between specific multi-hazards and the nexus between cultural heritage and community resilience. This might probably be due to the limited number of selected papers in the review process, but results have shown that, while several types of hazards have been addressed or mentioned, there is no direct linkage between the type of hazards and the role that specific heritage types can play in building community resilience. More focused research on this topic might be required.
For what concerns the above presented limitations of the study, due to the adopted methodology and the unclear definition of *cultural heritage* as a commonly shared concept, it must however be noted that the adopted methods suffice to meet the specific objectives of this study. This systematic review's aim was not that of being representative of all the globally available literature, but rather to provide an overview of how the topic has currently been explored, in order to be able to set a knowledge basis for the development of the theoretical framework presented in the following chapter.

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3. Theoretical Framework

The results and considerations deriving from the systematic literature review highlighted a need for bridging the gap between the disaster risk management and the cultural heritage field, in order to facilitate the operationalization of this nexus for community resilience to multi-hazard. While the results confirmed that such nexus exists, the lack of inter-, trans- disciplinarity of such studies poses a limit to understanding its dynamics. These results motivated the decision to develop a framework to understand how heritage can contribute to community resilience, identifying the relationship between:

- *Community resilience spheres* to which cultural heritage contributes (as presented in 2.4.6);
- *Outputs* enabled by cultural heritage in order to contribute to each one of the presented spheres of resilience (further developed and explained below);
- Related *actions* performed by communities through cultural heritage, enablers the interaction between cultural heritage and community resilience (further developed and explained below);
- Examples of *cultural heritage* that could support community resilience (based on the results presented in 2.4.5)

3.1 Presentation of the theoretical framework: main goals & structure

The theoretical framework has been developed leveraging the results of the literature review. Its objective is that of providing researchers, practical experts and other stakeholders with a map that showcases the dynamics that guide the linkages between cultural heritage and community resilience to disaster risks. There is increasing acknowledgment of the existence of this linkage, but the consulted literature has also revealed a gap between the two fields, which prevents experts from the cultural heritage field to fully understand and engage in community resilience processes, and experts engaged in the disaster management field from fully understanding the potential deriving from investing in cultural heritage.

This framework aims at bridging this gap, by unpacking this topic and showcasing the interrelation between the two fields. This was achieved through an internal workshop that took place on 14-15th December 2023 at Eurac Research Headquarters in Bolzano, Italy. The workshop, that saw involved the authors of this deliverable, consisted in reviewing the results from the systematic literature review and associating the different examples of cultural heritage presented in relation to the way they contribute to community resilience. This relationship has been graphically represented upon developing a map of cause-effects around four main concepts:

- ***Community resilience spheres:*** Community resilience in relation to cultural heritage has been conveniently represented through the four spheres identified through the literature review (see also 2.4.6): the social cohesion sphere, the wellbeing sphere, the coping capacity sphere, the economic support sphere;
- ***Outputs:*** Each one of the four community resilience spheres has been developed and further unpacked by investigating on the role that cultural heritage played in community resilience in the papers in the literature review (see 2.3.6). These elements have been called *outputs*. The table below (Table 3.1) shows the list of associated outputs to which cultural heritage contributes, in relation to their attributed community resilience sphere;
- ***Actions:*** The literature review suggests that cultural heritage contributes to the different spheres of community resilience through these outputs. However, as Erll, Nünning, and Young (2008) remind us, places and objects themselves do not have meanings or memories on their own but are triggers of meanings and memories. This problematic has been also addressed in Pierre Nora's "Between memory and history: les lieux de mémoire" (Nora, 1989). The French historian sees these "places of memory" as "places where memory crystallizes". Hence, cultural heritage on its own cannot automatically ensure the outputs to the resilience spheres presented in table 3.1. The connection between heritage and community resilience can only be activated through actions performed by those who benefit from and

interact with cultural heritage. Therefore, we decided to bridge this gap by indicating specific actions that act as enabler of cultural heritage's potential to contribute to community resilience;

- ***Examples of cultural heritage:*** In order to provide concrete examples of which kind of cultural heritage could contribute to these outputs, a list of examples has been provided based on the literature review results (2.4.5).

These associations are presented and further explained in the following chapter 3.2.

Table 3.1 Identified spheres of community resilience in relation to the outputs that see the contribution of cultural heritage, resulting from the workshop.

	The social cohesion sphere	The wellbeing sphere	The coping capacity sphere	The economic support sphere
OUTPUTS	Stronger social capital	Psychological relief / trauma grieving	Sense making of disaster	Increased touristic attraction & income
	Identity reinforcement	Routine normality / continuity	Lessons learned	
	Sense of belonging / place attachment	Safe space building	Early warning systems	
	Social continuity (= interaction between social and environmental element that built traditional villages. E.g. social networks, landscape management practices, aesthetic features)		Build back better	
			Disaster risk mitigation	
			Increased disaster risk awareness	
			Empowerment to take control over recovery process	

3.2 Heritage contribution to community resilience

In this chapter we will explain in detail the correlation between different types of heritage and the functions they can undertake for supporting specific aspects (i.e. outputs) of community resilience. We will firstly define the specific sphere of resilience we are considering and secondly describe heritage contribution to that specific sphere.

3.2.1 Social cohesion sphere

Definition: Social cohesion is not only identified as a prerequisite for community resilience but, primarily , as a core factor that strengths closeness and bonds among community members (DP Aldrich 2015; Imperiale and Vanclay 2021). A strong and close community is unanimously seen as decisive factor to foster resilience and improve management and response to natural hazards (Carmen et al. 2022; Fazey et al. 2021; Patel et al. 2017). In this dimension we record those resilience outputs that, according to literature, are directly linked with an improvement in social cohesion.

Table 3.2 Resilience outputs and type of heritage for social cohesion dimension

Resilience Output	Action	Type of heritage

Stronger social capital	Active involvement, participation, performance	- Rituals and community events / collective activities / cultural events *(Baumann et al. 2021; Saul and Waterton 2017; Wardekker, Nath, and Handayaningsih 2023)*
	Sharing and Experiencing	- Religious values *(Saul and Waterton 2017)* - Festival, traditional practices and events *(Ryzewski and Cherry 2012)*
	Visiting	- Sacred spaces *(Saul and Waterton 2017)*
	Reconstruction and transmission	- Traditional dwellings, traditional practices and events *(Garcia 2021*)
	People connection	- Dances & festival *(Kitamura 2021)*/ - Historic settlement *(Huang 2018)*
Identity reinforcement	Sharing	- Traditions, performances & events *(Kitamura 2021*)
	Experiencing	- Historic cities (vernacular architecture) *(Ghani 2020)* tradition and celebrations *(Kitamura 2021)*
	Reconstruction	- Traditional dwellings, traditional practices and events *(Garcia 2021; Garnier 2019)*
	Transmission	- Festivals *(Garnier 2019)*
Sense of belonging / place attachment	Active involvement / participation / place making / preservation	- Cultural landscape, historic cities, public spaces,
	Active involvement / participation / place making	- Cultural events *(Fabbricatti, Boissenin, and Citoni 2020)*
	Reconstruction and transmission	- Festivals, traditional dwellings, traditional practices and events *(Garcia 2021)*
	Strengthening human-place connection	- Historic settlement *(Kitamura 2021)* Cultural landscape *(Garnier 2019)*
Social continuity *(interaction between social and environmental element that built traditional villages. E.g. social networks, landscape management practices, aestethic features)*	Preservation / maintenance (buildings & traditions & huma- natural relations)	- Traditional village / Historic or heritage cities *(Shinde 2017)*
	Implementing	- Traditional social- organizational structure *(Lin and Lin 2020; Pomeroy and Tapuke 2016; Shinde 2017)*

For sake of clarity hereafter we will explain the connection existing between every specific type of heritage and the different resilience outputs. As we have outlined in the methodological section the link between the resilience and the heritage is given by the action that the community links with certain types of heritage.

Based on the literature reviewed a stronger social capital can be achieved through an active involvement and participation in community gathering, collective activities and festivities such as: religious rituals, traditional festivals and cultural events (Baumann et al. 2021; Saul and Waterton 2017; Wardekker, Nath, and Handayaningsih 2023). In addition to direct involvement, also experiencing or assisting as spectators to traditional and cultural events would foster bonds and connections among community members(Fabbricatti, Boissenin, and Citoni 2020; Saul and Waterton 2017). Stronger networks can be achieved also thanks to sharing of common religious values and practices, as well as visiting sacred spaces that are of paramount importance in the local culture (Ryzewski and Cherry 2012). Further than increasing social bonds within community members, sharing common background values and traditions will also foster identity reinforcement and sense of belonging(Ghani 2020; Kitamura 2021), both aspects that are likely to improve social cohesion and benefit community resilience. According to literature, identity will be also reinforced by an active involvement in restoration of traditional dwellings using transitional practices and knowledge coming from vernacular architecture (Minguez Garcia 2021). The restoration of settlement using traditional knowledge will keep alive traditional know-how using resources in which community identify, thus reinforcing the community identity (Huang 2018; Kitamura 2021). Similarly, transmission and practice of traditions and culture will also increase

sense of belonging to the community improving not only social cohesion but also the overall "functioning" of the community for what entails responsibilities and decision-making (Lin and Lin 2020). Social cohesion and community resilience also benefits from the strengthening of connections between the community and the environment they live in or take care. In that sense, implementing traditional practices that preserve the environment, or actively acting as "care-taker" will fortify human-place connection(Huang 2018; L. McEwen, Jones, and Robertson 2014). Strengthening place attachment is possible not only with active involvement in place maintenance but also through cultural events or traditional practices that stress the importance of environmental management practices in community life (Garnier 2019).

The last element we have identified as crucial in improving social cohesion is the so called "social continuity" , meaning interaction between social and environmental element that built traditional villages. In that sense, especially in very traditional or indigenous communities keep alive features of the traditional socio-organization structure will foster adaptive response and community resilience (Lin and Lin 2020; Pomeroy and Tapuke 2016; Shinde 2017).

3.2.2 Wellbeing sphere

Definition: The community hit by natural hazards, further than bearing physical and infrastructural damages and losses, have to bear an emotional trauma (Arefian et al. 2021). It is thus mandatory considering among the resilience sphere those aspects that contribute to alleviate the suffering of the post disaster condition both from an individual and community perspective (Baumann et al. 2021). In this dimension we record those types of heritage that will positively influence the elaboration of the traumatic experience, enabling people to cultivate mental health and trauma grieving (Minguez Garcia 2021).

Table 3.3 Resilience outputs and type of heritage for wellbeing dimension

Output	Action	Type of heritage
Psychological relief / trauma grieving	Disaster Commemoration	- Rituals / Religious rituals / disaster ruins (Wardekker, Nath, and Handayaningsih 2023)
	Visiting sacred spaces	- Religious / sacred buildings spaces (temples, churches, natural places, etc.) (Huang 2018; Saul and Waterton 2017)
	Experiencing / producing	- Community art (Baumann et al. 2021)
Routine normality / continuity	Performing / experiences	- Traditional dance, festivals, community events (Saul and Waterton 2017)
Safe space building	Experiencing and producing	- Community art (Baumann et al. 2021)

The recognition of the importance of cultural heritage for community and individual psychological wellbeing within the community resilience discourse is not deeply explored yet, but emerging literature is stressing the relevance of this aspect and the importance of heritage to fulfill several social demands (Mahouf, 2021; Arefian et al., 2021).

The heritage role in improving mental and emotional well-being is addressed only in few of the article analyzed. In particular authors have stressed how the participation to collective celebrations, traditional events and festival create continuity with the socio-cultural life prior to the event helping in creating a routine continuity with community life prior to the event (Baumann et al. 2021; Huang 2018; Saul and Waterton 2017). Visiting sacred or religious spaces, as well as participating to rituals would help in trauma grieving through the creation of an individual or collective process of healing (Saul and Waterton 2017). Also participate to disaster commemorations and visit disaster ruins will help give psychological relief as well as help in trauma grieving, enabling the process of sense-making in the face of adversity (Wardekker, Nath, and Handayaningsih 2023).

Lastly, performing, producing or experiencing community art will encourage a common sense of community wellbeing, creating a safe space for community members to cope with and elaborate trauma, providing positive impacts on health outcomes, such as reducing stress levels and improving mental health(Baumann et al. 2021)

3.2.3 Coping capacity sphere

Definitions: Being able to cope with consequences of natural hazards is crucial for community resilience. Coping capacity entails a set of abilities and knowledge that goes from anticipatory to mitigation actions. Traditional knowledge systems and cultural heritage are key elements to be considered in building up and fostering the coping capacity of a community. They indeed provide invaluable knowledge and practices accumulated by the community along time that have helped community members to minimize consequences of natural hazards, and deal with post- disaster situations (Beel et al. 2017; Bui et al. 2020).

In this dimension we pinpoint the contribution that different types of heritage can give to community to manage natural hazard risks.

Table 3.4 Resilience outputs and type of heritage for coping capacity dimension

Output	Action	Type of heritage
Lessons learned	Transmission	- Vernacular heritage - Historic cities, traditional practice *(Ghani 2020; Johnson et al. 2018; Wardekker, Nath, and Handayaningsih 2023)*
		- Mitigating measures transmission *(Johnson et al. 2018; L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014; Pomeroy and Tapuke 2016)* - Cultural landscape (human -nature relationship as consequences of past hazards) *(L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014*) - Storytelling of past disaster *(Johnson et al. 2018; L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014)*
Early warning systems	Recognition and application	- Social support systems, cultural technologies and innovations (*Lawangen and Roberts 2023)*
Build back better	Recognition and application	- Vernacular architecture *(Shinde 2017)*
Disaster risk mitigation	Implementation	- Technical local knowledge (traditional hydraulic system) *(Ghani 2020; Shirvani Dastgerdi and Kheyroddin 2023)* - Traditional land management *(Shirvani Dastgerdi and Kheyroddin 2023)* - Vernacular architecture and knowledge *(Ghani 2020; Johnson et al. 2018)*
	Acknowledgement & preservation	- Indigenous early warning systems *(Ghani 2020)* - Ecological local knowledge *(Johnson et al. 2018)* - Technical local knowledge (hydraulic system, drainage systems) *(Johnson et al. 2018)*
Increased disaster risk awareness	Communicate	- Storytelling of past disasters *(L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014)* - Rituals (*Wardekker, Nath, and Handayaningsih 2023)*
	Communication of disaster experiences	- Community art (Baumann et al. 2021)
Empowerment to take control over recovery process	Visiting / remembrance activities	- Historic settlement *(Huang 2018)*
	Implementation & Transmission	- Land management heritage *(L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014)* - Disaster storytelling *(L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014; Pomeroy and Tapuke 2016)*

Cultural heritage, identified as local traditions and knowledge, as well as memory transmission and technical skills are pillars for the development of a shared background within the community on how to deal with specific natural hazards. In that sense transmission of vernacular heritage and traditional technical skills, likewise storytelling of past disaster and landscape management techniques provide important lessons learned and management systems that will shape community coping capacities (Ghani 2020; Johnson et al. 2018; L. J. McEwen et al. 2012; L. McEwen, Jones, and Robertson 2014; Wardekker, Nath, and Handayaningsih 2023).

Transmission of local knowledge, practices and disaster memories will also improve governance and disaster risk management, and will spread risk awareness among community members (L. McEwen, Jones, and Robertson 2014; Wardekker, Nath, and Handayaningsih 2023). Scientific research has also investigated how cultural heritage could help in establishing modus operandi that can benefit specific phases or the disaster management cycle. There is empirical evidence that the application of traditional social support systems and informal social networks, as well as the acknowledgement and application of traditional ecological knowledge have benefit early warning systems and early warning communications (Lawangen and Roberts 2023).

Implementation of cultural technologies such as hydraulic and irrigation systems, and building practices and vernacular architecture have improved risk mitigation measures as well as post- hazard reconstruction (L. J. McEwen et al. 2012; Pomeroy and Tapuke 2016; Shinde 2017; Shirvani Dastgerdi and Kheyroddin 2023).

On the overall traditional technical knowledge and practices, as well the transmission of traditional values and memories allow the community to take control over the design and implementation of prevention and recovery measures, boosting the overall resilience (Lawangen and Roberts 2023; L. J. McEwen et al. 2012; Pomeroy and Tapuke 2016).

3.2.4 Economic support sphere

Definition: In this dimension we outline how cultural heritage could provide economic resources and economic alternatives that help the community to recover from the event. In community post- disaster rehabilitation process the re-establishment of community self-subsistence is a crucial and fundamental aspect. Cultural heritage and related sector could provide important opportunities to stimulate the local economy speeding up the recovery process (Bui et al., 2020; Fabbricatti et al., 2020).

Table 3.5 Resilience outputs and type of heritage for economic resource dimension

Output	Action	Type of heritage
Increased touristic attraction & income	Performing	- Dances & festival (Kitamura 2021) Rituals (Wardekker, Nath, and Handayaningsih 2023)
	Touristic promotion & official recognition	- Traditional livelihood (hunting / agricultural practices) (Lin and Lin 2020)

In the literature investigated, the contribution of cultural heritage to economic resilience has been the least analyzed aspect.

However there is empirical evidence of how traditional events and festivals, as well as rituals could play and important role in the economic rehabilitation as touristic resources (Kitamura 2021; Wardekker, Nath, and Handayaningsih 2023) . As well, the recognition of the value of traditional livelihood and art craft could lead to a community-based tourism that could boost economic development and consequently community resilience (Lin and Lin 2020).

3.3 Final consideration on framework application for improving cultural heritage role in hazard-risk-resilience nexus

3.3.1 Framework application in academic and research fields

Researchers working on various topics related to resilience and heritage can find the framework to be a helpful resource. The notion of resilience is a multifaceted construct that lends itself to multiple interpretations. It is the interest of many researchers to be able to understand the dynamic evolution of the concept, and heritage might be incorporated into this idea. System dynamic modelling (SDM), a technique that links various system components and tracks their progress over time, can capture this dynamicity. This section aims to expound on the development of the framework and the implementation of the hazard-risk-resilience nexus in scientific applications such as the SDM.

The role of cultural heritages and assets in enhancing resilience has been supported by investigations like that of (Fabbricatti, Boissenin and Citoni, 2020). Communities and the cultural heritage they exercise have been created though dynamic processes that are ever evolving (Cutter et al., 2008). This is a concept that goes hand in hand with system dynamics modelling. As a modelling technique that explores the dynamic transformation of a system through time, its applicability to the study of cultural heritages is fitting.

The quantification of resilience in systems dynamic modelling involves identifying resilience indicators that can be measured and substantiated with data. Cultural heritage tourism remains a major source of revenue in several countries (Syafrini et al., 2023). Cultural heritages, especially tangible ones like buildings and famous public spaces can enhance the economy of a city through their touristic significance. This can directly be linked to economic resilience, through its positive impact on the GDP. Thus, the impact on tourism, which can be measured in monetary terms, can be integrated into system modelling.

Cultural heritages can also be connected to social resilience measures, which is about increasing social cohesion, sense of identity or adaptability. However, it is difficult to quantify these elements to incorporate them in an SD model. It is important to use proxies in these instances. Some proxies include measuring participation in cultural activities or measuring the city's support and expenditure for cultural activities.

There should also be infrastructural elements that promote the expression of cultural heritages. Museums, theatres, or public squares can all provide the space for performing rituals. The focus given to these facilities, through budget or allocation of land can be inputs to infrastructure resilience. Developing indices that would capture the essence of these indicators and integrating them into the SD model could be one takeaway from this review.

The resilience of an urban system can be modelled on the concept of resilience attributes, which include robustness, rapidity, resourcefulness, and redundancy (Cimellaro et al., 2016). Cultural heritage assets can have multifaceted effects on these attributes. For instance, these assets can provide the required emotional support during the case of disasters. These emotional support mechanisms can be seen as intangible resources. They can also accelerate the recovery process, enhancing the rapidity component.

Overall, the dynamicity associated with these cultural elements can easily be portrayed in an SD modelling. However, longer simulation periods are required, which is the norm for cultural changes to take form and be reflected.

3.3.2 Framework application for practitioners

The theoretical framework presented aimed to highlight the benefits of integrating multiple aspects of cultural heritage in the design and implementation of strategies that boost communities' capacities for natural hazards management and climate change adaptation.

A deep analysis of scientific articles has stressed the benefits connected to bring together stakeholders coming from different backgrounds and expertise along with the community at risk during decision-making processes as well as measure formulation.

The framework presented could give some suggestions and insights regarding stakeholders to be included as well as tools to connect stakeholders through participatory methods combined with quantitative approaches for the resilience assessment in heritage-centred contexts.

Figure 3.1 provides a list of key stakeholders to be considered to improve resilience in multiple resilience spheres: social cohesion, coping capacity, wellbeing, and economic support. The implementation of an integrative approach that includes multiple functions of heritage for adaptation and recovery also needs the effective collaboration among representatives of key economic sectors, local institutions, community members as well as experts in disaster risk management and city planners. Ensuring the participation of these practitioners together with professional of heritage fields would ensure the recognition of the type of heritage that better serve different resilience purposes and that can be included in different stages of disaster risk management.

Further than the stakeholders mentioned hereafter we suggest identifying as key stakeholders' representatives of governmental institutions. Lack of engagement of stakeholders at national level could restrict the recognition of the role of cultural heritage only at the local level, hindering the development of a national and wide-spread strategy aiming at consistently include heritage as a key factor in risk and hazard management.

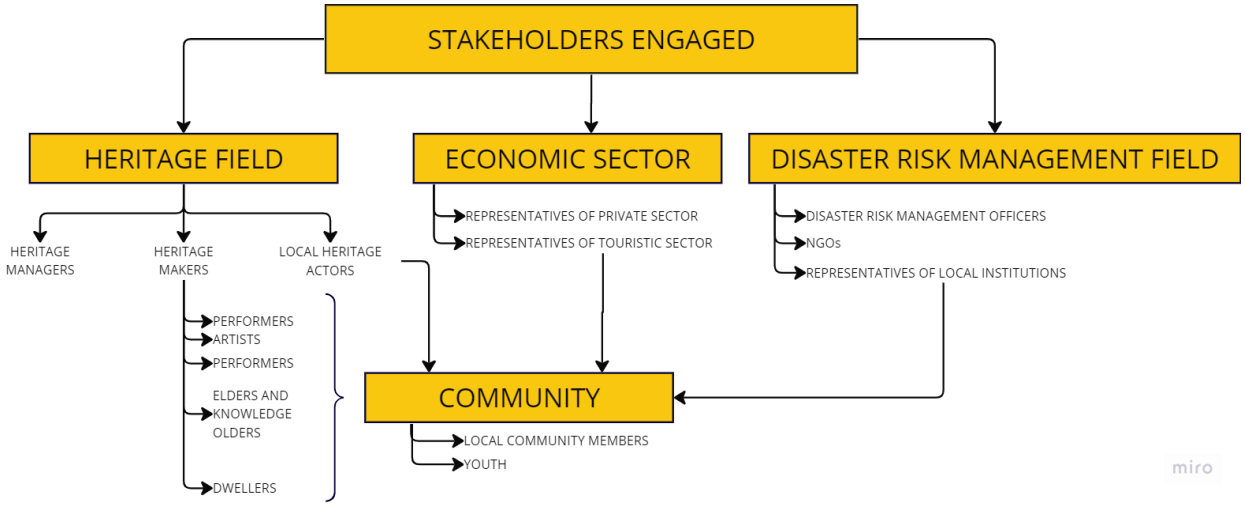

Figure 3.1 Sample of relevant stakeholders in the heritage-risk-resilience nexus

Another important aspect to consider is the level and type of stakeholder engagement to be implemented to create and ensure long-lasting collaborations. At empirical level, papers analysed struggle to implement a full engagement of the actors that should be involved to co-create community resilience strategies. The majority of studies were mainly interviewing stakeholders instead of implementing participatory methods that would allow exchange and contamination among different point of view and identification, share capacities and responsibilities. These difficulties identified some discrepancies and contradictions with the theoretical approaches taken as reference, that highlight suggest the implementation of methodologies that do not only consult stakeholders but fully included them in the design and decision-making process.
Recognizing that stakeholders' engagement methods must be tailored specifically to the context and to the stakeholders engaged, here we recommend developing:

I) Flexible approaches that can be modified and adjusted according to stakeholders' needs;
II) Approaches that build an atmosphere of trust and that facilitate commitment.

For the sake of example, the list hereafter mentions some participatory techniques outlining also related applications:

Participatory Mapping and participatory walks: Both methods could be used with various applications and with different degree of consultation. For example, it can be used to map assets, cultural heritage types or even exposed elements and related risks. Mapping and participatory walks activities can be done together with citizens or specific heritage experts and city planners. Those methods help in valorising and creating awareness among citizens as well as among experts about cultural heritage types available and potential uses in a resilience context (Kano, Tanaka, and Gota 2022; Torrieri, Oppio, and Rossitti 2021)

Participatory workshops: Participatory workshop are extremely versatile tools. They can be used in different phases of the designing and decision- making activities. In most of cases they have been used as consultation, validation or evaluation tools. They can include different degrees of expertise as well as different level of knowledge depending on the aim of the workshop. In all the three cases they can be framed as meetings of professionals and experts with the goal of brainstorming during the design phase of a strategy or for having feedback on an already define policy. Alternatively, they can be used as an opportunity to get citizens 'opinions, vet and validate solutions designed by professionals.

Lastly they can be structure with a mix of different participants coming both from experts side and citizens that dialogue together mapping different types and potential integration of heritage in resilience measures (Kano, Tanaka, and Gota 2022; Ryzewski and Cherry 2012; Shinde 2017).

Competency group engagement: The competency group is mostly directed to experts and aims at creating a supervising time of stakeholders engaged throughout all the process of decision making and implementation of measures. The idea behind is that key stakeholders could provide inputs during all the process and help in the dissemination of measures. Their constant engagement would ensure the interactions among different disciplines ensure the creation of resilience strategies tight to the context and that adequately include the recognition of cultural heritage (L. J. McEwen et al. 2012, 2012; Polymenopoulou 2018).

A group of experts could also be involved via Delphi interviews techniques, used to achieve group decisions that represent experts opinion (Alshehri, Rezgui, and Li 2015).

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ANNEX 1: Defining Community

The term *community* has been used in various areas of scientific research ranging from the natural sciences to the social sciences. The definition given to it in each of these scientific realms is supposedly different and it is usually tailored to the context. The definition of community as applied in this research is solely based on definitions given by the deliverable 7.4.1 within the RETURN project. In the cited deliverable, community is defined as a "collective of actors, such as individuals, organizations, and businesses, who possess a shared identity." Furthermore, community was formulated to be of place, interest and practice as illustrated below. The definitions are applied as they are in deliverable 7.4.1 without any addition, modification or alteration.

Community of place:

A group of individuals who share a common physical or online space as the primary basis of their connection and interaction (Christenson & Jerry W, 1989). A community of place emerges when individuals, due to their shared physical presence or frequenting of a specific space, develop a collective identity and perceive themselves as members of a community (Miller, 1992). The transition from merely coexisting in the same space to sharing a common identity occurs as individuals in the community of place also share social experiences, meanings, and actions. Examples of a community of place are individuals who live in the same urban neighborhood or residents of a remote mountain settlement.

Community of interest:

The interest-based conception of community pertains to groups of actors who establish a collective identity based on their shared concerns, purposes, and goals (Briard & Carter, 2013; Henri & Pudelko, 2003). What sets a community of interest apart is that its members may reside in disparate locations, have sporadic or even absent contact, yet still maintain a shared identity rooted in a common topic of interest. A community of interest can emerge within an existing community of place, but it is formed based on additional elements beyond the mere sharing of physical space. For instance, Keller introduces the concept of residents in a contaminated area who strengthen their connections due to a shared concern (Keller, 1992). Prior to the disaster, these residents only had a common identity rooted in their shared location. However, after the disaster, they developed shared concerns and a collective determination to mobilize and address the challenges posed by the disaster. In this scenario, rallying around a common issue has fostered social relationships and agency among the affected community members. Additional examples of a community of interests are individuals who share the same occupation (e.g., farmers, rangers, businessmen, and fishermen) as well as individuals who share common concerns, needs, or objectives related to a specific topic or context (e.g., students, members of religious groups, landowners, women, people with disabilities, indigenous minorities, representatives of civil protection associations, and civil society actors).

Community of practice

Building on the definition given by the social-learning theorist Etienne Wenger, a community of practice consists of a heterogeneous group of actors (e.g., individuals, associations, governmental and non-governmental agencies and organizations) which share a common interest or concern - the domain-, and collaborate to manage and address it (Etienne, 1998). The actors that compose the community operate as a network, fostering regular interactions and establishing relationships among its members. Wassermann and Faust define a social network as a collection of actors (individuals, groups or organizations) and the relationships that exist between them; relational ties are channels for transfer for resources, skills and knowledge (Wasserman & Faust, 1994). The activities conducted within a community of practice extend beyond the routine tasks and established responsibilities of actors' daily work or personal lives. Instead, activities are understood as new practices which community´s members gradually jointly learn how to perform. A community of practice defines itself in doing, meaning that activities in which members engage are not pre-defined or pre-institutionalized or formalized. Through their collaboration, community members engage in a collective learning process to enhance their skills

and deepen their knowledge to better act within the domain. Through a process of social learning, participants' understanding of a particular domain evolves as they engage in interactions with others, transcending individual perspectives and becoming embedded within a larger social framework (Reed et al., 2010). A community of practice distinguishes from a community of interests or of place, neither of which implies a shared practice. An example of a community of practice in the realm of DRR and CCA is a network of actors (comprising, citizens, researchers from diverse disciplines - including climate scientists, urban planners, and agronomists-, policymakers, community leaders and NGOs) that organize regular meetings, workshops, and knowledge-sharing events to enhance the resilience and preparedness of a certain territory in response to climate-related risks within their specific geographical context.

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